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PRODUCTIVITY OF LABOR SERIES

PRODUCTIVITY OF LABOR IN THE GLASS INDUSTRY

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INTRODUCTION AND SUMMARY

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EARLY HISTORY OF GLASS MAKING

Very little is known of the early history of glass making and absolutely nothing of the manner and date of its discovery. It is reasonably certain, however, that the art of blowing glass into bottles, making it into vases, coloring it to imitate precious stones, melting it into enormous masses to make pillars, and rolling and polishing it into mirrors was well known and practiced even in the most remote ages.

The earliest evidences of the existence of the art of glass making are found in Egypt. Champollion discovered on the walls of the tomb of Beni-Hassan-el-Gadim drawings of workmen engaged in glass blowing, and the reproduction of these drawings shows that until recently glass has been blown in exactly the same way as it was during the eighteenth dynasty, about 15 centuries before the Christian era. A recent translation of the texts of a number of Assyrian tablets shows that during the reign of Assur-bani-pal (669-626 B. C.) the Assyrians were not only adept in making glass but actually possessed numerous formulas for the making of various kinds and colors of glass, and on the basis of this discovery it is maintained that the Assyrians were far ahead of the Egyptians in the art of glass making. Samples of glass have been found in Syria, in the region of the Euphrates, which can be definitely dated as of 2500 B. C.

In following up the history of glass making among the various nations, ancient and modern, one is impressed with the fact that the art of glass making becomes most pronounced when a nation reaches a high degree of civilization, and declines with the downward trend of the nation. In Greece the fourth century and in Rome the age of the emperors were the periods of the highest development of glass making. With the decline and fall of Rome, Byzantium, the capital of Constantine the Great, became the center of attraction for the glassmakers of the world. Then came the Dark Ages, and very little glass making was done from the fifth to the close of the eleventh century. But with the coming of the Renaissance the art received a new stimulus and was revived in the city of Venice. This revival proved permanent and soon Venetian glass and Venetian glassmakers spread all over Europe, the glassmakers carrying their art with them. In France glass making was reintroduced in the sixteenth century by the finance minister Colbert, and in England during the reign of Queen Elizabeth.

Before the process became mechanical the making of glass was one of the most beautiful of arts and was so considered. To prove this one need but refer to the beautiful beads, vases, and mosaics made during the above-mentioned periods and to the social status enjoyed by glassmakers in all the countries. In the list of occupations which were proscribed in the Middle Ages as dishonorable for the nobility glass making was not mentioned. Early in the fourteenth century the French Government decreed not only that no derogation from nobility should follow the practice of glass making, but also that none save gentlemen or the sons of gentlemen should engage in any of its branches even as working artisans. This was also true of Altare, a city near Venice, while in Venice and Murano each glassmaker, no matter of what origin, was entitled to be called "gentleman glassmaker," thus becoming a nobleman by virtue of his trade alone.

During the Venetian period another important characteristic of the art of glass making became particularly noticeable. This is the mystery and secrecy of the trade which persisted throughout the ages and which clings to the glass industry to the present day. Upon the Assyrian tablets mentioned were found the following instructions as to the preparation of the glass furnace: [1]

When thou settest out the ground plan of a furnace for "minerals" thou shalt seek out a favorable day in a fortunate month. While they are making the furnace, thou shalt watch them and work thyself, in the house of the furnace; thou shalt bring in embryos [deities]—*another, a stranger, shall not enter,* nor shall one that is unclean tread before them; the day when thou puttest down the "mineral" into the furnace, thou shalt make a sacrifice before the embryos.

Thou shalt kindle a fire underneath the furnace and shalt put down the "mineral" into the furnace. The men whom thou shalt bring to be over the furnace shall cleanse themselves and then thou shalt set them to be over the furnace.

The Venetian glassmakers used every effort to keep secret the process of their art. Article 26 of the statutes passed by the Inquisition of State in 1454 decreed that if any glass workman should transport his craft to a foreign country and refuse to return an emissary should be commissioned to slay him. In Murano the following law was passed in 1459: [2]

If any glass workman carries his art to a foreign country he will have first an order to return; if he obeys not, all his nearest relatives will be put in prison; if in spite of this he obstinately remains abroad, some emissary will be charged to slay him.

It is recorded that two workmen whom the German Emperor Leopold (1658–1708) had induced to enter his States were so dealt with.

Referring to the introduction of glass making into the United States, the Encyclopedia Britannica of 1861 carries the following paragraph:

The mystery attached to the art of glass making followed it into America. The glass blower was considered a magician. His ability to transmute earthy and opaque matter into a transparent brilliancy was regarded as not less miraculous than the imputed skill of the alchemist to transmute base metals into gold.

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[1] The Glass Industry, November, 1926, pp. 264, 265.
[2] Wallace-Dunlop, M. A.: Glass in the Old World. New York [1882], p. 144.

In the introduction to his book, American Glass Practice, published in 1920, Mr. Bastow, a practical glassman with more than 20 years of experience in the glass industry, says: [3]

> The lack of real knowledge of the forces at work in the process of making glass is still aggravated by the age-old custom of secrecy. Observation will bear out the fact that the most narrow-minded and bigoted demonstration of secrecy is encountered where there is the least of real knowledge. Oftentimes this condition condemns a manufacturing plant to the wasteful use of an uneconomical formula, simply because that formula was acquired under conditions that tended to throw a sacredness over it.

The status of glass making as one of the fine arts and the mystery and secrecy with which it has been surrounded throughout its entire history are largely responsible for the fact that, in spite of its nearly prehistoric origin, until very recently, both in this country and in Europe, it has lagged behind all other industries in its development, especially as regards the introduction of machinery and labor-saving devices. The industrial revolution in the glass industry is not yet a generation old, and some of its branches are only now passing through the phases characteristic of this tremendous change.

REGENERATIVE FURNACE AND CONTINUOUS TANK

The first really revolutionary change in the glass industry was the introduction of the Siemens regenerative furnace, invented in 1861. Prior to that the "direct-fire" furnaces had been used, with the fuel—wood or coal—charged directly into the firepot or hearth of the furnace. In the regenerative furnace, which is now almost universally used in this country, the heat is supplied by the combustion of air and gas. The latter may be natural or supplied by a producer, located at the plant. The gas and air employed are first heated separately by the waste heat from the flames by means of what are called "regenerators," placed either beneath or at the side of the furnace. These are four chambers filled with fire brick stacked loosely in checker work. Two of the chambers are used for the admission of the gas and air into the furnace, and the other two for the passage of the waste flames from the furnace to the smoke stack. In passing through the chambers the intensely hot flames leave a large proportion of their heat with the bricks in the chambers. After a short period of time, usually 20 to 30 minutes, the draft is reversed. The cool air and gas are now admitted into the furnace via the two regenerators which had been previously used for the waste flames, the latter now being released through the other pair of regenerators. In passing over the heated bricks, the cold air and the gas absorb the heat and upon reaching the common entrance to the furnace combustion takes place, supplying the necessary heat for the melting of the glass. The regenerative furnace is not only more economical, effecting a saving of nearly 50 per cent in fuel, but the heat produced by it is more intense and uniform, both of which conditions are absolutely necessary for the proper melting of the glass.

More important, however, as regards the later development of machinery in the industry, was the introduction of the continuous melting tank to take the place of open or closed pots. The continuous tank was invented in 1872, but was not adopted in this country

[3] Bastow, Harry: American Glass Practice. Pittsburgh, 1920. p. 5.

until about 1888. One decade later, in the census year of 1900, 48.8 per cent of the total active melting capacity of this country was reported in tank furnaces. In 1925 open-pot furnaces were found only in the plate-glass branch of the industry. Closed pots are still used in the pressed and blown ware branch for the production of the better kind of glassware and also for colored glass. A few day tanks are used here and there, especially for the making of lamp chimneys by the offhand process. In all other branches of the industry the use of the continuous tank has become universal.

The principal advantage of the continuous tank lies in the opportunity it offers for uninterrupted working of the glass. With the pot furnaces nearly half the time is consumed in filling the pot with the batch, melting it, and bringing the molten material to the stage necessary for the making of glassware. With the continuous tank the batch is supplied at regular intervals to the melting end of the tank while the molten glass is being continuously withdrawn from the other end of the tank. The supply of the batch and the process of melting and withdrawing the glass are so timed that the working end of the furnace always remains at about the same temperature and the same working level. The improved furnace and the continuous tank made the industry ripe for the introduction of machinery, and it was not very long afterwards that the successful operation of the first semiautomatic machine for the production of wide-mouth jars was reported.

DEVELOPMENT OF MACHINERY IN THE INDUSTRY

The glass industry is composed of a number of branches whose only common characteristic is the molten glass from which the respective commodities are made. The nature of the ware made and the methods of production, whether by hand or by machine, are entirely different in the separate branches. The development of machinery also has not been uniform and simultaneous in all the branches. To all intent and purposes, therefore, the separate branches may be considered as independent industries and treated accordingly. In the present investigation the following four branches are studied: (1) Bottles and jars; (2) pressed and blown ware; (3) window glass; and (4) plate glass.

BOTTLES AND JARS

In his book on Machinery and Labor, Prof. G. E. Barnett of Johns Hopkins University distinguishes three periods in the development of machinery for the purpose of making jars and bottles:[4] (1) 1898–1905—semiautomatic machinery for the making of wide-mouth ware exclusively; (2) 1905–1917—the Owens automatic machine for the making of all kinds of bottles, wide and narrow mouth, and semiautomatic machinery for the narrow-mouth ware; (3) 1917 to date—semiautomatic machinery made automatic by the "feed and flow devices."

The first more or less successful semiautomatic machine was invented in 1882 by Philip Arbogast, of Pittsburgh, Pa., and 11 years later this machine was successfully applied to the making of vaseline jars. In 1896 a similar machine was invented for the purpose of making Mason jars. The growth of the semiautomatic machine

[4] Barnett, G. E.: Machinery and Labor. Cambridge, 1926. p. 67.

from 1897 to 1905, as shown by the number of machines in use in each of those years, is given by Professor Barnett as follows:[5] 1897, 20; 1898, 50; 1899, 60; 1900, 80; 1901, 90; 1902, 100; 1903, 150; 1904, 200; 1905, 250.

The first really revolutionary change, however, took place in 1904, with the successful introduction of the Owens automatic machine. It was invented by M. J. Owens, a glassworker, who later became the genius of the industry. The machine was automatic from the very start and where used, it at once displaced all the skilled blowers and most of their helpers in the shops. The output of the new machine was so much greater and the cost of production so much less than by the hand and semiautomatic processes that had it not been for the restrictive policies of the owners of the Owens machine these less economical processes would at once have been displaced by the automatic machine.

As it happened, however, the period of the Owens automatic machine was also the period of the development of semiautomatic machinery. In 1917 there were 200 Owens machines in operation in this country, but there were also 428 wide and narrow mouth semiautomatic machines. At about this time the "gob" feeder, which had been experimented with for some time, became a commercial success. This appeared to have certain advantages over both the Owens automatic and the semiautomatic machines. In the course of the next eight years the majority of the semiautomatic machines were reconstructed and equipped with automatic feeders so as to become completely automatic. The Owens machine has also undergone a series of important changes, especially as regards the number of arms and the number of molds on each arm. The most modern type of Owens machine has 15 arms, each equipped with two molds, and each mold contains cavities for two or three bottles, depending on the size of the bottle. At present these automatic processes completely dominate the bottle-making industry. The semiautomatic process has disappeared entirely, but a small number of plants are still using the hand process for the kind of bottles which can not be made more economically on the machine.

PRESSED WARE

Although the introduction of the side-lever press dates back to 1827, the general introduction of machinery in the pressed ware branch of the industry took place much later and is less significant than that in the bottle branch of the industry. The side-lever press is still used in a large number of plants. During the first part of this century the semiautomatic rotary press was introduced, but the real revolutionary change came with the introduction of the feeding devices. Modern machines equipped with these devices are made after the pattern of the bottle-blowing machines, but are less complicated. They are used primarily for making pressed tumblers of all sizes, nappies, and sherbets. The largest proportion of pressed ware, especially the so-called "novelties," is still made on either the old-fashioned side-lever press or the rotary press.

BLOWN WARE

In the field of blown ware the development of machinery has been much more pronounced than in the case of pressed ware. The

[5] Barnett, G. E.: Machinery and Labor. Cambridge, 1926, p. 69.

machines used are also more complicated and specialize in the production of some particular article, such as lamp chimneys, electric lamp bulbs, punch tumblers, and glass tubing.

The lamp-chimney semiautomatic machine dates back to 1894. Since then it has undergone a number of changes, but on the whole very little progress has been made in this branch of the glass industry. Hand production, especially the offhand method, is still an important factor, but the industry as a whole is diminishing in importance, as electricity is rapidly displacing the use of oil-burning lamps even in the most outlying and inaccessible districts.

On the other hand, the most amazing progress has been recorded in the making of electric-light bulbs. Since 1917 hand production has been almost entirely displaced—first by the semiautomatic Empire E machine and more recently by the completely automatic Westlake machine and the Empire F machine operated with an automatic feeder. At present more than 95 per cent of all the electric bulbs are made by the two automatic processes. The semiautomatic machine has been almost completely abandoned, while a few hand shops have been retained for experimental purposes or for the purpose of making oddly shaped and colored electric bulbs.

The Westlake machine, which revolutionized the bulb-making industry, has also recently invaded the field of punch tumblers. These are now made either on the Westlake machine or as a by-product on the lamp-chimney semiautomatic machine. Only the most expensive tumblers, those decorated with special designs, are still made by the hand shops.

The year 1917, which brought with it so many revolutionary innovations in the bottle and the pressed and blown ware branches of the industry, witnessed also the introduction of the Danner machine for the making of glass tubing. The new method was so superior that in the comparatively short period of less than eight years it displaced the old hand process, and not a single shop can now be found making glass tubing by hand.

WINDOW GLASS

The introduction of the Lubber cylinder machine in 1905 was the first successful attempt to replace the hand process of making window glass with machinery. The cylinder process may be called semiautomatic, as considerable handling of the glass is required in the various stages on its journey from the tank to the cutter's table. In 1917 the Colburn process of automatically drawing a continuous sheet of glass from the tank became a commercial success, while in 1921 the Fourcault automatic process, which was invented in Belgium, was successfully introduced into this country. As a result very little window glass is now being made by the hand process in this country. The cylinder machine is still the dominating factor in the industry, but the improved Colburn process and more recently the Fourcault machine have been rapidly gaining on the cylinder process and are becoming very important factors in the industry.

PLATE GLASS

The story of plate glass is essentially different from that of any other branch in the glass industry. It has been from the very beginning a nonskill industry, and the many simple operations involved in the process of handling the large and heavy plates soon suggested the use of labor-saving devices. When the industrial revolution finally reached the other branches of the glass industry plate-glass making had already become a progressive, well-integrated industry. Recently, however, the introduction of the continuous tank, the automatic process of casting rough plate, and the conveyor method of grinding and polishing the plates have tended to bring about changes in this branch almost as revolutionary as those in the other branches of the industry. The continuous process has not yet reached the stage of unquestioned superiority over the older so-called discontinuous process, and some time will probably elapse before the industry universally adopts the new process.

EFFECTS OF MACHINERY ON LABOR PRODUCTIVITY AND LABOR COST

The effects of the introduction of machinery on labor productivity and labor cost in the several branches of the glass industry are given in Table 1, where productivity and cost in hand production are compared with those in production by present-day machinery in terms of index numbers. The increase in man-hour output varies from 42.3 per cent (for lamp chimneys) to 4,009.8 per cent (for 4-ounce prescription oval bottles). The decrease in labor cost varies from 25.1 per cent (for rough plate glass) to 97.3 per cent (for 4-ounce prescription oval bottles).

TABLE 1.—*Index numbers of labor productivity and labor cost in the glass industry, by article and process*

Article	Labor productivity			Labor cost		
	Hand process	Machine	Per cent of increase	Hand process	Machine	Per cent of decrease
Bottles:						
2-ounce prescription ovals	100.0	3906.4	3806.4	100.0	2.74	97.26
4-ounce prescription ovals	100.0	4109.8	4009.8	100.0	2.70	97.30
2-ounce extract panels	100.0	2511.6	2411.6	100.0	4.20	95.80
½-pint sodas	100.0	1642.0	1542.0	100.0	6.70	93.30
1-pint whisky dandies	100.0	742.1	642.1	100.0	10.30	89.70
1-quart milk bottles	100.0	1449.3	1349.3	100.0	5.10	94.90
5-gallon water carboys	100.0	994.0	894.0	100.0	17.10	82.90
Pressed ware:						
8-9-ounce table tumblers	100.0	1228.1	1128.1	100.0	6.70	93.30
10-ounce table tumblers	100.0	1240.0	1140.0	100.0	6.65	93.35
4½-5-inch nappies	100.0	759.6	659.6	100.0	8.62	91.38
6-7-inch nappies	100.0	491.0	391.0	100.0	13.26	86.74
3½-ounce sherbets	100.0	817.0	717.0	100.0	8.97	91.03
4½-5 ounce sherbets	100.0	630.5	530.5	100.0	12.62	87.38
Blown ware:						
Lamp chimneys	100.0	142.3	42.3	100.0	62.50	37.50
25-watt electric bulbs	100.0	3126.2	3026.2	100.0	3.39	96.61
40-watt electric bulbs	100.0	3142.6	3042.6	100.0	3.39	96.61
9-10-ounce punch tumblers	100.0	1419.1	1319.1	100.0	7.00	93.00
Glass tubing, sizes 19-21	100.0	591.9	491.9	100.0	18.55	81.45
Glass tubing, sizes 32-34	100.0	746.7	646.7	100.0	14.70	85.30
Window glass:						
Single strength	100.0	261.1	161.1	100.0	31.30	68.70
Double strength	100.0	228.4	128.4	100.0	32.80	67.20
Plate glass:						
Rough plate	100.0	145.0	45.0	100.0	74.90	25.10
Polished plate	100.0	160.5	60.5	100.0	66.70	33.30

BOTTLES AND JARS

A comparison of man-hour output on seven of the most commonly used bottles made by the three processes—hand, semiautomatic machine, and automatic machine—is shown in Table 2. The average output per man-hour by the hand process ranges from 0.286 gross (quart milk bottles) to 0.643 gross (2-ounce prescription oval bottles); on the semiautomatic machines, it ranges from 0.711 gross (2-ounce extract panel bottles) to 1.043 gross (2-ounce prescription oval bottles); and on the automatic machines it ranges from 2.649 gross (1-pint whisky dandies) to 25.118 gross (2-ounce prescription oval bottles). For the purpose of comparison, the data are also expressed in terms of index numbers. Taking the average man-hour output in hand production as the base, or 100, the semiautomatic machine shows indexes ranging from 142.2 (for 2-ounce extract panel bottles) to 270.9 (for quart milk bottles); and the automatic machine shows indexes ranging from 742.1 (for pint whisky flasks) to 4,109.8 (for 4-ounce prescription oval bottles). It would take more than 41 workers to produce in one hour by hand as many 4-ounce prescription oval bottles as the most up-to-date automatic machine produces in the same period of time.

The table also shows a comparison of the labor cost of blowing the seven kinds of bottles by the three processes. This comparison is based on the rates of wages prevalent in the industry in 1925. The average labor cost of blowing a gross of bottles by hand ranges from $1.006 (for 2-ounce prescription oval bottles) to $25.308 (for 5-gallon water bottles); on the semiautomatic machine it ranges from 58.3 cents (for 2-ounce prescription oval bottles) to $1.027 (for 2-ounce extract panel bottles); and on the automatic machine it ranges from 2.8 cents (for 2-ounce prescription oval bottles) to $1.881 (for 5-gallon water carboys).

Taking the average labor cost in the hand process as the base, or 100, the semiautomatic machine shows indexes varying from 30.4 (for quart milk bottles) to 74.6 (for 2-ounce extract panel bottles), the average saving in labor cost thus ranging from 69.6 to 25.4 per cent. The automatic machine shows indexes varying from 2.7 (for 4-ounce prescription oval bottles) to 10.3 (for pint whisky dandies), the saving in labor cost thus ranging from 97.3 to 82.9 per cent. For every dollar spent on producing 4-ounce prescription oval bottles by hand it cost only 2.7 cents to make them on the most up-to-date automatic machine.

TABLE 2.—*Comparison of average output and labor cost of bottles made by hand and by machine*

Output (per man-hour)

Kind of bottle	Average output per man-hour of bottles made by—					
	Hand		Semiautomatic machine		Automatic machine	
	Amount	Index number	Amount	Index number	Amount	Index number
	Gross		*Gross*		*Gross*	
2-ounce prescription ovals	0.643	100.0	1.043	162.2	25.118	3906.4
4-ounce prescription ovals	.536	100.0	.797	148.7	22.028	4109.8
2-ounce extract panels	.500	100.0	.711	142.2	12.558	2511.6
½-pint sodas	.393	100.0	.778	198.0	6.453	1642.0
1-pint whisky dandies	.357	100.0	.774	216.8	2.649	742.1
1-quart milk bottles	.286	100.0	.775	270.9	4.145	1449.3
5-gallon water carboys	.026	100.0	--------	--------	.260	1000.0

Labor cost (per gross)

Kind of bottle	Hand Amount	Hand Index number	Semiautomatic Amount	Semiautomatic Index number	Automatic Amount	Automatic Index number
2-ounce prescription ovals	$1.006	100.0	$0.583	58.0	$0.028	2.74
4-ounce prescription ovals	1.177	100.0	.720	61.2	.032	2.70
2-ounce extract panels	1.377	100.0	1.027	74.6	.057	4.2
½-pint sodas	1.622	100.0	.888	54.7	.108	6.7
1-pint whisky dandies	1.790	100.0	.860	48.0	.185	10.3
1-quart milk bottles	2.980	100.0	.907	30.4	.152	5.1
5-gallon water carboys	25.308	100.0	--------	--------	1.880	7.43

PRESSED WARE

A comparison of man-hour output of the most commonly used tumblers, nappies, and sherbets made by the hand side-lever press, by the semiautomatic rotary press, and by the automatic machines is presented in Table 3. The average man-hour output on 10 and 8–9 ounce tumblers of a hand shop is 28.86 and 31 pieces, respectively; on the semiautomatic rotary press on 8–9 ounce tumblers it is 64.93 pieces; and on the automatic machine on 10 and 8–9 ounce tumblers it is 357.86 and 380.71 pieces, respectively. On 6–7 and 4½–5 inch nappies the average man-hour output is 27.37 and 39.61 pieces, respectively, by the hand process; 45.69 and 58.71 pieces, respectively, on the semiautomatic machine; and 134.39 and 300.87 pieces, respectively, on the automatic machine. On 4½–5 and 3½ ounce sherbets, the average man-hour output is 30.45 and 33.55 pieces, respectively, by the hand process; 48.79 and 58.21 pieces, respectively, on the semiautomatic rotary press; and 192 and 274.1 pieces, respectively, on the automatic machine.

Expressed in terms of index numbers, taking the man-hour output by the hand process as the base, or 100, the semiautomatic press shows a maximum index of 209.5 (for common 8–9 ounce tumblers) and a minimum of 148.2 (for 4½–5 inch nappies), and the automatic machine shows a maximum of 1,240 (for 10-ounce tumblers), and a minimum of 491 (for 6–7 inch nappies).

A comparison of the labor cost of production in pressing glassware by the three processes is also shown in Table 3. The average labor cost of making one hundred 8–9 and 10 ounce tumblers by the hand side-lever press is $1.95 and $2.075, respectively; of making one hundred 8–9 ounce tumblers on the semiautomatic rotary press, $1.073; and of making one hundred 8–9 and 10 ounce tumblers on the automatic machine, 13 and 13.8 cents, respectively. In making one hundred 4½–5 and 6–7 inch nappies the average labor cost is $1.718 and $2.549 respectively, by the hand process; $1.053 and $1.418, respectively, on the semiautomatic rotary press; and 14.8 and 33.8 cents, respectively, on the automatic machine. In making one hundred 4½–5 and 3½ ounce sherbets the labor cost by the hand process is $1.806 and $1.917, respectively; on the semiautomatic machine, $1.147 and $1.295, respectively; and on the automatic machine, 16.2 and 24.2 cents, respectively.

Expressed in terms of index numbers, taking the labor cost in the hand process as the base, or 100, the index numbers for the semiautomatic machine show a maximum of 67.55 (for 4½–5 ounce sherbets) and a minimum of 55 (for 8–9 ounce common table tumblers). The decrease in the labor cost of production thus effected by the semiautomatic machine from that of the hand process ranges from 32.45 to 45 per cent. On the same basis the automatic machine shows a maximum index of 13.26 (for 6–7 inch nappies) and a minimum index of 6.65 (for 10-ounce tumblers). For every dollar spent on making pressed glassware by hand the automatic machine effects a saving ranging from 86.74 to 93.35 cents.

TABLE 3.—*Comparison of average output and labor cost of tumblers, nappies, and sherbets made by hand and by machine*

Output (per man-hour)

Article	Average output per man-hour of specified article made by—					
	Hand		Semiautomatic machine		Automatic machine	
	Amount	Index number	Amount	Index number	Amount	Index number
8-9 ounce common tumblers	31.00	100.0	64.93	209.5	380.71	1228.1
10-ounce tumblers	28.86	100.0			357.86	1240.0
4½-5 inch nappies	39.61	100.0	58.71	148.2	300.87	759.6
6-7 inch nappies	27.37	100.0	45.69	166.9	134.39	491.0
3½-ounce sherbets	33.55	100.0	58.21	173.5	274.10	817.0
4½-5 ounce sherbets	30.45	100.0	48.79	160.2	192.00	630.5

Labor cost (per 100)

Article	Hand amount	Hand index number	Semiautomatic amount	Semiautomatic index number	Automatic amount	Automatic index number
8-9 ounce common tumblers	$1.951	100.0	$1.073	55.00	$0.130	6.70
10-ounce tumblers	2.075	100.0			.138	6.65
4½-5 inch nappies	1.718	100.0	1.053	61.29	.148	8.62
6-7-inch nappies	2.549	100.0	1.418	55.63	.338	13.26
3½-ounce sherbets	1.806	100.0	1.147	63.51	.162	8.97
4½-5 ounce sherbets	1.917	100.0	1.295	67.55	.242	12.62

BLOWN WARE

Lamp chimneys.—A comparison of man-hour output in making No. 2 sun-crimped lamp chimneys by the offhand process, by the paste-mold process, and by the semiautomatic machine is set forth in Table 4. The average man-hour output by the offhand process is 26.27 chimneys, by the paste-mold process 36.45, and by the semiautomatic machine 37.39. Taking the output by the offhand process as the base, or 100, the paste-mold process shows an index of 138.8, or an increase of 38.8 per cent, and the semiautomatic machine an index of 142.3, or an increase of 42.3 per cent.

The labor cost of production by the three processes is also shown in the table. It cost $2.710 to make 100 No. 2 sun-crimped lamp chimneys by the offhand process, $2.128 by the paste-mold process, and $1.712 on the semiautomatic machine. The decrease in labor cost from that of the offhand process is 21.5 per cent for the paste-mold process and 37.5 per cent for the semiautomatic machine.

TABLE 4.—*Comparison of average output and labor cost of No. 2 sun-crimped lamp chimneys made by hand and by machine*

Method of production	Average output per man-hour		Average labor cost per 100 pieces	
	Quantity	Index number	Amount	Index number
Hand:	*Pieces*			
Offhand process	26.265	100.0	$2.710	100.0
Paste-mold process	36.450	138.8	2.128	78.5
Semiautomatic machine	[1] 37.387	142.3	[2] 1.712	62.5

[1] In addition there was approximately an equal number of tumblers produced as a by-product requiring only grinding and glazing to finish them.
[2] Less the value of the tumblers produced as a by-product.

Electric-light bulbs.—A comparison of man-hour output in making 25 and 40 watt electric-light bulbs by hand, on the semiautomatic machine, and on the automatic machine is shown in Table 5. The average man-hour output of 25 and 40 watt bulbs of a hand shop is 54.36 and 54.21 bulbs, respectively; on the semiautomatic machine, 116.06 and 116.55 bulbs, respectively; and on the automatic machine, 1,699.22 and 1,703.59 bulbs, respectively. Expressed in index numbers, taking the man-hour output of the hand process as the base, or 100, the semiautomatic machine shows indexes for 25 and 40 watt bulbs of 213.52 and 215.00, respectively, and the automatic machine, 3,126.17 and 3,142.57, respectively. The semiautomatic machine doubled the man-hour output of the hand shop, while the man-hour output of the automatic machine is more than thirty-one times that of the hand process.

The labor cost of producing 25 and 40 watt electric bulbs by the three processes is also shown in the table. It costs $13.897 and $13.882, respectively, to make one thousand 25 and 40 watt bulbs by hand; $4.197 and $4.180, respectively, on the semiautomatic machine; and 47.1 and 47.0 cents, respectively, on the automatic machine. Taking the labor cost of the hand process as the base, or 100, the semiautomatic machine shows indexes for 25 and 40 watt bulbs of 30.20 and 30.11, respectively, or a decrease in labor cost of nearly 70 per cent. For the automatic machine the index is 3.39 for both kinds of bulbs. For every dollar spent on making electric lamp bulbs by hand it cost only 3.39 cents to make them on the automatic machine, a saving of 96.41 cents per dollar.

TABLE 5.—*Comparison of average output and labor cost of electric light bulbs made by hand and by machine*

Kind of bulbs and method of production	Average output per man-hour		Average labor cost per 1,000 pieces	
	Quantity	Index number	Amount	Index number
25-watt bulbs made by—	*Pieces*			
Hand	54.36	100.00	$13.897	100.00
Semiautomatic machine	116.06	213.52	4.197	30.20
Automatic machine	1,699.22	3,126.17	.471	3.39
40-watt bulbs made by—				
Hand	54.21	100.00	13.882	100.00
Semiautomatic machine	116.55	215.00	4.180	30.11
Automatic machine	1,703.59	3,142.57	.470	3.39

Punch tumblers.—In Table 6 is shown a comparison of man-hour output of 9–10 ounce punch tumblers made by hand and on the automatic machine. In the hand process the average output is 25.69 tumblers per man-hour, while on the automatic machine it is 364.57 tumblers per man-hour. Taking the output of the hand process as the base, or 100, the automatic machine shows an index of 1,419.1, or more than fourteen times the man-hour output by the hand process.

The labor cost of making a 9–10 ounce punch tumbler by the two processes is also shown in the table. The average labor cost of making 100 tumblers by hand is $1.90; on the automatic machine it is 13.3 cents per hundred. Taking the labor cost of the hand process as the base, or 100, the automatic machine shows an index of 7.0; that is, for every dollar spent on making punch tumblers by hand it costs only 7 cents to make them by the automatic machine, a saving of 93 cents per dollar.

TABLE 6.—*Comparison of man-hour output and labor cost of 9–10 ounce punch tumblers blown by hand and by machine*

Process	Man-hour output		Labor cost	
	Quantity	Index number	Amount per 100	Index number
	Pieces			
Hand production	25.69	100.0	$1.900	100.0
Automatic machine	364.57	1,419.1	.133	7.0

Glass tubing.—A comparison of man-hour output of glass tubing made by hand and by the Danner tubing machine is made in Table 7. The average output per man-hour of glass tubing made by the hand process is 9.957 pounds for sizes 19 to 21 and 10.067 pounds for sizes 32 to 34. On the Danner tubing machine the average man-hour output is 58.932 pounds of sizes 19 to 21 and 75.169 pounds of sizes 32 to 34. Expressed in terms of index numbers, with the man-hour output of the hand process taken as the base, or 100, the Danner machine shows an index of 591.9 for the smaller sizes and 746.7 for the larger sizes. It would take nearly eight workers to produce the same quantity of tubing as the Danner machine produces in an equal period of time.

A comparison of the labor cost of making glass tubing by the two processes is also given in the table. It cost $6.905 and $6.830, respectively, to draw 100 pounds of glass tubing of sizes 19 to 21 and 32 to 34. The labor cost of making the same sizes of glass tubing on the Danner tubing machine is $1.281 and $1.004, respectively, per 100 pounds. Expressed in terms of index numbers, taking the labor cost of the hand process as the base, or 100, the Danner machine shows indexes of 18.55 and 14.70, respectively, or a decrease in labor cost of 81.45 and 85.30 per cent of the labor cost of making glass tubing by hand.

TABLE 7.—*Comparison of average output and labor cost of glass tubing made by hand and by machine*

Size of glass tubing and method of production	Average output per man-hour		Average labor cost per 100 pounds	
	Quantity	Index number	Amount	Index number
Sizes 19 to 21 glass tubing made by—	*Pounds*			
Hand	9.957	100.0	$6.905	100.0
Machine	58.932	591.9	1.281	18.55
Sizes 32 to 34 glass tubing made by—				
Hand	10.067	100.0	6.830	100.0
Machine	75.169	746.7	1.004	14.70

WINDOW GLASS

Table 8 contains a comparison of man-hour output of single and double-strength window glass made by the hand shop, on the cylinder machine, and by the Fourcault automatic process.

On single-strength window glass the average output of the hand process is 0.709 boxes (50 square feet each) per man-hour; on the cylinder machine, 1.654 boxes per man-hour; and on the Fourcault machine, 1.851 boxes per man-hour. On double-strength window glass the average man-hour output is 0.561 boxes by the hand process, 0.972 boxes on the cylinder machine, and 1.280 boxes by the Fourcault automatic process. Expressed in terms of index numbers, with the man-hour output of the hand process taken as the base, or 100, the cylinder machine shows an index of 233.3 for single-strength and 173.4 for double-strength window glass. The Fourcault process shows an index of 261.1 for single-strength and 228.4 for double-strength glass, or an increase in man-hour output of 161.1 and 128.4 per cent, respectively, over the hand process.

The labor cost of making window glass by the three processes is also given in the table. In the hand process the labor cost of making a 50-square-foot box of window glass is 95.5 cents and $1.32, respectively, for single and double-strength glass; on the cylinder machine the corresponding costs are 40.7 and 69.9 cents per box; and on the Fourcault machine, 29.9 and 43.3 cents per box. Taking the labor cost of the hand process as the base, or 100, the cylinder machine shows an index of 42.6 for single-strength and 53.0 for double-strength glass, and the Fourcault process, 31.3 for single-strength and 32.8 for double-strength window glass. The savings in labor cost thus effected by the automatic is 68.7 and 67.2 cents on every dollar spent in making window glass by the hand process.

TABLE 8.—*Comparison of average output and labor cost of making window glass by hand and by machine*

Kind of window glass and method of production	Average output per man-hour		Average labor cost per box	
	Quantity	Index number	Amount	Index number
Single-strength window glass made by—	*Boxes* [1]			
Hand	0.709	100.0	$0.955	100.0
Cylinder machine	1.654	233.3	.407	42.6
Fourcault automatic machine	1.851	261.1	.299	31.3
Double-strength window glass made by—				
Hand	.561	100.0	1.320	100.0
Cylinder machine	.972	173.4	.699	53.0
Fourcault automatic machine	1.280	228.4	.433	32.8

[1] 50 square feet.

PLATE GLASS

A comparison of man-hour output of rough and polished plate glass made by the discontinuous and by the continuous processes is given in Table 9. When cast by the discontinuous process the average output of rough plate glass is 43.887 square feet per man-hour; by the continuous automatic process it is 63.630 square feet per man-hour.

Taking the man-hour output of the discontinuous process as the base, or 100, the automatic process shows an index of 145, or an increase in man-hour output of 45 per cent over the discontinuous process.

In the case of polished plate glass the average output by the discontinuous process is 7.664 square feet per man-hour, as compared with 12.300 square feet per man-hour by the continuous process. The man-hour output of polished plate glass made by the continuous process is 60.5 per cent larger than the man-hour output by the discontinuous process.

A comparison of the labor cost of making rough and polished plate glass by the two processes is also given in the table. It cost $1.812 to cast 100 square feet of rough plate glass by the pot process and $1.357 per 100 square feet by the automatic process. Taking the labor cost of the pot process as the base, or 100, the automatic process shows an index of 74.9, or a decrease in labor cost of 25.1 per cent. In the case of polished glass the labor cost of making it by the discontinuous process is $10.397 per 100 square feet, while by the continuous process it is $6.939. The decrease in labor cost effected by the continuous process is 33.3 per cent.

TABLE 9.—*Comparison of average output and labor cost of casting rough plate glass and of making polished plate glass by the discontinuous and the continuous processes*

Kind of plate glass and method of production	Average output per man-hour		Average labor cost per 100 square feet	
	Quantity	Index number	Amount	Index number
Rough plate glass cast by—	*Sq. feet*			
Discontinuous process	43.887	100.0	$1.812	100.0
Continuous process	63.630	145.0	1.357	74.9
Polished plate glass made by—				
Discontinuous process	7.664	100.0	10.397	100.0
Continuous process	12.300	160.5	6.939	66.7

EFFECTS OF THE INDUSTRIAL REVOLUTION ON THE INDUSTRY

In view of the tremendous changes in man-hour output and labor cost due to automatic machinery, it may be worth while to examine more or less in detail the effects of the introduction of machinery on the industry as a whole. Table 10, compiled from Census Bureau reports, presents statistics which represent the growth of the industry from 1899 to 1925, the period during which the change from hand production to semiautomatic and automatic machinery took place. The data given are the number of establishments, the wage earners employed, the total wages paid, and the quantity and value of output for the industry as a whole, and also, when available, for the four principal branches thereof, which combined constitute more than 90 per cent of the industry.

Table 10.—*Statistics of the glass industry, 1899 to 1925, by specified years*

[Data from United States Bureau of the Census]

Item	1899	1904	1909	1914	1919	1921	1923	1925
Establishments	**355**	**399**	**363**	**348**	**371**	**329**	**333**	**310**
Bottles and jars	147	158	166	150	145	(1)	117	120
Pressed and blown ware	84	103	114	107	130	(1)	127	123
Window glass	100	103	(1)	64	79	(1)	65	42
Plate glass	16	17	(1)	19	17	(1)	17	19
Wage earners	**52,818**	**63,969**	**68,911**	**74,502**	**77,520**	**54,748**	**73,335**	**69,371**
Bottles and jars	28,370	(1)	(1)	(1)	(1)	(1)	24,010	21,704
Pressed and blown ware	12,546	(1)	(1)	(1)	(1)	(1)	27,196	21,507
Window glass	8,682	(1)	(1)	(1)	(1)	(1)	8,826	8,346
Plate glass	3,220	(1)	(1)	(1)	(1)	(1)	9 961	11,124
Output:								
Bottles and jars thousand gross	7,780	12,005	12,316	19,290	22,295	(1)	28,393	26,044
Pressed and blown ware million pieces	360	428	532	701	1,080	(1)	(1)	1,963
Window glass thousand boxes	4,341	4,852	6,922	8,020	7,380	5,201	10,204	11,343
Plate glass thousand sq. ft.	16,884	27,293	47,370	60,384	56,823	56,239	94,470	117,369
Value of output (000 omitted)	**$56,540**	**$79,608**	**$92,095**	**$123,085**	**$261,884**	**$213,471**	**$309,353**	**$295,959**
Bottles and jars	21,677	33,631	36,018	51,959	94,670	(1)	107,231	100,301
Pressed and blown ware	17,076	21,956	27,398	30,279	70,749	(1)	77,279	72,085
Window glass	10,879	11,611	11,743	17,495	41,101	24,026	42,623	37,525
Plate glass	5,159	7,978	12,205	14,774	33,348	37,261	66,193	57,207
Wages (000 omitted)	**27,084**	**37,288**	**39,300**	**48,656**	**87,527**	**68,224**	**89,898**	**86,736**

[1] Not reported.

ESTABLISHMENTS AND WAGE EARNERS

In 1899 the glass industry comprised 355 establishments, employing 52,818 wage earners, an average of 149 wage earners per establishment; in 1925 there were only 310 establishments, employing 69,371 wage earners, an average of 224 wage earners per establishment. In the course of the 25 years the number of establishments decreased 12.7 per cent, while the number of wage earners increased 31.3 per cent, and the average number of wage earners per establishment increased 50.3 per cent.

The figures for the industry as a whole, however, do not tell the story of what happened in the separate branches. In 1899 there were 147 establishments making bottles and jars and employing 28,370 wage earners, an average of 193 wage earners per establishment; in 1925 there were 120 establishments, employing 21,704 wage earners—an average of 181 wage earners per establishment. The number of establishments in the bottle and jar branch therefore decreased 18.3 per cent, the number of wage earners 23.5 per cent, and the average number of wage earners per establishment 5.8 per cent.

For pressed and blown ware there were, in 1899, 84 establishments, employing 12,546 wage earners—an average of 149 wage earners per establishment; in 1925 there were 123 establishments employing 21,507 wage earners—an average of 175 wage earners per establishment. The number of establishments thus increased 46.4 per cent, the number of wage earners 71.4 per cent, and the average number of wage earners per establishment 17.5 per cent.

In the window-glass branch in 1899 there were 100 establishments, employing 8,682 wage earners—an average of 87 wage earners per establishment; in 1925 there were only 42 establishments, employing 8,346 wage earners—an average of 199 wage earners per establishment. The number of establishments decreased 58 per cent and the number of wage earners 3.9 per cent, but the average number of wage earners per establishment increased 128.7 per cent.

In the plate-glass branch in 1899 there were 16 establishments, employing 3,220 wage earners—an average of 201 wage earners per establishment; in 1925 there were 19 establishments, employing 11,124 wage earners—an average of 585 wage earners per establishment. The number of establishments increased 18.8 per cent, the number of wage earners, 245.3 per cent, and the average number of wage earners per establishment 191.0 per cent.

The effects of the introduction of machinery in the glass industry have thus been considerably different in its four principal branches, at least so far as total number of establishments and wage earners and average number of wage earners per establishment is concerned. In the bottle and jar branch the general adoption of the automatic machines resulted not only in a diminution of the number of plants and wage earners in the industry but also in a decrease of the average number of wage earners per establishment. Fewer workers are seen in a large up-to-date machine bottle plant than in a small hand plant. In the pressed and blown ware branch the automatic machines have so far invaded only a small part of the industry, and the growth in this branch has therefore resulted in an increase in the number of plants and wage earners as well as in the average number of workers per establishment. In the window-glass branch the predominance of the cylinder-machine process cut the number of establishments over half, somewhat diminished the total number of wage earners, and increased the average number of wage earners per plant nearly one and one-third times. As to plate glass, which until very recently witnessed no revolutionary changes, the growth in this branch more than tripled the number of wage earners and nearly tripled the average number of workers per establishment.

OUTPUT OF ESTABLISHMENTS

The number of workers employed and the average number per establishment can not, however, be used as an indication of the change in the size of the establishment, for the reason that the primary object of the introduction of machinery has been to decrease the number of wage earners employed. This is especially true of the bottle and jar branch. A better means of measuring the size of an establishment may be found either in the quantity or the value of output. For a period of years the quantity output is more effective, as it remains more or less untouched by a change in prices, which exerts a disturbing influence on the value of the output.

In 1899 the average output per establishment in the four branches was: Bottles and jars, 52,925 gross; pressed and blown ware, about 4,286,000 pieces; window glass, 43,410 boxes; and plate glass, 1,055,200 square feet. In 1925 it was: Bottles and jars, about 217,000 gross; pressed and blown ware, 15,959,000 pieces; window glass, 270,100 boxes; and plate glass, 6,177,000 square feet. Thus in 1925 the average output per establishment was four and one-tenth times as much as in 1899 in the case of bottles and jars; three and seven-tenths times as much in the case of pressed and blown ware; six and two-tenths times as much in window glass; and five and nine-tenths times as much in plate glass.

The distribution of total number of establishments and the value of their output on the basis of the value of output in each establishment is even more significant of the changes in the size of establishments than the actual output per establishment. Table 11 shows the total number of establishments in 1904[6] and 1925 with a yearly output of under $100,000, with an output of $100,000 and under $1,000,000, and with an output of $1,000,000 and over.

TABLE 11.—*Number of establishments in the glass industry and total value of their product, 1904 and 1925, classified by value of product per establishment*

Number and total value

Value of product per establishment	Number of establishments		Total value of product	
	1904	1925	1904	1925
Under $100,000	164	49	$8,341,000	$2,652,000
$100,000 and under $1,000,000	230	178	62,274,000	78,754,000
$1,000,000 and over	5	83	8,993,000	214,553,000
Total	399	310	79,608,000	295,959,000

Per cent

Value of product per establishment	Number of establishments 1904	Number of establishments 1925	Total value of product 1904	Total value of product 1925
Under $100,000	41.1	15.8	10.5	0.9
$100,000 and under $1,000,000	57.6	57.4	78.2	26.6
$1,000,000 and over	1.3	26.8	11.3	72.5
Total	100.0	100.0	100.0	100.0

In 1904, out of a total of 399 establishments in the industry, 164 establishments, or 41.1 per cent, were in the lowest group; 230, or 57.6 per cent, in the middle group; and only 5 establishments, or 1.3 per cent, in the highest group. In 1925, out of a total of 310 establishments in the industry, 49 establishments, or 15.8 per cent, were in the lowest group; 178, or 57.4 per cent, in the middle group; and 83, or 26.8 per cent, in the highest group.

Even more striking than the number of establishments is the distribution of the total value of output in these groups. In 1904 the 164 establishments in the lowest group reported a combined output of $8,341,000, or 10.5 per cent of the $79,608,000 which was the value of the output for the entire industry. The value of the output of the middle group was $62,274,000, or 78.2 per cent of the total, and that of the 5 establishments in the upper group was $8,993,000, or 11.3 per cent of the total. In 1925 the 49 establishments of the lowest group reported an output of $2,652,000, or less than 1 per cent of the $295,959,000, the value of the output of the entire industry. The value of the output of the middle group was $78,754,000, or 26.6 per cent of the total, while that of the 83 establishments in the upper

[6] The distribution for 1899 is not available.

group was $214,553,000, or 72.5 per cent of the total. Although the variation in prices from 1904 to 1925 no doubt had some effect on the value of output in those two years, the differences in the distribution of the three groups are so enormous as hardly to be affected by any such variation in prices.

STABILIZATION OF THE INDUSTRY

Prior to the introduction of machinery the glass industry was predominantly a small-unit industry. The amount of capital needed for a plant was comparatively negligible, and the principal item of expenditure, outside of labor, was fuel. A cheaper rate on coal or natural gas was enough of an inducement for the removal of a glass plant from one locality to another and from State to State. The history of the discoveries of natural gas in Pennsylvania, Indiana, West Virginia, and Oklahoma also tells the story of the migrations of the glass industry to and from these States.

But with the advent of machinery the situation changed completely. Fuel is still a big item in the cost of production of glass and is still considered as the factor determining the site of a new glass establishment. But once the plant is built, the capital outlays on the building, the furnaces, and the machines prevent the moving of the establishment irrespective of the cost of fuel. Thus, as migration was eliminated, the advantages of large-scale production were brought into play, with the result that in the short span of 25 years the glass industry has been converted from a small and loosely connected into a large and well-integrated industry.

VALUE OF OUTPUT

In 1899 the 7,780,000 gross of bottles and jars produced were valued at $21,677,000, an average of $2.79 per gross; in 1925 the value of the 26,044,000 gross produced was $100,301,000, an average of $3.86 per gross, an increase of 38.4 per cent over the average value in 1899.

In the pressed and blown ware branch of the industry the 360,000,000 pieces produced in 1899 were valued at $17,076,000, an average of $4.74 per hundred pieces; in 1925 the 1,963,000,000 pieces produced were worth $72,085,000, an average of $3.67 per hundred pieces, or 22.6 per cent lower than in 1899.

In the window-glass branch the 4,341,000 boxes produced in 1899 were valued at $10,879,000, an average of $2.50 per box; in 1925 the 11,343,000 boxes were worth $37,525,000, an average of $3.31 per box, or 32.4 per cent higher than in 1899.

In the plate-glass branch the 16,884,000 square feet of polished glass produced in 1899 were worth $5,159,000, making the average $30.56 per hundred square feet; in 1925 the 117,369,000 square feet produced were worth $57,207,000, an average of $48.74 per hundred square feet, which is 59.5 per cent higher than the average for 1899.

Table 12 and Chart 1 show a comparison of the trend of these average values in the four branches and of wholesale prices of manufacturing commodities from 1899 to 1925.

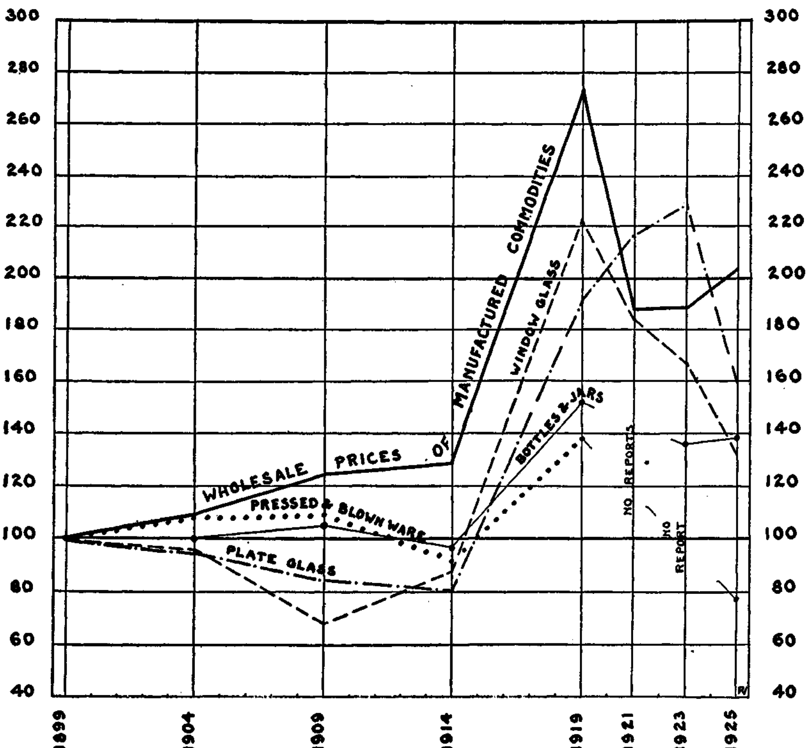
TABLE 12.—*Average unit values of bottles and jars, pressed and blown ware, window glass, and plate glass, and index numbers thereof and of wholesale prices of manufactured commodities in specified years, 1899 to 1925*

Year	Bottles and jars (per gross)	Pressed and blown ware (per 100 pieces)	Window glass (per box)	Plate glass (per 100 square feet)	Index numbers: Bottles and jars	Index numbers: Pressed and blown ware	Index numbers: Window glass	Index numbers: Plate glass	Index numbers: Wholesale prices of manufactured commodities [1]
1899	$2.79	$4.74	$2.50	$30.56	100.0	100.0	100.0	100.0	100.0
1904	2.80	5.13	2.40	29.23	100.0	108.2	96.0	95.6	109.8
1909	2.93	5.15	1.70	25.78	105.0	108.6	68.0	84.4	124.6
1914	2.70	4.33	2.18	24.47	96.8	91.4	87.2	80.1	128.7
1919	4.25	6.54	5.57	58.68	152.3	138.0	222.8	192.0	273.4
1921	(2)	(2)	4.61	66.25	----------	----------	184.4	216.8	188.2
1923	3.78	(2)	4.18	69.96	135.5	----------	167.2	228.9	188.7
1925	3.86	3.67	3.31	48.74	138.4	77.4	132.4	159.5	203.3

[1] Recomputed from indexes given in U. S. Bureau of Labor Statistics Bul. No. 415, p. 31: Wholesale prices, 1890 to 1925.
[2] Not reported.

CHART 1.—TREND OF AVERAGE UNIT VALUES OF BOTTLES AND JARS, PRESSED AND BLOWN WARE, WINDOW GLASS, AND PLATE GLASS AS COMPARED WITH TREND OF WHOLESALE PRICES OF MANUFACTURED COMMODITIES, 1899 TO 1925

[1899=100]



In average unit values each branch of the industry seems to have a trend entirely different from any other branch, due to conditions inherent in that branch. For instance, window glass and plate glass as building materials are largely affected by the general conditions in the building industry. This accounts for the slump in their values in 1909 and the steep rise in 1919 as compared with the value of bottles and jars or of pressed and blown ware. Again, for a number of years plate glass has been in great demand for the automobile industry, and in 1921, in spite of the slump in the other branches of the glass industry and in the wholesale price index of manufactured commodities, the value of plate glass continued to rise through 1923, when the introduction of the continuous process began to exert its influence and values began to drop.

On the whole, however, the general trend of the four branches of the industry is unmistakably downward and, with the exception of plate glass, none of the indexes of average unit values rose during the period above the wholesale price index of manufactured commodities. In 1925 the index for bottles and jars was 64.9 points below the wholesale price index of manufactured commodities; for pressed and blown ware it was 125.9 points lower, and actually 22.6 per cent lower than it was in 1899. The index for window glass was 70.9 points lower and for plate glass 43.8 points lower than the index for wholesale prices of manufactured commodities.

OUTPUT OF WAGE EARNERS

From the labor standpoint the most important change directly connected with the introduction of machinery in the glass industry is the increase in output per wage earner employed. Table 13 shows a comparison of output per man in the four principal branches of the industry in 1899 and 1925.

TABLE 13.—*Yearly output per man in specified branches of the glass industry, 1899 and 1925*

Branch of industry		1899	1925	
			Quantity	Index numbers (1899=100)
Bottles and jars	gross	274	1,200	438.0
Pressed and blown ware	pieces	28,694	91,272	318.1
Window glass	boxes	500	1,359	271.8
Plate glass	square feet	5,240	10,551	201.3

In 1899 the 28,370 wage earners engaged in making bottles and jars produced by hand alone, 7,780,000 gross, an average of 274 gross per man; in 1925 the 21,704 wage earners produced, partly by hand and partly on the semiautomatic machine, but chiefly on the automatic machines, 26,044,000 gross, an average of 1,200 gross per man, or four and four-tenths times as much as in 1899.

In the pressed and blown ware branch of the industry the 12,546 wage earners employed in 1899 produced by hand 360,000,000 pieces of ware, an average of 28,694 pieces per man; in 1925 the 21,507 wage earners employed produced, partly by hand and partly by machine, 1,963,000,000 pieces, an average of 91,972 pieces per man, or three and two-tenths times as much as in 1899.

In the window-glass branch the 8,682 workers engaged in 1899 produced by the cylinder hand process 4,341,000 boxes of 50 square feet each, an average of 500 boxes per man; in 1925 the 8,346 wage earners produced, partly by hand and partly by the Colburn and Fourcault automatic processes, but chiefly by the cylinder machine process, 11,343,000 boxes, an average of 1,359 boxes per man, or two and seven-tenths times as much as in 1899.

In the plate-glass branch the 3,220 wage earners employed in 1899 produced 16,884,000 square feet of polished plate glass, an average of 5,243 square feet per man; in 1925 the 11,124 wage earners engaged in making plate glass by the improved discontinuous and continuous processes produced 117,369,000 square feet of polished plate glass, an average of 10,551 square feet per man, or a little more than twice as much as in 1899.

In the figures for the separate branches of the industry there exists a slight error due to the fact that the hours worked per day in 1899 and 1925 are not strictly comparable. For instance, in the bottle industry the regular hours of work were eight and one-half in 1899 and only eight in 1925. On the other hand, in 1899 nearly all the plants, following a long-established custom, suspended production for a period of two months, while in 1925 only a few plants stopped producing for a month or more because of repairs or the usual reconstruction of tanks, which must be done every 12 to 18 months. Similar or somewhat different discrepancies in the hours worked also exist in the other branches of the industry, but their general effect on the output was so slight as to exert very little, if any, influence on the validity of the figures of productivity given.

WAGE WORKERS' EARNINGS

A comparison of rates of wages in the glass industry in 1899 and 1925 is of no significance, for the reason that the nature of the work done and the kind of labor used in 1925 were entirely different from the work done and the labor used in 1899. Twenty-five years ago the majority of workers employed in the industry consisted of highly skilled blowers, pressers, finishers, gatherers, flatteners, and cutters, and unskilled mold boys, snapping-up boys, warming-in boys, carry-in boys, carry-over boys, and the like. In 1925 only a small percentage of such labor had been retained, even in the hand plants. The new class of glassworkers is made up of tank men, machinists, machine foremen, machine operators, and helpers, with little if any preliminary training in handling machines. Again, in 1899 all skilled workers were paid on a piecework basis, while in 1925 the overwhelming majority of workers were paid on a time basis—by the hour, by the week, or by the month.

It is possible, however, to compare the yearly earnings of the wage earners in 1899 and in 1925. In 1899 the 52,818 wage earners in the industry received a total wage of $27,084,000, an average of $512.78 per wage earner per year. In 1925 the 69,371 wage earners received a total wage of $86,736,000, an average of $1,250.32 per wage earner per year, or nearly two and one-half times as much as in 1899.

But in making these comparisons of the wage workers' earnings of 1899 and 1925 it must be remembered that the group of wage earners in 1899 contained a large percentage of minors under 16 years of age, with extremely low wages, whereas in 1925 the number of minors under 16 years was practically nil. This difference would tend considerably to depress the average earnings per man in 1899 as compared with 1925. On the other hand, many of the skilled workers in 1899 working on a piece-rate basis were earning exceptionally high wages. Fifty to seventy-five dollars a week was not an exceptionally high wage for a skilled bottle or window-glass blower in those days. In 1925 this extreme had also been eliminated. How far the high earnings of the skilled workers in 1899 were neutralized by the very low earnings of the minors can only be guessed, but the existence of the two extremes can not be overlooked when comparing the average earnings of the two periods.

More important, however, than the money wages are the real earnings of the workers. Table 14 contains a comparison of the average yearly earnings of the wage earners in the industry from 1899 to 1925, with the cost of living during the same period.

TABLE 14.—*Average yearly earnings of wage earners in the glass industry compared with cost of living, 1899 to 1925, by specified years*

[1914=100]

Year	Average yearly earnings		Index number of cost of living	Purchasing power of earnings (measured by cost of living)	
	Amount	Index number		Index number	Per cent of change compared with 1914
1899	$512.78	78.5	65.7	119.5	+19.5
1904	582.91	89.3	73.8	121.0	+21.0
1909	570.30	87.3	86.1	101.4	+1.4
1914	653.08	100.0	100.0	100.0	0.0
1919	1,129.09	172.9	182.8	94.6	−5.4
1921	1,246.15	190.8	172.1	110.9	+10.9
1923	1,225.85	187.7	166.0	113.1	+13.1
1925	1,250.32	191.4	168.4	113.7	+13.7

The trend of real earnings, as expressed in the purchasing power of the money earnings (measured by the cost of living), has been downward from 1904, when real earnings were at their peak, 21 per cent above that of 1914, to 1919 when they were at their lowest, 5.4 per cent below that of 1914. Since then the trend has been steadily upward, the 1925 index being 13.7 per cent above that of 1914, but not so high as that of 1904 or 1899.

CHILD LABOR

Prior to the introduction of machinery the glass industry was one of the greatest exploiters of child labor. This was particularly true of the bottle and the pressed and blown ware branches, for very few children had been employed in the making of window glass and none in plate glass. In 1899, of the total of 40,916 wage earners employed in making bottles and pressed and blown ware, 7,035, or 17.2

per cent, were children under the age of 16 years. These were employed chiefly as mold boys, cleaning-off boys, and snapping-up boys in the furnace room, and partly as burning-off girls, glazing girls, and selectors in the finishing department. The general nature of their work is explained in the sections describing hand production in the separate branches of the industry.

The conditions under which the children were employed are fully discussed in the Commissioner of Labor's Report on Condition of Woman and Child Wage Earners in the Glass Industry in the United States made at the request of the United States Senate, which was published in 1910.

The following quotations are from this report. Referring to the work of the mold boy, it says:[7]

> The mold rests upon or very close to the floor. As a result the mold boy must either squat upon the ground in an awkward, cramped position * * * or, standing, must stoop constantly to his work. When the mold boy must thus sit with his legs doubled under him, or sitting on a crude chair or box, stoop over almost to the floor to operate the molds, the occupation becomes one which, continued for any great length of time, undoubtedly tends to dwarf and deform the child. * * *
>
> He must necessarily be close to the mold, and for speed of working the mold is placed near the furnace, directly in front of the working hole and some 3 feet below the level of the hole. As the mold tender works he faces the furnace, and his face and shoulders at least are in direct line with the radiated heat from the working hole. In addition to the furnace there are other sources of heat adding to the boy's discomfort. The blower in lowering the hot lump of glass into the mold necessarily swings it close to the boy's face; the mold itself after a short using becomes very hot and gives off considerable heat; in some factories the "glory holes," at which the finishing work is done, are crowded close to the furnace, and little space left between them and the mold boys.

The general conditions in the furnace room are thus described:[8]

> In some factories at times the air is so full of floating glass from the "blow-over"[9] that the hair is whitened by merely passing through the room. It sticks to the perspiration on the face and arms of the boys and men and becomes a source of considerable irritation. Getting into the eyes, it becomes especially troublesome.
>
> In other factories visited it was found that when the wind blew from the gas producers toward the furnace room the air of the whole room became filled with gas and smoke almost to the point of suffocation.

The heat conditions in the furnace room are set forth as follows:[10]

> The generally accepted figures of the heat within a furnace during the "fusing" is 2,507° F. between the pots and 2,390° F. in the metal itself. These temperatures are reduced when the holes are opened for working to a standard of 1,913° F., although glass is commonly worked at a temperature of a hundred degrees less than these figures. * * *
>
> Factory No. 2 was examined June 18, at 12.25 p. m. with the outside temperature at 90°. The temperature taken at a point 2 feet from but directly in front of a working hole showed 142°; two others taken the same distance from but slightly to the side of the holes showed 135° and 137°. Temperature near cleaning-off boy, 105°; near the mold boy, 113°; in front of the "glory hole," 116°; at finisher's bench, 104°; where snap-up boy stands to rub excess glass off neck of bottle, 103°; where carry-in boy picks up ware, 98°; in front of leer, where carry-in boy stands to deposit ware, 125°. * * *
>
> In warmer weather the ill effects of the heat show themselves directly in the form of prostration or affections directly due to the high temperature. * * * In the winter the immediate danger to health arises from sudden changes in

[7] U. S. Bureau of Labor. Report on Condition of Woman and Child Wage Earners in the United States. Vol. III, Glass industry. Washington, 1910, p. 48.
[8] Idem, pp. 66–92.
[9] For explanation of "blow-over," see p. 29.
[10] U. S. Bureau of Labor. Report on Condition of Woman and Child Wage Earners in the United States. Vol. III, Glass industry. Washington, 1910, pp. 69–80.

temperature. The boys, as a rule, have little or no extra clothing to protect them from the outside weather and rarely take the trouble to wait in the factory until their bodies are sufficiently cooled to bear the change. The danger is particularly acute when night work is being done.

On accidents and causes of death and diseases it is said:

Conditions in nearly all furnace rooms are favorable to minor accidental injury. * * * [11]

Many of the boys bear the scars of severe burns. In the crowded factories where so many of them are constantly moving to and fro carrying the hot bottles, occasional collisions are inevitable, and some of the boys show the marks of these terrible burnings in the form of scars which they will bear all through their lives. * * * It is indeed a hard and trying life they lead, these boys of 9, 10, 11 years and upward, for many such are in the factories. * * * [12]

With the introduction of machinery the child-labor situation changed. The mold boys, the cleaning-off boys, and the snapping-up boys were at once dispensed with, even in the case of the cruder semiautomatic machines. The job of the carry-in boys was retained for some time, but the introduction of the Owens automatic machine, with its automatic conveyor, eliminated all the work formerly done by child labor. Even where no conveyors have been installed and the job of the carry-in boys has been retained, the output of the machines has proved to be too large to be handled by minors, and the job, though retaining the name of "carry-in boy," is actually performed by an adult unskilled man or woman.

Table 15 gives the total number of wage earners and of children under 16 years employed in the industry from 1880 to 1919, the last year for which figures are available from the census reports.

TABLE 15.—*Number of wage earners and of minors under 16 years employed in the glass industry, 1880 to 1919, by specified years*

[Data from the U. S. Census Bureau]

Year	Number of wage earners	Minors under 16 years		Year	Number of wage earners	Minors under 16 years	
		Number	Per cent of total wage earners			Number	Per cent of total wage earners
1880	24, 177	[1] 5, 658	23. 4	1909	68, 911	3, 561	5. 2
1890	44, 892	[1] 6, 943	15. 5	1914	74, 502	1, 992	2. 7
1899	52, 818	7, 116	13. 5	1919	77, 520	1, 413	1. 8
1904	63, 969	6, 435	10. 1				

[1] Males under 16 years and females under 15 years.

From 1880 to 1899 the number of minors under 16 years increased from 5,658 to 7,116, but this increase was not as large as that of the total number of wage earners in the industry. The percentage that minors formed of the total number of wage earners decreased, therefore, from 23.4 to 13.5, though the actual number increased 25.7 per cent. Beginning with 1904, both the actual numbers and the percentages minors formed of the total decreased, while the total number of wage earners continued to rise rapidly. In 1899, with prac-

[11] U. S. Bureau of Labor. Report on Condition of Woman and Child Wage Earners in the United States. Vol. III, Glass industry. Washington, 1910.
[12] Idem, p. 254.

tically no machinery used in the industry, the 7,116 minor boys and girls under 16 years constituted 13.5 per cent of the total number of 52,818 wage earners in the industry. In 1919, the last year for which official figures are available, there were 1,413 minors—only 1.8 per cent of the 77,520 wage earners in the industry. In 1926 a representative of the Bureau of Labor Statistics, who visited about 60 plants engaged in the manufacture of bottles, pressed and blown ware, window glass, and plate glass, reported that he found few minors under the age of 15. Child labor in the glass industry has now become almost a thing of the past, and credit for this is due in no small measure to Michael J. Owens, the inventor of the Owens machine. In 1869, as a boy of 10 years, he joined the ranks of the thousands of children employed in the glass factories. He died in 1923, the genius of the glass industry, whose inventions contributed more than all other factors combined to the complete elimination of child labor from the industry.

CHAPTER I.—BOTTLES AND JARS

The process of making bottles, whether by hand or by machine, may be divided into three distinct operations: (1) Blowing, (2) annealing, and (3) assorting and classifying.

Blowing is by far the most important of the three operations. It is in the field of bottle blowing that the most striking changes from the hand process to semiautomatic machinery, and finally to automatic machinery have taken place in the last quarter of a century. These are the changes which have completely revolutionized the bottle industry. In general, therefore, whatever is characteristic of the operation of bottle blowing may well be considered as representative of the bottle industry as a whole.

Physically the bottle is actually completed at the end of the first operation. Due, however, to the special effects which the contact of the hot bottle with the iron mold has on the glass, all bottles, and for that matter all glassware made in molds, must undergo a process of annealing before they can be applied to the purposes for which they are to be used. In describing the various methods used in the operation of blowing bottles numerous references have been made to the methods of annealing and assorting bottles, and it is deemed worth while, before entering into a detailed analysis of blowing, to explain briefly the other two operations of bottle making—annealing and assorting.

ANNEALING BOTTLES

The process of annealing consists in reheating the bottles to a temperature just below the melting point of glass, in order to retain the shape of the bottles, and then gradually cooling them off to the normal temperature. This is accomplished in specially built ovens, formerly termed "kilns," and now more generally known as "leers." During the last 20 or 25 years a number of very important changes have taken place in the methods of constructing leers and in the process of annealing glassware. The old kilns have become rare. Their place was first taken by the open-fire hand-pan leers, in which the pans were pulled through the leer by hand and then returned over an iron railing to the front of the leer. Next, the automatic muffled leer was invented, with the pans moving automatically on an endless chain, and the fire muffled and not in direct contact with the ware. More recently the fireless leer was put in operation and still more recently an electric leer.

All these changes were chiefly concerned with the problem of more perfectly controlling and regulating the process of annealing. Another factor was the saving in the amount of fuel needed in the process. Although some labor saving has been accomplished, especially in the change from the hand leer to the automatic and then to the fireless leer, this was not an important factor in the development of the annealing process. The man-hour output in the operation of annealing bottles can not be determined either separately or in connection with the operation of blowing, for the following reasons:

(*a*) There is no distinct labor occupation which may be ascribed to the process of annealing as separate from either blowing or assorting bottles. At the hot end of the leer the carry-in boys who bring the ware to the leer are usually included either with the "shop" if the bottle is blown by hand or with the machine unit if blown by machine. At the cold end of the leer the laborers who take the ware off the leer also as a rule classify, inspect, and very often pack the ware in boxes or cartons, and these men are therefore included under the operation of assorting rather than that of annealing the bottles. The only labor which can be attributed to annealing proper is that of tending and controlling the fire in the leer, but this kind of labor is necessary for all leers alike and has no direct relationship to the quantity or kind of ware in the leer. Its output can not, therefore, be measured in terms of bottles annealed.

(*b*) The operations of blowing and annealing are separate processes, entirely independent of each other. With the exception, perhaps, of the Owens leers, which are used exclusively with the Owens machines, any kind of leer may be used with any method of blowing bottles, by hand or machine. Besides, any leer may at the same time be annealing various bottles made on more than one machine or made on a machine and by the hand process. Finally, there is no definite relationship between the machine or shop hours spent in blowing bottles and the leer hours needed for annealing purposes. It is therefore impossible to gauge quantitatively the effects of the various leers on the man-hour output of the blowing unit. It is, however, generally admitted in the industry that these effects are comparatively slight and may be classified with such other indeterminate factors as the condition of the molten glass in the tank, the weather, etc.

ASSORTING BOTTLES

No significant changes have taken place in the methods of assorting and classifying, which is the third operation in the process of making bottles. The job is purely a hand process, consisting in examining the bottles while taking them off the cold end of the leer and throwing out such of the bottles as do not come up to the required standard. The process is not very complicated, and any laborer may learn to assort bottles after a week or two of training. Nowadays this operation is performed almost exclusively by women.

There is no distinct relationship between the operation of assorting bottles and the method used in the process of blowing. The condition of the bottles produced by the blowers has, indeed, a definite effect on the output of the selectors, for the better the run of the bottles blown the smaller is the quantity of ware discarded and the higher the output of the assorters. It can not be proved, however, that any one process of blowing or any one machine continuously produces a larger percentage of good ware than any other process or any other machine. Although it is admitted that the introduction of machinery has somewhat increased the output of the bottle assorters, this slight increase can easily be offset by such other factors as the skill of the assorters, the process of annealing, and the variations in the methods of assorting bottles used in the separate plants.

Thus, neither the operation of annealing nor that of assorting bottles lends itself to a quantitative analysis of changes in man-hour output. It was therefore necessary to limit this study to the process of blowing, and in the following pages wherever bottle making is mentioned it refers to this operation only.

BLOWING BOTTLES BY HAND

Since time immemorial the operation of blowing bottles by hand has been performed by a group of workers, constituting a unit termed the "shop." The composition of a shop has varied from time to time, depending entirely upon the nature and the size of the bottles blown. For an average size bottle, ranging in contents from less than an ounce to a quart, a normal shop in this country has since 1870 consisted of three skilled workers and four helpers. Of the three skilled workers, two blowers usually gather the molten glass and blow the bottles independently of each other, while the third worker finishes the necks of the bottles made by the two blowers. In most cases the three workers are equally skilled in all three operations of gathering, blowing, and finishing, and when working in this order interchange occupations every 20 minutes.

The helpers to the blowers derive their names from the nature of their work, being termed mold boy, cleaning-off boy, snapping-up boy, and carry-in boy. The mold boy sits on a low stool at the foot of the blower's bench and opens and closes the molds as required by the two blowers. The cleaning-off or knocking-off boy stands near by and receives the pipe after it is disconnected from the bottle in the mold, and with a small iron tool resembling a file cleans the pipe of the bit of glass which solidifies around the blowing end. The snapping-up boy puts the bottle which has just been taken from the mold into "the snap" and places it into the "glory hole."[1] The carry-in boy carries the bottles from the finisher to the leer to be annealed.

The process of blowing bottles by hand may be briefly described as follows: Standing in front of the working hole of the furnace, the blower dips his pipe into the white mass of molten glass and by skillful movements of his hand gathers on the end of the pipe the exact quantity of glass necessary for the size of the bottle to be made. This he quickly removes from the furnace and rolls and smooths it on a flat piece of iron called the "marver." While thus marvering the glass the blower also gently blows into the free end of his pipe and by introducing a few puffs of air into the solid mass of glass forms the initial cavity in the prospective bottle. When the glass is marvered sufficiently the worker, while continuing to blow into the pipe, swings it forward and backward a few times. As a result of these operations the bit of glass suspended at the end of the pipe assumes a pear-shaped form, with a small central air cavity inside.

The mold boy now opens one of his two iron molds, the blower lowers the partially formed portion of glass into it, and the mold boy then closes the two halves of the mold. Continuing to blow into the pipe, the blower blows with sufficient force to distend the glass to the exact shape patterned in the mold, after which the pressure of the blowing on the small amount of glass remaining above the mold causes it to distend to a mere film, which breaks readily and

[1] For explanation of these terms see p. 31.

thus disconnects the pipe from the bottle in the mold. The film of glass above the mold, which is so thin and light that it actually floats in the air, is known as the "blow-over."

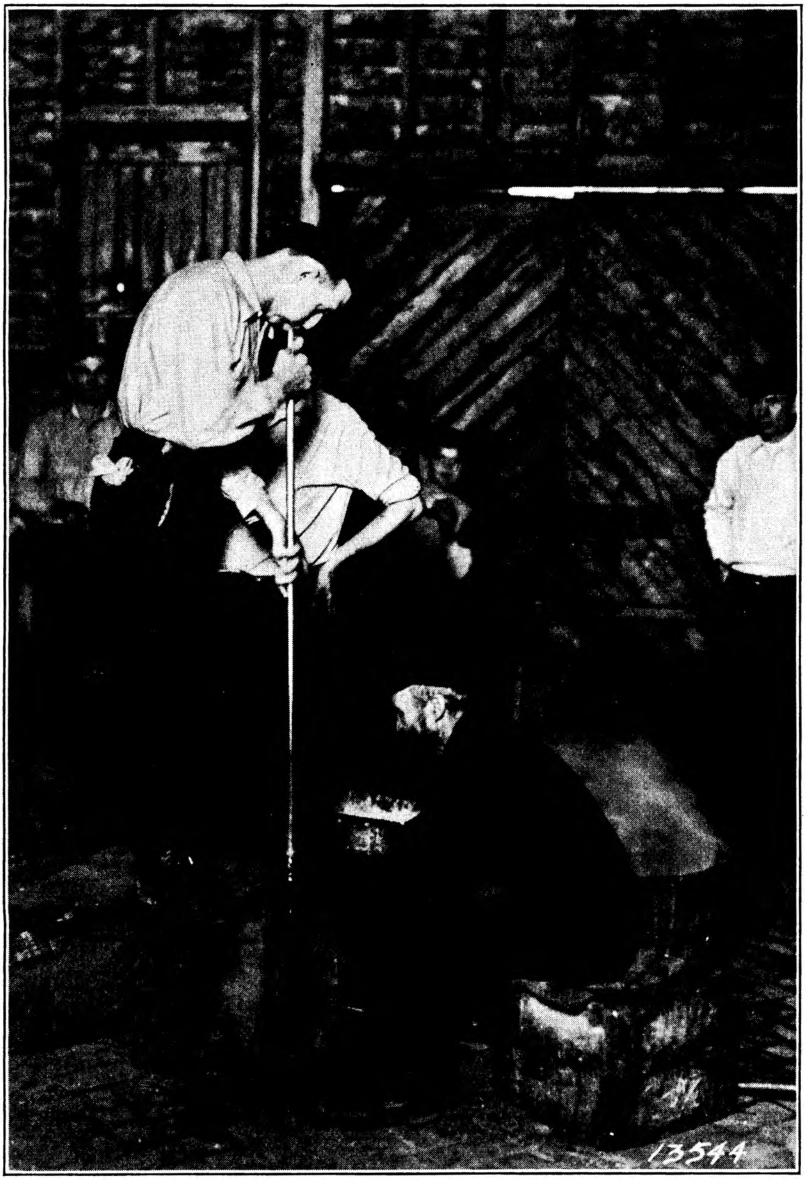


Fig. 1.—BLOWING BOTTLES BY HAND

While the bottle remains a short time in the mold until it solidifies sufficiently to be handled, the mold tender prepares the other mold for the second blower. Then he opens the first mold, takes out the

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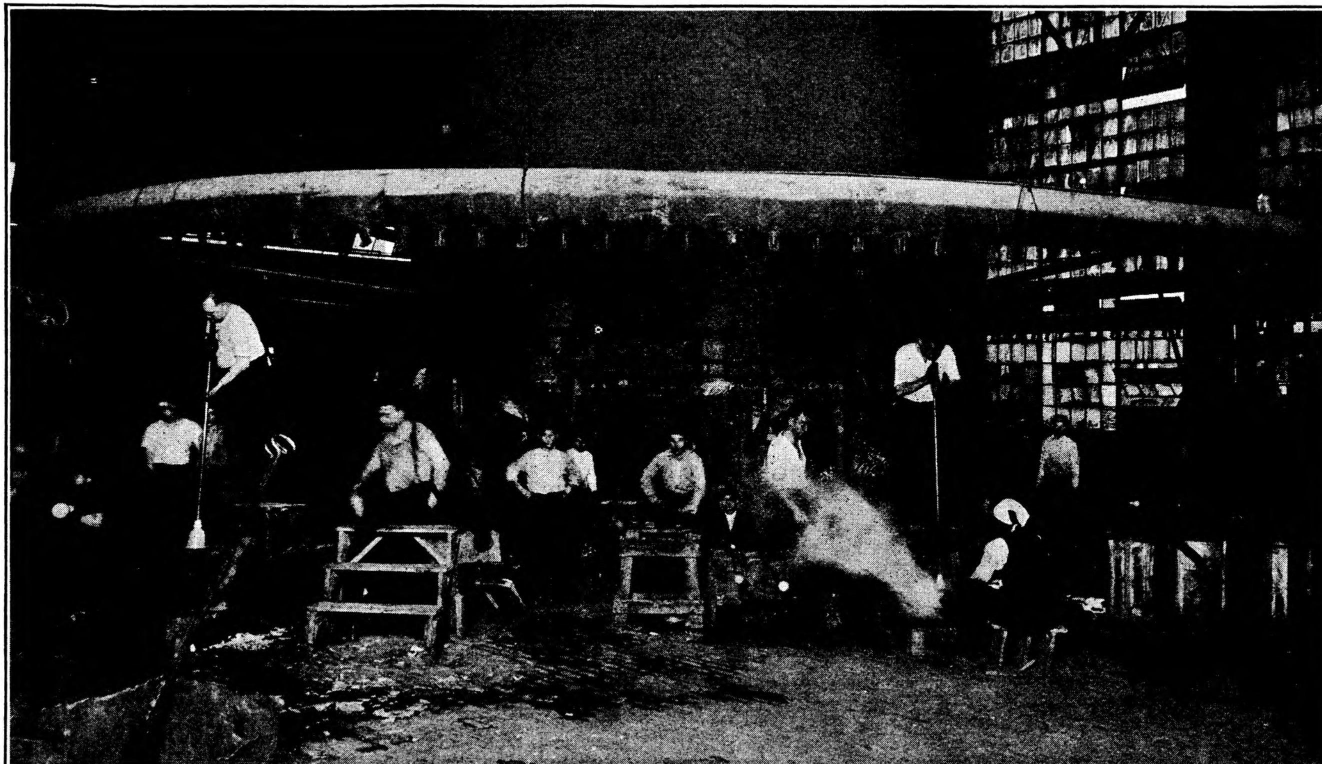

FIG. 2.—VIEW OF A HAND BOTTLE AND BLOWN-WARE PLANT

bottle with a pair of pincers, and places it on a stand at his side. Frequently he also weighs the bottle on a small scale standing near by.

At this stage of the process the bottle still needs to have its neck finished and the "lip" on the top formed. The snapping-up boy picks it up with a pair of pincers and puts it in a heavy can-like receptacle with a long handle, known as the "snap." He then places the snap with the bottle in the reheating furnace, termed the "glory hole," in order to reheat the neck of the bottle and thus make it ready for the finisher. The latter usually sits on a bench near the "glory hole," so that he may easily reach the snap and place it back in the fire when the bottle is finished. The work of the finisher consists of shaping the lip on the neck of the bottle, which he does very skillfully with a special wooden tool usually improvised by himself.

Next the snapping-up boy releases the finished bottle from the snap and places it on a stand for the carry-in boy, who picks up two or more bottles with a special iron fork and places them in the leer to be annealed.

While the normal shop is thus made up of seven workers, there are variations, in which the number of skilled workers as a rule remains the same while the number of helpers varies, depending upon the kind and size of bottles made. Quite often the cleaning-up boy is dispensed with. When an automatic mold is used which, operated by means of a treadle at the blower's foot, shuts and opens up by itself, the mold boy, too, is eliminated and the snapping-up boy adds to his duties the work of a take-out boy. Again, sometimes only one or two carry-in boys are used for as many as 10 shops or more. In such cases the snapping-up boys place the finished bottle in a large pan kept in a small iron oven termed the "peanut-roaster." The carry-in boy takes a full pan of bottles to the leer at one time and is thus enabled to serve all his shops in rotation.

The average daily productivity of the hand shop varies considerably with the size of the bottle, the condition of the glass, the skill of the workers, and the weather. In the case of small ware, ranging in contents up to 3 or 4 ounces, 30 to 35 gross constitutes a fair output for a shop of seven men during an eight-hour shift. As the weight of the bottle increases the output becomes smaller and smaller, so that in the case of quart jars 15 to 16 gross represents a very good output for an eight-hour day.

In the production of very large ware of a gallon and over, such as packer jugs, water bottles, carboys, etc., the total number of workers constituting a shop is considerably increased, although the number of skilled workers generally remains the same. Thus in the case of 5-gallon water bottles, which are still being made in large quantities by the hand process, a shop is made up of 13 workers, namely, 3 skilled blowers, 2 gatherers (who are as a rule apprentices to the blowers and are paid at a rate higher than the other helpers), 1 mold boy, 1 cleaning-off boy, 3 snapping-up boys, and 3 carry-in boys. The daily production of 5-gallon bottles by such a shop ranges from 250 to 350 bottles, depending on the skill of the blowers, the condition of the molten glass in the tank, and the weather.

BLOWING BOTTLES BY MACHINE

The successful introduction of the Owens automatic machine in 1904 was the first and most important revolutionary change in the production of bottles. The machine was automatic from the very start. It at once displaced the three skilled blowers and two of their helpers, the knocking-off boy, and the snapping-up boy. The mold boy (who became a take-out boy) and the carry-in boys also soon gave way to the automatic conveyors. One semiskilled machine operator, whose duty it is to supervise the machine and see that everything runs smoothly, has now taken the place of the seven workers in the hand shop. In addition to the very large saving of human labor accomplished by the machine its output was so much larger than that of a hand shop and the cost of production so much less that the manufacturing of bottles by hand was doomed.

The manufacturers were at once confronted with the dilemma of either acquiring the new machine or seeking such changes in the old process of manufacturing as would lessen their disadvantages in competition with the automatic machine. But not all the bottle manufacturers could install the automatic machine, as the owners of the patent refused to sell the machine on the open market. Instead they granted licenses to a number of manufacturers to use their machines on a royalty basis, and part of the agreement was that the licensees specialize in particular lines of ware, the owner of the machine guaranteeing that no other manufacturer would be granted the right to produce this same kind of ware on the automatic. What such a policy really meant was a monopoly not only in the ownership of the machine but also in the kinds of ware produced on the automatic. This policy, together with the great expense involved in the installation of an Owens machine, is chiefly responsible for the comparatively slow and very gradual spread of this machine in the industry. At the same time this policy was the chief stimulus to the introduction of semiautomatic machines, which soon developed into an automatic process entirely different from the Owens, but almost as successful.

SEMIAUTOMATIC MACHINERY

Shortly after the introduction and installation of the first Owens machine in 1904 there appeared on the market a hand machine which became known as the United, or English, or "Johnny Bull" machine. This machine was built on the pattern of the Ashley, a hand machine invented in England as early as 1887. This was soon followed by another semiautomatic, more widely used and generally known as the "Jersey Devil" machine. In its crudest form the machine was made up of two round tables, each equipped with spaces for from two to four molds. The first table, the one nearest the furnace, was equipped with blank molds and was surmounted by a plunger operated by compressed air. The second table was equipped with an equal number of form molds and was surmounted by the blowing valve, also operated by compressed air.

The first two hand operations eliminated by the introduction of the semiautomatic machine were the blowing and the finishing of the bottle. It is interesting to note here that the process of making the neck of the bottle, which is usually the last operation in hand blowing, became the first operation of the machine after the glass was fed to it by the gatherer. This is also true of the Owens automatic machine. The three skilled workers were retained, but the demands on their skill were considerably reduced. The gatherer no longer

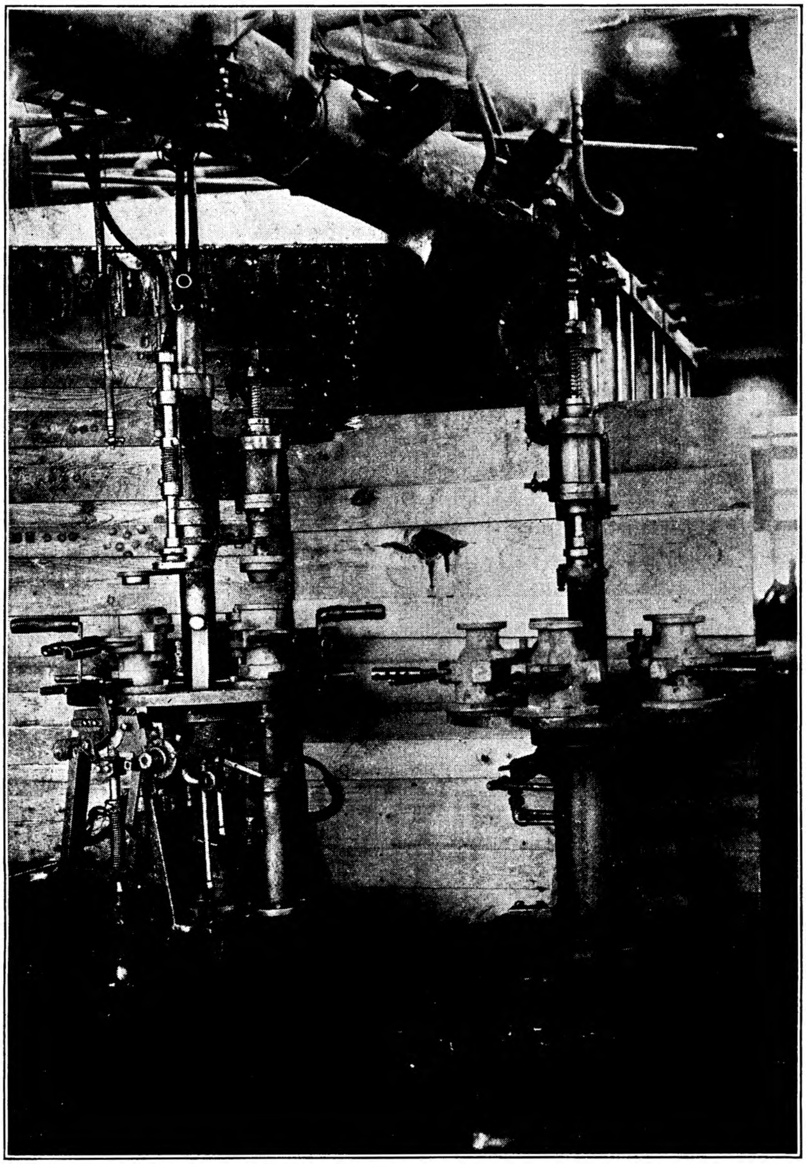

FIG. 3.—JERSEY DEVIL OR TWO-MAN SEMIAUTOMATIC MACHINE

collected the glass on the end of a pipe, but used a plain solid iron rod, called a "punty." He was no longer required to be exact as to the quantity of glass he gathered each time. The quantity of glass needed was now determined by the presser, who sheared it off the punty as the gatherer held it over the opening of the blank mold, thus allowing the bit of glass to drop into the mold of its own weight. The presser would then turn the table one notch by operating his foot treadle and cause the plunger to penetrate the molten mass of glass in the mold, shaping the lip of the bottle and at the same time introducing the initial small cavity into the solid glass. After the next turn of the table the partly formed bottle would be transferred from the blank mold into a form mold by the man operating the second table. He would turn his table one notch and thus bring the mold under the blowing valve. The compressed air, released by the operator of the second table, would blow into the already formed cavity of the "parison" or partly formed bottle and distend it into the exact shape of the pattern in the mold. The bottle was then complete. At the next turn of the table a take-out boy opened the mold, and after examining and frequently weighing the bottle, he placed it either on a little stand for the carry-in boys to take to the leer, or into a paddle in the "peanut roaster," where the bottles were collected and heated until enough of them were accumulated to be taken to the leer.

The total number of workers needed on a three-man semiautomatic machine was five, three skilled blowers and two helpers—a take-out and a carry-in boy. This represented a reduction of two helpers, as compared with the hand process. The principal difference, however, between the hand machine and hand blowing was not so much the reduction of the number of helpers needed as the elimination of the greater part of the skill required from the skilled blowers in the hand process. This was especially true in the case of the presser and the transfer man. It was not, therefore, very long before the machine was so changed as to eliminate first one and then the other of these workers, completely dispensing with both or replacing them by one unskilled laborer. The machine thus became first a two-man and then a one-man machine in the sense that at first two skilled workers were needed for its operation, and finally only one skilled worker—a gatherer.

The above technical changes were made either by the manufacturers of the machines or by the glass manufacturers, who themselves introduced improvements. Some of these improvements went so far as to change completely the old machine into a new machine; hence the various types and names of the semiautomatic machines used in the industry, such as the "Johnny Bull," "Jersey Devil," Teeple-Johnson, the South Millville machine, the Turner machine, etc. On the whole, however, these machines were very much alike and may be classified in one group, that of two-man machines. The average attendants on such a machine consisted of one gatherer and one presser (both skilled workers), one transfer boy, one take-out boy, and one carry-in boy. If a "peanut roaster" was used one carry-in boy usually took care of two machines, making the total average attendants on one machine four and one-half workers.

ONE-MAN MACHINE

Through further improvements of the machine more and more labor was dispensed with. With the use of electric power the two tables of the machine were made to rotate automatically, synchronizing with the other operations of the machine. At the same time a cutting-off device was added, which completely eliminated the presser and turned the two-man machine into a one-man machine.

The transfer boy soon gave way to an automatic transfer and the take-out boy to an automatic take-out device, both operated in unison with other movements of the machine. The last change actually turned the semiautomatic into an automatic machine, at least so far as the blowing of the bottle was concerned. In this group belong the O'Neill machines, the Miller, and the Lynch (which was put on the market as the "No-boy" machine). In all cases the difference between these machines and the Owens automatic was in the use of a gatherer to feed the glass to the machines. As in the case of the Owens, the carry-in boys were retained in some plants, while in other plants they were replaced by automatic conveyors to the leer. The usual attendants on a one-man machine would therefore consist of one gatherer [2] and one or more carry-in boys, depending on the size of the bottles. To these old workers, survivors of the "shop," was added one machine operator, whose duty it was to watch the operation of the machine, regulate its speed, change the molds, etc., and a machine foreman or "upkeep" man usually in charge of three or more machines in the plant.

"FEED AND FLOW" DEVICES

Simultaneously with the other changes in the development of the semiautomatic machine attempts have been made to devise means by which the gatherer could be replaced and the machine fed automatically, by a process different from the suction method patented by the Owens machine. As early as 1903 a device was invented which enabled the molten glass to flow in a continuous stream from the furnace into the mold, and this device is still being used in a number of plants for the manufacture of cheap pressed ware. Since then various experiments have been made in utilizing feeding devices in the manufacture of bottles and jars, and by 1917 this new method of getting the molten glass into the machine became a marked success.

Rapid success in the application of these feeding devices may be shown by referring to the rapidly diminishing numbers of semiautomatic machines in use without the feeder. Prof. George E. Barnett, in an article on "Machinery and labor," published in the Quarterly Journal of Economics for August, 1925, gives the number of semiautomatic machines used in the bottle and jar sections of the glass industry, 1916 to 1924, as follows:

1916	459	1921	288
1917	428	1922	164
1918	417	1923	130
1919	417	1924	72
1920	315		

In 1926, out of 25 bottle plants inspected only one plant was found using the semiautomatic to a large extent. In another plant the semiautomatic was found standing by the furnace but dismantled and ready to be displaced by an automatic. In still another plant a semiautomatic machine had recently been consigned to the scrap heap.

[2] Later on three gatherers were used for two machines, as it became impossible for one man alone to keep up with the speed of the machines.

AUTOMATIC MACHINERY

The difference between the two automatics, the Owens and the "feeder," lies chiefly in the method of delivering the molten glass to the machine. The Owens machine uses the suction method, whereby the arms of the machine pass over the open part of a revolving pot and come in contact with the glass for a period long enough to suck the necessary quantity of glass into the blank mold located at the end of the arm. This process is the principal characteristic of the Owens machine and is peculiar to this machine.

In the feeder process the glass, regulated by a special device, is delivered automatically into the blank molds of the machine. The feeding thus regulated completely synchronizes with the other movements of the machine. The same device also regulates the size of the "gob"; that is, the quantity of glass necessary for the production of the given size of bottle. The feeding devices are entirely independent of the machines, and may therefore be used with any standard bottle-making machine on the market.

OWENS MACHINE

The Owens machine consists of a number of working units, each one complete in itself, mounted on a circular and continuously rotating framework. Each unit completes a bottle during each revolution. Each unit or arm carries a vertical mold called a "blank mold" placed directly under and accurately fitted to another mold called a "neck mold." These two molds are bored to hold the exact amount of glass required to make the desired bottle. The neck mold is exactly the shape of the neck of the bottle, while the blank mold is nearly cylindrical in shape and is designed to hold all the glass which makes up the part of the bottle below the neck.

As the machine rotates each unit carries its neck mold and the attached blank mold over a revolving pot of molten glass. The revolving pot is built into a combustion chamber adjacent to the refining tank, with which it is connected by means of a trough, the glass constantly flowing from the tank into the revolving pot. Although part of the glass in the revolving pot is exposed, the rotation of the pot and the special heating devices make it possible to keep the temperature of the glass in the revolving pot at the precise degree needed for the weight and the size of the bottle.

As the arms of the machine pass over the revolving pot they are lowered for an instant, so that the bottom of the blank mold is slightly immersed in the molten glass. At this moment a vacuum valve is opened and all air is exhausted from the bored opening in the neck and blank molds, resulting in immediately filling the molds with hot glass—the lower part cylindrical and solid, the upper part a perfect neck of a bottle. As the molds rise from contact with the surface of the molten glass in the revolving pot, a chisel-shaped knife sweeps across under the bottom of the blank mold and cuts off the string of glass that clings to the mold.

Next, air is admitted into the top of the neck mold for the purpose of solidifying somewhat the imprisoned glass and enlarging the opening in the top of the neck of the partly formed bottle. Soon the two halves of the blank mold open and the glass "parison" (or partly formed bottle), now partly solidified, is seen hanging suspended by the neck portion inclosed in the neck mold.

From below now arises the finishing mold. It remains wide open until it has taken its proper position, when it closes around the suspended parison. Another valve opens and compressed air is

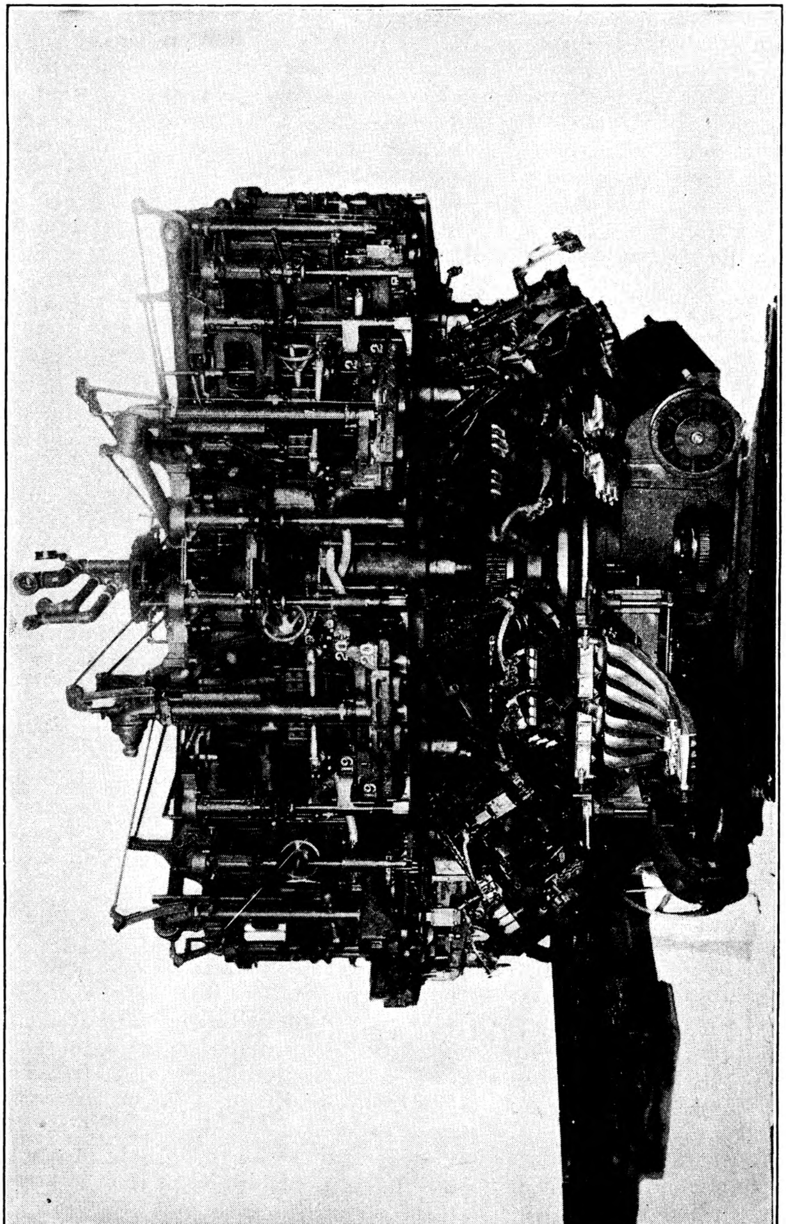

Fig. 4.—OWENS C. A. AUTOMATIC MACHINE (10 ARMS×2 HEADS×3 MOLDS=60 BOTTLES PER REVOLUTION

forced through the opening in the neck mold and distends the blank glass until it fills completely the pattern in the finishing mold. The bottle is then completed, and as the mold opens it falls out either on a rotating table near by, if no conveyor is used, or into the receptacle of the Owens conveyor.

The bottle as it leaves the machine is still red hot in parts, but is sufficiently solidified to keep its shape while being carried or conveyed to the leer to be annealed.

The Owens machines were first made with but six arms; that is, six complete sets of molds each. Later 10 arms were used, and still later 15 arms. Originally each arm carried only one complete set of molds, but now some of the 10-arm machines carry two sets of molds; and each mold contained a cavity for but one bottle, while now the molds are made with two cavities each for large ware (4 to 13 ounces) and three cavities each for small ware (less than 4 ounces). One of these machines blows 6 bottles at one time and thus throws out 60 bottles with each revolution. At the rate of four revolutions per minute, this machine throws out 240 bottles per minute, or almost as many bottles as a hand shop of 7 workmen could make in 20 minutes.

The attendants on the Owens machines vary with the plant—whether a conveyor or carry-in boys are used—and with the number of arms on the machine. The average Owens machine requires one operator, whose duty it is to watch the operations of the machine and to see that everything runs smoothly. Either a machinist or a foreman is needed to adjust the speed of the machine, to change molds, and otherwise to take care of the machine; if a machinist, he usually takes care of at least two machines. This is the total direct labor needed in attending an Owens machine. In addition one or more carry-in boys are needed if no conveyor is used.

CONVEYORS

By means of a conveyor the last member of the hand shop, the carry-in boy, is eliminated from the field of bottle making. The process thus becomes truly automatic in the sense that from the tank through the machine and through the leer no worker needs to handle the bottle.

There are numerous devices used in the industry to transfer the red-hot bottles from the machine to the leer. In this study, however, only two kinds need be mentioned—the Owens conveyor, used in connection with the Owens machine and the Owens leers only, and the regular belt conveyor, used in one form or another for all other machines.

The Owens conveyor consists of a series of narrow steel pans, with suspended cups placed at regular intervals. The pans constantly move over an elevated path fitted with iron rails, and are so arranged that there is a continuous circuit from the machine through the leer and back again to the machine over a similar path constructed outside the leer. The machine, the conveyor, and the leer are exactly timed and run as a unit.

As each pan passes longitudinally under the receptacle into which the bottles are thrown from the machine, each one of the cups of the pan is filled by a bottle. At the same time the pan is entering the leer through a side opening and by the time the last cup of the pan is filled the pan will have completely entered the leer and have joined the other pans to make up the floor of the leer. Propelled by a special device, properly timed, it now begins its journey through the leer.

The latter has no floor other than the one made by the pans, and the bottles pass through it completely suspended in mid-air, thus being thoroughly annealed from all sides.

At the cold end of the leer the bottles are taken out of the cups by the selectors, and each pan, when emptied, is sent along the external path on its journey back to the machine.

FEEDERS

Since 1917 a large number of various kinds of feeders have been introduced in the industry. The differences among the various patents are very minute and are of a technical nature only. For the purpose of this study, therefore, it will be necessary to distinguish but two kinds of feeders: (1) The multiple feeder, used for more than one machine; and (2) the single feeder, used for only one machine.

Multiple feeder.—The multiple feeder, or the P. N. (paddle needle), as it is known in the industry, may be described as follows:

The device consists of a small chamber built in front of the furnace, usually called the forehearth or the boot. The extension is made out of clay blocks and is connected with the tank by a trough or a channel about 2 feet wide through which the glass flows from the refining chamber of the tank into the forehearth. The portion of the forehearth above the surface of the glass forms two combustion chambers, one next to the furnace and the other adjoining the nose of the chamber, where the glass passes down through the orifice to the machine. Oil or gas burners in these two chambers can be so regulated as to supply the glass to the machine in the particular temperature required for any special kind of bottle, irrespective of fluctuations in the temperature of the tank proper.

In the very nose of the forehearth there is a small bowl with a round opening at the bottom. Into this opening is fitted a clay ring of such size as to give the glass flowing through it the diameter which will allow it to fit well into the blank mold of the machine. A clay paddle working in the channel with a motion exactly the reverse to that of a canoe paddle—down, forward, up, and back—keeps the bowl supplied with glass. By gravity it runs down through the orifice ring, assisted by the downward thrust of a clay plunger, which works directly over the orifice. Each time the plunger pulls up sharply it holds the glass sufficiently long to allow the shears which close in from each side below the ring to make a clean cut. The stream of glass thus cut off is known as the "gob" and the process is often referred to as the "gob" feeder. The operations of the paddle, the plunger, and the shears are so timed as to make the "gob" of precisely the length needed for the bottle desired. The "gob" then slides down an iron trough on a fine film of water into the mold of the machine.

When two or three or four machines are fed from one feeder two or three or four troughs are used. These move forward and backward and come alternately under the orifice of the feeder to receive the "gob." The movement of the troughs are synchronized with the operations of the machines, so that the upper end of the trough comes under the orifice of the feeder at the precise moment when the lower end gets in contact with a blank mold ready to receive the "gob." When one machine is not working the trough for that machine is stopped. Adjustments can then be made to feed the remaining machines. When a machine is stopped temporarily only the feeder keeps on working at the previous rate, dropping the unused "gob" down to the floor, where a receptacle is usually placed to receive the superfluous glass which is to be returned to the tank as cullet.

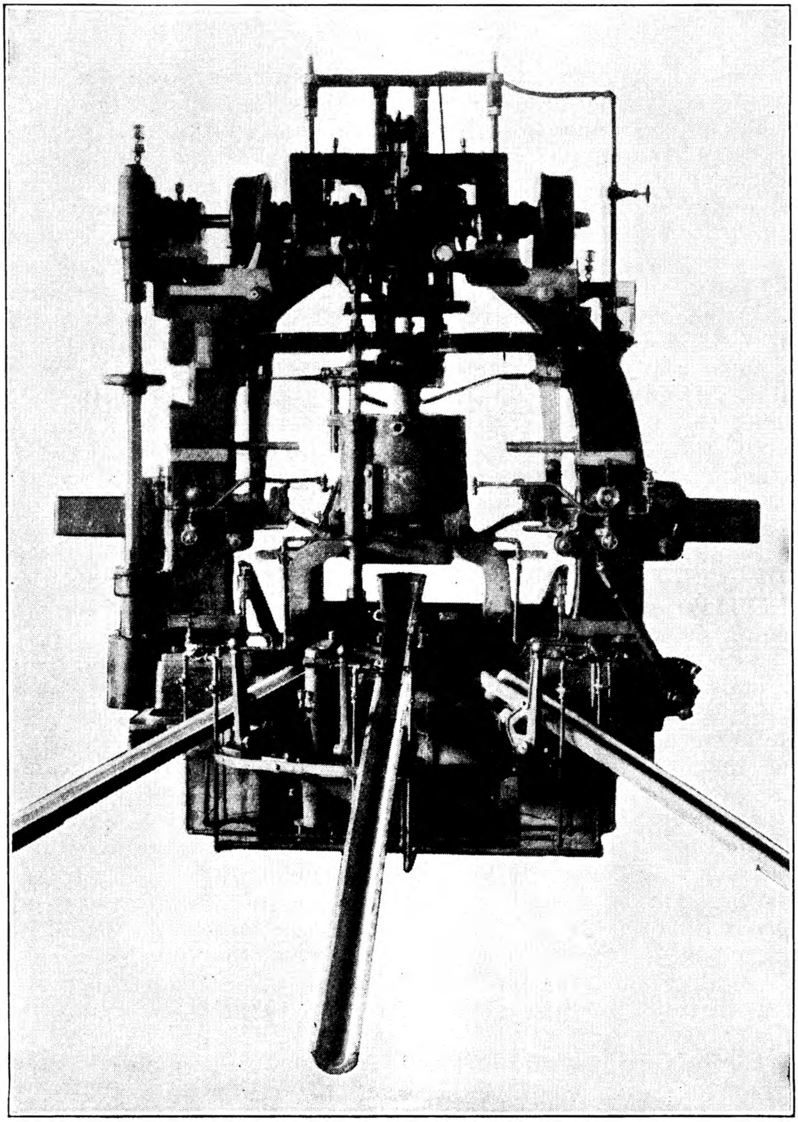

Fig. 5.—HARTFORD-EMPIRE PADDLE NEEDLE FEEDER (FRONT)

Single feeder.—The single feeder does not require a paddle, as the orifice is a few inches below the surface of the glass which flows out by force of gravity through a somewhat different type of bowl or spout. A hollow clay tube somewhat larger than the orifice hangs above the orifice and the plunger operates inside this tube. The latter can be raised and lowered to regulate the supply of glass for the orifice. This adjustment, together with the plunger and the shears below the ring, enables the operator to control the size and the weight of the glass desired. The tube revolves continuously and thus assists in keeping the glass about the orifice at a uniform temperature.

Although the multiple feeder implies a considerable saving in labor and equipment, there are a number of technical and economic

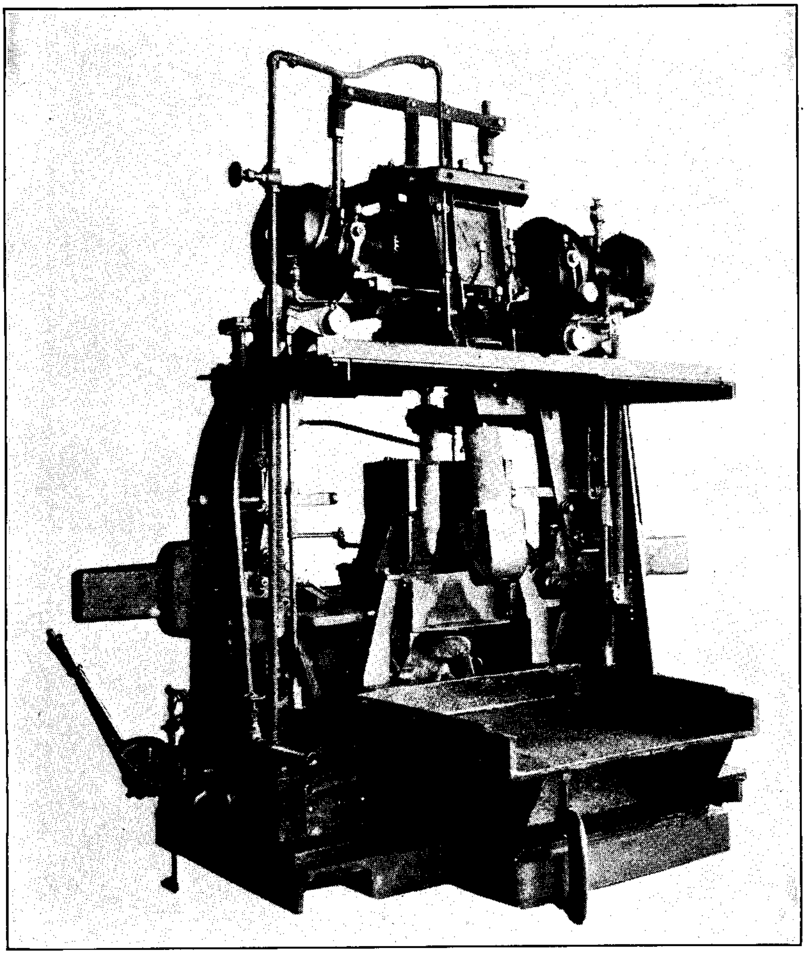

FIG. 6.—HARTFORD-EMPIRE PADDLE NEEDLE FEEDER (BACK)

reasons which make the use of the single feeder more advantageous. The result is that a number of plants which have been using the P. N. feeder for two or three machines are gradually going over to the single-feeder system.

MACHINES USED WITH FEEDERS

As already stated, the feeder is an entirely independent unit and can be used with any machine in the plant. Even the old "Johnny

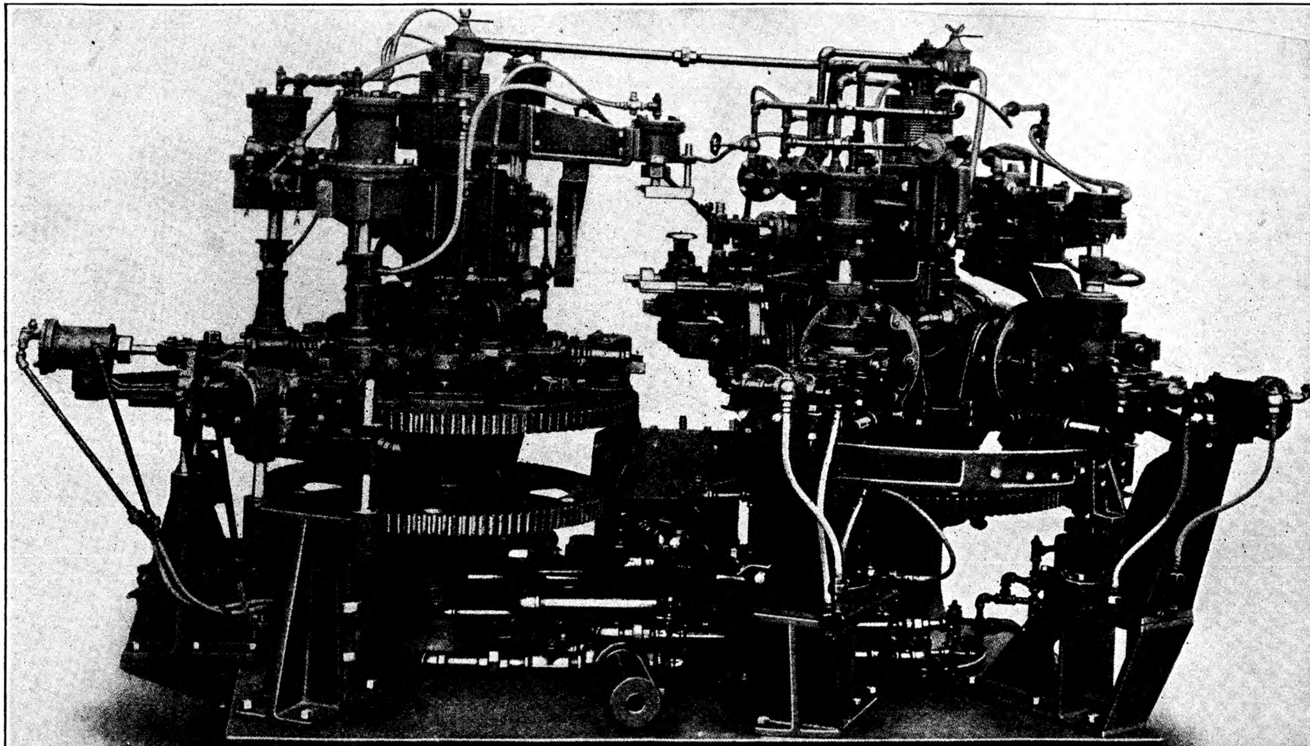

Fig. 7.—O'NEILL AUTOMATIC BOTTLE-MAKING MACHINE

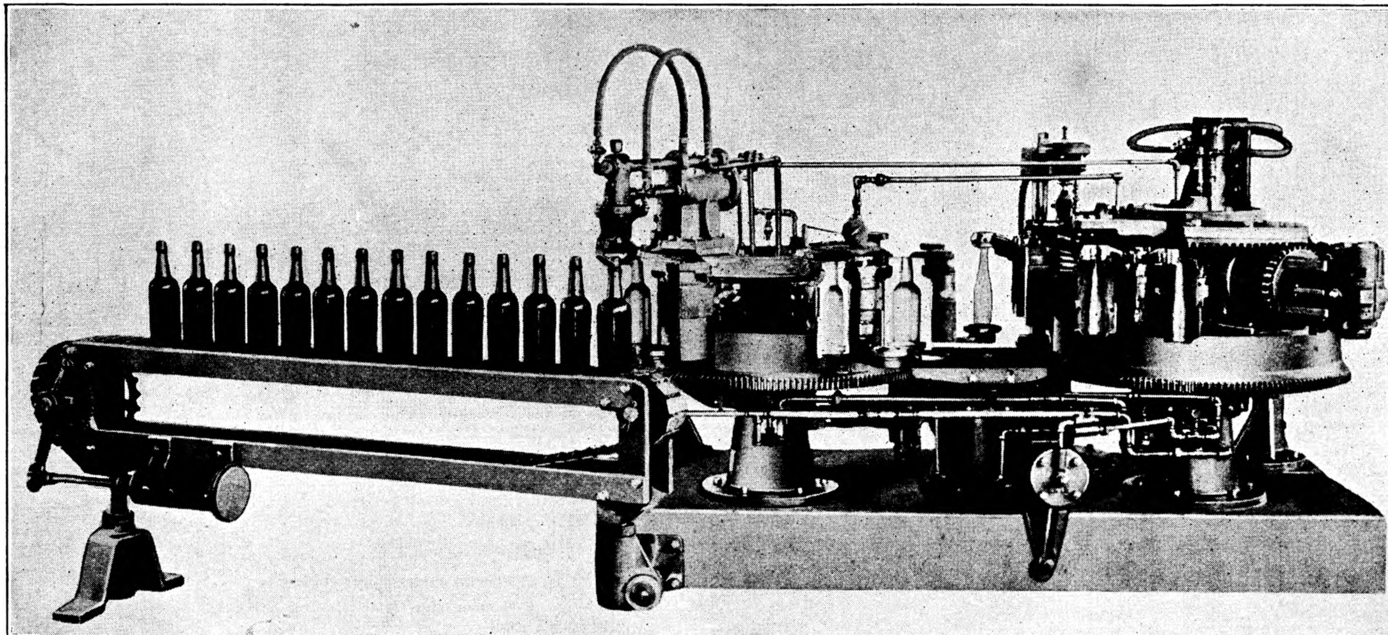

FIG. 8.—LYNCH NO-BOY AUTOMATIC MACHINE

Bull" hand machines could be used with a feeder. Nevertheless, the expensive installation outlays and the possible maximum speed of the feeders resulted in improving and almost standardizing the machines used with the feeder. The latest models of the O'Neill machines, the Miller, the Lynch, and the Hartford-Empire, have been built to fit the speed of the feeders. Most of these machines now carry eight blank and eight blow molds and are capable of producing daily a definite quantity of bottles, depending entirely upon the size and weight of the bottle. There is usually only one operator on any

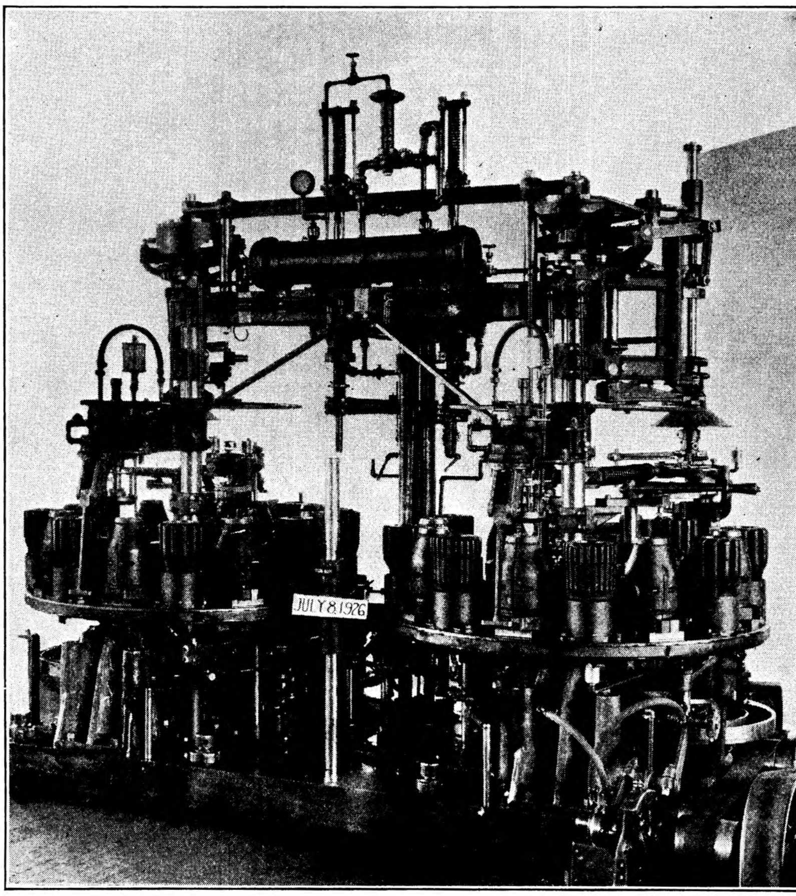

FIG. 9.—HARTFORD-EMPIRE MILK BOTTLE DOUBLE MACHINE

one of these machines, whose duty it is to see that the machine runs smoothly. The work of changing molds and the initial adjustment of the machine and the feeder to the particular kind of bottle desired, as well as the small repair work, is done either by a machine foreman or a machinist, who is as a rule in charge of more than one machine.

As in the case of the Owens machine, a carry-in boy is used in a number of plants to take the bottles from the machine to the leers. In other plants, however, the belt conveyor is used for this purpose, in which case the bottles are transferred from the machine to the conveyor either by an automatic device or with the help of a take-out boy. Some of the belts are provided with special cups, in which the bottles stand up while journeying to the leer. The conveyor enters the leer through a side opening and the bottles are pushed into the leer by means of a pushing device. The floor of the leer is made up of a series of pans moving on an endless chain. The floor moves just fast enough to make room for the incoming bottles, which fill up every pan at successive regular intervals.

Thus, as in the case of the Owens machines, the feeder process of blowing bottles has become completely automatic from the tank until the bottle reaches the cold end of the leer.

LABOR PRODUCTIVITY AND LABOR COST

Before analyzing the statistics of labor productivity and blowing labor cost in the production of bottles the following points must be made clear:

1. The data representing output of a hand unit of three skilled workers and four helpers, which has been used as the basis for comparing the output of all other units, do not represent actual present-day production, for the simple reason that with the exception of a small quantity of prescription ware and the 5-gallon carboys none of the bottles included in this study are made nowadays by the hand process. The small quantity of prescription ware still made by hand is produced under conditions which do warrant its use as a fair representation of the hand process. The mere fact that, because of the very small orders usually given to hand plants, the workers of a "shop" are compelled to change molds several times in the course of one day is sufficient to curtail seriously the average output of the shop.

The figures used represent the concerted opinions of experienced bottle blowers, foremen, and employers of a number of bottle plants. In the case of prescription ware they are considerably higher than the actual figures of output secured in one plant. They are even somewhat larger than the corresponding figures of output given in the Eleventh Special Report of the Commissioner of Labor Statistics, published in 1904 (pp. 630, 631). The figures given are termed "ideal," because they really show what a "shop" of three experienced blowers and four helpers could produce when working on any one kind of bottles for a complete eight-hour day without changing molds and under conditions at least as favorable as those under which the machines are working to-day. In the case of the 5-gallon water bottle the actual output of a shop of 13 workers has been used as the basis of comparison with the machine output.

2. The 15 kinds of bottles covered in this investigation represent but a very small fraction of the thousands of varieties of bottles which are made. The principal factors, however, affecting the average output of any one unit of production are the weight and the contents of the bottles made. Since the 15 kinds of bottles studied cover a range of from half an ounce to 5 gallons in contents and from less than 1 ounce to 12 pounds in weight, they may therefore be considered as a representative cross section of the bottle branch of the glass industry.

MAN-HOUR OUTPUT

The most outstanding factor in the recent development of bottle blowing is the tremendous increase in man-hour output effected by the automatic machines.

Table 16 shows the man-hour output on 15 kinds of bottles made by hand and by the various semiautomatic and automatic machines. The bottles shown are: One-half ounce and 2-ounce prescription ovals; 4 and 8 ounce prescription ovals; three-fourths and 2 ounce extract panels; 8 and 16 ounce whisky dandies; 8-ounce sodas and 16-ounce beers; pint and quart milk bottles; one-half gallon and 1-gallon packer jugs; and 5-gallon water carboys. The table gives the man-hour output in terms of gross of bottles actually produced and also in terms of index numbers based on the man-hour output by the hand process.

TABLE 16.—*Average output per man-hour of specified kinds of bottles made by hand and by machine*

Prescription ovals

Method of production and kind of machine	½-ounce		2-ounce	
	Quantity	Index number	Quantity	Index number
Hand production:	*Gross*		*Gross*	
Ideal	0.714	100.0	0.643	100.0
Actual	.498	69.7	.408	63.5
Semiautomatic machine:				
2-man machine			.850	132.2
1-man machine			1.043	162.2
1-man machine and feeder			1.824	283.7
Automatic machine:				
O'Neill single and feeder			2.476	385.1
O'Neill triple and P. N. feeder	2.582	361.6		
Lynch and feeder	5.453	763.7	4.799	746.3
Owens A. N. double	8.870	1242.3	7.970	1239.5
Owens A. N. double, with conveyor	15.238	2134.2		
Owens A. V. single, with conveyor	9.959	1394.5	9.645	1500.1
Owens A. V. double, with conveyor	20.022	2804.2	18.341	2852.4
Owens C. A. double triplex, with conveyor	25.120	3518.2	25.118	3906.4

Method of production and kind of machine	4-ounce		8-ounce	
	Quantity	Index number	Quantity	Index number
Hand production:	*Gross*		*Gross*	
Ideal	0.536	100.0	0.446	100.0
Actual	.285	53.2	.227	50.1
Semiautomatic machine:				
2-man machine			.644	144.4
1-man machine	.797	148.7	.714	160.1
Automatic machine:				
O'Neill and feeder	2.464	459.7	1.796	402.7
Lynch and feeder	3.782	705.6	3.290	737.7
Owens A. E			2.178	488.3
Owens A. N. single			3.024	678.0
Owens A. N. double	6.254	1166.8		
Owens A. N. single, with conveyor	7.135	1331.2		
Owens A. V. single, with conveyor	9.908	1848.5		
Owens A. R. double			4.852	1087.9
Owens A. R. double, with conveyor			10.006	2243.5
Owens A. Q. single, with conveyor			9.006	2019.3
Owens A. Q. double, with conveyor			11.778	2640.8
Owens A. V. double, with conveyor	16.212	3024.7		
Owens C. A. double duplex, with conveyor			12.117	2716.8
Owens C. A. double triplex, with conveyor	22.028	4109.8		

TABLE 16.—*Average output per man-hour of specified kinds of bottles made by hand and by machine*—Continued

Extract panels

Method of production and kind of machine	6-dram		2-ounce	
	Quantity	Index number	Quantity	Index number
	Gross		*Gross*	
Hand production	0.571	100.0	0.500	100.0
Semiautomatic machine:				
Jersey Devil			.711	142.2
O'Neill with feeder			1.500	300.0
Automatic machine:				
O'Neill single and feeder			2.854	570.8
O'Neill triple and feeder			2.872	574.4
Owens A. N. single			3.452	690.4
Owens A. N. double	6.222	1089.7	4.402	880.4
Owens A. N. double, with conveyor	10.679	1870.2		
Owens A. R. single, with conveyor	6.783	1187.9	5.779	1155.8
Owens A. R. double, with conveyor	10.480	1835.4	8.067	1613.4
Owens A. V. single, with conveyor	8.817	1544.1	9.048	1809.6
Owens A. V. double, with conveyor	16.430	2877.4	12.558	2511.6
Owens C. A. double duplex, with conveyor			12.072	2414.4
Owens C. A. double triplex, with conveyor	16.292	2853.3		

Sodas and beers

Method of production and kind of machine	½-pint sodas		1-pint beers	
	Quantity	Index number	Quantity	Index number
	Gross		*Gross*	
Hand production	0.393	100.0	0.393	100.0
Semiautomatic machine:				
Jersey Devil	.505	128.5	.464	118.1
Teeple-Johnson, with gatherer	.778	198.0	.776	197.5
O'Neill, with gatherer	1.141	290.3		
Lynch, with gatherer	1.351	343.8		
Automatic machine:				
O'Neill and feeder	2.814	716.0		
Hartford-Empire triple unit and P. N. feeder	1.815	461.8	1.675	426.2
Owens A. E. single, with conveyor	4.842	1232.0	4.931	1254.7
Owens A. R. single, with conveyor	6.453	1642.0	7.342	1868.2
Owens A. Q. single, with conveyor	6.188	1574.5	7.661	1949.3

Whisky dandies

Method of production and kind of machine	½-pint		1-pint	
	Quantity	Index number	Quantity	Index number
	Gross		*Gross*	
Hand production	0.446	100.0	0.357	100.0
Semiautomatic machine:				
Jersey Devil	.658	147.5	.508	142.3
Teeple-Johnson, with gatherer			.774	216.8
O'Neill, with gatherer			.904	253.2
Lynch, with gatherer			1.549	433.9
O'Neill, with feeder	1.428	320.2		
Automatic machine:				
O'Neill and feeder	2.725	611.0	2.368	663.3
Lynch and feeder	3.444	772.2	2.649	742.1
Owens A. E. single			1.819	509.5
Owens A. R. single	2.321	520.4	1.940	543.4

TABLE 16.—*Average output per man-hour of specified kinds of bottles made by hand and by machine*—Continued

Milk bottles

Method of production and kind of machine	1-pint		1-quart	
	Quantity	Index number	Quantity	Index number
	Gross		*Gross*	
Hand production	0.357	100.0	0.286	100.0
Semiautomatic machine:				
Teeple-Johnson with gatherer	.924	258.8	.775	270.9
Miller with gatherers	.976	273.4	.856	299.3
Automatic machine:				
Miller with single feeder and with conveyor	1.876	525.5	1.457	509.4
Hartford-Empire, with double feeder	1.487	416.5	1.242	434.3
Hartford-Empire, with double feeder and with conveyor	5.265	1474.8	4.145	1449.3
Owens A. E	1.156	323.8	1.064	372.0
Owens A. R	1.139	319.0	.961	336.0

Packer jugs

Method of production and kind of machine	½-gallon		1-gallon	
	Quantity	Index number	Quantity	Index number
	Gross		*Gross*	
Hand production	0.179	100.0	0.143	100.0
Semiautomatic machine: Jersey Devil	.263	146.9	.202	141.3
Automatic machine:				
O'Neill and feeder	1.192	665.9		
Owens A. L. single	.606	338.5	.620	433.6
Owens A. R. single	.614	343.0		
Owens A. Q. single	1.477	825.1	1.165	814.7

5-gallon water carboys

Method of production	Quantity	Index number
	Gross	
Hand production	0.026	100.0
Automatic machine	.260	1000.0

The following analysis of man-hour output of the 2-ounce prescription ovals, the 8-ounce soda, and the quart milk bottle is given to illustrate the contents of Table 16. In the case of the 2-ounce prescription ovals the "ideal" output of a hand shop is 0.643 gross per man-hour. The actual output of the single plant for which data could be secured is much less, namely, 0.408 gross per man-hour, for reasons previously explained (see p. 45). On the semiautomatic machine the output ranges from a minimum of 0.850 gross per man-hour on the "Jersey Devil," or two-man machine, to a maximum of 1.824 gross per man-hour on a semiautomatic O'Neill machine operated with the help of a feeder. On the automatic machines the output of 2-ounce prescription ovals varies from 2.476 gross per man-hour on an automatic machine operated with a single feeder to 25.118 gross per man-hour on the Owens 10-arm double triplex machine (each arm has 2 blow heads and each head has 3 cavities, thus blowing 6 bottles per arm or 60 bottles per revolution). In the case of the half-pint soda bottle the average output of a hand shop is 0.393 gross per man-hour. By the semiautomatic process the average output varies from 0.505 gross per man-hour on the Jersey Devil machine to 1.351 gross per man-hour on the Lynch machine operated with the help of gatherers. The automatic machine average output of the half-pint sodas varies from 1.815 to 6.453 gross per man-hour. In the case of the quart milk bottle the average output of an ideal hand shop is 0.286 gross per man-hour. On the semiautomatic machine the output varies from 0.775 to 0.856 gross per man-hour, while on the automatic machines it varies from 0.961 gross per man-hour on an Owens 10-arm single machine to 4.145 gross per man-hour on the Hartford-Empire milk-bottle machine operated with the help of a Hartford-Empire P. N. double feeder.

Expressed in terms of index numbers, taking the man-hour output of the ideal hand shop as the base, or 100, the semiautomatic process shows indexes varying from 132.2 to 283.7 for the 2-ounce prescription oval, from 128.5 to 343.8 for the half-pint soda, and from 270.9 to 299.3 for the quart milk bottle. On the same basis, the automatic process shows indexes varying from 385.1 to 3,906.4 for the 2-ounce prescription oval, from 461.8 to 1,642 for the half-pint soda, and from 336 to 1,449.3 for the quart milk bottle.

Table 17 shows the percentage increases in man-hour output on 15 kinds of bottles made by the most efficient semiautomatic and automatic machines as compared with the hand process.

TABLE 17.—*Per cent of increase in man-hour output on specified kinds of bottles made by the most efficient semiautomatic and automatic machines as compared with hand production*

Kind of bottles	Semiautomatic machines	Automatic machines	Kind of bottles	Semiautomatic machines	Automatic machines
Prescription ovals:			Whisky dandies:		
½-ounce		3,418.2	½-pint	220.2	672.2
2-ounce	183.7	3,806.4	1-pint	333.9	642.1
4-ounce	48.7	4,009.8	Milk bottles:		
8-ounce	60.1	2,616.8	1-pint	173.4	1,374.8
Extract panels:			1-quart	199.3	1,349.3
6-dram		2,777.4	Packer jugs:		
2-ounce	200.0	2,411.6	½-gallon	46.9	725.1
Sodas and beers:			1-gallon	41.3	714.7
½-pint sodas	243.8	1,542.0	Water carboys: 5-gallon		900.0
1-pint beers	97.5	1,849.3			

The maximum increase in man-hour output took place in prescription ware—3,806.4 per cent in the 2-ounce oval and 4,009.8 per cent in the 4-ounce oval. These are the most commonly used stock bottles and show clearly the effects of mass production of standardized commodities on productivity in the industry.

Translated in terms of labor, the percentage of increase of man-hour output on the machine really signifies the percentage of labor displaced by the machine. The number of workers displaced by the most up-to-date automatic machine ranges from a minimum of 6.4 in the case of the pint whisky dandy to a maximum of 40 in the case of the 4-ounce prescription oval. In the latter case it would require

41 workers to produce by the hand process as many bottles as the machine operated by a single worker could produce in an equal period of time.

The great variations in the man-hour output by the automatic process are due chiefly to the fact that different machines are used for the various bottles shown and that not all machines are capable of producing the same quantity of bottles per hour. Another important factor causing considerable variation in man-hour output is the presence or absence of an automatic conveyer between the machine and the leer to take the place of the carry-in boys. In the machines covered in Table 17 conveyors were used for all bottles except the whisky dandies, the packer jugs, and the 5-gallon water carboys, and it is in these bottles that the increase in man-hour output on the automatic machine is the lowest.

The effects of the automatic conveyor on man-hour output is further illustrated by Table 18 presenting a comparison of man-hour output of the same kind of bottle made on the same machine, but in one case with carry-in boys and in the other with a conveyor.[3]

TABLE 18.—*Man-hour output of machines without and with automatic conveyors*

Kind of bottle	Machine A				Machine B			
	With 2⅓ carry-in boys		With conveyor		With 6 carry-in boys		With conveyor	
	Quantity	Index number	Quantity	Index number	Quantity	Index number	Quantity	Index number
	Gross		*Gross*		*Gross*		*Gross*	
½-ounce prescription ovals	8.870	100.0	15.238	171.8				
8-ounce prescription ovals	4.852	100.0	10.006	207.3				
6-dram extract panels	6.222	100.0	10.679	171.6				
2-ounce extract panels	4.402	100.0	8.067	183.3				
1-pint milk bottles					1.487	100.0	5.265	354.1
1-quart milk bottles					1.242	100.0	4.145	341.5

The increase in man-hour output caused by the automatic conveyor ranges from 71.6 to 107.3 per cent when replacing two and one-third carry-in boys and from 241.5 to 254.1 per cent when replacing six carry-in boys. It is self-evident that the more carry-in boys a conveyor replaces the higher will be the increase in man-hour output, and this is fully shown by the above figures.

BLOWING LABOR COST

The tremendous decrease in blowing labor cost effected by the automatic machines is no less striking than the increase in man-hour output caused by the same machine. Table 19 shows a comparison of labor cost of blowing the 15 kinds of bottles by the hand process and by semiautomatic and automatic machinery. The table gives the actual labor cost expressed in dollars per gross, and also in terms of index numbers, based on the blowing labor cost of the hand process.

[3] Unfortunately, not in same plant, and therefore affected by such additional factors as variation in management and number of workers on the machine.

Table 19.—*Average blowing labor cost per gross of specified kinds of bottles made by hand and by machine*

Prescription ovals

Method of production and kind of machine	½-ounce		2-ounce	
	Amount	Index number	Amount	Index number
Hand production:				
Ideal	$0.940	100.0	$1.006	100.0
Actual	.851	90.53	.974	96.82
Semiautomatic machine:				
2-man machine			.874	86.9
1-man machine			.583	58.0
O'Neill, with feeder			.311	30.9
Automatic machine:				
O'Neill and single feeder			.195	19.4
O'Neill and triple feeder	.176	18.7		
Lynch and single feeder	.090	9.5	.102	10.1
Owens A. N. double	.058	6.2	.064	6.4
Owens A. N. double, with conveyor	.050	5.3		
Owens A. V. single, with conveyor	.077	8.1	.079	7.8
Owens A. V. double, with conveyor	.038	4.1	.042	4.1
Owens C. A. double triplex, with conveyor	.028	2.9	.028	2.7

Method of production and kind of machine	4-ounce		8-ounce	
	Amount	Index number	Amount	Index number
Hand production:				
Ideal	$1.177	100.0	$1.472	100.0
Actual	1.212	103.0	1.528	103.8
Semiautomatic machine:				
2-man machine			1.052	71.5
1-man machine	.720	61.2	.774	52.6
Automatic machine:				
O'Neill and feeder	.196	16.7	.269	18.3
Lynch and feeder	.129	11.0	.149	10.1
Owens A. E. machine			.218	14.8
Owens A. N. single			.169	11.5
Owens A. N. single, with conveyor	.107	9.1		
Owens A. N. double	.082	7.0		
Owens A. V. single, with conveyor	.077	6.5		
Owens A. R. double			.105	7.1
Owens A. R. double, with conveyor			.075	5.0
Owens A. Q. single, with conveyor			.085	5.8
Owens A. Q. double, with conveyor			.065	4.4
Owens A. V. double, with conveyor	.047	4.0		
Owens C. A. double duplex, with conveyor			.057	3.9
Owens C. A. double triplex, with conveyor	.032	2.7		

Extract panels

Method of production and kind of machine	6-dram		2-ounce	
	Amount	Index number	Amount	Index number
Hand production	$1.170	100.0	$1.377	100.0
Semiautomatic machine:				
Jersey Devil			1.027	74.6
O'Neill, with feeder			.384	27.9
Automatic machine:				
O'Neill single and feeder			.167	12.1
O'Neil triple and feeder			.155	11.3
Owens A. N. single			.135	9.8
Owens A. N. double	.082	7.0	.115	8.4
Owens A. N. double, with conveyor	.071	6.1		
Owens A. R. single, with conveyor	.108	9.2	.135	9.8
Owens A. R. double, with conveyor	.074	6.3	.096	7.0
Owens A. V. single, with conveyor	.086	7.4	.084	6.1
Owens A. V. double, with conveyor	.046	3.9	.061	4.4
Owens C. A. double duplex, with conveyor			.057	4.2
Owens C. A. double triplex, with conveyor	.043	3.7		

Table 19.—*Average blowing labor cost per gross of specified kinds of bottles made by hand and by machine*—Continued

Sodas and beers

Method of production and kind of machine	½-pint sodas		1-pint beers	
	Amount	Index number	Amount	Index number
Hand production	$1.622	100.0	$1.622	100.0
Semiautomatic machine:				
Two-man machine	1.299	80.1	1.354	83.5
Teeple-Johnson, with gatherer	.888	54.7	.889	54.8
O'Neill, with gatherer	.841	51.8		
Lynch, with gatherer	.607	37.4		
Automatic machine:				
O'Neill and single feeder	.229	14.1		
Hartford-Empire and triple feeder	.272	16.8	.294	18.1
Owens A. E. single, with conveyor	.144	8.9	.141	8.7
Owens A. R. single, with conveyor	.108	6.7	.095	5.9
Owens A. Q. single, with conveyor	.123	7.6	.102	6.3

Whisky dandies

Method of production and kind of machine	½-pint		1-pint	
	Amount	Index number	Amount	Index number
Hand production	$1.382	100.0	$1.790	100.0
Semiautomatic machine:				
Jersey Devil	1.042	75.5	1.295	72.3
Teeple-Johnson			.860	48.0
O'Neill, with gatherer			.717	40.1
Lynch, with gatherer			.552	30.8
O'Neill, with feeder	.403	29.2		
Automatic machine:				
O'Neill and feeder	.231	16.8	.266	14.9
Lynch and feeder	.142	10.3	.185	10.3
Owens A. E. single			.278	15.5
Owens A. R. single	.194	14.0	.252	14.1

Milk bottles

Method of production and kind of machine	1-pint		1-quart	
	Amount	Index number	Amount	Index number
Hand production	$2.390	100.0	$2.980	100.0
Semiautomatic machine:				
Teeple-Johnson, with gatherer	.796	33.3	1.096	36.8
Miller, with gatherers	.647	27.0	.907	30.4
Automatic machine:				
Miller, with single feeder and with conveyor	.269	11.3	.346	11.7
Hartford-Empire, with double feeder	.354	14.8	.424	14.2
Hartford-Empire, double feeder, with conveyor	.120	5.0	.152	5.1
Owens A. E. single	.382	16.0	.415	13.9
Owens A. R. single	.455	19.0	.539	18.1

TABLE 19.—*Average blowing labor cost per gross of specified kinds of bottles made by hand and by machine*—Continued

Packer jugs

Method of production and kind of machine	½-gallon		1-gallon	
	Amount	Index number	Amount	Index number
Hand production	$3.710	100.0	$5.150	100.0
Semiautomatic machine: Jersey Devil	2.018	54.4	2.784	54.0
Automatic machine:				
O'Neill and feeder	.501	13.5		
Owens A. L. single	.816	22.1	.769	14.6
Owens A. R. single	.805	21.6		
Owens A. Q. single	.340	9.2	.431	8.3

5-gallon water carboys

Method of production	Amount	Index number
Hand production	$25.308	100.0
Automatic machine	1.880	7.43

An analysis of the blowing labor cost of the 2-ounce prescription oval, the half-pint soda, and the quart milk bottle is given as an illustration of the contents of Table 19. The "ideal" labor cost of blowing by hand one gross of 2-ounce prescription ovals is $1.006; the actual labor cost in the one plant where prescription ware is still being made by hand is 97.4 cents per gross. On the semiautomatic machines the blowing labor cost of the 2-ounce prescription ovals varies from a minimum of 31.1 cents to a maximum of 87.4 cents per gross, while on the automatic machines it varies from a minimum of 2.8 cents to a maximum of 19.5 cents per gross.

The blowing labor cost of making a gross of half-pint soda bottles by hand is $1.622. On the semiautomatic machines the cost varies from 60.7 cents to $1.299 per gross, while on the automatic machines it ranges from 10.8 to 27.2 cents per gross.

The blowing labor cost of making quart milk bottles by the hand process is $2.980 per gross. By the semiautomatic process the blowing labor cost varies from 90.7 cents to $1.096 per gross, while by the automatic process it ranges from 15.2 to 53.9 cents per gross.

Expressed in terms of index numbers, taking the blowing labor cost of the hand process as the base, or 100, the semiautomatic process shows the following indexes: 30.9 to 86.9 for 2-ounce prescription ovals; 37.4 to 80.1 for half-pint soda bottles; and 30.4 to 36.8 for quart milk bottles. On the same base, the automatic machines show the following minimum and maximum indexes: 2.7 and 19.4 for 2-ounce prescription ovals; 6.7 and 16.8 for half-pint sodas; and 5.1 and 18.1 for quart milk bottles.

Table 20 shows the per cent of decrease in the labor cost of the 15 bottles made by the most efficient semiautomatic and automatic machines as compared with the cost of hand production.

TABLE 20.—*Per cent of decrease in labor cost of making specified kinds of bottles on the most efficient semiautomatic and automatic machines as compared with hand production*

Kind of bottles	Semi-automatic machines	Automatic machines	Kind of bottles	Semi-automatic machines	Automatic machines
Prescription ovals:			Whisky dandies:		
½-ounce		97.1	½-pint	70.8	89.7
2-ounce	69.1	97.3	1-pint	69.2	89.7
4-ounce	38.8	97.3	Milk bottles:		
8-ounce	47.4	96.1	1-pint	73.0	95.0
Extract panels:			1-quart	69.6	94.9
6-dram		96.3	Packer jugs:		
2-ounce	72.1	95.8	½-gallon	45.6	90.8
Sodas and beers:			1-gallon	46.0	91.7
½-pint sodas	62.6	93.3	Water carboys: 5-gallon		92.57
1-pint beers	45.2	94.1			

For every dollar spent on blowing bottles by hand the maximum cost of bottles blown by the most efficient automatic machine was 10.3 cents (for pint whisky dandies and the minimum 2.7 cents (for 4-ounce prescription ovals). The saving in labor cost effected by the automatic-machine process over the hand process thus ranges from 89.7 to 97.3 cents on every dollar.

As in the case of the man-hour output, the maximum amount of saving was accomplished in prescription bottles, a standardized commodity subject to mass production. The smallest amount of saving was registered in whisky flasks, which were made without the help of a conveyor.

The effects of an automatic conveyor on the blowing labor cost of bottles may best be illustrated by Table 21, presenting the cost of the same kind of bottles made on similar machines, but in one case with the help of carry-in boys and in the other with the help of an automatic conveyor.[4]

TABLE 21.—*Blowing labor cost of bottles made on same machine with and without an automatic conveyor*

Kind of bottle	Machine A				Machine B			
	With 2⅓ carry-in boys		With conveyor		With 6 carry-in boys		With conveyor	
	Amount	Index number	Amount	Index number	Amount	Index number	Amount	Index number
½-ounce prescription ovals	$0.058	100.0	$0.050	86.2				
8-ounce prescription ovals	.105	100.0	.075	71.4				
6-dram panel extracts	.082	100.0	.071	86.6				
2-ounce panel extracts	.115	100.0	.096	83.5				
1-pint milk bottles					$0.269	100.0	$0.120	44.6
1-quart milk bottles					.346	100.0	.152	43.9

The saving in blowing labor cost which may be attributed to the automatic conveyor thus varies from 13.4 to 28.6 per cent when replacing two and one-third carry-in boys and from 55.4 to 56.1 per cent when replacing six carry-in boys.

[4] Unfortunately, not in the same plant, and therefore affected by such additional factors as variations in management, in the number of workers on the machine, and in their wages.

PRESENT SITUATION IN THE BOTTLE BRANCH OF THE INDUSTRY

The successful introduction of the various kinds of feeders was almost entirely in the field of semiautomatic machinery. The hand process, relegated to a place where the utilization of machinery proved uneconomical, was but little affected by the new method. Nor was the Owens machine seriously affected by this process. As a result bottle making as at present organized can be divided into three parts: (*a*) Hand process, limited to very small orders and oddly shaped bottles; (*b*) the Owens automatic machines, used for mass production of stock bottles and principally for very large orders; (*c*) the "feed and flow" automatics, also used for mass production of stock bottles, but at the same time capable of producing comparatively smaller orders than the Owens, and therefore in position to compete with the Owens automatic.

The statistics of man-hour output and blowing labor cost of bottles presented above make it absolutely clear why production of bottles by hand has become almost a thing of the past. The few plants in the country where bottles are being made by hand are making the kinds of bottles which can not be made economically on the machine. The principal advantage of the machine lies in mass production. The high cost of making the necessary number of molds and the time required in adjusting the machine and changing molds make it uneconomical for the large machines to work on orders less than 1,000 gross of bottles. Even for the smaller six-arm machines the order has to be at least 250 gross to make the production economical. Hence the smaller orders, especially those below 100 gross, necessarily go to the hand plants. Among bottles of this kind the principal place is occupied by perfumery and toilet ware, individually shaped bottles being used as a means of identifying and advertising their contents.

As a competitive factor in the bottle branch of the glass industry hand production is absolutely nonexistent. At best it fills the gaps left by the machine and must therefore be considered as supplementary to the machine rather than competitive.

The semiautomatic machine is in about the same situation as hand blowing as regards competition with automatic machinery. It will be remembered that the principal difference between the semiautomatic and the automatic process is in the way in which the glass is delivered to the machine. In the semiautomatic process the molten glass is delivered to the machine by hand; in the automatic process the glass is delivered automatically. At least five or six molds are needed for any semiautomatic machine, and once the order is large enough to justify the making of so many molds it is much more advantageous to produce the bottles on a smaller automatic machine than on the semiautomatic. There are, therefore, no opportunities left for the semiautomatic process similar to those in the case of hand production.

STATISTICS OF PRODUCTION AND LABOR COST

Table A contains data on the production of 15 representative bottles ranging from half-ounce prescription ovals to 5-gallon water carboys, made by hand and by the various semiautomatic and automatic machines. In securing these statistics an attempt was made to choose one or two representative plants and then follow up the changes of output and labor cost of making bottles as the plants passed from hand production to the semiautomatic and finally to the automatic process. Such analysis would give to the study a historical perspective and at the same time eliminate the effects of management on production and cost, management supposedly remaining more or less constant throughout the history of the plant. This plan, however, had to be abandoned for the following reasons:

1. No single bottle plant in the country is known to have gone through all stages of bottle making from the hand process to the most up-to-date machinery. Some plants have gone directly from the hand process to the Owens automatic machines or to the smaller machines made automatic by the "feed-and-flow" devices; other plants have been using simultaneously semiautomatic and automatic machinery for the purpose of producing the same kind of ware; still others, especially the most modern plants—those using the most up-to-date machines—have experienced no transition stages whatever, having been equipped from the very start with the machines now in use.

2. The number of types of bottle-making machines, especially in the automatic field, is so large and the kind and size of bottles made on the separate machines so variable that it is well-nigh impossible to choose any one machine as better fitted for the production of any one kind of bottle than any other machine. Some machines—such as the Owens machine especially designed for the purpose of making 5-gallon carboys and the Hartford-Empire and Miller machines for the purpose of making milk bottles—have, indeed, been built for making one kind of bottles; but on the whole most of the machines are used to make a large variety of bottles and must be taken into consideration in a study dealing with the effects of machinery on output.

3. There is probably not a bottle plant in the country where the data of output prior to 1917 for the separate kinds of bottles and the time spent on their production, either by hand or machine, can be found. Most of the data available go back to 1920 and are only for the more up-to-date plants, which are using automatic machines exclusively. In the smaller plants either no statistics whatever are kept or the data available are not sufficiently in detail to enable one to separate the statistics needed.

Instead of a historical study of the development of any one or two representative bottle plants, the problem resolved itself into a study of the various types of machines, semiautomatic and automatic, which have been used in this country to replace the hand process. Fortunately, the change from hand production to the machine and especially from the semiautomatic process to the automatic has been so recent that occasional plants can be found in the country which are still using the older methods of production or which are just now passing through the transition stage. But these plants are very scarce and are disappearing so rapidly that it became necessary to visit more than 25 separate establishments before the data secured could be considered as representative, if not of all at least of the majority, of the types of machines, semiautomatic and automatic, in use in this country since 1900.

Wherever a machine is still in operation the data given are for the year 1925. If the machine has been completely abandoned or is no longer used for the production of any one of the 15 kinds of bottles covered in this study the statistics of output given are for the last period obtainable and in the form available. The labor cost of production, however, is based in all cases on the actual rates of wages which prevailed in the separate plants during 1925, the object being to eliminate the effects of the changing wage rates in a comparison involving different time periods.

Each section of the table covers a single kind of bottle made by a single labor unit—hand or machine—and is divided into two parts: Labor unit, and output and labor cost. The number and the kind of workers constituting the particular labor unit and their rates of wages, whether by the piece or by the hour, are shown in the first part of each section. When fractions are shown for the number of workers, it merely implies that the particular kind of worker is in charge of more than one machine and that only that part of his labor is shown which can be attributed to any one unit. The unit consists of the total number of workers shown, irrespective of their skill or occupation. The total labor cost per hour is that of the entire unit, exclusive of those workers who are paid on a piecework basis, whose rates are shown in a separate column.

The second part of each section presents statistics of the output of the unit. The period for which the data are given is usually by the month or by the year when monthly figures are not available. The data shown for output are the actual number of gross of good bottles produced by the one or the several exactly similar shops or machines in operation. The actual number of unit hours, shop or machine, spent in the production of the quantity of bottles given is also shown. If only one unit was in operation the hours given are the actual hours which the unit put in during the month or the year in making the particular kind of bottle. If there were several similar shops or machines used simultaneously for the production of any one kind of bottle the hours worked by the several units have been added. In that case the unit-hours given represent the total number of hours the average machine would have to be in operation to produce the quantity of bottles produced by all the machines in a correspondingly shorter period of time. This precludes the possible errors inherent in choosing any one shop or any one machine as representative of similar shops or similar machines. For, in spite of the similarity in the composition of the labor unit, no two shops or two machines are actually working alike. For one reason or another some shops or some machines will always produce more or less than others working under exactly similar conditions. But by combining the good, the bad, and the indifferent units one can reasonably expect that their effects on output will neutralize each other, and for this reason the aggregate output and the aggregate hours of all the similar units in the plant have been taken rather than any one unit as representative of similar units.

The average output per unit-hour is derived by dividing the output by the unit-hours. By dividing the output per unit-hour by the total number of workers constituting the unit one gets the man-hour output of the unit. The labor cost per gross of bottles which is shown is the result of dividing the unit labor cost per hour by the number representing the output per unit-hour. If some of the workers constituting the unit are paid on a piecework basis their total wages per gross must be added to the labor cost per gross of the time workers, and the sum will be the total labor cost of blowing a gross of the particular kind of bottle by the particular process.

In examining the month-by-month statistics of output of any one machine one is at once confronted with the big variations in output shown by the machine-hour figures given. This is true of the simplest Jersey Devil semiautomatic machine as well as of the largest Owens 10-arm double triplex automatic machine. In making 2-ounce prescription ovals by the Jersey Devil semiautomatic machine the output varies from a minimum of 4.015 to a maximum of 5.638 gross per hour, the minimum being 28.8 per cent less than the maximum. In making the same kind of bottle by the Owens 10-arm double triplex automatic machine (10 arms × 2 heads × 3 molds = 60 bottles per revolution), the output varies from 74.849 to 86.556 gross per hour, with the minimum 13.5 per cent less than the maximum. But in making the one-half ounce prescription ovals on the same machine the output varies from 70.659 to 88.717 gross per hour, the minimum being 20.4 per cent less than the maximum.

It is universally accepted in bottle making that these variations in output are due to causes which are more or less outside of the control of the workers in charge of the machine. The principal cause mentioned is the condition of the molten glass in the continuous tank. In spite of all the precautions taken to have the glass melted in accordance with the chemical formulas and the other requirements of the process, the results do not always prove satisfactory. The run of glass may be good for a long time and then suddenly, for no apparent cause, turn bad and keep on running bad, notwithstanding all attempts to improve it. Whether or not means can be found by which the condition of the glass in the tank will be completely controlled to fit the requirements of the machines in operation, the variations in output due to the lack of control of the glass must at present be accepted as inherent in the industry. In the same class must be considered the variations due to larger or smaller orders and to the weather. It is estimated, however, that during the period of a year the favorable and adverse factors will more or less neutralize their respective effects on output, and that the average for the year will come pretty close to representing the true average for the machine. The yearly averages have therefore been taken as the basis of comparison for the various machines and processes in use. The monthly averages are also given to show the degree of variation in output from month to month, while the maximum and minimum are italicized to emphasize the extreme limits of these variations. What is true of the machine-hour output applies also to the man-hour output and to the blowing labor cost.

Table A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE

ONE-HALF OUNCE PRESCRIPTION OVALS—HAND (IDEAL)

[In this table all wage rates are for 1925 and labor cost is based on 1925 wage rates regardless of year of output data. Italicized figures represent minimum and maximum]

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	} $0.62			Average output per 8 hours ... gross	40
1	Finisher				Average output per unit-hour ... do	5
1	Mold boy		$0.40	$0.40	Average man-hour output ... do	.714
1	Cleaning-off boy		.40	.40	Average blowing labor cost ... per gross	$0.94
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.62		1.60		

ONE-HALF OUNCE PRESCRIPTION OVALS—HAND (ACTUAL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2	Blowers	} $0.61			1925	*Gross*		*Gross*	*Gross*	
1	Finisher				Jan.	154.3	45.75	3.373	0.482	$0.859
1	Mold boy		$0.21	$0.21	Feb.	239.5	61.50	3.894	.556	.826
1	Cleaning-off boy		.21	.21	Mar.	105.7	26.75	3.952	.565	.823
1	Snapping-up boy		.21	.21	Apr.	104.3	28.00	3.725	.532	.836
1	Carry-in boy		.21	.21	June	27.7	12.00	*2.308*	*.330*	*.992*
					July	18.2	6.50	2.800	.400	.910
					Aug.	51.1	16.00	3.194	.456	.873
					Sept.	191.3	59.75	3.202	.458	.872
					Oct.	182.6	57.25	3.189	.456	.873
					Dec.	93.8	22.00	*4.264*	*.609*	*.807*
7	Total	.61		.84	Total	1,168.5	335.50	3.483	.498	.851

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: O'NEILL AND TRIPLE FEEDER

2/5	Machine foreman		$0.78	$0.31	1925					
1	Feeder operator		.70	.70	Mar.	367.0	23.40	15.685	2.120	$0.214
1	Machine operator		.70	.70	Apr.	2,219.0	117.50	18.885	2.552	.178
4	Peanut roaster boys		.30	1.20	Sept.	2,695.0	135.50	19.889	2.688	.169
1	Carry-in boy		.45	.45						
7 2/5	Total			3.36	Total	5,281.0	276.40	19.107	2.582	.176

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: LYNCH AND SINGLE FEEDER

1/6	Chief operator		$0.90	$0.150	1925					
1	Machine operator		.60	.600	Sept.	1,009.0	90.00	11.211	5.174	$0.095
1	Carry-in boy		.31	.310	Oct.	1,487.0	116.00	*12.819*	*5.916*	*.083*
					Nov.	1,351.0	116.00	11.647	5.375	.091
					Dec.	335.0	32.00	*10.469*	*4.882*	*.101*
2 1/6	Total			1.06	Total	4,182.0	354.00	11.814	5.453	.090

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/8	Machine foreman		$0.80	$0.267	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.60	.600	Jan	5,145.0	161.10	31.937	8.454	$0.061
1/9	Hot-ware inspector		.55	.061	Feb	1,400.0	53.20	*26.316*	*6.966*	*.074*
2 1/3	Carry-in boys		.43	1.003	Mar	5,305.0	152.80	34.719	9.190	.056
					Apr	1,830.0	55.20	33.152	8.775	.059
					May	2,912.8	85.50	34.068	9.018	.057
					Aug	7,029.0	213.70	32.892	8.707	.059
					Oct	648.6	21.80	29.752	7.875	.065
					Nov	7,490.0	205.30	*36.483*	*9.657*	*.054*
					Dec	2,256.0	66.50	33.925	8.980	.058
3 7/9	Total			1.931	Total	34,016.4	1,015.10	33,510	8.870	.058

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	1,480.0	43.50	*34.023*	*15.703*	*$0.048*
1	Machine operator		.55	.55	Sept	645.0	21.00	*30.714*	*14.176*	*.054*
					Oct	3,941.0	118.20	33.342	15.389	.050
					Nov	2,308.0	72.00	32.056	14.795	.051
					Dec	1,602.0	47.50	33.726	15.566	.049
2 1/6	Total			1.65	Total	9,976.0	302.20	33.011	15.238	.050

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1918	8,720.0	430.40	20.260	9.351	$0.081
1	Machine foreman		.90	.90	1919	38,844.0	1,906.60	20.373	9.403	.081
1	Machine operator		.55	.55	1920	22,225.0	897.40	24.766	10.969	.067
2 1/6	Total			1.65	Total	69,789.0	3,234.40	21.577	9.959	.077

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) DOUBLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Feb	3,071.00	78.50	*39.121*	*18.056*	*$0.042*
1	Machine operator		.55	.55	May	3,560.00	72.00	*49.444*	*22.820*	*.033*
					June	1,870.00	43.00	43.488	20.071	.038
					July	4,624.00	113.20	40.848	18.853	.040
					Aug	3,053.00	66.30	46.048	21.253	.036
2 1/6	Total			1.65	Total	16,178.00	373.00	43.373	20.022	.038

ONE-HALF OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS C. A. (10 ARMS) DOUBLE TRIPLEX, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Feb	8,490.0	101.90	83.316	26.310	$0.0265
2	Machine operators		.55	1.10	May	9,970.0	141.10	*70.659*	*22.313*	*.0312*
					Aug	2,675.0	34.90	76.648	24.205	.0288
					Sept	4,270.0	58.40	73.116	23.089	.0301
					Oct	7,800.0	95.10	82.019	25.901	.0269
					Nov	5,480.0	63.20	86.709	27.382	.0254
					Dec	6,361.0	71.70	*88.717*	*28.016*	*.0248*
3 1/6	Total			2.20	Total	45,046.0	5,663.00	79.545	25.120	.0276

Table A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

2-OUNCE PRESCRIPTION OVALS—HAND (IDEAL)

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$0.65			Average output per 8 hours .... gross	36
1	Finisher				Average output per unit-hour ...... do	4.5
1	Mold boy		$0.40	$0.40	Average man-hour output .... do	.643
1	Cleaning-off boy		.40	.40	Average blowing labor cost .... per gross	$1.006
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.65		1.60		

2-OUNCE PRESCRIPTION OVALS AND ROUNDS—HAND (ACTUAL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2	Blowers	$0.68			1925	*Gross*		*Gross*	*Gross*	
1	Finisher				Jan	139.8	47.75	2.928	0.418	$0.977
1	Mold boy		$0.21	$0.21	Feb	101.3	42.25	2.398	.343	1.030
1	Cleaning-off boy		.21	.21	Mar	162.9	55.25	2.948	.421	.965
1	Snapping-up boy		.21	.21	Apr	168.0	55.75	3.013	.430	.959
1	Carry-in boy		.21	.21	May	50.4	18.25	2.762	.395	.984
					June	71.7	25.00	2.844	.406	.975
					July	9.1	6.00	*1.517*	*.219*	*1.234*
					Aug	7.3	3.00	2.433	.348	1.025
					Sept	113.4	46.50	2.439	.348	1.024
					Oct	24.6	7.75	3.175	.454	.945
					Nov	48.7	18.50	2.632	.376	.999
					Dec	119.6	33.25	*3.594*	*.513*	*.914*
7	Total	.68		.84	Total	1,026.2	359.25	2.856	.408	.974

2-OUNCE PRESCRIPTION OVALS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.17	1923					
1	Gatherer	$0.50			Jan	611.4	120.00	5.095	0.899	$0.853
1	Presser				Feb	219.5	45.00	4.878	.861	.869
1	Transfer boy		.50	.50	Mar	465.1	82.50	*5.638*	*.995*	*.819*
1	Take-out boy		.50	.50	Apr	255.0	60.00	4.250	.750	.923
1/2	Carry-in boy		.50	.25	May	652.4	162.50	*4.016*	*.708*	*.948*
1	Peanut-roaster boy		.38	.38	June	461.8	87.50	5.278	.931	.841
					July	397.0	90.00	4.411	.778	.908
					Aug	408.0	72.50	5.628	.993	.832
5 2/3	Total	.50		1.80	Total	3,470.2	720.00	4.820	.850	.874

2-OUNCE PRESCRIPTION OVALS—SEMIAUTOMATIC ONE-MAN MACHINE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1	Gatherer	$0.30			1923	3,819.0	884.00	*4.320*	*0.960*	*$0.608*
1	Transfer boy		$0.38	$0.38	1922	3,570.0	736.00	4.851	1.078	.574
1	Take-out boy		.38	.38	1921	6,632.0	1,248.00	*5.314*	*1.181*	*.550*
1	Peanut-roaster boy		.38	.38	1920	6,893.0	1,578.00	4.368	.971	.604
1/2	Carry-in boy		.38	.19	1919	6,038.0	1,296.00	4.659	1.035	.586
4 1/2	Total	.30		1.33	Total	26,952.0	5,742.00	4.694	1.043	.583

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

2-OUNCE PRESCRIPTION OVALS—SEMIAUTOMATIC MACHINE: O'NEILL, WITH FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.000	$0.170	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.700	.700	Jan	577.0	88.00	6.557	1.788	$0.317
1	Transfer boy		.475	.475	Feb	637.0	84.00	7.584	2.068	.274
1/2	Carry-in boy		.500	.250	Mar	344.0	50.00	6.880	1.876	.302
1	Peanut-roaster boy		.475	.475	Apr	582.0	66.00	*8.819*	*2.405*	*.235*
					May	269.0	47.00	5.724	1.561	.363
					June	177.0	26.00	6.810	1.857	.305
					July	290.0	38.00	7.632	2.081	.272
					Aug	176.0	33.00	*5.834*	*1.454*	*.890*
					Sept	224.0	35.00	6,400	1.745	.325
					Oct	129.0	21.00	6.143	1.675	.338
					Nov	441.0	72.00	6.125	1.670	.339
3 2/3	Total			2.070	Total	3,746.0	560.00	6.689	1.824	.311

2-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: O'NEILL AND SINGLE FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/15	Machine foreman		$0.78	$0.104	1925					
1	Machine operator		.70	.700	May	60.0	9.30	*6.452*	*2.304*	*$0.209*
1 1/3	Peanut-roaster boys		.30	.400	Sept	535.0	79.00	6.773	2.419	.200
1/3	Carry-in boys		.45	.150	Nov	234.0	29.30	*7.987*	*2.853*	*.170*
					Dec	720.0	105.80	6.806	2.431	.199
2 4/5	Total			1.354	Total	1,549.0	223.40	6.934	2.476	.195

2-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: LYNCH AND SINGLE FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief operator		$0.90	$0.15	1925					
1	Machine operator		.60	.60	July	239.0	26.00	*9.193*	*4.243*	*$0.115*
1	Carry-in boy		.31	.31	Aug	456.0	48.00	9.500	4.385	.112
					Sept	1,442.0	144.00	10.014	4.622	.106
					Oct	1,348.0	144.00	9.361	4.320	.113
					Nov	1,378.0	144.00	9.569	4.416	.111
					Dec	2,519.0	241.00	*10.452*	*4.824*	*.101*
2 1/6	Total			1.06	Total	7,382.0	710.00	10.397	4.799	.102

2-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Jan	7,113.0	248.00	28.682	7.592	$0.067
1/9	Hot-ware inspector		.55	.061	Feb	9,308.9	320.90	29.006	7.678	.067
2 1/3	Carry-in boys		.43	1.003	Mar	9,075.6	292.50	31.027	8.213	.062
					Apr	7,095.9	234.30	30.286	8.017	.064
					May	2,204.5	76.80	28.705	7.598	.067
					June	7,207.0	257.30	*28.010*	*7.414*	*.069*
					July	4,865.3	164.80	29.523	7.815	.055
					Aug	2,088.7	70.40	29.670	7.854	.065
					Sept	7,183.9	236.10	30.428	8.054	.064
					Oct	4,832.1	150.00	*32.214*	*8.527*	*.060*
					Nov	2,934.6	93.00	31.555	8.353	.061
					Dec	10,137.5	315.10	32.172	8.516	.060
3 7/9	Total			1.931	Total	74,047.0	2,459.20	30.110	7.970	.064

2-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1918	13,680.0	654.50	20.901	9.645	$0.079
1	Machine foreman		.90	.90						
1	Machine operator		.55	.55						
2 1/6	Total			1.65						

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

2-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) DOUBLE, WITH CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925	*Gross*		*Gross*	*Gross*	
1	Machine foreman		.90	.90	Jan	3,715.0	96.00	38.698	17.861	$0.043
1	Machine operator		.55	.55	Feb	4,870.0	120.00	40.583	18.731	.041
					Mar	1,115.0	47.60	*23.424*	*10.811*	*.070*
					Apr	5,835.0	144.00	40.521	18.702	.041
					May	725.0	22.20	32.658	15.073	.051
					June	910.0	24.00	37.917	17.500	.044
					July	3,300.0	81.20	40.640	18.757	.041
					Aug	345.0	5.90	*58.475*	*26.988*	*.028*
					Sept	560.0	13.80	40.580	18.729	.041
					Oct	3,140.0	71.00	44.225	20.412	.037
					Nov	1,246.0	30.80	40.455	18.672	.041
					Dec	3,042.0	68.30	44.540	20.557	.037
2 1/6	Total			1.65	Total	28,803.0	724.80	39.739	18.341	.042

2-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS C. A. (10 ARMS) DOUBLE TRIPLEX, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Mar	11,520.0	144.00	80.000	25.263	$0.028
2	Machine operators		.55	1.10	Apr	10,885.0	139.30	78.141	24.676	.028
					May	7,235.0	88.90	81.384	25.700	.027
					June	1,784.0	23.40	76.239	24.075	.029
					July	1,867.0	24.00	77.792	24.566	.028
					Aug	8,719.0	116.10	75.099	23.715	.029
					Sept	10,666.0	142.50	*74.849*	*23.637*	*.029*
					Oct	6,232.0	72.00	*86.556*	*27.333*	*.025*
					Nov	2,836.0	34.40	82.442	26.034	.027
					Dec	12,108.0	143.90	84.142	26.571	.026
3 1/6	Total			2.20	Total	73,852.0	928.50	79.539	25.118	.028

4-OUNCE PRESCRIPTION OVALS—HAND (IDEAL)

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	}$0.75			Average output per 8 hours .... gross	30
1	Finisher				Average output per unit-hour ...... do	3.75
1	Mold boy		$0.40	$0.40	Average man-hour output .... do	.536
1	Cleaning-off boy		.40	.40	Average blowing labor cost .... per gross	$1.177
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.75		1.60		

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

4-OUNCE PRESCRIPTION OVALS—HAND (ACTUAL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2	Blowers	$0.78			1925	*Gross*		*Gross*	*Gross*	
1	Finisher				Jan	531.4	290.50	*1.829*	*0.261*	*$1.239*
1	Mold boy		$0.21	$0.21	Feb	136.0	67.50	2.015	.288	1.197
1	Cleaning-off boy		.21	.21	Mar	254.4	133.75	1.902	.272	1.222
1	Snapping-up boy		.21	.21	Apr	271.0	134.00	2.022	.289	1.195
1	Carry-in boy		.21	.21	May	97.5	38.25	2.549	.364	1.110
					June	47.2	17.75	*2.659*	*.380*	*1.096*
					July	22.8	9.00	2.533	.362	1.112
					Aug	99.3	52.75	1.882	.269	1.226
					Sept	139.2	68.00	2.047	.292	1.190
					Oct	124.4	64.50	1.929	.276	1.216
					Nov	178.5	92.50	1.930	.276	1.215
					Dec	277.3	122.50	2.264	.323	1.151
7	Total	.78		.84	Total	2,179.0	1,091.00	1.997	.285	1.212

4-OUNCE PRESCRIPTION OVALS—SEMIAUTOMATIC ONE-MAN MACHINE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1	Gatherer	$0.33			1919	5,993.0	1,876.00	*3.195*	*0.710*	*$0.746*
1	Transfer boy		$0.38	$0.38	1920	6,095.0	1,628.00	3.744	.832	.685
1	Take-out boy		.38	.38	1921	7,395.0	2,068.00	3.576	.795	.702
1	Peanut-roaster boy		.38	.38	1922	3,679.0	892.00	*4.124*	*.916*	*.653*
½	Carry-in boy		.38	.19	1923	4,630.0	1,284.00	3.606	.801	.699
4½	Total	.33		1.33	Total	27,792.0	7,748.00	3.587	.797	.720

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: O'NEILL AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/15	Machine foreman		$0.78	$0.104	1925					
1	Machine operator		.70	.700	Jan	95.0	14.30	6.644	2.372	$0.204
1⅓	Peanut-roaster boy		.30	.400	June	218.0	29.70	7.340	2.621	.185
⅓	Carry-in boy		.45	.150	Oct	370.0	55.00	6.727	2.402	.201
2⅘	Total			1.354	Total	683.0	99.00	6.899	2.464	.196

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: LYNCH AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅙	Chief operator		$0.90	$0.15	1925					
1	Machine operator		.60	.60	Aug	783.0	96.00	8.156	3.764	$0.130
1	Carry-in boy		.31	.31	Sept	488.0	68.00	*7.176*	*3.312*	*.148*
					Oct	1,123.0	144.00	7.799	3.600	.136
					Nov	1,028.0	120.00	*8.567*	*3.954*	*.124*
					Dec	2,666.0	315.00	8.463	3.906	.125
2⅙	Total			1.06	Total	6,088.0	743.00	8.194	3.782	.129

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅙	Chief foreman		$1.20	$0.20	1917	7,918.0	506.70	15.627	7.212	$0.106
1	Machine foreman		.90	.90	1918	3,408.0	225.70	15.100	6.969	.109
1	Machine operator		.55	.55						
2⅙	Total			1.65	Total	11,326.0	732.40	15.460	7.135	.107

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.60	.600	Jan	4,223.8	185.50	22.770	6.027	$0.085
1/9	Hot-ware inspector		.55	.061	Feb	9,224.3	382.40	24.122	6.385	.080
2 1/3	Carry-in boys		.43	1.003	Mar	10,350.1	421.10	24.579	6.506	.079
					Apr	3,860.5	164.20	23.511	6.223	.082
					May	8,408.9	368.00	22.850	6.048	.085
					June	3,321.9	154.50	21.500	5.691	.090
					July	6,248.5	270.90	23.065	6.105	.084
					Aug	3,172.4	141.70	22.390	5.927	.086
					Sept	5,445.8	233.30	23.340	6.178	.086
					Oct	7,487.2	293.20	25.536	6.759	.076
					Nov	5,219.3	199.20	*26.200*	*6.936*	*.074*
					Dec	2,012.5	104.80	*19.206*	*5.084*	*.105*
3 7/9	Total			1.931	Total	68,975.2	2,918.30	23.627	6.254	.082

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1918	29,996.0	1,411.20	21.256	9.810	$0.078
1	Machine foreman		.90	.90	1919	22,716.0	1,197.30	18.973	8.757	.087
1	Machine operator		.55	.55	1920	65,214.0	2,885.00	22.605	10.433	.073
2 1/6	Total			1.65	Total	117,926.0	5,493.50	21.467	9.908	.077

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) DOUBLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	2,061.0	57.50	35.843	16.543	$0.046
1	Machine operator		.55	.55	Feb	2,996.0	84.20	35.582	16.422	.046
					Mar	252.0	7.00	36.000	16.615	.046
					May	3,738.0	105.00	35.600	16.431	.046
					June	1,740.0	48.00	36.250	16.731	.046
					Aug	845.0	26.60	31.767	14.662	.052
					Sept	1,724.0	44.00	*39.182*	*18.084*	*.042*
					Nov	1,134.0	38.00	29.842	13.773	.055
					Dec	326.0	11.50	*28.348*	*13.084*	*.058*
2 1/6	Total			1.65	Total	14,816.0	421.80	35.126	16.212	.047

4-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS C. A. (10 ARMS) DOUBLE TRIPLEX, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	8,108.0	144.00	56.306	17.782	$0.039
2	Machine operators		.55	1.10	Feb	10,014.0	142.70	70.175	22.161	.031
					Mar	7,950.0	142.30	*55.868*	*17.643*	*.039*
					Apr	10,314.0	144.00	71.625	22.618	.031
					May	5,943.0	82.00	72.476	22.887	.030
					Aug	10,442.0	142.50	73.277	23.140	.030
					Oct	11,383.0	144.00	79.049	24.963	.028
					Nov	11,494.0	143.00	*80.378*	*25.378*	*.027*
3 1/6	Total			2.20	Total	75,648.0	1,084.50	69.754	22.028	.032

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

8-OUNCE PRESCRIPTION OVALS—HAND (IDEAL)

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$0.96			Average output per 8 hours.......gross..	25
1	Finisher				Average output per unit-hour.......do....	3.125
1	Mold boy		$0.40	$0.40	Average man-hour output.........do....	.446
1	Cleaning-off boy		.40	.40	Average blowing labor cost....per gross..	$1.472
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.96		1.60		

8-OUNCE PRESCRIPTION OVALS—HAND (ACTUAL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
					1925	*Gross*		*Gross*	*Gross*	
2	Blowers	$1.00			Jan	78.3	34.75	2.253	0.322	$1.373
1	Finisher				Feb	93.8	56.50	1.660	.237	1.506
1	Mold boy		$0.21	$0.21	Mar	31.2	19.50	1.600	.229	1.525
1	Cleaning-off boy		.21	.21	Apr	66.3	39.00	1.700	.243	1.494
1	Snapping-up boy		.21	.21	May	8.4	5.00	1.680	.240	1.500
1	Carry-in boy		.21	.21	June	9.0	6.75	1.333	.190	1.630
					July	13.3	7.00	1.900	.271	1.442
					Aug	36.2	23.25	1.557	.222	1.540
					Sept	63.3	41.25	1.535	.219	1.547
					Oct	40.6	37.50	*1.083*	*.155*	*1.776*
					Nov	109.5	80.00	1.369	.196	1.614
					Dec	25.0	10.75	*2.326*	*.332*	*1.361*
7	Total	1.00		.84	Total	574.9	361.25	1.591	.227	1.528

8-OUNCE PRESCRIPTION OVALS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00	$0.17	1923					
1	Gatherer	$0.56			Jan	249.8	69.50	3.594	0.634	$1.061
1	Presser				Feb	250.7	75.00	*3.343*	*.590*	*1.098*
1	Transfer boy		.50	.50	Sept	120.0	30.00	4.000	.706	1.010
1	Take-out boy		.50	.50	Oct	37.2	10.50	3.543	.625	1.068
1	Peanut-roaster boy		.38	.38	Nov	127.0	30.00	*4.233*	*.747*	*.985*
1/2	Carry-in boy		.50	.25	Dec	95.5	26.00	3.673	.648	1.050
5 2/3	Total	.56		1.80	Total	880.2	241.00	3.652	.644	1.052

8-OUNCE PRESCRIPTION OVALS—SEMIAUTOMATIC ONE-MAN MACHINE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1	Gatherer	$0.36			1918	2,096.0	652.00	3.214	0.714	$0.774
1	Transfer boy		$0.38	$0.38	1919	1,168.0	440.00	*2.654*	*.590*	*.861*
1	Take-out boy		.38	.38	1920	2,643.0	864.00	3.059	.680	.795
1	Peanut-roaster boy		.38	.38	1921	2,030.0	716.00	2.835	.630	.829
1/2	Carry-in boy		.38	.19	1922	2,217.0	600.00	*3.695*	*.821*	*.720*
					1923	2,981.0	812.00	3.671	.815	.722
4 1/2	Total	.36		1.33	Total	13,135.0	4,084.00	3.216	.714	.774

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: O'NEILL AND FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/15	Machine foreman		$0.78	$0.104	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.70	.700	July	818.0	145.80	5.611	2.004	$0.241
1 1/3	Peanut-roaster boys		.30	.40	Oct	586.0	124.60	4.703	1.680	.288
1/3	Carry-in boy		.45	.15	Nov	609.0	129.80	4.692	1.676	.289
2 4/5	Total			1.354	Total	2,013.0	400.20	5.030	1.796	.269
	8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: LYNCH AND FEEDER									
1/6	Chief operator		$0.90	$0.15	1925					
1	Machine operator		.60	.60	Jan	293.0	42.00	6.976	3.220	$0.152
1	Carry-in boy		.31	.31	Feb	377.0	52.00	7.250	3.346	.146
2 1/6	Total			1.06	Total	670.0	94.00	7.128	3.290	.149
	8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. E. (6 ARMS) SINGLE									
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Sept	97.1	17.80	5.455	1.964	$0.242
1/9	Hot-ware inspector		.55	.061	Oct	84.3	13.50	6.244	2.248	.216
1 1/3	Carry-in boys		.43	.573	Nov	138.1	21.50	6.423	2.312	.206
2 7/9	Total			1.501	Total	319.5	52.80	6.051	2.178	.218
	8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) SINGLE									
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Jan	1,001.2	91.40	10.954	2.899	$0.176
1/9	Hot-ware inspector		.55	.061	Feb	952.6	84.50	11.273	2.984	.171
2 1/3	Carry-in boys		.43	1.003	Mar	1,150.2	98.70	11.654	3.085	.166
					Apr	2,102.8	183.80	11.441	3.029	.169
					May	2,011.7	180.80	11.127	2.946	.173
					June	3,324.7	302.50	10.991	2.910	.176
					July	2,790.7	248.70	11.221	2.970	.172
					Aug	1,550.8	133.30	11.634	3.080	.166
					Sept	2,355.0	205.60	11.454	3.032	.168
					Oct	3,002.8	276.50	*10.860*	*2.875*	*.178*
					Nov	3,380.6	271.30	*12.461*	*3.299*	*.155*
					Dec	1,600.0	131.10	12.204	3.231	.158
3 7/9	Total			1.931	Total	25,223.1	2,208.20	11.424	3.024	.169
	8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) DOUBLE									
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Jan	747.1	41.70	17.916	4.743	$0.108
1/9	Hot-ware inspector		.55	.061	Feb	472.4	25.20	18.746	4.962	.103
2 1/3	Carry-in boys		.43	1.003	Mar	1,060.0	54.80	19.343	5.120	.100
					Apr	326.4	17.00	19.200	5.082	.101
					May	1,020.4	60.80	*16.783*	*4.443*	*.115*
					June	691.2	38.00	18.189	4.815	.106
					Sept	154.6	7.70	*20.078*	*5.315*	*.096*
					Oct	460.0	26.20	17.557	4.647	.110
					Nov	437.5	24.70	17.713	4.689	.109
					Dec	914.2	46.70	19.572	5.181	.099
3 7/9	Total			1.931	Total	6,283.8	342.80	18.331	4.852	.105

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) DOUBLE, WITH CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925	*Gross*		*Gross*	*Gross*	
1	Machine foreman		.90	.90	Apr	1,375.0	72.00	19.097	8.814	$0.086
1	Machine operator		.55	.55	July	790.0	39.00	20.256	9.349	.082
					Sept	613.0	33.80	*18.136*	*8.370*	*.091*
					Oct	3,297.0	142.70	23.104	10.663	.071
					Nov	2,651.0	114.80	23.092	10.658	.072
					Dec	1,767.0	71.20	*24.817*	*11.454*	*.067*
2 1/6	Total			1.65	Total	10,493.0	473.50	22.161	10.006	.075

8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. Q. (15 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	1,426.0	72.00	19.806	9.141	$0.083
1	Machine operator		.55	.55	Feb	861.0	42.70	*20.164*	*9.306*	*.081*
					Sept	619.0	36.00	*17.194*	*7.936*	*.096*
					Oct	404.0	22.10	18.281	8.437	.090
					Nov	1,431.0	75.30	19.004	8.771	.087
					Dec	1,386.0	71.00	19.521	9.010	.085
2 1/6	Total			1.65	Total	6,227.0	319.10	19.514	9.006	.085

8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS A. Q. (15 ARMS) DOUBLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	1,005.0	48.00	20.937	9.663	$0.079
1	Machine operator		.55	.55	Feb	3,755.0	138.50	27.112	12.513	.061
					May	4,206.0	143.50	*29.310*	*13.528*	*.056*
					Sept	284.0	14.00	*20.286*	*9.363*	*.081*
					Oct	643.0	25.70	25.019	11.547	.066
					Dec	4,193.0	182.30	23.000	10.615	.072
2 1/6	Total			1.65	Total	14,086.0	552.00	25.518	11.778	.065

8-OUNCE PRESCRIPTION OVALS—AUTOMATIC MACHINE: OWENS C. A. (10 ARMS) DOUBLE DUPLEX, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Feb	5,569.0	144.00	38.674	12.213	$0.057
2	Machine operators		.55	1.10	Mar	4,808.0	133.00	36.150	11.416	.061
					Apr	4,220.0	108.60	38.858	12.271	.057
					May	5,740.0	134.60	42.645	13.467	.052
					June	2,518.0	91.70	*27.459*	*8.671*	*.080*
					July	3,544.0	106.20	33.371	10.538	.066
					Aug	5,916.0	144.00	41.083	12.974	.054
					Oct	6,056.0	143.50	42.202	13.327	.052
					Nov	6,229.0	142.00	*43.866*	*13.852*	*.050*
					Dec	4,544.0	117.90	38.541	12.171	.057
3 1/6	Total			2.20	Total	49,144.0	1,265.50	38.337	12.117	.057

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

6-DRAM EXTRACT PANELS—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$0.77			Average output per 8 hours.......gross..	32
1	Finisher				Average output per unit-hour......do....	4
1	Mold boy		$0.40	$0.40	Average output per man-hour.....do....	.571
1	Cleaning-off boy		.40	.40	Average blowing labor cost....per gross..	$1.170
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.77		1.60		

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.60	.600	Jan	5,081.5	219.00	23.203	6.142	$0.083
1/9	Hot-ware inspector		.55	.061	Feb	2,259.0	112.00	*20.170*	*5.339*	*.095*
2 1/3	Carry-in boys		.43	1.003	Mar	4,807.1	211.50	22.729	6.017	.085
					Apr	543.0	24.70	21.984	5.819	.088
					May	11,853.0	501.30	23.645	6.259	.082
					June	543.8	24.00	22.658	5.998	.085
					July	2,244.0	96.80	23.182	6.136	.083
					Aug	2,121.5	91.00	23.313	6.171	.083
					Sept	3,582.0	143.80	24.910	6.594	.078
					Oct	2,735.0	112.20	24.376	6.452	.079
					Nov	840.0	32.50	25.846	6.842	.075
					Dec	2,496.0	94.80	*26.329*	*6.969*	*.073*
3 7/9	Total			1.931	Total	39,105.9	1,663.60	23.507	6.222	.082

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE, WITH CONVEYOR

1/6	Chief foreman		$1.20	$0.20	1924	1,164.0	45.30	25.695	11.859	$0.064
1	Machine foreman		.90	.90	1925	606.0	31.20	19.423	8.964	.085
1	Machine operator		.55	.55						
2 1/6	Total			1.65	Total	1,770.0	76.50	23.138	10.679	.071

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE, WITH CONVEYOR

1/4	Chief foreman		$1.20	$0.30	1917	16,190.0	1,112.40	14.555	6.469	$0.120
1	Machine foreman		.90	.90	1918	4,917.0	337.80	14.556	6.469	.120
1	Machine operator		.55	.55	1919	12,044.0	799.80	15.059	6.693	.116
					1920	8,718.0	493.50	17.666	7.852	.099
2 1/4	Total			1.75	Total	41,869.0	2,743.50	15.261	6.783	.108

Table A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) DOUBLE, WITH CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
¼	Chief foreman		$1.20	$0.30		*Gross*		*Gross*	*Gross*	
1	Machine foreman		.90	.90	1920	25,653.0	1,004.50	25.538	11.350	$0.067
1	Machine operator		.55	.55	1922	22,816.0	996.00	22.908	10.181	.076
					1923	21,476.0	972.00	22.095	9.820	.079
					1924	6,264.0	259.20	24.167	10.741	.072
2¼	Total			1.75	Total	76,209.0	3,231.70	23.582	10.480	.074

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) SINGLE, WITH CONVEYOR

⅙	Chief foreman		$1.20	$0.20	1919	62,174.0	3,400.70	18.283	8.438	$0.090
1	Machine foreman		.90	.90	1920	6,264.0	263.70	23.754	10.963	.069
1	Machine operator		.55	.55	1921	6,108.0	237.60	25.707	11.865	.064
2⅙	Total			1.65	Total	74,546.0	3,902.00	19.104	8.817	.086

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) DOUBLE, WITH CONVEYOR

⅙	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	6,915.0	201.40	34.335	15.847	$0.048
1	Machine operator		.55	.55	Mar	7,041.0	205.30	34.296	15.829	.048
					Apr	747.0	22.50	33.200	15.323	.050
					May	3,054.0	75.50	*40.450*	*18.669*	*.041*
					June	2,277.0	70.00	*32.529*	*15.009*	*.051*
					Aug	4,575.0	138.90	32.937	15.202	.050
					Sept	8,517.0	225.00	37.853	17.471	.044
					Oct	2,811.0	70.90	39.647	18.299	.042
2⅙	Total			1.65	Total	35,937.0	1,009.50	35.599	16.430	.046

6-DRAM EXTRACT PANELS—AUTOMATIC MACHINE: OWENS C. A. (10 ARMS) DOUBLE TRIPLEX, WITH CONVEYOR

⅙	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Mar	9,039.0	144.00	62.771	19.822	$0.035
2	Machine operators		.55	1.10	Apr	5,360.0	111.00	48.289	15.249	.046
					Aug	6,186.0	144.00	42.958	13.566	.051
3⅙	Total			2.20	Total	20,585.0	399.00	51.592	16.292	.043

2-OUNCE EXTRACT PANELS—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity and amount
2	Blowers	} $0.92			Average output per 8 hours......gross	28
1	Finisher				Average output per unit-hour......do	3.50
1	Mold boy		$0.40	$0.40	Average output per man-hour......do	.50
1	Cleaning-off boy		.40	.40	Average blowing labor cost....per gross	$1.377
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.92		1.60		

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

2-OUNCE EXTRACT PANELS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00	$0.17	1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$0.58 (Gatherer and Presser)			Jan	438.0	120.00	3.650	0.644	$1.073
1	Presser				June	78.6	20.00	3.930	.694	1.038
1	Transfer boy		.50	.50	July	267.3	72.50	3.687	.651	1.068
1	Take-out boy		.50	.50	Sept	80.6	22.50	*3.563*	*.629*	*1.085*
1	Peanut-roaster boy		.38	.38	Oct	126.4	30.00	4.213	.743	1.007
1/2	Carry-in boy		.50	.25	Nov	350.5	75.00	*4.673*	*.825*	*.965*
					Dec	511.0	120.00	4.258	.751	1.003
5 2/3	Total	.58		1.80	Total	1,852.4	460.00	4.030	.711	1.027

2-OUNCE EXTRACT PANELS—SEMIAUTOMATIC MACHINE: O'NEILL, WITH FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00	$0.17	1925					
1	Operator		.70	.70	Jan	175.0	30.00	5.833	1.591	$0.362
1	Transfer boy		.50	.50	June	53.0	9.00	5.888	1.606	.358
1	Peanut-roaster boy		.50	.50	Sept	209.0	39.00	5.360	1.462	.394
1/2	Carry-in boy		.50	.25	Oct	135.0	26.00	5.231	1.427	.403
3 2/3	Total			2.12	Total	572.0	104.00	5.500	1.500	.384

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: O'NEILL AND SINGLE FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/15	Chief operator		$0.78	$0.104	1925					
1	Operator		.70	.700	Jan	356.0	50.00	7.120	2.543	$0.187
1 1/3	Turn-out boys		.30	.400	Feb	1,190.0	138.00	8.623	3.080	.155
2/15	Peanut-roaster boy		.30	.040	Mar	206.0	36.50	*5.644*	*2.016*	*.236*
1/5	Carry-in boy		.45	.090	Apr	634.0	71.50	*8.867*	*3.167*	*.150*
					May	412.0	47.50	8.674	3.098	.154
					Sept	1,156.0	143.10	8.078	2.885	.165
					Oct	416.0	59.00	7.051	2.518	.189
					Nov	502.0	71.20	7.051	2.518	.189
					Dec	1,176.0	140.00	8.400	3.000	.159
2 4/5	Total			1.334	Total	6,048.0	756.80	7.992	2.854	.167

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: O'NEILL TRIPLE, WITH P. N. FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/5	Chief operator		$0.78	$0.31	1925					
1	Machine operator		.70	.70	Feb	3,122.0	143.40	21.771	2.942	$0.152
1	Feeder operator		.70	.70	Mar	3,042.0	142.30	21.377	2.889	.154
4	Turn-out boys		.30	1.20	Apr	1,052.0	47.50	22.147	2.993	.149
2/5	Peanut-roaster boy		.30	.12	May	2,044.0	95.50	21.403	2.892	.154
3/5	Carry-in boy		.45	.27	June	3,110.0	143.30	21.703	2.933	.152
					July	2,740.0	132.30	20.711	2.799	.159
					Aug	3,186.0	143.00	*22.280*	*3.011*	*.148*
					Sept	2,440.0	118.00	20.678	2.794	.160
					Oct	2,540.0	119.50	21.255	2.872	.155
					Nov	2,690.0	136.40	*19.721*	*2.665*	*.167*
					Dec	1,422.0	67.30	21.129	2.855	.156
7 2/5	Total			3.30	Total	27,388.0	1,288.50	21.256	2.872	.155

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/5	Machine foreman		$0.75	$0.150	1925					
1	Machine operator		.55	.550	Oct	1,021.1	79.30	12.876	3.503	$0.133
1/7	Hot-ware inspector		.52	.074	Nov	1,207.8	98.00	12.324	3.352	.139
2 1/3	Carry-in boys		.40	.933	Dec	4,758.9	373.30	12.748	3.468	.134
2 71/105	Total			1.708	Total	6,987.8	550.60	12.691	3.452	.135

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. N. (10 ARMS) DOUBLE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.60	.600	Jan	121.6	9.00	13.511	3.494	$0.145
1/5	Hot-ware inspector		.56	.112	June	774.8	42.80	18 103	4.682	.108
2 1/3	Carry-in boys		.42	.980	July	1,210.8	72.00	16.817	4.349	.116
3 13/15	Total			1.959	Total	2,107.2	123.80	17.021	4.402	.115

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/4	Chief foreman		$1.20	$0.30	1917	3,733.0	287.00	13.007	5.780	$0.135
1	Machine foreman		.90	.90	1918	466.0	35.90	12.981	5.769	.135
1	Machine operator		.55	.55						
2 1/4	Total			1.75	Total	4,199.0	322.90	13.004	5.779	.135

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) DOUBLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/4	Chief foreman		$1.20	$0.30	1922	15,227.0	828.00	18.390	8.173	$0.095
1	Machine foreman		.90	.90	1923	14,758.0	824.00	17.910	7.960	.098
1	Machine operator		.55	.55						
2 1/4	Total			1.75	Total	29,985.0	1,652.00	18.151	8.067	.096

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1919	13,460.0	760.00	17.711	8.174	$0.093
1	Machine foreman		.90	.90	1920	24,468.0	1,257.30	19.461	8.982	.085
1	Machine operator		.55	.55	1921	21,414.0	1,009.70	21.208	9.788	.078
2 1/6	Total			1.65	Total	59,342.0	3,027.00	19.604	9.048	.084

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS A. V. (15 ARMS) DOUBLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	202.0	10.00	*20.200*	*9.323*	*$0.082*
1	Machine operator		.55	.55	Feb	1,072.0	57.50	20.816	9.607	.079
					Mar	2,890.0	122.20	23.650	10.915	.070
					Apr	4,286.0	144.00	29.764	13.787	.055
					May	4,384.0	144.00	*30.444*	*14.051*	*.054*
2 1/6	Total			1.65	Total	12,834.0	471.70	27.208	12.558	.061

2-OUNCE EXTRACT PANELS—AUTOMATIC MACHINE: OWENS C. A. (10 ARMS) DOUBLE DUPLEX, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Apr	4,502.0	111.40	40.413	12.762	$0.054
2	Machine operators		.55	1.10	May	1,386.0	40.00	34.650	10.942	.063
					Sept	3,474.0	90.50	38.387	12.122	.057
					Oct	5,169.0	138.20	37.402	11.811	.059
3 1/6	Total			2.20	Total	14,531.0	380.10	38.229	12.072	.057

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

ONE-HALF PINT SODAS—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$1.04			Average output per 8 hours ... gross	22
1	Finisher				Average output per unit-hour ... do	2.75
1	Mold boy		$0.40	$0.40	Average output per man-hour ... do	.393
1	Cleaning-off boy		.40	.40	Average blowing labor cost ... per gross	$1.622
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	1.04		1.60		

ONE-HALF PINT SODAS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00	$0.167	1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$0.67			Jan.	200.0	60.00	3.333	0.588	$1.210
1	Presser				Feb.	317.1	120.00	2.643	.466	1.351
1	Transfer boy		.50	.500	Mar.	426.3	162.00	2.631	.464	1.354
1	Take-out boy		.50	.500	Apr.	567.4	225.00	*2.522*	*.445*	*1.381*
1	Peanut roaster boy		.38	.380	May	694.8	245.50	2.830	.499	1.306
1/2	Carry-in boy		.50	.250	June	411.4	142.50	2.887	.509	1.290
					July	609.3	180.00	*3.385*	*.597*	*1.202*
					Aug.	408.5	135.00	3.026	.534	1.265
5 2/3	Total	.67		1.797	Total	3,634.8	1,270.00	2.861	.505	1.299

ONE-HALF PINT SODAS—SEMIAUTOMATIC MACHINE: TEEPLE-JOHNSON, WITH GATHERER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.95	$0.080	1925					
1/4	Machinist		1.15	.287	Jan.	1,272.0	343.00	*3.709*	*0.860*	*$0.847*
1	Gatherer	$0.44			Feb.	1,112.0	327.00	3.401	.785	.884
1	Transfer boy		.38	.380	Mar.	1,696.0	468.00	3.624	.836	.857
1	Take-out boy		.38	.380	Apr.	1,069.0	301.00	3.552	.820	.865
1	Carry-in boy		.38	.380	May	1,191.0	370.00	3.219	.743	.909
					June	895.0	271.00	3.303	.762	.894
					Aug.	1,705.0	566.00	3.011	.695	.941
					Sept.	216.0	72.00	*3.000*	*.692*	*.943*
					Oct.	273.0	77.00	3.546	.818	.866
					Dec.	819.0	245.00	3.343	.771	.892
4 1/3	Total	.44		1.507	Total	10,248.0	3,040.00	3.371	.778	.888

ONE-HALF PINT SODAS—SEMIAUTOMATIC MACHINE: O'NEILL, WITH GATHERER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.167	1925					
1	Gatherer	$0.67			Jan.	3,213.0	752.00	4.273	1.115	$0.845
1	Transfer man				Feb.	2,957.0	728.00	4.062	1.060	.855
1/2	Swing man				Mar.	2,170.0	512.00	4.238	1.106	.847
1 1/6	Carry-in boys		.50	.583	Apr.	3,641.0	904.00	*4.028*	*1.051*	*.856*
					May	5,991.0	1,272.00	4.710	1.229	.829
					June	3,759.0	872.00	4,311	1.125	.844
					July	3,468.0	736.00	4.712	1.229	.829
					Aug.	622.0	128.00	*4.859*	*1.268*	*.824*
3 5/6	Total	.67		.750	Total	25,821.0	5,904.00	4.373	1.141	.841

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

ONE-HALF PINT SODAS—SEMIAUTOMATIC MACHINE: LYNCH, WITH GATHERER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.95	$0.080	1925	*Gross*		*Gross*	*Gross*	
1/4	Machinist		1.15	.287	Jan	413.0	93.00	4.409	1.323	$0.610
2	Gatherers	$0.44			Feb	667.0	157.00	*4.249*	*1.275*	*.616*
1	Carry-in boy		.38	.380	Mar	1,329.0	292.00	4.551	1.365	.605
					Apr	531.0	111.00	*4.784*	*1.435*	*.597*
3 1/3	Total	.44		.747	Total	2,940.0	653.00	4.503	1.351	.607

ONE-HALF PINT SODAS—AUTOMATIC MACHINE: O'NEILL AND FEEDER

1/6	Machine foreman		$1.00	$0.167	1925					
1	Machine operator		.75	.750	Feb	1,902.0	288.00	6.604	2.830	$0.227
1 1/6	Carry-in boys		.50	.582	Mar	840.0	134.00	6.269	2.687	.239
					Apr	4,291.0	726.00	*5.910*	*2.533*	*.254*
					May	7,721.0	1,143.50	6.752	2.894	.222
					June	5,364.0	809.00	6.630	2.841	.226
					July	6,173.0	959.00	6.437	2.759	.233
					Aug	4,353.0	662.00	6.576	2.818	.228
					Nov	2,927.0	427.00	*6.855*	*2.938*	*.219*
					Dec	6,741.0	992.00	6.795	2.912	.221
2 1/3	Total			1.499	Total	40,312.0	6,140.50	6.565	2.814	.229

ONE-HALF PINT SODAS—AUTOMATIC MACHINE: HARTFORD-EMPIRE TRIPLE UNIT AND P. N. FEEDER

1/2	Machine foreman		$0.80	$0.400	1925					
3	Machine operators		.60	1.800	Jan	5,303.7	287.20	18.467	1.664	$0.296
3/5	Hot-ware inspector		.56	.336	Feb	5,710.9	326.80	*17.475*	*1.574*	*.313*
6	Carry-in boys		.42	2.520	Mar	8,911.6	421.40	21.148	1.905	.259
1	Swing (extra) man		.42	.420	Apr	10,283.7	516.60	19.907	1.793	.275
					May	8,484.6	402.60	21.075	1.899	.260
					June	10,765.1	524.50	20.524	1.849	.267
					July	8,125.1	383.70	*21.176*	*1.908*	*.259*
					Aug	1,511.5	72.10	20.964	1.889	.261
					Sept	819.2	39.70	21.168	1.907	.259
					Oct	6,889.2	338.40	20.358	1.834	.269
					Dec	5,098.0	255.90	19.922	1.795	.275
11 1/10	Total			5.476	Total	71,902.6	3,568.90	20.147	1.815	.272

ONE-HALF PINT SODAS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE, WITH CONVEYOR

1/12	Machine foreman		$0.90	$0.075	1923	24,269.0	2,074.00	11.702	6.382	$0.109
1/2	Machinist		.75	.375	1924	43,597.0	3,663.00	11.902	6.492	.107
1	Machine operator		.70	.700	1925	253.0	21.00	12.048	6.572	.106
1/4	Helper		.50	.125						
1 5/6	Total			1.275	Total	68,119.0	5,758.00	11.830	6.453	.108

ONE-HALF PINT SODAS—AUTOMATIC MACHINE: OWENS A. E. (6 ARMS) SINGLE, WITH CONVEYOR

1/12	Machine foreman		$0.90	$0.075	1923	198,730.0	21,685.00	9.164	4.999	$0.136
1/2	Machinist		.75	.375	1924	115,358.0	13,481.00	8.557	4.667	.149
1	Machine operator		.70	.700	1925	167,738.0	19,015.00	8.821	4.811	.145
1/4	Helper		.50	.125						
1 5/6	Total			1.275	Total	481,726.0	54,181.00	8.878	4.842	.144

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

ONE-HALF PINT SODAS—AUTOMATIC MACHINE: OWENS A. Q. (15 ARMS) SINGLE, WITH CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅛	Machine foreman		$0.90	$0.113		*Gross*		*Gross*	*Gross*	
2	Machine operators		.80	1.600	1923	41,150.0	2,724.00	15.106	6.042	$0.126
¼	Helper		.50	.125	1924	9,965.0	580.00	17.181	6.872	.111
⅛	Hot-ware inspector		.50	.063	1925	1,062.0	69.00	15.391	6.156	.124
2½	Total			1.900	Total	52,177.0	3,373.00	15.469	6.188	.123

1-PINT BEERS—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$1.04			Average output per 8 hours.......gross	22
1	Finisher				Average output per unit-hour.......do	2.75
1	Mold boy		$0.40	$0.40	Average output per man-hour.......do	.393
1	Cleaning-off boy		.40	.40	Average blowing labor cost.......per gross	$1.622
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	1.04		1.60		

1-PINT BEERS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅙	Machinist		$1.00	$0.167	1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$0.67			May	148.4	60.00	*2.423*	*0.428*	*$1.418*
1	Presser				June	43.5	15.00	2.900	.512	1.291
1	Transfer boy		.50	.500	Nov	49.0	16.50	*2.970*	*.524*	*1.276*
1	Take-out boy		.50	.500	Dec	95.0	35.00	2.714	.479	1.333
1	Peanut-roaster boy		.38	.380						
½	Carry-in boy		.50	.250						
5⅔	Total	.67		1.797	Total	332.9	126.50	2.632	.464	1.354

1-PINT BEERS—SEMIAUTOMATIC MACHINE: TEEPLE-JOHNSON, WITH GATHERER

1/12	Machine foreman		$0.95	$0.080	1925					
¼	Machinist		1.15	.287	Sept	319.0	96.00	3.323	0.767	$0.876
1	Gatherer	$0.44			Oct	338.0	98.00	*3.449*	*.796*	*.878*
1	Transfer boy		.38	.380	Nov	527.0	153.00	3.445	.795	.878
1	Take-out boy		.38	.380	Dec	208.0	67.00	*3.105*	*.717*	*.926*
1	Carry-in boy		.38	.380						
4⅓	Total	.44		1.507	Total	1,392.0	414.00	3.362	.776	.889

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-PINT BEERS—AUTOMATIC MACHINE: HARTFORD-EMPIRE TRIPLE UNIT, WITH P. N. FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
					1925	*Gross*		*Gross*	*Gross*	
1/2	Machine foreman		$0.80	$0.400	Mar	802.5	48.80	*16.445*	*1.482*	*$0.333*
3	Machine operators		.60	1.800	Apr	3,143.0	170.30	18.456	1.663	.296
3/5	Hot-ware inspector		.56	.336	May	889.1	49.20	18.071	1.628	.303
6	Carry-in boys		.42	2.520	June	734.5	44.50	16.506	1.487	.332
1	Swing (extra) man		.42	.420	July	1,775.3	95.40	18.610	1.677	.294
					Aug	2,227.0	118.10	18.857	1.699	.290
					Sept	784.4	39.90	19.659	1.771	.278
					Oct	559.3	30.30	18.460	1.663	.297
					Nov	953.3	46.80	*20.364*	*1.835*	*.269*
					Dec	1,847.9	94.30	19.596	1.765	.279
11 1/10	Total			5.476	Total	13,716.3	737.60	18.595	1.675	.294

1-PINT BEERS—AUTOMATIC MACHINE: OWENS A. E. (6 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.90	$0.075	1923	212,283.0	22,377.00	*9.487*	*5.175*	*$0.134*
1/2	Machinist		.75	.375	1924	96,961.0	11,330.00	*8.558*	*4.668*	*.149*
1	Machine operator		.70	.700	1925	270,055.0	30,377.00	8.890	4.849	.143
1/4	Helper		.50	.125						
1 5/6	Total			1.275	Total	579,299.0	64,084.00	9.040	4.931	.141

1-PINT BEERS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.90	$0.075	1923	31,171.0	2,466.00	12.640	6.895	$0.101
1/2	Machinist		.75	.375	1924	60,343.0	4,471.00	13.497	7.362	.095
1	Machine operator		.70	.700	1925	155,894.0	11,437.00	13.631	7.435	.094
1/4	Helper		.50	.125						
1 5/6	Total			1.275	Total	247,308.0	18,374.00	13.460	7.342	.095

1-PINT BEERS—AUTOMATIC MACHINE: OWENS A. Q. (15 ARMS) SINGLE, WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/8	Machine foreman		$0.90	$0.113	1923	109,820.0	6,652.00	16.509	6.604	$0.115
2	Machine operators		.80	1.600	1924	250,557.0	13,508.00	18.549	7.420	.102
1/4	Helper		.50	.125	1925	381,301.0	19,613.00	19.441	7.776	.098
1/8	Hot-ware inspector		.50	.063						
2 1/2	Total			1.900	Total	741,678.0	39,763.00	18.652	7.661	.102

ONE-HALF PINT WHISKY DANDIES—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$0.87 (Blowers and finisher)			Average output per 8 hours gross	25
1	Finisher				Average output per unit-hour do	3.125
1	Mold boy		$0.40	$0.40	Average output per man-hour do	.446
1	Cleaning-off boy		.40	.40	Average blowing labor cost per gross	$1.382
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	.87		1.60		

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

ONE-HALF PINT WHISKY DANDIES—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.167	1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$0.56 (Gatherer and Presser)			Jan	46.0	15.00	*3.067*	*0.541*	*$1.147*
1	Presser				Feb	141.8	40.00	3.545	.626	1.068
1	Transfer boy		.50	.500	Mar	266.3	67.50	*3.950*	*.697*	*1.016*
1	Take-out boy		.50	.500	May	198.0	55.00	3.600	.635	1.060
1	Peanut-roaster boy		.38	.380	July	133.5	37.50	3.560	.628	1.066
½	Carry-in boy		.50	.250	Aug	151.5	45.00	3.367	.594	1.095
					Oct	266.0	67.50	*3.950*	*.697*	*1.016*
					Nov	197.7	52.00	3.790	.669	1.035
					Dec	293.1	75.00	3.908	.690	1.021
5⅔	Total	.56		1.797	Total	1,693.9	454.00	3.731	.658	1.042

ONE-HALF PINT WHISKY DANDIES—SEMIAUTOMATIC MACHINE: O'NEILL, WITH FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00	$0.167	1925					
1	Machine operator		.70	.700	Jan	728.0	131.00	*5.558*	*1.516*	*$0.380*
1	Transfer boy		.50	.500	Feb	52.0	11.00	4.727	1.289	.446
1	Peanut-roaster boy		.50	.500	July	224.0	53.00	*4.227*	*1.153*	*.500*
½	Carry-in boy		.50	.250	Aug	638.0	118.00	5.407	1.475	.390
					Sept	729.0	142.00	5.134	1.401	.411
					Oct	276.0	58.00	4.759	1.298	.443
					Nov	1,242.0	229.00	5.424	1.479	.389
					Dec	1,227.0	235.00	5.221	1.424	.404
3⅔	Total			2.117	Total	5,116.0	977.00	5.237	1.428	.403

ONE-HALF PINT WHISKY DANDIES—AUTOMATIC MACHINE: O'NEILL AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.167	1925					
1	Machine operator		.70	.700	Jan	357.0	69.00	5.174	2.388	$0.264
1	Carry-in boy		.50	.500	Aug	382.0	64.50	5.922	2.733	.231
					Sept	99.0	20.00	*4.950*	*2.285*	*.276*
					Oct	2,164.0	360.00	*6.011*	*2.774*	*.227*
					Nov	1,334.0	224.00	5.955	2.748	.229
					Dec	1,890.0	317.00	5.962	2.752	.229
2⅙	Total			1.367	Total	6,226.0	1,054.50	5.904	2.725	.231

ONE-HALF PINT WHISKY DANDIES—AUTOMATIC MACHINE: LYNCH AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅙	Chief operator		$0.90	$0.15	1925					
1	Machine operator		.60	.60	May	718.0	96.00	7.479	3.452	$0.142
1	Carry-in boy		.31	.31	June	1,124.0	144.00	*7.806*	*3.603*	*.136*
					July	200.0	26.00	7.692	3.550	.138
					Aug	443.0	57.00	7.772	3.587	.136
					Sept	413.0	58.00	*7.121*	*3.287*	*.149*
					Oct	356.0	48.00	7.417	3.423	.143
					Nov	543.0	76.00	7.145	3.298	.148
					Dec	956.0	132.00	7.243	3.343	.146
2⅙	Total			1.06	Total	4,753.0	637.00	7.462	3.444	.142

ONE-HALF PINT WHISKY DANDIES—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS), SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅓	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Sept	531.4	41.10	*12.929*	*2.657*	*$0.184*
⅕	Hot-ware inspector		.56	.112	Oct	336.4	27.70	12.144	2.495	.196
3⅓	Carry-in boys		.42	1.400	Nov	953.8	73.90	12.907	2.652	.184
					Dec	674.4	60.30	*11.184*	*2.298*	*.213*
4 13/15	Total			2.379	Total	2,496.0	203.00	12.296	2.321	.194

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Table A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-PINT WHISKY DANDIES—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$1.15 (Blowers and finisher)			Average output per 8 hours......gross..	20
1	Finisher				Average output per unit-hour......do....	2.50
1	Mold boy		$0.40	$0.40	Average output per man-hour......do....	.357
1	Cleaning-off boy		.40	.40	Average blowing labor cost....per gross..	$1.790
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	1.15		1.60		

1-PINT WHISKY DANDIES—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.167	1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$0.67 (Gatherer and presser)			July	121.1	48.00	*2.523*	*0.445*	*$1.383*
1	Presser				Aug	178.4	65.50	2.724	.481	1.331
1	Transfer boy		.50	.500	Sept	322.3	115.00	2.803	.495	1.312
1	Take-out boy		.50	.500	Oct	337.4	116.00	2.909	.513	1.289
1	Peanut-roaster boy		.38	.380	Nov	289.4	90.00	*3.216*	*.568*	*1.230*
1/2	Carry-in boy		.50	.250	Dec	131.0	45.00	2.911	.514	1.283
5 2/3	Total	.67		1.797	Total	1,379.6	479.50	2.878	.508	1.295

1-PINT WHISKY DANDIES—SEMIAUTOMATIC MACHINE: TEEPLE-JOHNSON, WITH GATHERER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.95	$0.080	1925					
1/4	Machinist		1.15	.287	Jan	1,006.0	279.00	3.606	0.832	$0.829
1	Gatherer	$0.41			Feb	588.0	160.00	3.675	.848	.821
1	Transfer boy		.38	.380	Mar	422.0	122.00	3.459	.798	.847
1	Take-out boy		.38	.380	Apr	731.0	218.00	3.353	.774	.860
1	Carry-in boy		.38	.380	May	646.0	194.00	3.330	.768	.863
					Aug	163.0	56.00	*2.911*	*.672*	*.929*
					Sept	871.0	298.00	2.923	.676	.927
					Oct	700.0	199.00	3.518	.766	.839
					Nov	19.0	5.00	*3.800*	*.877*	*.807*
					Dec	664.0	202.00	3.287	.759	.869
4 1/3	Total	.41		1.507	Total	5,810.0	1,733.00	3.353	.774	.860

1-PINT WHISKY DANDIES—SEMIAUTOMATIC MACHINE: O'NEILL, WITH GATHERER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/11	Machine foreman		$0.75	$0.068	1917	11,531.0	3,783.00	3.048	0.906	$0.716
2/11	Machinist		.75	.136	1918	722.0	241.00	2.996	.891	.722
1	Gatherer	$0.39								
1	Transfer boy		.40	.400						
1 1/11	Carry-in boys		.35	.382						
3 4/11	Total	.39		.986	Total	12,253.0	4,024.00	3.042	.904	.717

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-PINT WHISKY DANDIES—SEMIAUTOMATIC MACHINE: LYNCH, WITH GATHERER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/11	Machine foreman		$0.75	$0.068		*Gross*		*Gross*	*Gross*	
2/11	Machinist		.75	.136	1919	9,228.0	2,485.00	3.713	1.571	$0.550
1	Gatherer	$0.39			1920	3,578.0	1,012.00	3.536	1.496	.558
1 1/11	Carry-in boys		.35	.382						
2 4/11	Total	.39		.586	Total	12,806.0	3,497.00	3.662	1.549	.552

1-PINT WHISKY DANDIES—AUTOMATIC MACHINE: O'NEILL AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.167	1925					
1	Machine operator		.70	.700	Jan	1,250.0	244.00	5.123	2.364	$0.267
1	Carry-in boy		.50	.500	Feb	117.0	25.00	4.680	2.160	.292
					Apr	340.0	69.00	4.920	2.274	.277
					May	297.0	67.00	*4.433*	*2.046*	*.308*
					June	205.0	42.00	4.881	2.253	.280
					July	404.0	86.00	4.698	2.168	.291
					Aug	594.0	122.00	4.869	2.247	.281
					Sept	931.0	181.00	5.144	2.374	.266
					Oct	1,020.0	185.00	*5.514*	*2.545*	*.248*
					Nov	1,237.0	227.00	5.449	2.515	.251
					Dec	254.0	48.00	5.292	2.442	.258
2 1/6	Total			1.367	Total	6,649.0	1,296.00	5.130	2.368	.266

1-PINT WHISKY DANDIES—AUTOMATIC MACHINE: LYNCH AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief operator		$0.90	$0.15	1925					
1	Machine operator		.60	.60	Aug	381.0	72.00	5.292	2.442	$0.200
1	Carry-in boy		.31	.31	Sept	232.0	49.00	*4.735*	*2.185*	*.224*
					Oct	684.0	112.00	6.108	2.819	.174
					Nov	750.0	122.00	*6.148*	*2.838*	*.172*
					Dec	817.0	144.00	5.674	2.619	.187
2 1/6	Total			1.06	Total	2,864.0	499.00	5.740	2.649	.185

1-PINT WHISKY DANDIES—AUTOMATIC MACHINE: OWENS A. E. (6 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Jan	247.2	32.30	*7.653*	*1.979*	*$0.256*
1/5	Hot-ware inspector		.56	.112	Feb	464.4	65.80	7.058	1.825	.277
2 1/3	Carry-in boys		.42	.980	Mar	499.8	71.00	7.039	1.820	.278
					June	990.0	143.80	*6.885*	*1.781*	*.284*
3 13/15	Total			1.959	Total	2,201.4	312.90	7.035	1.819	.278

1-PINT WHISKY DANDIES—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Jan	1,442.3	143.20	*10.080*	*2.071*	*$0.236*
1/5	Hot-ware inspector		.56	.112	Feb	1,010.2	106.20	9.603	1.973	.248
3 1/3	Carry-in boys		.42	1.400	Mar	483.3	52.70	9.171	1.884	.259
					Apr	248.0	30.50	8.131	1.671	.293
					May	585.5	63.50	9.221	1.895	.258
					July	413.3	53.70	*7.690*	*1.580*	*.309*
					Aug	773.2	82.20	9.406	1.933	.253
					Sept	771.5	79.00	9.760	2.005	.244
					Dec	1,110.2	113.20	9.807	2.015	.242
4 13/15	Total			2.379	Total	6,837.5	724.20	9.441	1.940	.252

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-PINT MILK BOTTLES—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
1	Blower	} $1.75			Average output per 8 hours.........gross..	20
1	Gatherer		....	....	Average output per unit-hour.......do....	2.5
1	Finisher				Average output per man-hour......do....	.357
1	Mold boy	....	$0.40	$0.40	Average blowing labor cost per gross.....	$2.390
1	Knocking-off boy	....	.40	.40		
1	Snapping-up boy	....	.40	.40		
1	Carry-in boy	....	.40	.40		
7	Total	1.75	....	1.60		

1-PINT MILK BOTTLES—SEMIAUTOMATIC MACHINE: TEEPLE-JOHNSON, WITH GATHERER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman	....	$0.95	$0.080	1925	*Gross*		*Gross*	*Gross*	
1/4	Machinist	....	1.15	.287	Jan	1,597.0	506.00	3.156	0.947	$0.787
1	Gatherer	$0.43	....	....	Feb	2,328.0	764.00	3.047	.914	.800
1	Turn-out boy	....	.38	.380	Mar	1,648.0	529.00	3.115	.935	.792
					Apr	1,750.0	543.00	3.223	.967	.780
1	Carry-in boy	....	.38	.380	May	1,860.0	648.00	2.870	.861	.823
					June	1,252.0	404.00	3.099	.930	.794
					Aug	1,713.0	625.00	*2.741*	*.822*	*.841*
					Sept	1,511.0	500.00	3.022	.907	.803
					Oct	1,726.0	544.00	3.173	.952	.785
					Nov	2,479.0	752.00	*3.297*	*.989*	*.772*
					Dec	1,205.0	379.00	3.179	.954	.784
3 1/3	Total	.43	....	1.127	Total	19,069.0	6,194.00	3.079	.924	.796

1-PINT MILK BOTTLES—SEMIAUTOMATIC MACHINE: MILLER, WITH GATHERER

1/12	Machine foreman	....	$0.95	$0.080	1925					
1/4	Machinist	....	1.15	.287	Jan	599.0	125.00	4.792	$0.899	$0.665
3	Gatherers	$0.43	....	....	Feb	1,176.0	224.00	5.250	.984	.645
1	Transfer boy (machine tender)	....	.38	.380	Mar	1,192.0	237.00	5.030	.943	.654
					Apr	1,678.0	340.00	4.935	.925	.658
1	Carry-in boy	....	.38	.380	May	1,226.0	266.00	4.759	.892	.667
					June	1,142.0	247.00	*4.623*	*.867*	*.674*
					Aug	136.0	24.00	5.667	1.063	.629
					Sept	929.0	166.00	5.596	1.049	.631
					Oct	1,056.0	178.00	*5.933*	*1.112*	*.620*
					Nov	2,134.0	375.00	5.691	1.067	.628
					Dec	963.0	176.00	5.472	1.026	.636
5 1/3	Total	.43	....	1.127	Total	12,271.0	2,358.00	5.204	.976	.647

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-PINT MILK BOTTLES—AUTOMATIC MACHINE: MILLER, WITH SINGLE FEEDER AND CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/5	Machine foreman		$0.70	$0.28	1925	*Gross*		*Gross*	*Gross*	
1	Machine operator		.65	.65	Jan	3,202.0	735.00	4.356	1.815	$0.278
1	Take-out boy		.28	.28	Feb	2,251.0	612.00	*3.678*	*1.533*	*.329*
					Mar	3,526.0	723.00	4.877	2.032	.248
					Apr	3,249.0	783.00	4.149	1.729	.292
					May	4,073.0	856.00	4.758	1.983	.254
					June	2,641.0	712.00	3.709	1.545	.326
					July	4,481.0	1,071.00	4.184	1.743	.289
					Aug	4,335.0	1,015.00	4.271	1.780	.283
					Sept	4,437.0	912.00	4.865	2.027	.249
					Oct	3,465.0	688.00	5.036	2.098	.240
					Nov	3,605.0	712.00	5.063	2.110	.239
					Dec	3,351.0	648.00	*5.171*	*2.155*	*.234*
2 2/5	Total			1.21	Total	42,616.0	9,467.00	4.502	1.876	.269

1-PINT MILK BOTTLES—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1	Machine foreman		$0.90	$0.90	1925					
2	Machine operators		.66	1.32	Jan	3,981.0	314.00	*12.678*	*1.409*	*$0.374*
6	Carry-in boys		.42	2.52	Feb	554.0	42.00	13.190	1.466	.359
					Mar	2,558.0	184.50	*13.864*	*1.540*	*.342*
					Apr	3,215.0	239.00	13.452	1.495	.352
					May	1,703.0	123.00	13.846	1.538	.342
					June	8,277.0	603.50	13.715	1.524	.346
					July	2,688.0	199.00	13.508	1.501	.351
					Aug	5,530.0	415.00	13.325	1.481	.356
					Sept	4,447.0	331.00	13.435	1.493	.353
					Oct	4,494.0	340.00	13.218	1.469	.359
					Nov	3,877.0	300.00	12.923	1.436	.367
					Dec	4,176.0	309.00	13.515	1.502	.351
9	Total			4.74	Total	45,500.0	3,400.00	13.382	1.487	.354

1-PINT MILK BOTTLES—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER AND CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.17	1925					
1	Machine operator		.70	.70	Jan	1,481.0	141.50	10.466	4.830	$0.131
1	Helper		.50	.50	Feb	868.0	90.00	9.644	4.451	.142
					Mar	565.0	61.00	*9.262*	*4.275*	*.148*
					Apr	1,975.0	176.00	11.222	5.179	.122
					May	1,692.0	147.00	11.510	5.312	.119
					June	2,270.0	196.00	11.582	5.346	.118
					July	3,417.0	289.50	11.803	5.448	.116
					Aug	2,092.0	179.00	11.687	5.394	.117
					Sept	2,201.0	188.00	11.707	5.403	.117
					Oct	1,777.0	152.00	11.691	5.396	.117
					Nov	1,400.0	117.00	11.966	5.523	.114
					Dec	1,388.0	115.00	*12.070*	*5.571*	*.113*
2 1/6	Total			1.37	Total	21,126.0	1,852.00	11.407	5.265	.120

1-PINT MILK BOTTLES—AUTOMATIC MACHINE: OWENS A. E. (6 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/4	Machine foreman		$0.75	$0.188	1925					
1	Machine operator		.50	.500	Jan	1,666.0	273.50	6.091	1.282	$0.344
1/2	Helper		.42	.210	Feb	1,494.0	254.00	5.882	1.238	.357
3	Carry-in boys		.40	1.200	Mar	1,040.0	180.00	5.778	1.216	.363
					Apr	1,840.0	316.00	5.823	1.226	.360
					May	2,557.0	414.00	*6.176*	*1.300*	*.340*
					June	2,470.0	411.00	6.032	1.270	.348
					July	1,960.0	351.00	5.584	1.176	.376
					Aug	852.0	161.00	5.292	1.114	.396
					Sept	1,423.0	250.00	5.692	1.198	.369
					Oct	5,121.0	1,118.00	*4.581*	*.964*	*.458*
					Nov	1,676.0	311.00	5.389	1.135	.389
					Dec	875.0	146.00	5.993	1.262	.350
4 3/4	Total			2.098	Total	22,983.0	4,185.50	5.491	1.156	.382

Table A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-PINT MILK BOTTLES—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
½	Machine foreman		$0.70	$0.35	1923	*Gross*		*Gross*	*Gross*	
1	Machine operator		.60	.60	Mar	2,795.0	432.00	6.470	1.078	$0.481
½	Helper		.48	.24	Apr	3,345.0	576.00	*5.807*	*.968*	*.536*
4	Carry-in boys		.48	1.92	June	5,518.0	740.00	*7.457*	*1.243*	*.417*
					July	4,011.0	600.00	6.685	1.114	.465
					Aug	4,427.0	648.00	6.832	1.139	.455
					Sept	3,968.0	576.00	6.889	1.148	.451
					Oct	4,667.0	648.00	7.202	1,200	.432
					Nov	4,063.0	600.00	6.772	1.129	.459
					Dec	4,065.0	576.00	7.057	1.176	.441
6	Total			3.11	Total	36,859.0	5,396.00	6.831	1.139	.455

1-QUART MILK BOTTLES—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
1	Blower	$2.18			Average output per 8 hours.......gross	16
1	Finisher				Average output per unit-hour.......do	2
1	Gatherer				Average output per man-hour.......do	.286
1	Mold boy		$0.40	$0.40	Average blowing labor cost.......per gross	$2.980
1	Knocking-off boy		.40	.40		
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	2.18		1.60		

1-QUART MILK BOTTLES—SEMIAUTOMATIC MACHINE: TEEPLE-JOHNSON, AND GATHERER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.95	$0.080	1925	*Gross*		*Gross*	*Gross*	
¼	Machinist		1.15	.287	Jan	1,302.0	506.00	2.573	0.772	$1.098
1	Gatherer	$0.66			Feb	1,368.0	519.00	2.636	.791	1.087
1	Turn-out boy		.38	.380	Mar	1,434.0	529.00	*2.711*	*.813*	*1.076*
1	Carry-in boy		.38	.380	Apr	1,470.0	543.00	2.707	.812	1.076
					May	1,247.0	497.00	2.509	.753	1.109
					June	766.0	298.00	2.570	.771	1.098
					Aug	1,188.0	500.00	*2.376*	*.713*	*1.134*
					Sept	1,248.0	471.00	2,650	.795	1.085
					Oct	1,446.0	572.00	2.528	.758	1.106
					Nov	1,389.0	542.00	2.563	.769	1.100
					Dec	754.0	294.00	2.565	.770	1.099
3⅓	Total	.66		1.127	Total	13,612.0	5,271.00	2.582	.775	1.096

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-QUART MILK BOTTLES—SEMIAUTOMATIC MACHINE: MILLER, WITH GATHERER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/12	Machine foreman		$0.95	$0.080	1925	*Gross*		*Gross*	*Gross*	
1/4	Machinst		1.15	.288	Jan	1,849.0	418.00	4.423	0.829	$0.915
3	Gatherers	$0.66			Feb	1,092.0	250.00	4.368	.819	.918
1	Machine tender		.38	.380	Mar	1,275.0	293.00	4.352	.816	.919
1	Carry-in boy		.38	.380	Apr	841.0	202.00	4.163	.781	.931
					May	1,027.0	245.00	4.396	.824	.916
					June	1,170.0	278.00	4.209	.789	.928
					Aug	991.0	247.00	*4.012*	*.752*	*.941*
					Sept	1,676.0	348.00	4.816	.903	.894
					Oct	1,926.0	375.00	5.136	.963	.879
					Nov	422.0	94.00	4.489	.842	.911
					Dec	1,835.0	351.00	*5.228*	*.980*	*.876*
5⅓	Total	.66		1.128	Total	14,154.0	3,101.00	4.564	.856	.907

1-QUART MILK BOTTLES—AUTOMATIC MACHINE: MILLER, WITH FEEDER AND WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
2/5	Machine foreman		$0.70		1925					
1	Machine operator		.65	$0.28	Jan	7,136.0	1,985.00	3.595	1.498	$0.337
1	Take-out boy		.28	.65	Feb	4,429.0	1,532.00	2.891	1.205	.418
				.28	Mar	7,099.0	1,983.00	3.580	1.492	.338
					Apr	5,983.0	2,008.00	2.980	1.242	.406
					May	6,235.0	1,816.00	3.433	1.430	.352
					June	4,408.0	1,679.00	*2.625*	*1.094*	*.461*
					July	9,258.0	2,927.00	3.163	1.318	.382
					Aug	8,778.0	2,432.00	3.609	1.504	.335
					Sept	8,810.0	2,144.00	4.109	1.712	.294
					Oct	10,038.0	2,376.00	*4.225*	*1.760*	*.286*
					Nov	7,478.0	2,088.00	3.581	1.492	.338
					Dec	8,313.0	2,184.00	3.806	1.586	.318
2⅖	Total			1.21	Total	87,965.0	25,154.00	3.497	1.457	.346

1-QUART MILK BOTTLES—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1	Machine foreman		$0.90	$0.90	1925					
2	Machine operators		.66	1.32	Jan	6,409.0	583.00	10.993	1.222	$0.431
6	Carry-in boys		.42	2.52	Feb	640.0	56.00	11.429	1.270	.415
					Mar	8,481.0	809.00	*10.483*	*1.165*	*.452*
					Apr	11,453.0	987.00	11.604	1.289	.408
					May	11,830.0	1,032.50	11.458	1.273	.414
					June	6,760.0	612.00	11.046	1.227	.429
					July	10,703.0	980.50	10.916	1.213	.434
					Aug	7,974.0	736.00	10.834	1.204	.437
					Sept	8,671.0	775.00	11.188	1.243	.424
					Oct	9,028.0	767.50	*11.763*	*1.307*	*.403*
					Nov	8,688.0	771.00	11.268	1.252	.421
					Dec	3,501.0	315.00	11.114	1.235	.426
9	Total			4.74	Total	94,138.0	8,424.50	11.174	1.242	.424

1-QUART MILK BOTTLES—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER AND WITH CONVEYOR

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machine foreman		$1.00	$0.17	1925					
1	Machine operator		.70	.70	Jan	3,374.0	383.50	8.798	4.061	$0.155
1	Helper		.50	.50	Feb	1,881.0	229.00	8.214	3.791	.166
					Mar	73.0	13.00	*5.615*	*2.592*	*.243*
					Apr	2,699.0	332.00	8.130	3.752	.168
					May	2,548.0	287.00	8.878	4.098	.154
					June	3,309.0	368.50	8.980	4.145	.152
					July	2,352.0	259.00	9.081	4.191	.151
					Aug	2,873.0	317.00	9.063	4.183	.151
					Sept	3,307.0	365.00	9.060	4.182	.151
					Oct	3,578.0	388.00	9.222	4.256	.148
					Nov	3,712.0	388.00	*9.567*	*4.416*	*.143*
					Dec	3,918.0	414.00	9.464	4.368	.144
2⅙	Total			1.37	Total	33,624.0	3,744.00	8.981	4.145	.152

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-QUART MILK BOTTLES—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
½	Machine foreman		$0.70	$0.35	1923	*Gross*		*Gross*	*Gross*	
1	Machine operator		.60	.60	Jan	7,107.0	1,152.00	6.169	1.028	$0.504
½	Helper		.48	.24	Feb	5,345.0	864.00	*6.186*	*1.031*	*.603*
4	Carry-in boys		.48	1.92	Mar	3,454.0	648.00	5.330	.888	.583
					June	1,584.0	288.00	5.500	.917	.565
					July	3,124.0	600.00	*5.210*	*.868*	*.597*
					Aug	3,490.0	648.00	5.386	.898	.577
					Sept	3,196.0	576.00	5.549	.925	.560
					Oct	3,841.0	648.00	5.927	.988	.525
					Nov	3,624.0	600.00	6.040	1.007	.515
					Dec	3,290.0	576.00	5.712	.952	.544
6	Total			3.11	Total	38,055.0	6,600.00	5.766	.961	.539

1-QUART MILK BOTTLES—AUTOMATIC MACHINE: OWENS A. E. (6 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
¼	Machine foreman		$0.75	$0.188	1925					
1	Machine operator		.50	.50	Jan	3,649.0	638.00	*5.719*	*1.204*	*$0.367*
½	Helper		.42	.21	Feb	3,861.0	708.00	5.453	1.148	.385
3	Carry-in boys		.40	1.20	Mar	3,318.0	617.00	5.378	1.132	.390
					Apr	3,214.0	617.00	5.209	1.097	.403
					May	1,700.0	329.00	5.167	1.088	.406
					June	941.0	190.00	4.953	1.043	.423
					July	3,954.0	836.00	4.730	.996	.443
					Aug	2,959.0	609.00	4.859	1.023	.432
					Sept	2,900.0	589.00	4.924	1.037	.426
					Oct	822.0	175.00	4.697	.989	.447
					Nov	2,544.0	626.00	*4.064*	*.856*	*.516*
					Dec	3,270.0	615.00	5.317	1.119	.394
4¼	Total			2.098	Total	35,790.0	7,082.00	5.054	1.064	.415

ONE-HALF GALLON PACKER JUGS—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	}$2.43			Average output in 8 hours gross	10
1	Finisher				Average output per unit-hour do	1.25
1	Mold boy		$0.40	$0.40	Average output per man-hour do	.179
1	Cleaning-off boy		.40	.40	Average blowing labor cost per gross	$3.710
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	2.43		1.60		

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

ONE-HALF GALLON PACKER JUGS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00		1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$1.29		$0.17	Apr	70.4	50.00	*1.408*	*0.249*	*$2.059*
1	Presser				June	71.6	50.00	1.432	.253	2.046
1	Transfer boy		.50	.50	July	140.8	94.50	1.490	.263	2.017
1	Take-out boy		.50	.50	Aug	171.3	110.00	*1.557*	*.275*	*1.986*
1½	Carry-in boys		.50	.75	Sept	117.0	80.00	1.462	.258	2.031
					Oct	68.8	47.50	1.449	.256	2.037
					Nov	87.6	57.00	1.536	.271	1.995
5⅔	Total	1.29		1.92	Total	727.5	489.00	1.488	.263	2.018

ONE-HALF GALLON PACKER JUGS—AUTOMATIC MACHINE: O'NEILL AND FEEDER

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Machinist		$1.00	$0.17	1925					
1	Machine operator		.70	.70	June	55.0	18.00	*3.056*	*0.965*	*$0.618*
2	Carry-in boys		.50	1.00	July	95.0	21.00	*4.524*	*1.429*	*.418*
					Aug	37.0	10.00	3.700	1.168	.511
					Sept	60.0	19.00	3.158	.997	.598
					Oct	85.0	22.00	3.864	1.220	.489
					Nov	185.0	47.00	3.936	1.243	.480
3⅙	Total			1.87	Total	517.0	137.00	3.774	1.192	.501

ONE-HALF GALLON PACKER JUGS—AUTOMATIC MACHINE: OWENS A. L. (6 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1919	640.0	172.70	3.706	0.601	$0.823
1	Machine foreman		.90	.90	1920	96.0	24.30	3.951	.640	.772
1	Machine operator		.55	.55						
4	Carry-in boys		.35	1.40						
6⅙	Total			3.05	Total	736.0	197.00	3.736	.606	.816

ONE-HALF GALLON PACKER JUGS—AUTOMATIC MACHINE: OWENS A. R. (10 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1921	973.0	239.40	4.064	0.659	$0.750
1	Machine foreman		.90	.90	1922	1,787.0	484.80	3.686	.598	.828
1	Machine operator		.55	.55	1923	2,003.0	532.80	3.759	.610	.811
4	Carry-in boys		.35	1.40						
6⅙	Total			3.05	Total	4,763.0	1,257.00	3.789	.614	.805

ONE-HALF GALLON PACKER JUGS—AUTOMATIC MACHINE: OWENS A. Q. (15 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/6	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan	790.0	71.70	11.018	1.537	$0.327
2	Machine operators		.55	1.10	Feb	180.0	18.70	9.626	1.343	.374
4	Carry-in boys		.35	1.40	Mar	1,400.0	116.30	*12.038*	*1.680*	*.299*
					Aug	487.0	46.80	10.406	1.452	.346
					Sept	488.0	50.50	9.663	1.348	.373
					Oct	462.0	42.70	10.820	1.510	.333
					Nov	855.0	91.70	*9.324*	*1.301*	*.386*
					Dec	408.0	40.60	10.049	1.402	.358
7⅙	Total			3.60	Total	5,070.0	479.00	10.585	1.477	.340

TABLE A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

1-GALLON PACKER JUGS—HAND

Labor unit					Output and labor cost	
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Item	Quantity or amount
2	Blowers	$3.55 (Blowers and Finisher)			Average output in 8 hours ... gross	8
1	Finisher				Average output per unit-hour ... do	1
1	Mold boy		$0.40	$0.40	Average output per man-hour ... do	.143
1	Cleaning-off boy		.40	.40	Average blowing labor cost ... per gross	$5.150
1	Snapping-up boy		.40	.40		
1	Carry-in boy		.40	.40		
7	Total	3.55		1.60		

1-GALLON PACKER JUGS—SEMIAUTOMATIC TWO-MAN MACHINE (JERSEY DEVIL)

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅙	Machinist		$1.00	$0.17	1923	*Gross*		*Gross*	*Gross*	
1	Gatherer	$1.84 (Gatherer and Presser)			Apr.	207.7	180.00	1.154	0.204	$2.779
1	Presser				May	112.7	105.00	1.073	.189	2.849
1	Transfer boy		.50	.50	June	141.8	124.00	*1.053*	*.186*	*2.868*
1	Take-out boy		.50	.50	July	107.8	98.00	1.100	.194	2.825
1½	Carry-in boys		.50	.75	Aug.	60.1	54.00	1.113	.196	2.813
					Sept.	247.9	215.00	1.153	.204	2.879
					Oct.	266.9	231.00	1.156	.204	2.877
					Nov.	163.8	133.50	*1.227*	*.217*	*2.721*
5⅔	Total	1.84		1.92	Total	1,308.7	1,140.50	1.147	.202	2.784

1-GALLON PACKER JUGS—AUTOMATIC MACHINE: OWENS A. L. (6 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅓	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	Jan.	2,400.2	651.70	3.683	0.628	$0.760
⅕	Hot-ware inspector		.56	.112	Feb.	623.0	157.90	3.946	.673	.709
4⅓	Carry-in boys		.42	1.820	Mar.	515.3	143.50	3.591	.612	.779
					Apr.	1,337.4	367.20	3.642	.621	.769
					May	1,276.7	430.50	*2.966*	*.506*	*.944*
					June	963.5	311.90	3.089	.527	.906
					July	1,599.4	511.30	3.128	.533	.895
					Aug.	1,064.6	256.60	4.149	.707	.675
					Sept.	1,811.9	442.10	4.098	.699	.682
					Oct.	229.8	52.00	*4.419*	*.753*	*.683*
					Dec.	1,947.7	459.50	4.239	.723	.660
5 13/15	Total			2.799	Total	13,769.5	3,784.20	3.639	.620	.769

1-GALLON PACKER JUGS—AUTOMATIC MACHINE: OWENS A. Q. (15 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
⅙	Chief foreman		$1.20	$0.20	1925					
1	Machine foreman		.90	.90	Jan.	1,676.0	210.80	7.951	1.109	$0.423
2	Machine operators		.55	1.10	Feb.	657.0	86.20	*7.622*	*1.063*	*.472*
4	Carry-in boys		.35	1.40	Mar.	4,414.0	512.60	8.611	1.201	.418
					Apr.	493.0	54.30	*9.079*	*1.267*	*.397*
					May	3,744.0	447.50	8.366	1.167	.430
					July	2,313.0	282.00	8.202	1.144	.439
					Aug.	3,113.0	357.40	8.710	1.215	.413
					Sept.	2,960.0	344.60	8.590	1.199	.419
					Oct.	2,981.0	364.00	8.190	1.143	.440
					Nov.	3,834.0	484.70	7.910	1.104	.455
					Dec.	1,849.0	213.70	8.652	1.207	.416
7⅙	Total			3.60	Total	28,034.0	3,357.80	8.349	1.165	.431

Table A.—PRODUCTION AND LABOR COST IN MAKING BOTTLES BY HAND AND BY MACHINE—Continued

5-GALLON WATER CARBOYS—HAND

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
					1925	*Gross*		*Gross*	*Gross*	
3	Blowers	$9.72			Jan	159.1	403.00	*0.397*	*0.030*	*$23.138*
2	Gatherers		$0.65	$1.30	Feb	110.3	304.00	.363	.028	24.321
1	Mold-boy		.50	.50	Mar	125.4	328.00	.382	.029	23.594
1	Cleaning-off boy		.50	.50	Apr	184.0	480.00	.383	.029	23.558
3	Snapping-up boys		.50	1.50	May	81.3	279.00	.291	.022	27.933
3	Carry-in boys		.50	1.50	June	121.9	410.00	.297	.023	27.565
					July	129.4	366.00	.354	.027	24.692
					Aug	120.9	454.00	*.266*	*.020*	*29.645*
					Sept	208.6	638.00	.327	.025	25.928
					Oct	210.4	652.00	.323	.025	26.129
					Nov	128.0	356.00	.360	.028	24.442
					Dec	242.8	685.00	.354	.027	24.692
13	Total	9.72		5.30	Total	1,822.1	5,355.00	.340	.026	25.308

5-GALLON WATER CARBOYS—AUTOMATIC MACHINE: OWENS A. T. (6 ARMS) SINGLE

Number of workers	Occupation	Wage rates per gross	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per gross
1/3	Machine foreman		$0.80	$0.267	1925					
1	Machine operator		.60	.600	June	786.9	605.80	1.299	0.270	$1.831
1/5	Hot-ware inspector		.56	.112	July	760.2	593.80	1.280	.266	1.859
3 1/3	Carry-in boys		.42	1.400	Aug	957.9	617.00	*1.553*	.323	*1.532*
					Sept	648.7	532.30	1.219	.253	1.952
					Oct	535.9	506.80	1.057	.220	2.251
					Nov	102.9	141.10	*.729*	.151	*3.263*
4 13/15	Total			2.379	Total	3,792.5	2,996.80	1.265	.263	1.880

CHAPTER II.—PRESSED AND BLOWN WARE

PRESSED WARE

It was purely through accident that the pressed and blown ware branches of the glass industry grew up and developed under the same roof. With the exception of the common raw materials which are used in all branches of the glass industry, there is nothing, either in the methods of production or in the nature of the product, to justify the classification of the pressed and blown ware in the same group. Some products, such as tumblers or sherbets for instance, are produced by both methods, but the similarity of the products goes only as far as the name. In fact, there is much more in common between the blown ware and the bottle industry than between the pressed and the blown ware. A blown tumbler or any other blown product when taken from the leer looks more like a bottle than like the object it is intended to be, while in the case of pressed ware the object is usually complete when it is taken out of the leer. As this study concerns itself primarily with methods of production and output, both of which are decidedly different in pressed and in blown ware, it is necessary to treat the two branches separately.

The development of machinery for the making of pressed glassware has been much slower and less striking than that for making bottles. One of the reasons for this rather slow development of machinery is the multiplicity of products classified in this branch of the glass industry. There are literally tens of thousands of individually shaped articles which are pressed in molds either by hand or by machine. With the exception of tumblers, which are produced in very large quantities, pressed glassware is made in comparatively limited quantities, not justifying the use of expensive machinery for its production.

Besides, the use of machinery was not as compelling as it was in the case of bottles. When any pressed article began to be made by machine the manufacturers were not forced either to install the machine or to withdraw entirely from business, as had been the case with the bottle manufacturers, because they had a third alternative, which was merely to stop producing the article in question and to divert their attention and labor force to some other product not yet affected by the machine. The field for such new products proved to be almost limitless, as shown by the countless items of pressed ware on the market under the general classification of "novelties."

At present there seems to be no indication of the machine invading the novelty business. The modern machine is devised primarily for mass output of a uniform product, while novelties are generally made in very small quantities to appeal to individual whims and tastes. Nearly all staple products, of which the tumbler in its various forms and sizes is by far the leading item, are made on the automatic machine. Some few plants are still using the semiautomatic rotary press. The hand plants which refused to install the semiautomatic or automatic machinery have also survived, but instead of competing with the machines in producing staple articles they have taken up the making of novelties and developed an entirely new branch of the industry.

The machine plants and the hand plants do not compete with each other; their relationship must therefore be considered as of a complementary rather than a competitive nature. The situation is somewhat similar to the case of plants making toilet and perfume bottles, but with this difference, that the toilet and perfume bottles represent but a very small fraction of the bottles made, while the novelties represent a very considerable part, if not fully a half, of the entire pressed-ware production.

In spite of the ever-growing importance of novelties as a factor in pressed-ware production, the processes used in making these products will not be discussed in this study for the following reasons:

(1) No two plants in the country specialize in the same kind of novelty. Many of the items are patented and are produced in a single plant only, thus offering no basis whatever of measuring the comparative productivity of the workers engaged in making the patented articles.

(2) As implied in the name, novelties are extremely short lived and often disappear from the market before the shop engaged in their production has a chance to develop sufficient skill to stabilize its productivity, and this precludes the possibility of comparing present efficiency with that of previous years.

(3) Very few, if any, of the novelties are made on the machine, and there is therefore no way of gauging the effects of machinery on man-hour output in this field, which is the principal aim of this study.

In the following pages only such pressed ware will be discussed as can be and is being made both by hand and by machine processes, so that the effects of machinery on man-hour output can be measured in quantitative terms. Specifically, the study will deal with tumblers, nappies, and sherbets, as the three items constitute by far the major portion of the staple articles in the field of pressed ware.

MAKING PRESSED GLASSWARE BY HAND

The art of making pressed glassware by hand is neither so difficult nor so complicated as blowing bottles by hand. As in the case of bottles, the work is usually performed by a group of workers, constituting a unit called the "shop." A normal shop usually consists of three skilled workers, the gatherer, the presser, and the finisher, and two or more helpers. In making very simple articles, such as packer tumblers, nappies, etc., a finisher is not needed. In more complicated products like pitchers and stemware two finishers are sometimes required. The helpers are termed "carry-in boys," "carry-over boys," "bit boys," and "warming-in boys," the designation depending entirely on the nature of their services. Their number varies from two for the simplest articles to as many as seven for the more complicated products.

The work of making pressed glassware by hand proceeds as follows: The gatherer inserts his iron rod, the punty, into the opening of the pot,[1] and by skillful manipulation accumulates at the end of the punty the necessary quantity of molten glass. He then withdraws this glass

[1] Most hand-pressed articles are still being made from covered pots.

from the pot and holds the punty over the mold in such a position as to allow the glass to flow into the mold, which is usually placed on a table in front of the presser. At the proper moment, determined by the weight of the article, the presser cuts off the flow with a pair of shears, and then pushes the mold toward the center of the table right under the plunger mounted over the table. By operating a hand lever, usually located at the side of the table (thus giving to the apparatus the name "side lever press"), with the necessary pressure, the presser causes the plunger to drop into the mold and to impart to the soft glass the shape of the mold on the outside and that of the plunger on the inside.

The working of the lever is the most skillful part of the operation, as upon the pressure of the plunger depends the smooth and uniform

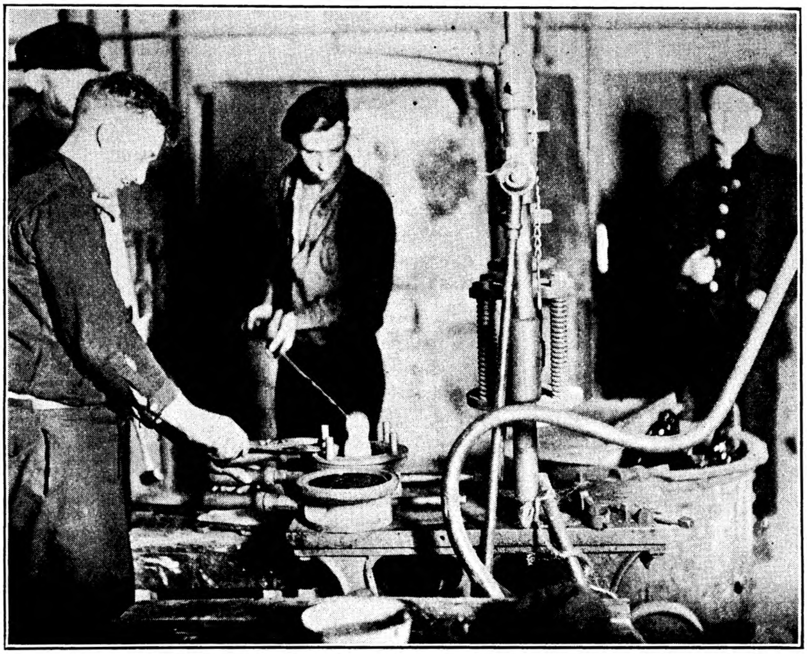

FIG. 10.—SIDE LEVER PRESS FOR MAKING PRESSED GLASSWARE

distribution of the glass in the article. The presser is therefore considered the most important member and the leader of the shop. His position corresponds to that of the blower in making bottles. His wage, whether on a time basis or by the piece, determines the wages of the other skilled workers of the shop, the gatherer's wage being 80 per cent and that of the finisher 90 per cent of the presser's earnings.

When taken out of the mold by the presser the article is physically completed, at least so far as its shape is concerned. If of the cheaper ware, it is then taken by the carry-in boy to the leer to be annealed. The majority of the pressed glassware, however, must undergo a finishing process, due to the dullness of the glass as a result of the contact with the iron mold and to the ragged edge usually left by the plunger. In such case the carry-over boys take the articles, one at a time, from the side lever press to the "warming-in" or "snapping-up" boy. He places each article in a snap somewhat different from the type used in making bottles, and inserts the snap with the article in the glory hole to reheat and fire-polish the glass.

The glory hole is a more complicated affair than that used for bottles, and it requires a good deal of experience and skill on the part of the warming-in boy so to manipulate the snap as to give the article in it a thorough polish without completely remelting it. It is also the duty of the warming-in boys to flatten the nappies into plates while fire polishing them in the glory hole. Their work is therefore considered of a higher skill than that of the carry-in or carry-over boys and their rate of wages is also considerably higher.

From the glory hole the article is delivered to the finisher, who smooths and bevels the edges and adds whatever additional touches may be necessary for the completion of the ware. The carry-in boy then takes it to the leer to be annealed.

SEMIAUTOMATIC MACHINERY

The transition from hand production to the semiautomatic stage in making pressed ware did not constitute such a radical change as the corresponding transition in bottle making. In the case of bottles, the semiautomatic machine completely displaced the finisher and gradually replaced the blower by a semiskilled machine operator. No such changes took place in the making of pressed glassware. In fact, the transition was so gradual and the effects on the industry so small that were it not for the comparative increase in man-hour output effected by the semiautomatic rotary press, one could hardly draw a line of distinction between the two stages. The principal differences in the two processes were the number of molds and the kind of power used to operate the plunger. But even these two changes were not brought about simultaneously. Many a side lever press had already been worked with two and more molds when the rotary press was introduced.

The rotary press consists merely of a rotating table equipped with four to six molds and surmounted by a plunger operated by compressed air or by electric power. There were no direct perceptible changes brought about by the rotary press either in the composition of the shop or in the method of production. The work of the presser was lightened and the output of the shop considerably increased. The indirect result, however, of the introduction of the rotary press and the increased output was the gradual replacement of the warming-in boys and the hand finisher by a glazing machine.

There are several types of glazing machines used in the glass industry. Some are longitudinal, in the form of a belt conveyor, but the majority are of the circular type. The latter consists of a revolving table, rimmed with a series of spindles or cups. The average machine has about 24 such spindles, but some larger machines have as many as 60 or more. Each spindle is equipped with a receptacle to receive and hold the article to be glazed. The receptacles can be made smaller or larger to fit the article glazed. Part of the circular path of the machine is hooded and contains a series of gas jets, which throw their flame upon the ware in the spindles as they pass the hooded area. While moving around the common axis of the machine, each spindle also rotates very rapidly on its own axis, thus uniformly exposing to the flame every part of the article. The heat of the gas is sufficiently strong to melt and polish the edge exposed to it, but is not sufficient to affect the entire article. It takes but one revolution of the machine to complete the process, and the glazing is done so rapidly that the machine requires the constant attendance of two boys, a "sticking-up" boy to place the article in the receptacle of the spindle to be glazed and another boy to take out the glazed articles from the machine. The work of the carry-over boy, the warming-in boy, and

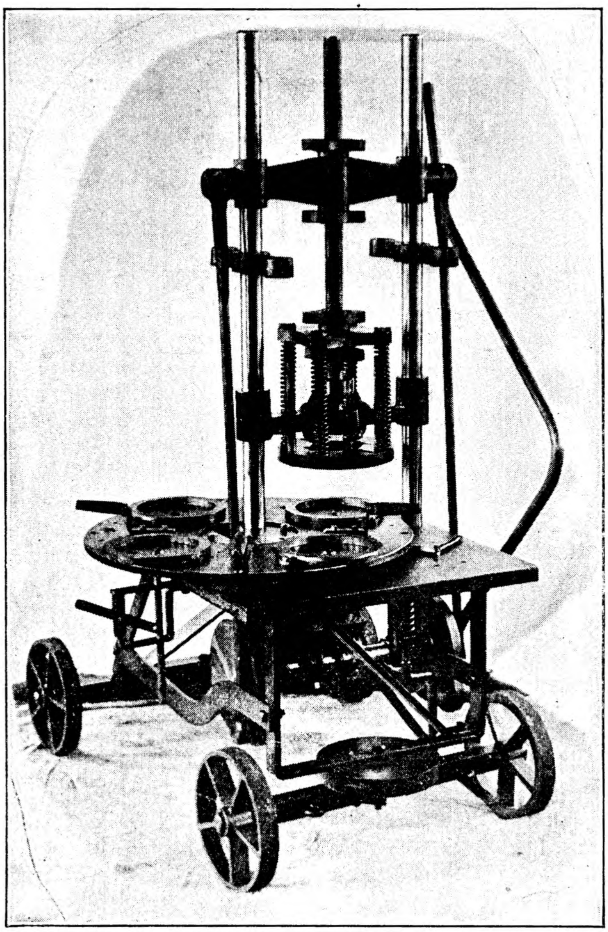

FIG. 11.—SEMIAUTOMATIC ROTARY PRESS FOR MAKING PRESSED GLASSWARE

the finisher has thus been replaced by that of two unskilled glazing boys, who are now in a position to finish all the ware pressed on a semiautomatic or even an automatic machine.

AUTOMATIC MACHINERY

The really revolutionary change in the making of pressed glassware came with the successful introduction of the "feed and flow" devices in 1917. As in bottle making, the gatherer was completely eliminated. The work of the presser became so simplified as to amount merely to tending the machine, and accordingly the presser gave place to a semiskilled machine operator. As the speed of the machine was increased, and with it the output per hour, the work of taking out the pressed ware from the molds was relegated to a special boy, termed the "take-out" boy. In the case of unfinished ware, the take-out boy merely transfers the ware from the machine to a tray, for the carry-in boy to take it to the leer to be annealed; in the case of finished ware, he places the ware on a small stand between the pressing machine and the glazing machine, which is sufficiently near both machines to allow the take-out boy and the glazing boy to reach it without moving. In some plants the glazing machine is located so close to the pressing machine that the take-out boy can transfer the article directly from the mold to a receptacle of the glazing machine, in which case the "sticking-up" boy is eliminated.

After the ware is glazed it is removed by the other glazing boy to the tray of the carry-in boy. In some plants the carry-in boy is replaced by an automatic conveyor, and in other plants the leers, especially the modern fireless leers, are located so close to the machines that the glazing boy can transfer the ware directly from the glazing machine to the leer, thus dispensing with the carry-in boy.

Machines used.—There are several types of automatic machines used for making pressed glassware, none of which, however, is as large or as complicated as the automatic machines used in bottle making. Neither do they differ among themselves sufficiently to warrant separate descriptions of the types used. Whatever differences exist are purely of a mechanical nature and do not affect to any great extent the methods of production or the output.

An automatic press consists of a round table, equipped with from six to eight molds, and surmounted by a plunger operated by electric power. The table rotates intermittently, and its motion is synchronized with that of the feeder on the one hand and the plunger on the other. As a result, the feeder is ready to discharge the "gob" of molten glass into the mold just at the moment the mold takes its position under the feeder. As the table moves a notch, the plunger descends into the mold, and the article is pressed, while another mold assumes its position under the feeder to receive its "gob."

The feeding and pressing are thus entirely automatic, but in the majority of the machines now in use a take-out boy is needed to take the pressed article out of the mold. There are, however, a few machines where the taking-out process is performed by an automatic take-out device, and then the machine becomes completely automatic.

Feeders.—The feeders used in pressing glassware are, as a rule, of the same type used in bottle making. It may perhaps be emphasized here that the first flow devices used were for the purpose of pressing glassware rather than blowing bottles. There is therefore a larger variety of feeders and more antiquated types used in pressing glassware than in making bottles. In some plants the paddle needle feeders are used to feed two machines at the same time, but normally one feeder is used for each machine.

Principal products.—The principal articles produced on the automatic machines are tumblers of all kinds, shapes, and sizes. Large quantities of nappies, bowls, trays, and a considerable number of small stemware, such as sherbets and sundaes, are also produced by the automatic machines.

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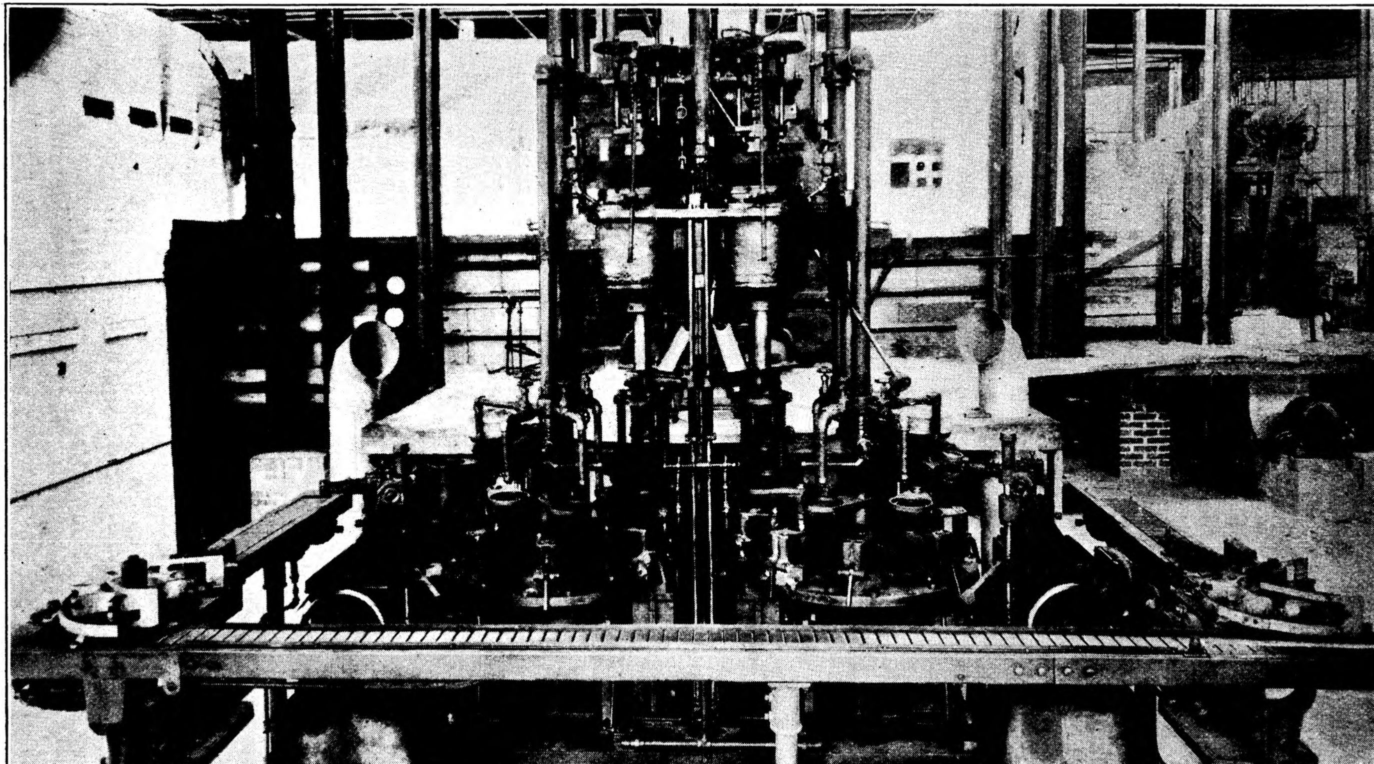

FIG. 12.—HARTFORD-EMPIRE TWIN PRESS WITH AUTOMATIC CONVEYOR

LABOR PRODUCTIVITY AND LABOR COST

MAN-HOUR OUTPUT

As in the case of bottles, the most striking result of the introduction of machinery for the making of pressed glassware is the very large increase in man-hour output effected by the automatic machines. Table 22 presents a comparison of man-hour output of 8–9 and 10 ounce tumblers, 3½ and 4½–5 ounce sherbets, and 4½–5 and 6–7 inch nappies made by hand and by the semiautomatic and various automatic machines.

TABLE **22.**—*Average output per man-hour of tumblers, sherbets, and nappies made by hand and by machine*

Common tumblers

Method of production and kind of machine	8–9 ounce		10 ounce	
	Quantity	Index number	Quantity	Index number
	Pieces		*Pieces*	
Hand production: Side lever press	31.00	100.0	28.86	100.0
Semiautomatic machine: Rotary press	64.93	209.5		
Automatic machine:				
Hartford-Empire, with double feeder	209.03	675.2		
Hartford-Empire, with double feeder and automatic take out	316.60	1021.3	268.65	930.9
Hartford-Empire, with double feeder and automatic take out and conveyor	380.71	1228.1	357.86	1240.0
Ed. Miller, with single feeder	226.15	729.5	189.22	655.7
W. J. Miller, with single feeder and conveyor	249.30	804.2	232.35	805.1
Special machine, with single feeder	324.42	1046.5	320.85	1111.7

Sherbets

Method of production and kind of machine	3½ ounce		4½–5 ounce	
	Quantity	Index number	Quantity	Index number
	Pieces		*Pieces*	
Hand production: Side lever press	33.55	100.0	30.45	100.0
Semiautomatic machine: Rotary press—				
Hand finish			41.66	136.8
Machine finish	58.21	173.5	48.79	160.2
Automatic machine:				
Hartford-Empire, with double feeder			192.00	630.5
Ed. Miller, with single feeder	274.10	817.0	183.61	603.0
W. J. Miller, with single feeder	146.39	436.3	132.56	435.3

Nappies

Method of production and kind of machine	4½–5 inch		6–7 inch	
	Quantity	Index number	Quantity	Index number
	Pieces		*Pieces*	
Hand production: Side lever press	39.61	100.0	27.37	100.0
Semiautomatic machine: Rotary press	58.71	148.2	45.69	166.9
Automatic machine:				
Hartford-Empire, with double feeder	186.95	472.0		
Ed. Miller, with single feeder	300.87	759.6	77.18	282.0
W. J. Miller, with single feeder	205.24	518.2	108.45	396.3
Special machine, with single feeder			134.39	491.0

As will be seen from the foregoing table the average output of a hand shop is 31 eight to nine ounce tumblers and 28.86 ten-ounce tumblers per man-hour. On the semiautomatic rotary press the output is 64.93 eight to nine ounce tumblers per man-hour, while on the automatic machines the man-hour output varies from 209.03 eight to nine ounce tumblers made on a machine, which still requires the services of take-out and carry-in boys, to 380.71 tumblers made on the same kind of machine but equipped with an automatic take-out device and an automatic conveyor. Taking the man-hour output of the hand shop as the base, or 100, the semiautomatic machine shows an increase of 109.5 per cent, while the various automatic machines register increases which range from 575.2 to 1,128.1 per cent for the 8–9 ounce tumbler, and from 555.7 to 1,140 per cent for the 10-ounce tumbler.

In the case of 3½-ounce sherbets, the average man-hour output of a hand shop operating with the help of a side lever press is 33.55 pieces; on the semiautomatic rotary press, 58.21 pieces; and on the automatic machines, from 146.39 pieces to 274.10 pieces. On 4½–5 ounce sherbets the average man-hour output of a hand shop is 30.45 pieces; of the semiautomatic rotary press, 48.79 pieces; and of the automatic machine, from 132.56 to 192 pieces. Taking the average man-hour productivity of a hand shop as the base, or 100, the semiautomatic rotary press registers an increase of 36.8 per cent when the 4½–5 ounce sherbet is finished by hand and 60.2 per cent when the finishing is done on a glazing machine. The automatic machines show increases varying from 336.3 to 717 per cent on 3½-ounce sherbets and from 335.3 to 530.5 per cent on 4½–5 ounce sherbets.

In the case of 4½–5 inch nappies the average output of a hand shop is 39.61 pieces per man-hour; on the semiautomatic rotary press it is 58.71 pieces; and on the automatic presses it ranges from 186.95 to 300.87 pieces. On 6–7 inch nappies the average output of a hand shop is 27.37 pieces per man-hour; of the semiautomatic rotary press, 45.69 pieces per man-hour; and on the automatic machines, from 77.18 to 134.39 pieces per man-hour. Taking the man-hour output of a hand shop operating with a side lever press as the base, or 100, the semiautomatic rotary press indicates an increase of 48.2 per cent for 6–7 inch nappies; and the various automatic machines show increases varying from 372 to 659.6 per cent for 4½–5 inch nappies, and from 182 to 391 per cent for 6–7 inch nappies.

The particularly large increase in man-hour output in tumblers is due to the fact that tumblers are the principal item produced on automatic machinery, and also to the fact that they are made in exceedingly large quantities at a time. Another factor is the use of automatic take-out devices and an automatic conveyor, as yet used only in the making of tumblers.

The effects of these two automatic devices on the man-hour output can best be illustrated by Table 23, presenting man-hour output of the same kind of tumbler made on the same machine and in the same plant, but in one case with take-out and carry-in boys; in another case with an automatic take-out device and carry-in boys; and in the third case with an automatic take-out device and an automatic conveyor.

TABLE 23.—*Comparison of man-hour output of tumblers made on the automatic machine with and without automatic take-out device and automatic conveyor*

Kind of machine	Man-hour output		
	Quantity	Index number A	Index number B
	Pieces		
Machine with 3 take-out boys and 2 carry-in boys	209.03	100.0	
Machine with automatic take out and 2 carry-in boys	316.60	151.5	100
Machine with automatic take out and automatic conveyor	380.71	182.1	120.3

The application of the automatic take-out device resulted in an increase of 51.5 per cent in the man-hour output, when compared with the output on the same machine but using three take-out boys; the application of the automatic conveyer resulted in an additional increase of 30.6 per cent. The direct increase, however, attributable to the automatic conveyor is only 20.3 per cent, when compared with the output on the same machine but without a conveyor. This comparatively small increase in man-hour output effected by a conveyor, and the necessity to subject the tumblers, after their leaving the press, to glazing and sometimes also cupping, is probably the reason why so few plants have actually installed automatic conveyors.

DIRECT LABOR COST

Side by side with the increase in man-hour output due to the transition from hand production to machinery, there has also been registered a remarkable decrease in the direct labor cost of making glassware. Here, however, it must be emphasized that the figures of direct labor cost hereafter given do not represent the total labor cost of manufacturing the articles concerned. Such labor, for instance, as is needed in mixing the batch, tending the furnace, and examining and packing the ware, as well as the general supervision, is not included in the labor cost figures, partly because there is no way of even approximately measuring the output of these workers in terms of ware produced, but chiefly because this labor is of no direct value in this study. To gauge accurately the effects of machinery on man-hour output and labor cost, only such labor must be included as has been directly or indirectly affected by a change from one process to another. In the hand plants it was the shop and the shop alone which was affected by the introduction of semiautomatic and automatic machinery. The shop has therefore been selected as the basic unit with which to measure productivity in hand plants, and in the machine processes, both semiautomatic and automatic, care has been taken to include only the direct labor which superseded the "shop," as hand production gave way first to the semiautomatic rotary press and later to the automatic machines.

The sum total of direct labor omitted in this analysis constitutes but a small percentage of the total labor used—probably less than 10 per cent. While the statistics admittedly do not represent the total labor needed in a plant to carry on its productive activities, the figures given here are sufficient to show the general trend of the industry as affected by the change from hand to machine production.

Table 24 shows a comparison of the direct labor cost of making tumblers, sherbets, and nappies by the side lever press, by the semiautomatic rotary press, and by automatic machinery. By the hand process, it costs $1.951 to make one hundred 8–9 ounce common tumblers. One hundred 10-ounce common tumblers when made by the same process cost $2.075. On the rotary press, the one hundred 8–9 ounce common tumblers cost only $1.073, representing a decrease in direct labor cost of 45 per cent. On the automatic machines, the labor cost of making 8–9 ounce common tumblers varies from 13 to 21.9 cents per hundred, showing decreases varying from 88.87 to 93.30 per cent. In the case of the 10-ounce tumblers, the corresponding costs are 13.8 to 25.6 cents per hundred, and the decreases vary from 87.66 to 93.35 per cent. In other words, for every dollar spent on direct labor in pressing 8–9 ounce common tumblers by hand, it cost 55 cents on the semiautomatic rotary press, and less than 7 cents on the most efficient automatic machine. By the same method it can be shown that for every dollar spent on direct labor in pressing 3½-ounce sherbets by hand, it cost 63.51 cents on the rotary press and only 8.97 cents on the most efficient automatic machine, and for every dollar spent on pressing 4½–5 inch nappies by hand, it cost 61.29 cents on the semiautomatic rotary press and only 8.62 cents on the most efficient automatic machine.

The largest saving in direct cost of pressing glassware was thus in tumblers, for the same reasons that the largest increase in man-hour output was in this article—the very large quantity of tumblers produced as compared with other kinds of pressed glassware, and the automatic take-out devices and automatic conveyor used almost exclusively in the production of tumblers.

TABLE 24.—*Average labor cost of pressing 100 pieces of specified kinds of pressed ware by hand and by machine*

Common tumblers

Method of production and kind of machine	8–9 ounce		10 ounce	
	Amount	Index number	Amount	Index number
Hand production: Side lever press	$1.951	100.0	$2.075	100.0
Semiautomatic machine: Rotary press	1.073	55.0		
Automatic machine:				
Hartford-Empire, with double feeder	.219	11.23		
Hartford-Empire, with double feeder and automatic take out	.149	7.64	.176	8.48
Hartford-Empire, with double feeder and automatic take out and conveyor	.130	6.70	.138	6.65
Ed. Miller, with single feeder	.215	11.02	.256	12.34
W. J. Miller, with single feeder and conveyor	.217	11.13	.233	11.23
Special machine, with single feeder	.140	7.18	.142	6.84

Sherbets

Method of production and kind of machine	3½ ounce		4½–5 ounce	
	Amount	Index number	Amount	Index number
Hand production: Side lever press	$1.806	100.0	$1.917	100.0
Semiautomatic machine: Rotary press—				
Hand finish			1.721	89.78
Machine finish	1.147	63.51	1.295	67.55
Automatic machine:				
Hartford-Empire, with double feeder			.246	12.81
Ed. Miller, with single feeder	.162	8.97	.242	12.62
W. J. Miller, with single feeder	.335	18.55	.370	19.30

TABLE 24.—*Average labor cost of pressing 100 pieces of specified kinds of pressed ware by hand and by machine*—Continued

Nappies

Method of production and kind of machine	4½-5 inch		6-7 inch	
	Amount	Index number	Amount	Index number
Hand production: Side lever press	$1.718	100.0	$2.549	100.0
Semiautomatic machine: Rotary press	1.053	61.29	1.418	55.63
Automatic machine:				
Hartford-Empire, with double feeder	.253	14.73		
Ed. Miller, with single feeder	.148	8.62	.629	24.68
W. J. Miller, with single feeder	.219	12.75	.414	16.24
Special machine, with single feeder			.338	13.26

The effects of the automatic take-out device and the automatic conveyor on the labor cost can best be illustrated by Table 25 which gives a comparison of labor cost of the same kind of tumbler made on the same machine, but in one case with the help of three take-out boys and two carry-in boys; in another case with an automatic take-out device and two carry-in boys; and in the third case with an automatic take-out device and an automatic conveyor.

TABLE 25.—*Comparison of direct labor cost of pressing 100 tumblers on the automatic machine with and without automatic take-out device and automatic conveyor*

Kind of machine	Labor cost		
	Amount	Index number A	Index number B
Machine with 3 take-out boys and 2 carry-in boys	$0.219	100.0	
Machine with automatic take out and 2 carry-in boys	.149	68.0	100.0
Machine with automatic take out and automatic conveyor	.130	59.4	87.3

The saving in labor cost thus attributable to the automatic take-out device is 32 per cent of the labor cost of pressing without the device. Similarly a saving in labor cost amounting to 12.7 per cent is to be attributed to the automatic conveyor as compared with the same machine without a conveyor.

EFFECTS OF THE INTRODUCTION OF MACHINERY

The outstanding effect of the introduction of machinery in the pressed-glassware branch of the glass industry is the sharp division brought about in the making of staple products and the so-called "novelties." In the first group the automatic machine is supreme, "Uniformity in kind, mass output in quantity," being the slogan. The hand plants and even the semiautomatic machines can not compete with the automatic machine in this field. In order to survive, the hand plants have turned their attention to a different field, with a slogan directly opposite to that for the automatic machine. "Quality and variety" has become the new motto, giving stimulus to the making of novelties. This branch not only has survived the introduction of the machine, but bids well to become in the future as important a factor as the staple commodities produced by machine.

As explained elsewhere, the two must not be considered as on a competitive basis, but rather as two separate and independent branches of a large industry.

Another important effect of the introduction of machinery in this field is the elimination of the "limited move" in the union hand plants. A "move" represents the number of articles a shop is supposed to make in a "turn"—an uninterrupted period of work which was formerly 4½ but since the war has been 4¼ hours. Two complete turns constitute a day's work. Until a few years ago the "move" was really the maximum number of articles the shop was permitted to make in a turn. If for reasons which could be attributed to the fault of the employers the shop did not produce the exact number of pieces in the move, the workers were to receive their pay for the entire move.

With the rapid encroachment of the automatic machine on the hand plants, the union was compelled to abandon the "limited move." The move has been retained and is still the basis on which the piece rates of the skilled workers are determined, but the shop is no longer required to adhere to it as a maximum. The workers are paid pro rata for all the pieces made during the turn. In cases where the output is less than the move and it can be attributed directly to the fault of the employer, the workers are paid a minimum wage per turn, decided upon in the yearly conferences between the employers' association and the American Flint Glass Workers' Union. The unlimited output ranges from 15 to 20 per cent above the move—an indirect but nevertheless a very important effect of the introduction of machinery in the glass industry.

STATISTICS OF PRODUCTION AND LABOR COST

Table B contains data on the production of tumblers, sherbets, and nappies made on the side-lever hand press, on the semiautomatic rotary press, and on the various automatic machines. The statistics were secured from a number of plants, as no single establishment could be found to have gone through all the stages of development or to use all the machines in the industry. The side lever press and the rotary press are more or less uniform in all the plants, but the automatic machines in use are considerably different. No one of these machines can be selected as representing the automatic process better than any other machine, and hence the necessity to show the output, if not of all the types of machines used, at least of the majority in use for the production of the articles chosen as representative of pressed ware.

Each section of the table covers a single kind of tumbler, sherbet, or nappy made by a single process—hand, semiautomatic machine, or automatic machine, and is divided into two parts: Labor unit, and output and labor cost.

The number and kind of workers engaged in the process, their rates of wages, whether by the piece or the hour, and the total labor cost per hour of operating the entire unit, are shown in the first part of each section. If any one worker is performing services for more than one unit simultaneously, only that part of his labor is shown which is attributed to a single unit. This is the explanation of the fractions appearing in the column headed "Number of workers."

In the second part of each section are given statistics of the output of the unit. The period to which the data refer is a specified month of the year 1925, that being the latest year for which complete data could be secured. The actual number of good tumblers, sherbets, and nappies produced during the period, and the actual number of hours spent in producing the articles, are shown. If two or more similar units have been engaged in the process simultaneously, the aggregate number of hours put in by all the units is given. The output of a single shop or a single machine per hour, and the output per hour of a single worker in the unit, irrespective of his occupation or skill, are also shown, and in addition the total labor cost of pressing by the particular process 100 articles of the particular kind.

As in the case of bottles, the figures of output of any unit show considerable variation from month to month. This is true of all articles and all methods of production, and is due to the same causes as in the case of bottles (see p. 58). During the course of a whole year, however, the favorable and adverse effects more or less neutralize each other, and the average of the year may therefore be taken as more or less representative of the process. The monthly figures are given to show the various degrees of variation, while the maximum and minimum are italicized to emphasize the extreme limits of these variations during any one year.

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE

8-9 OUNCE COMMON TUMBLERS—HAND: SIDE-LEVER PRESS

[Italicized figures represent minimum and maximum]

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.45			1925	*Pieces*		*Pieces*	*Pieces*	
1	Finisher	.41			Feb	4,751	17.00	279.47	31.05	$1.950
1	Gatherer	.36			Mar	10,135	34.00	298.09	33.12	1.904
3	Warming-in boys		$0.38	$1.14	Apr	11,331	36.25	312.58	34.73	1.873
2	Carry-over boys		.30	.60	May	14,933	47.00	*317.72*	*35.30*	*1.862*
1	Carry-in boy		.30	.30	June	10,841	38.25	283.42	31.68	1.940
					July	15,148	56.95	265.99	28.44	1.987
					Aug	6,171	22.00	280.50	31.17	1.947
					Sept	8,279	34.00	*243.50*	*27.06*	*2.058*
					Oct	10,830	40.40	268.07	29.79	1.981
					Nov	8,052	32.00	251.63	27.96	2.031
					Dec	10,025	38.25	262.09	29.12	1.998
9	Total	1.22		2.04	Total	110,496	396.10	278.96	31.00	1.951

8-9 OUNCE COMMON TUMBLERS—SEMIAUTOMATIC MACHINE: 4-MOLD ROTARY PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.41			1925					
1	Gatherer	.33			Jan	8,872	25.50	347.92	69.58	$1.050
1	Take-out boy		$0.39	$0.39	Feb	13,689	42.50	322.09	64.42	1.075
1	Glazing-boy		.39	.39	Mar	14,104	42.50	331.86	66.37	1.065
1	Carry-in boy		.30	.30	Apr	10,180	29.75	342.18	68.44	1.056
					May	6,437	21.25	302.92	60.58	1.096
					June	4,335	17.00	*258.00*	*51.00*	*1.163*
					July	6,521	21.25	306.87	61.37	1.092
					Sept	10,597	34.00	311.68	60.34	1.086
					Oct	11,100	29.75	*373.11*	*74.62*	*1.029*
					Nov	8,022	25.50	314.59	62.92	1.083
					Dec	12,389	38.25	323.90	64.78	1.073
5	Total	.74		1.08	Total	106,246	327.25	324.66	64.93	1.073

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

8-9 OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅓	Machine foreman		$1.00	$0.333	1925	*Pieces*		*Pieces*	*Pieces*	
⅓	Feeder operator		.70	.233	Feb	214,244	108.00	1,983.74	205.21	$0.223
1	Machine operator		.65	.650	Mar	305,160	140.25	2,175.83	225.09	.203
3	Glazing boys		.40	1.200	Apr	188,868	86.08	*2,194.10*	*226.98*	*.201*
3	Take-out boys		.40	1.200	May	160,224	78.90	2,030.70	210.07	.217
2	Carry-in boys		.40	.800	June	135,384	65.16	2,077.72	214.94	.212
					July	309,816	156.42	1,980.67	204.90	.223
					Aug	83,880	46.00	1,823.48	188.64	.242
					Sept	98,004	55.08	*1,779.96*	*184.13*	*.248*
					Oct	168,408	87.60	1,922.47	198.86	.230
9⅔	Total			4.417	Total	1,663,988	823.49	2,020.66	209.03	.219

8-9 OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER AND AUTOMATIC TAKE OUT

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$1.00	$0.250	1925					
¼	Feeder operator		.70	.175	Jan	168,228	84.08	2,000.8	307.82	$0.154
1	Machine operator		.65	.650	Feb	308,292	146.30	2,107.3	324.20	.146
3	Glazing boys		.40	1.200	Mar	285,312	143.06	*1,994.4*	*306.83*	*.154*
2	Carry-in boys		.40	.800	Apr	328,428	162.59	2,020.0	310.77	.152
					May	315,336	149.99	2,102.4	323.45	.146
					July	306,432	138.25	*2,216.5*	*341.00*	*.139*
					Aug	232,200	114.00	2,036.8	313.35	.151
					Sept	474,600	235.08	2,018.9	310.60	.152
					Oct	306,228	146.33	2,092.7	321.95	.147
					Nov	278,856	136.32	2,045.6	314.71	.150
					Dec	253,248	116.75	2,169.2	333.72	.142
6½	Total			3.075	Total	3,257,160	1,582.75	2,057.9	316.60	.149

8-9 OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER AND AUTOMATIC TAKE OUT AND CONVEYOR

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$1.00	$0.250	1925					
¼	Feeder operator		.70	.175	Jan	226,128	128.08	*1,765.52*	*353.10*	*$0.140*
1	Machine operator		.65	.650	Feb	471,444	243.41	1,936.83	387.37	.128
3	Glazing boys		.40	1.200	Mar	522,312	266.59	1,959.23	391.85	.126
½	Conveyor tender		.40	.200	Apr	736,068	403.18	1,825.66	365.13	.136
					May	257,364	137.50	1,871.74	374.35	.132
					July	476,184	265.76	1,791.78	358.36	.138
					Aug	365,028	193.75	1,884.02	376.80	.131
					Sept	360,984	183.24	1,970.01	394.00	.126
					Oct	541,512	267.50	*2,024.35*	*404.87*	*.122*
					Nov	539,388	269.65	2,000.33	400.07	.124
					Dec	373,596	199.73	1,870.51	374.10	.132
5	Total			2.475	Total	4,870,008	2,558.39	1,903.54	380.71	.130

8-9 OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: ED. MILLER, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅛	Machine foreman		$0.85	$0.106	1925					
½	Machine operator		.65	.325	Jan	154,720	148.00	1,045.21	226.03	$0.215
1⅓	Take-out boys		.52	.693	Feb	27,940	28.00	997.86	215.75	.225
1⅓	Glazing boys		.42	.560	Mar	365,716	344.00	1,063.13	229.87	.211
1⅓	Carry-in boys		.42	.560	Apr	90,112	84.00	1,072.76	231.95	.209
					May	305,920	288.00	1,062.22	229.67	.211
					June	251,872	256.00	*983.87*	*212.73*	*.228*
					July	271,516	264.00	1,028.47	222.37	.218
					Aug	599,332	544.00	*1,101.71*	*238.21*	*.204*
					Sept	384,752	384.00	1,001.96	216.64	.224
					Oct	291,394	280.00	1,040.69	225.01	.216
					Nov	84,798	80.00	1,059.97	229.18	.212
					Dec	297,264	288.00	1,032.16	223.17	.217
4⅝	Total			2.244	Total	3,125,336	2,988.00	1,045.96	226.15	.215

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

8-9 OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: W. J. MILLER, WITH SINGLE FEEDER AND CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$0.75	$0.187	1925	*Pieces*		*Pieces*	*Pieces*	
1	Machine operator		.75	.750	Jan	114,716	135.70	845.37	260.11	$0.208
1	Take-out boy		.40	.400	Feb	59,901	81.50	734.99	226.15	.239
1	Glazing boy		.42	.420	Mar	90,787	106.20	854.87	263.03	.206
					Apr	127,517	157.70	808.60	248.80	.217
					May	102,666	110.50	*929.10*	*285.87*	*.189*
					June	25,416	35.70	*711.94*	*219.06*	*.247*
					July	141,665	185.40	764.10	235.11	.230
					Aug	38,239	53.00	721.49	222.00	.240
					Sept	102,987	130.40	789.78	243.01	.222
					Oct	73,875	97.70	756.14	232.66	.232
					Nov	131,795	148.40	888.11	273.26	.198
					Dec	46,531	61.20	760.31	233.94	.231
3¼	Total			1.757	Total	1,056,095	1,303.40	810.26	249.30	.217

8-9 OUNCE COMMON TUMBLERS—SPECIAL AUTOMATIC MACHINE, WITH FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅙	Machine foreman		$1.00	$0.167	1925					
½	Machine operator		.60	.300	Jan	268,500	182.00	1,475.27	402.35	$0.113
1	Take-out boy		.40	.400	Feb	210,372	132.00	*1,593.73*	*434.61*	*.105*
1	Glazing boy		.40	.400	Mar	499,164	416.00	1,199.91	327.22	.139
1	Carry-in boy		.40	.400	Apr	551,892	444.00	1,243.00	338.97	.134
					May	445,860	394.00	1,131.62	308.60	.147
					June	519,696	430.00	1,208.60	329.59	.138
					July	426,564	369.00	1,156.00	315.24	.144
					Aug	782,736	702.00	*1,115.01*	*304.07*	*.149*
					Sept	547,428	475.00	1,152.48	314.28	.145
					Oct	433,932	381.00	1,138.93	310.59	.146
					Nov	474,384	419.00	1,132.19	308.75	.147
					Dec	898,344	749.00	1,199.39	327.08	.139
3⅔	Total			1.667	Total	6,058,872	5,093.00	1,189.65	324.42	.140

10-OUNCE COMMON TUMBLERS—HAND: SIDE-LEVER PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.48			1925					
1	Finisher	.43			Feb	3,372	12.75	264.47	29.36	$2.061
1	Gatherer	.38			Mar	4,323	17.00	254.29	28.25	2.092
3	Warming-in boys		$0.38	$1.14	Apr	4,556	17.00	268.00	29.78	2.051
2	Carry-over boys		.30	.60	June	6,477	25.50	254.00	28.22	2.093
1	Carry-in boy		.30	.30	Aug	4,045	17.00	*237.94*	*26.44*	*2.147*
					Sept	5,926	21.25	*278.87*	*30.99*	*2.021*
9	Total	1.29		2.04	Total	28,699	110.50	259.72	28.86	2.075

10-OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER AND AUTOMATIC TAKE OUT

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$1.00	$0.250	1925					
¼	Feeder operator		.70	.175	Feb	81,660	50.25	*1,625.08*	*250.01*	*$0.189*
1	Machine operator		.65	.650	Apr	115,056	66.67	1,725.75	265.50	.178
3	Glazing boys		.40	1.200	July	125,568	70.67	1,776.83	273.36	.173
2	Carry-in boys		.40	.800	Aug	97,236	59.60	1,631.48	251.00	.188
					Sept	223,392	125.16	1,784.85	274.59	.172
					Oct	167,064	91.50	*1,825.84*	*280.90*	*.168*
6½	Total			3.075	Total	809,976	463.85	1,746.20	268.65	.176

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

10-OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER AND AUTOMATIC TAKE OUT AND CONVEYOR

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$1.00	$0.250	1925	*Pieces*		*Pieces*	*Pieces*	
¼	Feeder operator		.70	.175	Mar	107,664	59.75	1,801.81	360.36	$0.137
1	Machine operator		.65	.650	Apr	88,536	48.67	*1,819.11*	*363.82*	*.136*
3	Glazing boys		.40	1.200	May	71,100	39.16	1,815.63	363.13	.136
½	Conveyor tender		.40	.200	June	115,675	63.82	1,812.52	362.50	.137
					Sept	95,387	54.67	*1,744.78*	*348.96*	*.142*
					Oct	166,490	94.32	1,765.17	353.13	.140
5	Total			2.475	Total	644,852	360.39	1,789.32	357.86	.138

10-OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: ED. MILLER, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅛	Machine foreman		$0.85	$0.106	1925					
½	Machine operator		.65	.325	Jan	42,080	48.00	876.67	189.55	$0.256
1⅓	Take-out boys		.52	.693	Feb	97,596	106.00	920.72	199.07	.244
1⅓	Glazing boys		.42	.560	Mar	48,354	56.00	863.47	186.70	.260
1⅓	Carry-in boys		.42	.560	Apr	48,146	54.00	891.59	192.77	.252
					May	59,894	56.00	*1,069.54*	*231.25*	*.210*
					June	66,637	70.00	952.34	205.91	.236
					July	93,399	100.00	933.99	201.94	.240
					Aug	193,904	235.00	825.12	178.40	.272
					Sept	63,140	78.00	*809.49*	*175.02*	*.277*
					Oct	58,680	70.00	838.29	181.25	.268
					Nov	104,200	128.00	814.07	176.01	.276
4⅝	Total			2.244	Total	876,030	1,001.00	875.16	189.22	.256

10-OUNCE COMMON TUMBLERS—AUTOMATIC MACHINE: W. J. MILLER, WITH SINGLE FEEDER AND CONVEYOR

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$0.75	$0.187	1925					
1	Machine operator		.75	.750	Jan	25,249	32.50	776.89	239.04	$0.226
1	Take-out boy		.40	.400	Feb	19,311	23.70	814.81	250.71	.216
1	Glazing boy		.42	.420	Mar	6,609	9.20	718.37	221.04	.244
					Apr	14,884	18.50	804.54	247.55	.218
					May	15,871	22.40	708.53	218.01	.248
					June	23,727	36.20	655.44	201.67	.268
					July	22,428	31.20	718.85	221.18	.245
					Aug	24,829	40.40	*614.58*	*201.50*	*.286*
					Sept	20,673	30.50	677.80	208.55	.259
					Oct	25,357	33.90	747.99	230.15	.235
					Nov	44,205	46.30	*954.75*	*293.77*	*.184*
					Dec	17,761	20.70	858.02	264.01	.205
3¼	Total			1.757	Total	260,904	345.50	755.15	232.35	.233

10-OUNCE COMMON TUMBLERS—SPECIAL AUTOMATIC MACHINE, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅙	Machine foreman		$1.00	$0.167	1925					
½	Machine operator		.60	.300	Jan	229,956	186.00	1,236.32	337.18	$0.135
1	Take-out boy		.40	.400	Feb	212,196	152.00	*1,396.03*	*380.74*	*.119*
1	Glazing boy		.40	.400	Mar	462,708	384.00	1,204.97	328.63	.138
1	Carry-in boy		.40	.400	Apr	301,672	252.00	1,197.11	326.48	.139
					May	447,358	402.00	*1,112.83*	*303.50*	*.150*
					June	250,698	207.00	1,211.10	330.30	.138
					July	647,320	575.00	1,125.77	307.03	.148
					Aug	474,375	425.00	1,116.17	304.41	.149
					Sept	356,248	305.00	1,168.03	318.55	.143
					Oct	678,540	568.00	1,194.61	325.80	.139
					Nov	243,700	198.00	1,230.81	335.68	.135
					Dec	365,749	316.00	1,157.43	315.66	.144
3⅔	Total			1.667	Total	4,670,520	3,970.00	1,176.45	320.85	.142

Table B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

3½-OUNCE SHERBETS—HAND: SIDE-LEVER PRESS

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.47			1925	*Pieces*		*Pieces*	*Pieces*	
1	Finisher	.42			Jan	2,589	12.75	203.06	33.84	$1.802
1	Gatherer	.38			Feb	1,936	8.50	227.76	37.96	1.744
2	Snappers		$0.38	$0.76	Mar	3,747	17.00	220.41	36.74	1.760
1	Carry-in boy		.32	.32	Apr	2,002	8.50	*235.53*	*39.26*	*1.728*
					May	2,950	12.75	231.37	38.56	1.737
					June	1,758	8.50	206.82	34.47	1.792
					Aug	7,013	34.00	206.26	34.38	1.794
					Sept	9,975	56.75	*175.77*	*29.30*	*1.884*
6	Total	1.27		1.08	Total	31,970	158.75	201.30	33.55	1.806

3½-OUNCE SHERBETS—SEMIAUTOMATIC MACHINE: 4-MOLD ROTARY PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.41			1925					
1	Gatherer	.33			Jan	10,743	29.75	361.11	60.19	$1.133
2	Glazing boys		$0.40	$0.80	Feb	8,471	21.25	*398.64*	*66.44*	*1.096*
1	Carry-over boy		.31	.31	Mar	8,943	25.50	350.71	58.45	1.145
1	Carry-in boy		.31	.31	Apr	8,928	25.50	350.12	58.35	1.146
					May	9,231	25.50	362.00	60.33	1.132
					June	7,227	21.25	340.09	56.68	1.157
					Aug	5,462	17.00	321.29	53.55	1.182
					Sept	4,329	12.75	339.53	56.59	1.158
					Oct	3,996	12.75	*313.41*	*52.24*	*1.193*
					Nov	8,829	25.50	346.24	57.71	1.150
					Dec	8,453	25.50	331.49	55.25	1.168
6	Total	.74		1.42	Total	84,612	242.25	349.28	58.21	1.147

3½-OUNCE SHERBETS—AUTOMATIC MACHINE: ED. MILLER, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1/8	Machine foreman		$0.70	$0.233	1925					
1	Machine operator		.55	.550	Jan	228,489	224.00	1,020.05	306.01	$0.145
1	Glazing boy		.30	.300	Feb	105,366	136.00	*774.75*	*232.43*	*.191*
1	Carry-in boy		.40	.400	Mar	157,453	144.00	*1,093.43*	*328.03*	*.136*
					Apr	123,403	136.00	907.38	272.21	.163
					May	130,050	136.00	956.25	286.88	.155
					July	387,360	480.00	807.00	242.10	.184
					Sept	391,692	408.00	960.03	288.01	.155
					Oct	77,712	86.00	903.63	271.09	.164
					Dec	70,470	80.00	880.88	264.26	.168
3 1/8	Total			1.483	Total	1,671,995	1,830.00	913.66	274.10	.162

3½-OUNCE SHERBETS—AUTOMATIC MACHINE: W. J. MILLER, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1/4	Machine foreman		$0.75		1925					
1	Machine operator		.75	$0.187	Jan	34,620	50.20	*689.64*	*131.36*	*$0.374*
1	Take-out boy		.40	.750	Apr	13,336	14.20	*939.15*	*178.89*	*.275*
2	Glazing boys		.42	.400	May	40,567	53.20	762.53	145.24	.338
1	Carry-in boy		.40	.840	June	17,515	23.50	745.32	141.97	.346
				.400	July	44,372	58.50	758.50	144.48	.340
					Aug	12,634	15.20	831.18	158.32	.310
					Sept	28,600	34.40	831.40	158.36	.310
					Dec	23,396	30.60	764.58	145.63	.337
5 1/4	Total			2.577	Total	215,040	279.80	768.55	146.39	.335

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

4½-5 OUNCE SHERBETS—HAND: SIDE LEVER PRESS

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.47			1925	*Pieces*		*Pieces*	*Pieces*	
1	Finisher	.42			Jan.	26,249	127.50	205.87	29.41	$1.940
1	Gatherer	.38			Feb.	14,502	59.50	*243.73*	*34.82*	*1.836*
2	Snappers		$0.37	$0.74	Mar.	8,015	38.25	209.54	29.93	1,929
1	Carry-over boy		.32	.32	Apr.	10,511	51.00	206.10	29.44	1.940
1	Carry-in boy		.32	.32	Oct.	6,893	34.00	*202.74*	*28.96*	*1.951*
					Nov.	8,909	42.50	209.62	29.95	1.928
					Dec.	5,544	25.50	217.41	31.06	1.905
7	Total	1.27		1.38	Total	80,623	378.25	213.15	30.45	1.917

4½-5 OUNCE SHERBETS—SEMIAUTOMATIC MACHINE: ROTARY PRESS (HAND FINISH)

1	Presser	$0.45			1925					
1	Finisher	.41			June	1,218	4.25	*286.59*	*40.94*	*$1.729*
1	Gatherer	.36			Sept.	3,674	12.75	288.16	41.17	1.727
3	Warming-in boys		$0.38	$1.14	Oct.	4,948	17.00	291.06	41.58	1.722
1	Carry-in boy		.32	.32	Nov.	7,510	25.50	*294.51*	*42.07*	*1.716*
7	Total	1.22		1.46	Total	17,350	59.50	291.60	41.66	1.721

4½-5 OUNCE SHERBETS—SEMIAUTOMATIC MACHINE: ROTARY PRESS (MACHINE FINISH)

1	Presser	$0.45			1925					
1	Gatherer	.36			Jan.	3,592	12.75	*281.73*	*46.96*	*$1.314*
2	Glazing boys		$0.40	$0.80	Apr.	5,274	17.00	*310.24*	*51.71*	*1.268*
1	Carry-over boy		.31	.31	Aug.	8,585	29.75	288.57	48.10	1.302
1	Carry-in boy		.31	.31	Sept.	4,958	17.00	291.65	48.61	1.297
					Oct.	3,674	12.75	288.16	48.03	1.303
					Nov.	7,510	25.50	294.51	49.09	1.292
6	Total	.81		1.42	Total	33,593	114.75	292.75	48.79	1.295

4½-5 OUNCE SHERBETS—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER

¼	Machine foreman		$1.00	$0.250	1925					
¼	Feeder operator		.70	.175	Feb.	66,996	59.25	*1,130.74*	*173.96*	*$0.272*
1	Machine operator		.65	.650	Mar.	120,048	81.66	*1,470.10*	*226.17*	*.209*
3	Glazing boys		.40	1.200	Apr.	303,000	267.73	1,131.74	174.11	.272
2	Carry-in boys		.40	.800	May	109,428	83.41	1,311.93	201.84	.234
					June	86,736	63.21	1,372.19	211.11	.224
					Sept.	233,172	176.89	1,318.18	202.80	.233
					Nov.	151,164	125.67	1,202.87	185.06	.256
6½	Total			3.075	Total	1,070,544	857.82	1,247.99	192.00	.246

4½-OUNCE SHERBETS—AUTOMATIC MACHINE: ED. MILLER, WITH SINGLE FEEDER

⅛	Machine foreman		$0.70	$0.233	1925					
1	Operator		.55	.550	Feb.	55,798	84.00	664.27	199.28	$0.223
1	Glazing boy		.30	.300	May	6,918	16.00	*432.38*	*129.71*	*.343*
1	Carry-in boy		.40	.400	June	47,560	80.00	594.50	178.35	.250
					Sept.	31,098	44.00	*706.77*	*212.03*	*.210*
					Nov.	54,475	96.00	567.45	170.24	.261
3⅛	Total			1.483	Total	195,849	320.00	612.03	183.61	.242

Table B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

4½-OUNCE SHERBETS—AUTOMATIC MACHINE: W. J. MILLER, WITH SINGLE FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$0.75	$0.187	1925	*Pieces*		*Pieces*	*Pieces*	
1	Machine operator		.75	.750	Jan	45,246	69.10	654.79	124.72	$0.394
1	Take-out boy		.40	.400	Feb	57,537	90.90	632.97	120.57	.407
2	Glazing boys		.42	.840	Mar	71,393	115.40	*618.66*	*117.84*	*.417*
1	Carry-in boy		.40	.400	Apr	56,446	89.20	632.80	120.53	.407
					May	113,299	139.65	*811.31*	*154.54*	*.318*
					June	54,614	72.60	752.26	143.29	.343
					July	41,788	55.10	758.40	144.46	.340
					Aug	63,401	99.20	639.12	121.74	.403
					Sept	44,707	56.90	785.71	149.47	.328
5¼	Total			2.577	Total	548,431	788.05	695.93	132.56	.370

4½–5 OUNCE NAPPIES—HAND: SIDE-LEVER PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.45			1925					
1	Finisher	.41			Jan	2,456	8.50	*288.94*	*41.28*	*$1.698*
1	Gatherer	.36			Feb	4,766	17.00	280.41	40.59	1.712
2	Snappers		$0.38	$0.76	Mar	2,299	8.50	270.47	38.64	1.730
1	Carry-over boy		.31	.31	Apr	3,597	12.75	282.12	40.30	1.709
1	Carry-in boy		.31	.31	July	3,585	12.75	281.18	40.17	1.711
					Sept	4,507	17.00	*265.12*	*37.87*	*1.740*
7	Total	1.22		1.38	Total	21,210	76.50	277.25	39.61	1.718

4½–5 INCH NAPPIES—SEMIAUTOMATIC MACHINE: 4-MOLD ROTARY PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.36			1925					
1	Gatherer	.29			Feb	3,308	8.50	*389.18*	*64.86*	*$1.015*
2	Snappers		$0.40	$0.80	May	4,283	12.75	*335.92*	*55.99*	*1.073*
1	Carry-over boy		.31	.31	June	4,629	12.75	363.06	60.51	1.041
1	Carry-in boy		.31	.31	Sept	5,765	17.00	339.12	56.52	1.069
					Oct	10,461	29.75	351.63	58.61	1.054
					Nov	13,297	38.25	347.63	57.94	1.059
					Dec	9,159	25.50	359.18	59.86	1.045
6	Total	.65		1.42	Total	50,902	144.50	352.26	58.71	1.053

4½–5 INCH NAPPIES—AUTOMATIC MACHINE: HARTFORD-EMPIRE, WITH DOUBLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
¼	Machine foreman		$1.00	$0.250	1925					
¼	Feeder foreman		.70	.175	Mar	17,484	13.25	1,319.55	203.01	$0.233
1	Machine operator		.65	.650	Apr	55,860	47.18	1,184.00	182.15	.260
3	Glazing boys		.40	1.200	May	39,780	36.50	1,089.87	167.67	.282
2	Carry-in boys		.40	.800	June	75,300	73.25	*1,028.00*	*158.15*	*.299*
					July	342,504	270.65	1,265.50	194.69	.243
					Aug	85,944	64.75	*1,327.32*	*204.20*	*.232*
					Dec	162,275	135.60	1,196.72	184.11	.257
6½	Total			3.075	Total	779,147	641.18	1,215.18	186.95	.253

4½–5 INCH NAPPIES—AUTOMATIC MACHINE: ED. MILLER, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅓	Machinist		$0.70	$0.233	1925					
1	Machine operator		.55	.550	Feb	99,983	104.00	959.91	287.97	$0.154
1	Glazing boy		.30	.300	Apr	72,370	80.00	904.63	271.39	.164
1	Carry-in boy		.40	.400	May	151,320	168.00	*900.72*	*270.22*	*.165*
					June	83,290	80.00	1,041.13	312.34	.143
					Aug	132,311	136.00	972.88	291.86	.153
					Sept	141,202	136.00	1,038.25	311.48	.143
					Oct	203,918	184.00	*1,108.25*	*332.48*	*.134*
					Dec	591,872	584.00	1,013.48	304.04	.146
3⅓	Total			1.483	Total	1,476,266	1,472.00	1,002.90	300.87	.148

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

4½-5 INCH NAPPIES—AUTOMATIC MACHINE: W. J. MILLER, WITH SINGLE FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅛	Machine foreman		$0.65	$0.217	1925	*Pieces*		*Pieces*	*Pieces*	
1	Machine operator		.50	.500	Jan	72,612	72.00	1,008.50	189.09	$0.238
1	Take-out boy		.42	.420	Feb	67,549	54.50	*1,239.43*	*232.39*	*.193*
2	Glazing boys		.42	.840	Mar	24,743	22.50	1,099.69	206.19	.218
1	Carry-in boy		.42	.420	Apr	47,084	46.00	1,023.57	191.92	.234
					June	27,993	28.50	982.21	184.16	.244
					Aug	26,439	24.00	1,101.63	206.56	.218
					Sept	17,479	16.00	1,092.44	204.82	.219
					Oct	24,892	26.50	*939.32*	*176.12*	*.255*
					Nov	53,179	47.75	1,113.70	208.82	.215
					Dec	69,311	56.25	1,232.20	231.04	.195
5⅛	Total			2.397	Total	431,281	394.00	1,094.62	205.24	.219

6-7 INCH NAPPIES—HAND: SIDE-LEVER PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.61			1925					
1	Finisher	.55			Jan	21,968	114.75	191.44	29.45	$2.486
1	Gatherer	.49			Feb	24,837	162.00	*153.31*	*23.59*	*2.694*
2	Snappers		$0.50	$1.00	Mar	15,267	85.00	179.61	27.63	2.541
1½	Carry-in boys		.40	.60	Nov	8,826	42.50	*207.67*	*31.96*	*2.421*
					Dec	7,836	38.25	204.86	31.52	2.431
6½	Total	1.65		1.60	Total	78,734	442.50	177.93	27.37	2.549

6-7 INCH NAPPIES—SEMIAUTOMATIC MACHINE: 4-MOLD ROTARY PRESS

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1	Presser	$0.50			1925					
1	Gatherer	.40			Jan	14,740	51.00	289.02	48.17	$1.391
2	Snappers		$0.40	$0.80	Feb	11,205	38.25	292.94	48.66	1.385
1	Carry-over boy		.31	.31	Mar	14,324	46.75	*306.40*	*51.07*	*1.363*
1	Carry-in boy		.31	.31	Apr	5,932	21.25	279.15	46.53	1.409
					May	7,209	29.75	242.32	40.39	1.486
					June	6,789	29.75	228.13	38.02	1.522
					July	5,337	21.25	251.15	41.86	1.465
					Aug	7,570	25.50	296.86	48.48	1.378
					Sept	4,682	21.25	*220.33*	*36.72*	*1.544*
					Oct	11,234	42.50	264.33	44.06	1.437
					Nov	17,783	68.00	261.51	43.54	1.443
					Dec	15,532	51.00	304.55	50.76	1.366
6	Total	.90		1.42	Total	122,337	446.25	274.14	45.69	1.418

6-7 INCH NAPPIES—AUTOMATIC MACHINE: ED. MILLER, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅛	Machine foreman		$0.85	$0.106	1925					
½	Machine operator		.65	.325	Feb	16,752	48.00	*349.00*	*75.46*	*$0.643*
1⅓	Take-out boys		.52	.693	Apr	22,528	64.00	352.00	76.11	.638
1⅓	Glazing boys		.42	.560	May	11,288	32.00	352.75	76.27	.636
1⅓	Carry-in boys		.42	.560	June	36,946	104.00	355.25	76.81	.632
					July	30,965	88.00	351.88	76.08	.638
					Oct	67,496	185.00	*364.85*	*78.89*	*.615*
4⅝	Total			2.244	Total	185,975	521.00	356.96	77.18	.629

TABLE B.—PRODUCTION AND LABOR COST IN MAKING PRESSED GLASSWARE BY HAND AND BY MACHINE—Continued

6-7 INCH NAPPIES—AUTOMATIC MACHINE: W. J. MILLER, WITH SINGLE FEEDER

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
					1925	*Pieces*		*Pieces*	*Pieces*	
⅙	Machine foreman		$0.65	$0.217	Jan	12,862	21.00	612.48	114.84	$0.391
1	Operator		.50	.500	Feb	13,986	21.75	643.03	120.57	.373
1	Take-out boy		.42	.420	Mar	7,007	13.25	*528.83*	*99.16*	*.453*
2	Glazing boys		.42	.840	Apr	16,666	30.75	541.98	101.62	.442
1	Carry-in boy		.42	.420	May	17,725	33.00	537.12	100.71	.446
					June	18,213	32.75	556.12	104.27	.431
					Oct	15,630	24.00	*651.25*	*122.11*	*.368*
5⅙	Total			2.397	Total	102,089	176.50	578.41	108.45	.414

6-7 INCH NAPPIES—SPECIAL AUTOMATIC MACHINE, WITH SINGLE FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
⅙	Machine foreman		$1.00	$0.167	1925					
½	Machine operator		.60	.300	Jan	81,300	151.00	538.41	146.84	$0.310
1	Take-out boy		.40	.400	Feb	95,376	182.00	524.04	142.92	.318
1	Glazing boy		.40	.400	Mar	72,264	160.00	451.65	123.18	.369
1	Carry-in boy		.40	.400	Apr	46,140	90.00	512.44	139.76	.325
					May	58,404	138.00	423.22	115.42	.394
					June	68,712	148.00	464.27	126.62	.359
					July	48,648	132.00	*368.55*	*100.51*	*.452*
					Aug	123,744	306.00	404.39	110.29	.412
					Sept	70,980	123.00	577.07	157.38	.289
					Oct	80,916	143.00	565.85	154.32	.294
					Nov	150,096	274.00	547.80	149.40	.304
					Dec	90,408	156.00	*579.54*	*158.06*	*.288*
3⅔	Total			1.667	Total	986,988	2,003.00	492.75	134.39	.338

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BLOWN WARE

The development of machinery in the field of blown ware has been more pronounced than in the case of pressed ware. The machines used in this branch of the glass industry are larger in size and more intricate than the automatic presses. They are also more limited as to the kind of ware they can produce. In fact some of the machines were devised for the purpose of producing one article exclusively, such as the electric-light bulb or glass tubing.

To gauge the effects of these various machines on labor productivity and labor cost of manufacturing, it becomes necessary to study separately the individual articles in which the machines are specializing, the most important of which are lamp chimneys, electric-light bulbs, punch tumblers, and glass tubing.

LAMP CHIMNEYS

There are three methods still in use in this country in making lamp chimneys: (1) The offhand method of blowing lamp chimneys by hand without a mold; (2) the paste-mold method of blowing lamp chimneys by hand with the help of a paste mold; and (3) the semiautomatic machine process.

OFFHAND PROCESS

In the offhand process the group constituting a shop is made up of 3 workers—the gatherer, the blower, and the crimper. The first two are skilled workers, and the third is an unskilled or semiskilled helper.

The process of making a crimped lamp chimney is as follows: The gatherer collects a bit of molten glass on the end of his pipe, marvers it, and by gently blowing through the free end of the pipe produces the first air cavity in the glass, which at this stage looks like an elongated pear, partly hollowed inside. The blower then takes the pipe and by carefully blowing and skillfully swinging it to and fro distends the glass until the walls acquire the necessary thinness, while the glass assumes the general shape of a lamp chimney, but closed on both ends. This operation the blower performs entirely without the aid of tools.

The next step is to make the heel of the chimney. While the glass is still hot enough to be ductile, the blower pinches the lower end of the chimney into a small knob known as the "horn." The cold air which rushes in through the small aperture rapidly cools the glass, and the horn is easily broken off by a quick blow with a wooden tool, leaving an irregular opening at the bottom of the chimney. The blower then places the chimney, still on the pipe, in the glory hole to be reheated. He afterwards shapes the lower end of the chimney with the help of his forceps and a gauge to determine the exact height and diameter of the heel. This is the portion of the chimney which fits into the lamp holder.

When the heel is formed, the blower easily cracks off the chimney from the blowing pipe and turns it over to the crimper. The latter inserts it in a special chimney snap and again places it in the glory hole to be reheated. When the top of the chimney has been sufficiently softened by the fire the crimper withdraws it from the glory hole and presses it against a rotating crimping machine, which leaves its impression on the top of the chimney. The crimping device is simply a circular crimped mold with a revolving cone inside which smooths out the top of the chimney and at the same time guides it toward the mold which crimps the glass at the top.

The chimney is now complete, ready to be used. As at no time during the operation does the glass come in contact with iron, the chimneys made by the off-hand process do not need to be annealed and are, therefore, transferred directly from the furnace to the packing room, where they are assorted and packed ready to be shipped.

PASTE-MOLD PROCESS

In making lamp chimneys by the paste-mold process the shop is made up of 3 skilled workers, the blower, the blocker, and the ball gatherer, and 1 unskilled helper, the carry-in boy. The initial stages of gathering and marvering or blocking the glass are similar to those used in the offhand process. In the offhand process, however, the shop can make only one chimney at a time, while in the paste-mold process, two, three, and nowadays even four chimneys are blown at once. This implies the gathering of larger quantities of glass and also more marvering and blocking; hence two workers are needed for the separate operations of gathering and marvering, both of which are performed by the gatherer alone in the offhand process.

When the glass has been sufficiently blocked and marvered, the blower takes the pipe and by swinging it to and fro gives to the glass a pear-shape form. He then lowers the glass into the dummy mold, which he operates with a foot treadle, and by continuous blowing, at the same time rapidly rotating the pipe, distends the glass to the shape of the mold. The paste mold and the rapid rotation are necessary to save the glass from seams or other impressions which a dry mold might leave upon the glass. The carry-in boy then opens the mold and takes the long block of blown glass, consisting of four chimneys, to the leer to be annealed, while the mold falls of its own accord into a pool of water to be bathed for the next block of chimneys.

From the cold end of the leer the blocks of chimneys are transferred to the cutting department, where the chimneys are separated. From the cutting machine they pass over to a glazing machine in the form of a conveyor, which remelts and glazes first the heel and then the top of the chimney. Finally the chimney passes under a crimping machine, after which operation it is complete and is taken to the packing room to be assorted.

SEMIAUTOMATIC PROCESS

The lamp chimney semiautomatic machine was first put into operation in 1898, but since then it has undergone a number of important changes. At present the machine consists of a rotary table equipped with five paste molds, which open and close automatically. The initial stages of gathering and blocking the glass are performed by hand and do not differ from the paste-mold process described above. When the glass is ready to be blown, the blower, now called the feeder (due to the change in the nature of his work) swings the pipe forward and backward, allowing the glass to run down until it assumes the shape of a sausage. He then places the pipe in a socket of the machine. While the lower end of the pipe just reaches the paste mold, which automatically rises from the water and closes around the glass, the upper end of the pipe is connected with a valve through which compressed air enters the pipe and distends the glass into the shape of the mold. During this process of blowing the pipe is also rapidly being rotated around its own axis, thus imparting to the chimney a perfectly smooth and seamless surface. At a definite point on its journey around the table the mold opens automatically and releases the pipe with the chimney. The cracking-off boy easily separates the chimney from the pipe and places it on a near-by stand for the carry-in boy to take to the leer to be annealed.

As in the case of the paste-mold hand process, two or more chimneys can be blown at once on the semiautomatic machine. However, since the lower end of the chimney comes out of the mold completely closed, it has been found more practical to blow but one chimney at a time, but with its lower end lengthened and so shaped as to make from it a good salable tumbler when cut off from the chimney and properly finished.

After having been annealed, the chimney is really only a "blank" chimney, not a finished product. Its lower end, whether ending in a tumbler or not, is still closed, while the upper end has a very ragged and irregular opening made by the cracking-off boy in separating the chimney from the blowing pipe. Both ends must be cut and then glazed, and the top crimped before the chimney is completed.

Cutting the tumbler from the lower end of the chimney and the cullet from the upper end is done on a special cracking-off machine. The chimneys are then placed in the bottomless cups of a conveyor, below and above which are located the glazing burners. While rotating rapidly in the cups on their axes, the chimneys move forward on the conveyor and pass first over a set of burning fires which glaze the heel and then under a stronger set of fires which glaze and partly remelt the tops of the chimney. As the chimney emerges from under these glazers, an operator causes a crimping device to descend upon the top of the chimney, which stamps it while the glass is still hot and plastic. The chimney is then transferred to the inspection and packing room.

While the chimney completes its course through the cutting machine, the glazing machine, and the crimper, the tumbler which was separated from the chimney by the cutting machine proceeds on a somewhat similar path, but in the opposite direction. It passes first to the grinding machine, where the sharp edges left by the cutting machine are beveled and smoothed. The tumbler is then washed and wiped to eliminate any residue left by the grinding machine, after which it is glazed, the glazing machine being of the same type used for pressed tumblers. (See pp. 91 and 92.) After glazing, the tumblers are removed to the inspection room to be assorted and packed.

MAN-HOUR OUTPUT AND LABOR COST

The increase in man-hour output caused by the lamp-chimney machine is rather small when compared with the effects of machinery in the other branches of the glass industry. Table 26 presents a comparison of man-hour output of No. 2 sun-crimped lamp chimneys made by the three processes—offhand, paste mold, and semiautomatic machine. By the offhand process the average man-hour output of a union plant is 27.434 lamp chimneys and of a nonunion plant 25.095 lamp chimneys, making the average output of the two plants 26.265 lamp chimneys per man-hour. By the paste-mold process, the average man-hour output is 36.450 lamp chimneys, while on the semiautomatic machine it is 37.387 lamp chimneys.

For the purpose of comparison index numbers are also given. Taking the average man-hour output of a union and nonunion shop as the base, or 100, the increase in man-hour output by the paste-mold process is 38.8 per cent. This increase is due wholly to the fact that in the paste-mold process more than one chimney (four chimneys in the plant concerned) is blown at a time. The man-hour output shown would have been considerably larger but a large number of chimneys are broken on their journey from the leer through the cutting off, glazing, and crimping machines. The man-hour output of the lamp-chimney machine is not much higher than that of the paste-mold process—only 2.5 per cent—and only 42.3 per cent higher than the man-hour output of the average for the offhand process.

TABLE 26.—*Comparison of man-hour output of No. 2 sun-crimped lamp chimneys made by hand and by machine*

Process	Man-hour output	
	Quantity	Index number
Offhand process:	*Pieces*	
Union shop	27.434	104.4
Nonunion shop	25.095	95.5
Average, union and nonunion shop	26.265	100.0
Paste-mold process, hand	36.450	138.8
Semiautomatic machine	[1] 37.387	142.3

[1] In addition there was approximately an equal number of tumblers produced as a by-product, requiring only grinding and glazing to finish them.

Table 27 gives a comparison of labor cost in making lamp chimneys by the three processes. The labor cost of making 100 No. 2 sun-crimped lamp chimneys by the offhand method is $2.740 in a union plant and $2.680 in a nonunion plant, the average cost in the two plants being $2.710. By the paste-mold process the corresponding cost per 100 lamp chimneys is $2.128 or 21.5 per cent less than the average cost by the offhand process. The same kind of lamp chimneys made on the semiautomatic machine cost only $1.712 per hundred pieces or 37.5 per cent less than those made by the offhand process. It must again be emphasized, however, that for every good lamp chimney turned out by the machine process there is at least one good tumbler turned out as a by-product. The additional labor and cost of handling the tumbler after it has been separated from the chimney by the cutting-off machine is comparatively negligible. Were it possible to translate these tumblers into terms of lamp chimneys, the man-hour output of the machine would have been considerably increased, probably doubled, and the labor cost decreased accordingly.

TABLE 27.—*Comparison of labor cost of 100 No. 2 sun-crimped lamp chimneys made by hand and by machine*

Process	Amount	Index number
Offhand process:		
Union shop	$2.740	101.1
Nonunion shop	2.680	98.9
Average, union and nonunion shop	2.710	100.0
Paste-mold process, hand	2.128	78.5
Semiautomatic machine	[1] 1.712	62.5

[1] Less the value of approximately an equal number of tumblers made as a by-product, which require but a slight additional expense for grinding and glazing.

Considering the early introduction of the lamp-chimney machine, it being one of the first machines used in the glass industry, the influence of machinery on the making of lamp chimneys has not been very great. The principal cause of this peculiar situation is the declining tendency of the lamp-chimney market as a whole. In spite of the large quantities of lamp chimneys still produced in this country, the total output decreases steadily from year to year. The extensive use of electric power, which has penetrated even the most remote and inaccessible sections of the United States and of Canada, is the chief factor in this decline. The manufacturers of lamp chimneys, whether by hand or by machine, are fully aware of the situation, and refuse to make the large outlay necessary in the introduction of new machinery.

As a result, the making of lamp chimneys is probably the only field in the glass industry where hand manufacturing not only has survived the introduction of machinery, but actually manages to subsist side by side with the machine. It is variously estimated that 40 to 50 per cent of all the lamp chimneys made in this country are still made by the offhand process.

There is another reason why the hand manufacturers can compete with the machine in spite of lower man-hour output and higher direct labor cost. This is the claim of the hand manufacturers and their workers alike that the offhand made lamp chimney is a better chimney and lasts longer than either the paste-mold or the machine-made chimney. One of the characteristics of a good chimney is the variation in the thickness of glass at the top, the heel, and the bulge of the chimney. The hand manufacturers claim that this variation can not be attained by blowing into a mold, whether by hand or machine; that only an expert offhand blower can make such a chimney, and therefore that the offhand product is the best of the three and the demand for it is larger.

Apparently the lamp chimney is doomed. It is only a matter of a short time until the oil-burning lamp will have flickered its last before the onslaught of the electric bulb. But the manufacturers are of the opinion that so long as there is any demand for lamp chimneys, just so long will the offhand process persist side by side with the machine.

STATISTICS OF PRODUCTION AND LABOR COST

The data on production here given cover four plants: Two plants where chimneys are made by the offhand process, one plant for the paste-mold process, and one for the semiautomatic machine. The average of the first two plants, one union operated and the other nonunion, is taken as the standard by which the man-hour output and the labor cost in all plants have been measured.

In the offhand process the chimneys are made complete by the blowing shop, and this shop has been taken as the labor unit of production. But in the paste-mold plants, as well as in those using the semiautomatic machine, the lamp chimneys, upon leaving the blowing shop or the machine, must be annealed, cut off, glazed, and crimped before they are completed. For the purpose of comparison with the offhand labor unit, such additional labor as is needed to finish the articles made by the blowing shop or the machine must be added to the blowing units in the paste-mold and machine processes. For example, it is estimated that two cutting boys can handle in nine hours all the lamp chimneys made by seven paste-mold shops in one turn of four hours. It would require, therefore, nine-fourteenths of the time of one cutting boy to handle in one hour the ware made by the blowing shop in one hour, and the equivalent of nine-fourteenths of the labor of a cutting boy must therefore be added to the blowing shop. For similar reasons the equivalent of nine-fourteenths of the labor of a glazing girl and nine-fourteenths of the labor of a crimping girl are also added to the shop.

In the plants using the automatic machine, the labor needed in tending a single machine has been taken as the labor unit of production. If any worker tended more than one machine, only that part of his labor has been taken which is allotted to one machine. To this blowing unit must also be added that portion of the finishing labor which is needed to anneal, cut off, glaze, and crimp all the ware produced by a single machine in an equal period of time. These proportions have been determined on a basis similar to that used in the paste-mold process.

Each section of Table C is divided into two parts—labor unit, and output and labor cost. In the first part are given the number and kind of workers engaged in the process of production, their rates of wages, and the total hourly labor cost of a single labor unit. The second part gives the total number of salable lamp chimneys made, the shop or machine hours spent on their production, the output per shop or machine hour, the output per man-hour, and the labor cost of 100 No. 2 sun-crimped lamp chimneys made by the three processes.

TABLE C.—PRODUCTION AND LABOR COST IN MAKING NO. 2 SUN-CRIMPED LAMP CHIMNEYS BY HAND AND BY MACHINE

[In this table all wage rates are for 1925 and labor cost is based on 1925 wage rates regardless of year of output. Italicized figures represent minimum and maximum]

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Total output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
OFFHAND PROCESS (UNION SHOP)										
1	Blower	$1.240			1925	*Pieces*		*Pieces*	*Pieces*	
1	Gatherer	1.000			Aug	34,636	420.0	82.467	27.489	$2.740
1	Crimper	.500			Sept	32,151	392.0	82.018	27.339	2.740
					Oct	30,738	372.0	82.629	27.543	2.740
					Nov	35,259	436.0	*80.870*	*26.957*	2.740
					Dec	52,788	636.0	*83.000*	*27.667*	2.740
3	Total	2.740			Total	185,572	2,256.0	82.301	27.434	2.740
OFFHAND PROCESS (NONUNION SHOP)										
1	Blower	$1.250			1925					
1	Gatherer	.990			May	23,664	293.0	*80.769*	*26.922*	$2.680
1	Crimper	.440			June	26,769	376.0	71.194	23.731	2.680
					July	29,374	459.0	*64.000*	*21.333*	2.680
					Aug	33,243	459.0	72.425	24.142	2.680
					Sept	29,750	378.0	78.700	26.233	2.680
					Oct	41,280	522.0	79.080	26.360	2.680
					Nov	39,988	520.0	76.900	25.633	2.680
					Dec	49,060	621.0	79.002	26.334	2.680
3	Total	2.680			Total	273,128	3,628.0	75.284	25.095	2.680
PASTE-MOLD PROCESS—HAND BLOWN										
	Blowing:				1925					
1	Blower	$0.659			Apr	18,981	88.0	215.700	36.380	$2.129
1	Blocker	.549			May	17,925	80.0	224.060	37.790	2.112
1	Ball gatherer	.475			June	13,050	60.0	217.500	36.690	2.125
1	Carry-in boy		$0.32	$0.320	July	8,434	44.0	*191.690*	*32.330*	*2.185*
	Finishing:				Aug	14,905	64.0	*232.890*	*39.280*	*2.096*
9/14	Cutting girl		.50	.321	Sept	16,935	84.0	201.610	34.010	2.160
9/14	Glazing girl		.25	.161	Nov	13,508	60.0	225.130	37.970	2.110
9/14	Crimping girl		.25	.161						
5 13/14	Total	1.683		.963	Total	103,738	480.0	216.120	36.450	2.128
SEMIAUTOMATIC MACHINE										
	Blowing:				1926 [1]					
1/6	Machine foreman		$0.70	$0.117	1st week	11,747	34.5	*340.500*	*34.050*	*$1.764*
1	Feeder	$0.370			2d week	11,826	30.0	394.200	39.420	1.684
3	Gatherers	.810			3d week	15,841	41.0	386.370	38.640	1.695
1	Cracking-off boy		.47	.470	4th week	16,390	45.0	364.220	36.420	1.726
1	Carry-in boy		.47	.470	5th week	18,040	49.0	368.160	36.820	1.720
5/6	Leer tender		.29	.241	6th week	13,641	34.5	*395.390*	*39.540*	*1.683*
	Finishing:									
1 1/5	Cutting-off girls		.23	.276						
3/5	Glazing girl		.23	.138						
3/5	Crimping girl		.23	.138						
3/5	Transfer girl		.23	.138						
10	Total	1.180		1.988	Total	37,485	234.0	373.870	37.387	1.712

[1] The actual dates of the weekly periods for which data are given are not available.

BLOWN WARE: ELECTRIC-LIGHT BULBS

MAKING BULBS BY HAND

In the process of making electric-light bulbs by hand the shop consists of two skilled workers, the gatherer and the blower, and two unskilled helpers, a section boy and a cutting-off operator, both usually working for from six to eight shops simultaneously. The process of blowing electric-light bulbs may be described as follows: The gatherer inserts his iron pipe in the pot of molten glass and by skillful manipulation accumulates on the end of the pipe the necessary quantity of glass for the size of bulb desired. He then withdraws the pipe and by marvering the glass and slightly blowing into the pipe gives to the bit of glass a pear-shaped form, with a small cavity in the center. The pipe is then turned over to the blower, who by swinging it a few times to and fro and letting the glass run down elongates it into the shape of a sausage. With the help of a foot treadle he then raises the "dummy" or automatic mold from its water bath and causes it to close around the glass. By continued blowing and at the same time constantly rotating the pipe with his hand the blower distends the glass to fill out the mold. A paste mold is used to prevent the glass from sticking to the iron and to keep the bulb free from any of the seams which are usually left by a dry iron mold. When the blowing is finished the blower releases the mold, which falls back into the water, and turns over the pipe with the bulb on it to the section boy. The latter rapidly disengages the formed article from the pipe, which he places within convenient reach of the gatherer. At this point of the process the bulb carries with it an extra quantity of glass, a "moile," which needs to be cut off before the bulb is finished. This operation is usually performed by a girl on a special cutting-off machine, and it is estimated that one cutting-off operator can take care of all the bulbs made by eight shops. It is therefore necessary to add the equivalent of one-eighth of the labor of a cutting-off operator to each shop engaged in the process of making electric-light bulbs by hand.

SEMIAUTOMATIC PROCESS

The semiautomatic machine consists of a long base filled with water, over which rise four or five operating units, all driven by a common shaft but with individual clutches, so that each unit functions independently. Each unit is equipped with an arm to hold and operate the blowing pipe, a paste mold, and a piston through which compressed air is introduced through the blowing pipe to the glass.

In the process of blowing electric-light bulbs by the semiautomatic machine the gatherer, or the chief operator, as he is often termed, withdraws an iron blowing pipe from the "blow-iron trap" and proceeds to gather the necessary quantity of glass exactly as in the case of the hand shop. Upon withdrawing the glass from the pot he does not stop to marver it, as in the case of hand production, but places it at once in an arm of the machine, which is at rest in a position slightly above the horizontal. He then pulls a lever which locks the

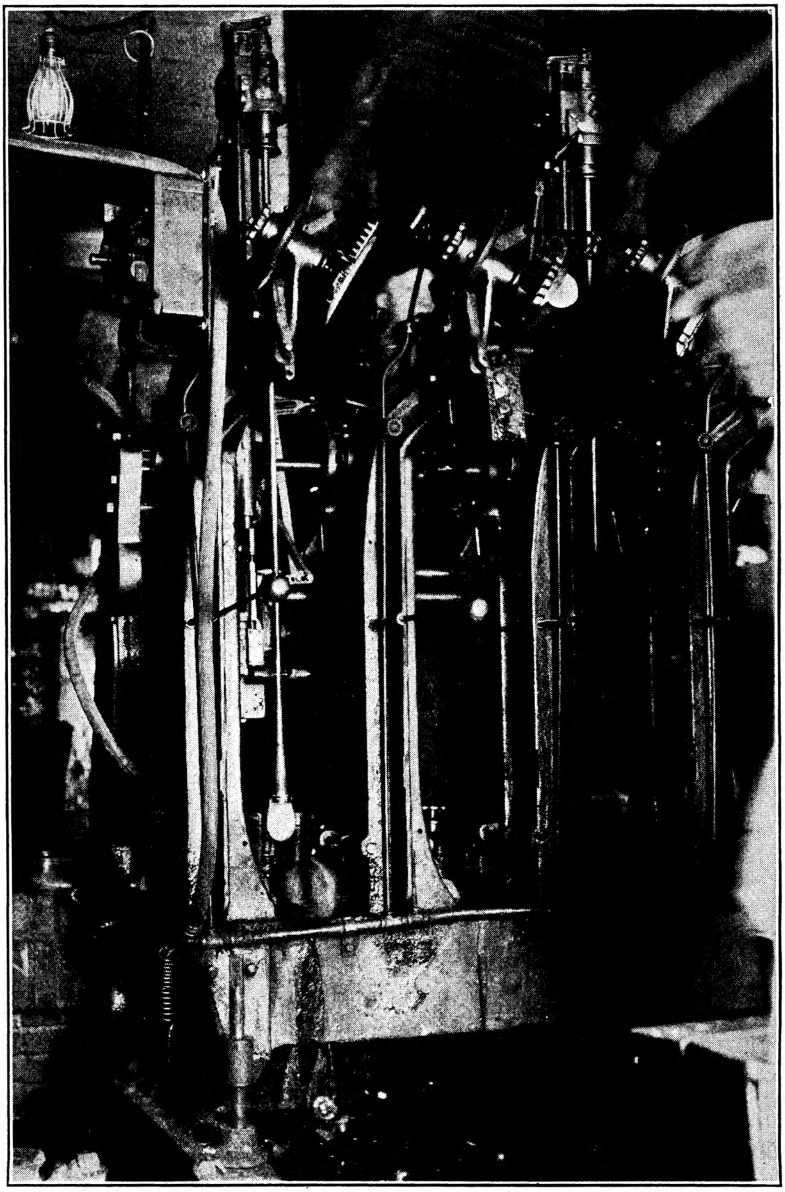

FIG. 13.—SEMIAUTOMATIC EMPIRE E MACHINE FOR MAKING ELECTRIC-LIGHT BULBS

blowing pipe into the "blowhead" of the arm, and at the same time trips the clutch and sets the unit in operation.

As the blowing pipe rotates rapidly on its axis, the arm rises slowly and brings the glass on the end of the pipe into contact with a metallic marver. The latter also revolves, but much more slowly, and is so adjusted that the marvering is completed at a single revolution of the marver. A small quantity of air is then admitted into the blowing pipe by means of a cylinder located at the blowhead, and the first air cavity is formed in the marvered glass. Immediately afterwards the arm starts swinging downward, admitting more air into the glass, which finally assumes a pear-shaped form, hollowed in the center. The downward swing continues until the blowing pipe reaches a vertical position, at which point the arm is automatically disengaged from the clutch, which stops the operation of the entire unit.

Until the beginning of the downward swing of the arm the paste mold has been hanging downward in an open position immersed in the base of the machine. As the arm swings down, the mold, still open, swings upward out of the water until it reaches a vertical position slightly ahead of the blowpipe. The unit remains unoperated for a certain length of time, during which the glass continues to elongate of its own weight until it assumes a position between the two halves of the mold. When the glass reaches the desired length the take-out boy or the "spiffer" pushes a lever, which again starts the unit in operation. The mold immediately closes around the glass, and sufficient air is admitted to the pipe to distend the glass to fill out the mold. When this is completed the mold opens automatically, the arm begins to swing upward, and upon reaching a definite position releases the blowpipe into the hands of the take-out boy, who turns it over to the cracking-off boy. The latter cracks off the glass article from the pipe and returns the pipe to the "blow-iron trap." This is simply a rack designed to hold several blowpipes, keeping them in their order as used and in a convenient position for the gatherer to grasp as he returns from the machine to the pot. When cut off by the spiffer the electric bulbs are completely finished and are removed by the section boy to the inspection room to be examined and packed.

The use of the semiautomatic machine thus dispenses with the services of a blower. The work of the gatherer is also considerably reduced and simplified, being limited to the mere operation of gathering the glass, while the initial blowing and marvering are performed by the machine. In addition to the gatherer, the machine requires the services of a take-out boy, a cracking-off boy, and a section boy. The total number of workers needed to tend the semiautomatic machine is thus somewhat larger than the number of workers in a hand shop. But the average output of the machine is more than three times that of a hand shop, and the man-hour output of the machine is also appreciably larger than in hand production.

AUTOMATIC MACHINERY

Empire F machine.—The Empire F machine, when operated in connection with an automatic feeding device, constitutes a complete automatic unit. This machine, though capable of producing any paste-mold ware of limited size, is used almost exclusively for the purpose of making electric-light bulbs.

The machine consists of two intermittently rotating tables, each supplied with six blowing units. Each unit is made up of a blank-forming press, a blowing spindle, and a blow mold. Gobs of glass are fed alternately to each blank-forming press down an inclined trough, which oscillates between the two tables, loading them alternately. The blank is pressed in the spindle, reheated, inverted into the blow mold, and blown to shape. When finished it is ejected automatically from the machine. All movements are entirely mechanical and completely synchronized. The driving force is supplied by an electric motor, which operates the feeding device and the machine simultaneously.

All the blowing units of the machine operate exactly alike, so that a description of the process of a single unit will be representative of the whole machine.

Just before the operation begins the spindle swings into an upward vertical position, ready to receive the gob of glass from the feeder down the chute, which has also swung into the proper position. The receiving end of the spindle is in the form of a cup of a size just sufficient to contain the quantity of glass needed for the bulb blown. It is made up of two lock jaws, which automatically close around the glass and force the superfluous glass to run down into a sleeve in the spindle specially provided for this purpose. The excess glass in the sleeve cools rapidly and serves to hold the gob in place on the spindle. This glass is called the "collar." The jaws then open up, and the collar forms the only contact of the glass with the machine. The spindle automatically starts rotating, at the same time passing under a hot flame which serves to reheat and soften the glass chilled by exposure to the air. A small quantity of air is then admitted into the blank to form the initial air bubble, and the spindle, without ceasing to rotate, swings down 180°, so that the glass is suspended downward from the spindle, which then stops rotating. While in this position, and because of its weight, the glass changes from an egg shape into a pear shape, rapidly becoming longer and longer. In the meantime the paste mold, which has all the time been traveling immersed in a basin of water at the foot of the machine, swings upward, and while still open assumes its position around the glass, which can be seen suspended between the two halves of the mold. When the glass has reached its proper length the mold closes, the spindle again starts revolving, and air is blown into the glass, distending it into the shape of the mold. At the end of this operation the mold opens, the spindle swings upward about 30°, automatically releasing the collar of the bulb, and the completed article slides down a chute out of the machine. The mold swings downward into the water pan, while the empty spindle swings up 150° farther to its zero position ready for another operation.

The blown bulb, sliding down a chute, is picked up by an automatic conveyor and is carried to the burning-off machine. This machine consists of a series of receptacles or chucks rotating around a common axis. The chucks are equipped with narrow gas fires, which first cut off the superfluous collar or the "moile" of the bulb and then fire-polish the rough edges. The bulbs are then automatically released from the burning-off machine and are forwarded to the packing room.

Westlake machine.—The Westlake machine consists essentially of a large rotating drum from which are suspended 12 bulb-blowing units. Each of these units carries two spindles or blowing pipes, a ram with two pipes for the purpose of gathering the glass, a mech-

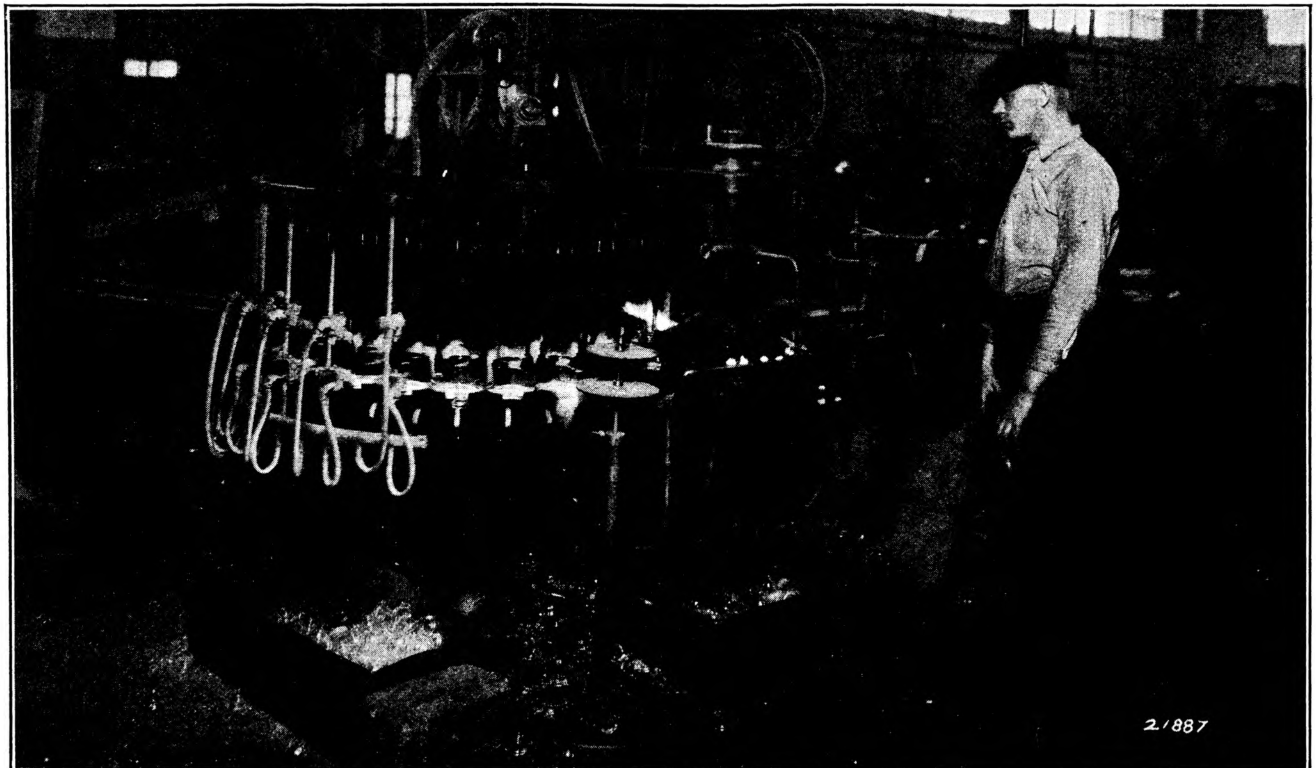

FIG. 14.—AUTOMATIC BURN-OFF MACHINE WITH AUTOMATIC CONVEYOR

anism for admitting air into the blowpipes, two paste molds, and a series of cams and wheels to synchronize the operations of the various parts mentioned. When the machine is rotating, normally about two revolutions per minute, the rams, operating on a slide on top of the machine, are automatically projected into the furnace opening to gather the glass. There are two arms or gathering pipes to each ram, and two "gathers" of glass are made at one time. By a vacuum

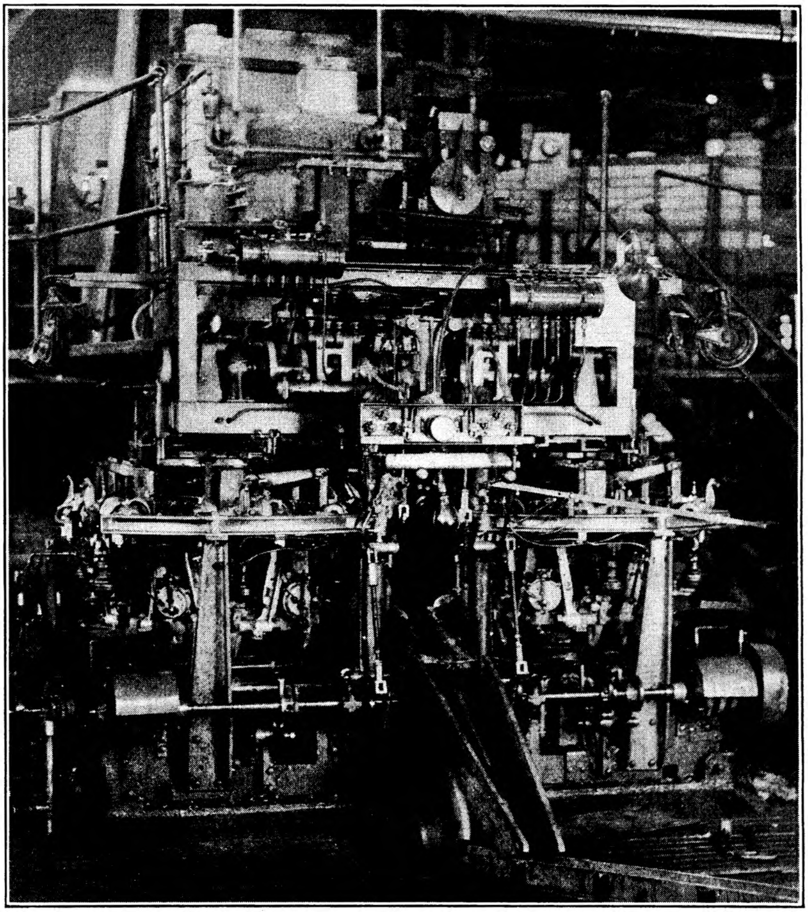

FIG. 15.—AUTOMATIC EMPIRE F MACHINE

process the "gathers" are sucked up into copper or cast-iron blank molds of the size and shape required for the particular bulb wanted. As the ram is automatically withdrawn from the tank a knife sweeps under the arms and automatically cuts off the string of glass from the "gathers" just made. When the arms are out of the tank the suction in the molds is released and the two "gathers" of glass drop into the jaws of the two spindles, which at this moment assume a vertical position just under the arms of the gathering ram. The transfer of the glass from one mold to another comparatively cooler

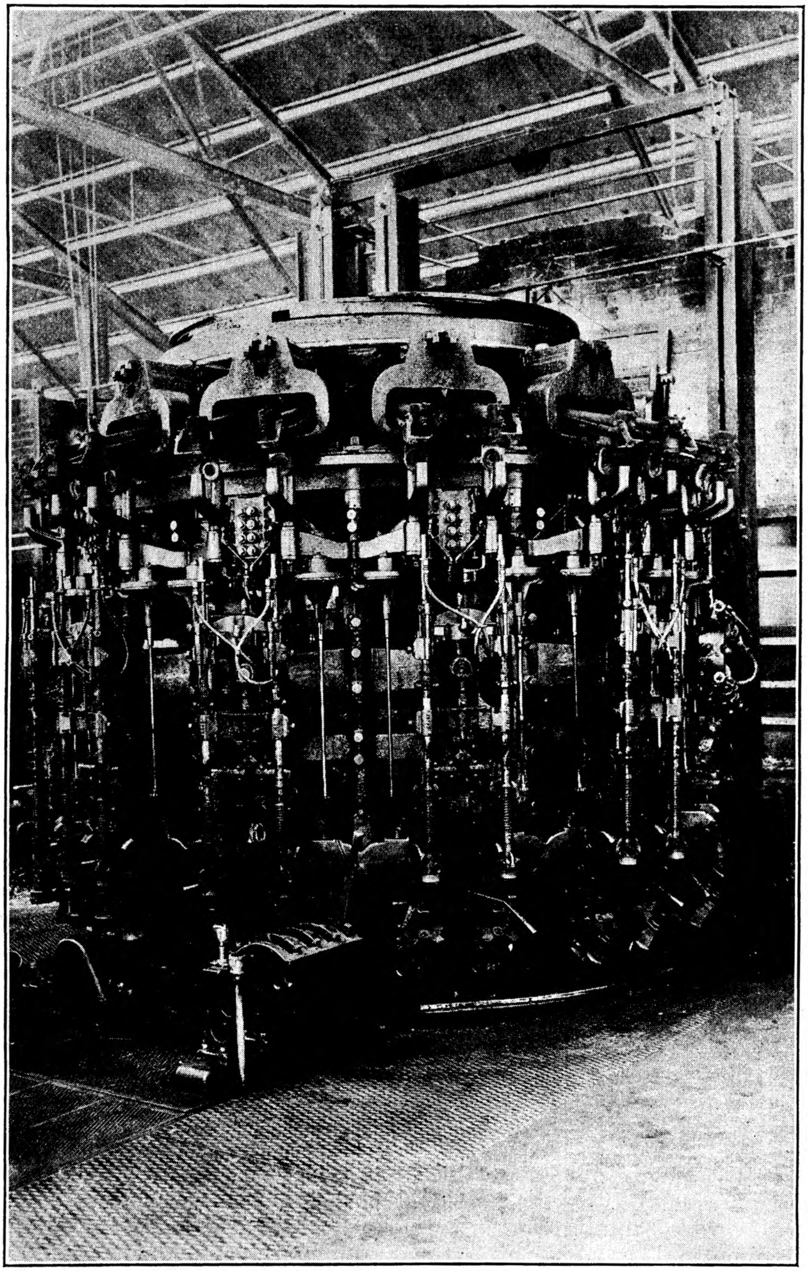

FIG. 16.—WESTLAKE AUTOMATIC MACHINE (OLD TYPE)

mold chills the outer surface of the "gather," which is equivalent to marvering the glass.

After the jaws of the spindle close on the "gather" a plunger automatically makes a small indentation in the center of the gather and immediately afterwards compressed air is admitted in short puffs into the spindle by means of a valve system. The spindle then

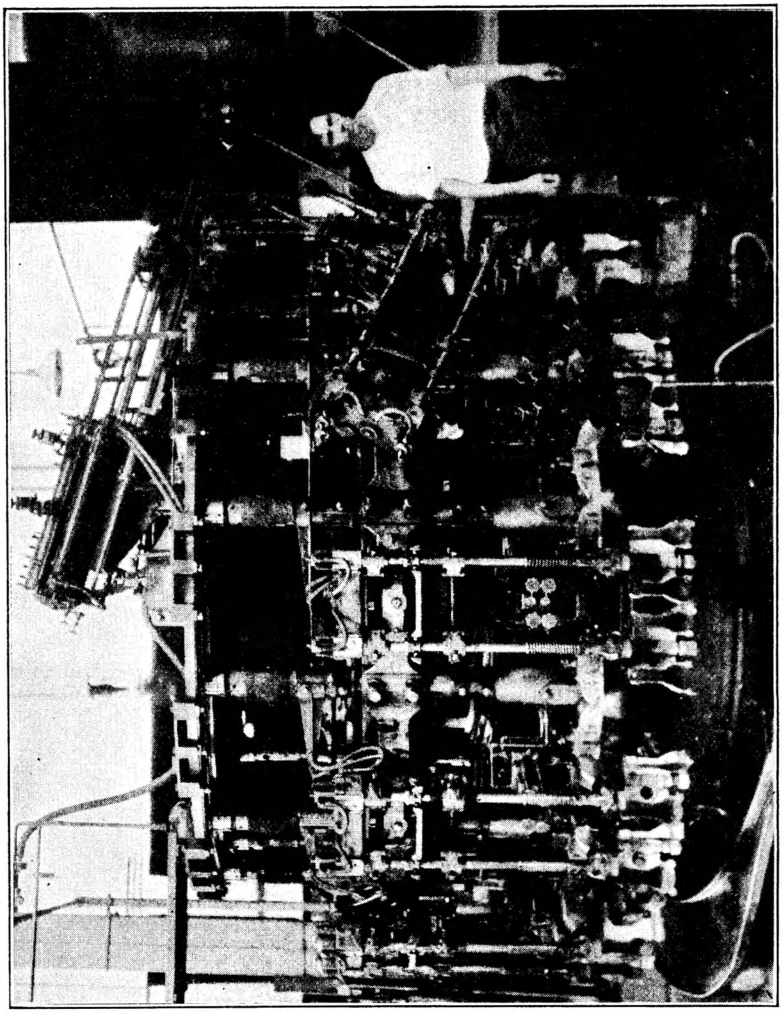

FIG. 17.—WESTLAKE AUTOMATIC MACHINE (NEW TYPE)

starts rotating on its axis, at the same time swinging around first to a horizontal and then to a vertical position, with the glass hanging downward. Simultaneously with the downward swing of the spindles the open molds emerge from the water pool and begin to swing upward, reaching the vertical position just ahead of the spindles, so that the glass is suspended between the two halves of the mold. The weight of the glass and the puffs of air which it receives intermittently elongate the "gather," and just when it reaches the proper length and shape, usually in the form of a sausage, the molds close around it and a steady pressure of air is introduced which fills out the molds. The latter then open up and the spindles, after releasing the fully blown and rigid bulb, swing upward into their original position while the molds swing downward and sink into the water tank.

When thrown out of the machine the bulb is complete, except for the superficial glass shoulder which connected it to the blowing spindle. This extra glass, or "moile" as it is called, must be cut off, and this operation is also done automatically. As the bulb falls out from the machine it is picked up by an automatic conveyor which takes it via an automatic loading device to the burning-off machine. The latter consists of a rotating drum with 24 receptacles or chucks in which the bulbs are rotated. The receptacles are equipped with a set of sharp flat gas fires, which first cut off the moile and then fire polish the edges of the bulb. At a certain point of the operation, after the moile is off and the fire polishing finished, the gas is automatically shut off from the particular burner and the bulb is allowed to cool before it is pushed out automatically from the machine upon another conveyor. This conveyor carries the bulb automatically through a short leer, and from there another automatic conveyor carries it to the inspection station, where it is examined and packed or stood up in a rack, to be sent to the spraying room to be frosted. This is the first time in the whole process that the bulb is handled. The only labor needed is a machine operator to see that all the separate parts of the machine are running smoothly. Sometimes an additional attendant is needed on the burning-off machine. Both workers need no preparatory skill and learn their work in a comparatively short time.

The latest type of the Westlake machine marks a considerable improvement upon the type described above. Instead of having a ram with two arms for each operating unit this type carries but one stationary ram with two arms to feed the 12 pairs of spindles of the machine. This change appreciably reduces the weight and bulk of the machine. The older type Westlake machine weighed on the average 45 to 50 tons. The 12 rams, weighing about 15 tons, have now been replaced by a single ram weighing about a ton, thus reducing the entire weight of the machine nearly one-third. The direct results of this change have been an improvement in the quality of the product, especially so far as uniformity is concerned, and an increase in output due to higher speed in the rotation of the simplified and less bulky machine.

MAN-HOUR OUTPUT AND LABOR COST

The most outstanding characteristic in the production of electric-light bulbs has been the phenomenal increase in man-hour output caused by the automatic machines. Table 28 contains a comparison of man-hour output of 25 and 40 watt electric-light bulbs made by the three processes—hand, semiautomatic machinery, and automatic machinery. In hand production the average man-hour output on 25-watt bulbs ranges from 52.52 pieces in Plant A to 56.19 pieces in Plant B, making the average output of the two plants 54.355 bulbs per man-hour. The average man-hour output on 40-watt bulbs is 54.21 pieces. On the semiautomatic Empire E machine the average man-hour output is 116.06 twenty-five-watt bulbs and 116.55 forty-watt bulbs. On the automatic machines the average man-hour output on 25-watt bulbs is 801.82 pieces on the Empire F machine operated with a feeder, 1,283.63 pieces on the older type Westlake machine, and 1,699.22 pieces per man-hour on the newer type. The corresponding figures for a 40-watt electric bulb are 787.50 pieces for the Empire F machine, 1,319.15 pieces for the older type Westlake machine, and 1,703.59 pieces per man-hour for the newer type Westlake machine.

Taking the average man-hour output of the two hand plants as the base, or 100, the semiautomatic machine shows an index of 213.52 for a 25-watt bulb and 215 for a 40-watt bulb, an increase of more than 100 per cent over the average man-hour output in hand production. On the same basis, the indexes of man-hour output of a 25-watt bulb made by the automatic process are 1476.16 for the Empire F machine, 2361.60 for the older type Westlake machine, and 3126.17 for the newer type Westlake machines. The corresponding indexes for a 40-watt electric bulb are 1452.70 for the Empire F, 2433.41 for the older type Westlake machine, and 3142.57 for the newer type Westlake machine. The man-hour output on the most up-to-date automatic process is thus more than thirty-one times the man-hour output of the same kind of bulbs made by hand. This increase is exceeded only by that caused by the Owens double triplex machine in the production of 2 and 4 ounce prescription bottles. (See pp. 49.)

Not less remarkable is the reduction in the direct labor cost by the automatic process. The average labor cost of 1,000 electric-light bulbs made by hand is $13.882 for 40-watt bulbs and $13.897 for 25-watt bulbs. When made on the semiautomatic machine the labor cost is $4.180 and $4.197 for 40 and 25 watt bulbs, respectively. When made by the newer type Westlake machine the labor cost of 1,000 bulbs is reduced to 47.0 and 47.1 cents for 40 and 25 watt bulbs, respectively. In other words, for every dollar spent on the labor of making 40 and 25 watt electric-light bulbs by hand it cost only 30.11 and 30.22 cents, respectively, to make them on the semiautomatic machine and only 3.39 cents on the automatic. The saving in labor cost thus brought about by the automatic machine is 96.61 cents for every dollar spent on hand production. (See Table 28.)

The effects of such changes in output and costs on the electric-light bulb industry are obvious. They are best expressed in the following statement of conditions in the plants by one of the most important electric-light bulb producers in the country:

Per cent of bulbs produced by—	1920	1926 (6 mos.)
Hand	39. 2	11. 3
Semiautomatic machine	60. 7	5. 4
Automatic machine	. 1	83. 3
Total	100. 0	100. 0

Within the short span of five years production by the automatic process has increased from one-tenth of 1 per cent to 83.3 per cent of the total output. At the same time hand production has declined from 39.2 per cent to 11.3 per cent, while production on the semi-automatic has declined from 60.7 per cent to 5.4 per cent. Another important concern reports more than 98 per cent of its total production of bulbs made on the automatic machine and less than 2 per cent by hand, there being no production on the semiautomatic machine.

The semiautomatic process of making electric-light bulbs has thus suffered the most from the introduction of the automatic machine. The situation is exactly parallel to that in the case of bottles. Hand production has been retained to make such of the large sizes and oddly shaped and colored bulbs as can not be economically produced on the machine, partly because the molds are too expensive, but chiefly because such bulbs are produced in very small quantities. For this purpose and for the purpose of experimentation, which can be better controlled when the bulbs are made by hand, hand production, even if only a small fraction of the whole industry, will survive no matter what strides are made by the automatic machines. The semiautomatic process, however, is doomed to disappear and it is only a matter of a few years before the last semiautomatic will be consigned to the scrap heap and replaced by the automatic.

TABLE 28.—*Comparison of man-hour output and labor cost of electric-light bulbs made by hand and by machine*

Man-hour output

Process and machine	25-watt bulb		40-watt bulb	
	Quantity or amount	Index number	Quantity or amount	Index number
Hand production:	*Pieces*		*Pieces*	
Plant A	52.52	96.62	52.64	97.10
Plant B	56.19	103.38	55.78	102.90
Average	54.355	100.00	54.21	100.00
Semiautomatic machine: Empire E	116.06	213.52	116.55	215.00
Automatic machine:				
Empire F, with feeder	801.82	1476.16	787.50	1452.70
Westlake, old type	1,283.63	2361.60	1,319.15	2433.41
Westlake, new type	1,699.22	3126.17	1,703.59	3142.57

Labor cost (per 1,000)

Process and machine	25-watt bulb: Quantity or amount	25-watt bulb: Index number	40-watt bulb: Quantity or amount	40-watt bulb: Index number
Hand production:				
Plant A	$14.750	106.13	$14.716	106.01
Plant B	13.044	93.86	13.048	93.99
Average	13.897	100.00	13.882	100.00
Semiautomatic machine: Empire E	4.197	30.20	4.180	30.11
Automatic machine:				
Empire F, with feeder	.570	4.10	.580	4.17
Westlake, old type	.584	4.22	.568	4.09
Westlake, new type	.471	3.39	.470	3.39

STATISTICS OF PRODUCTION AND LABOR COST

The data given in Table D are actual figures of output of 25 and 40 watt electric-light bulbs made by hand, by the semiautomatic Empire E machine, by the automatic Empire F machine operated with an automatic feeder, and by the older and newer types of the Westlake machine. Hand production is represented by two plants, Plant A and Plant B. The average of these two plants has been taken as the standard by which to measure the output and labor cost in the other plants.

The statistics of hand production refer to periods different from the period for the machine plants, for the reason that no standard 25 or 40 watt bulbs were made by hand in 1925, so completely did the machine displace the hand process in the production of these two staple articles. The rates of wages used are in all cases those which prevailed in the respective plants during 1925.

There is a separate section in the table for each of the processes for the two kinds of bulbs studied. Each section is divided into two parts—labor unit, and output and labor cost. The first part gives the number and the kind of workers composing a single shop or attending a single machine; the rates of wages paid, per 100 bulbs or per hour, and the total labor cost of an hour's operation either by a single shop or a single machine. The second part gives the actual number of bulbs made, by months; the number of shop or machine hours in operation; the output per shop-hour in hand plants and per machine-hour in machine plants; the output per man-hour and the labor cost per 1,000 bulbs in all plants.

Table D.—PRODUCTION AND LABOR COST IN MAKING ELECTRIC-LIGHT BULBS BY HAND AND BY MACHINE

25-WATT BULBS—HAND: PLANT A

[In this table all wage rates are for 1925 and labor cost is based on 1925 wage rates regardless of year of output. Italicized figures represent minimum amd maximum]

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1	Blower		$0.882	$0.882	1916	*Pieces*		*Pieces*	*Pieces*	
1	Gatherer		.741	.741	Jan.-June	737,906	6,238.40	118.28	52.57	$14.736
⅛	Carry-in boy		.450	.056	July-Dec.	960,500	8,092.20	118.69	52.75	14.685
⅛	Cutting-off boy		.500	.063	1917					
					Jan.-June	1,015,035	8,559.50	118.59	52.71	14.698
					July-Dec.	1,385,937	11,883.00	*116.63*	*51.84*	*14.945*
					1918					
					Jan.-June	1,718,849	14,551.60	118.12	52.50	14.756
					July-Dec.	923,939	7,749.90	*119.22*	*52.99*	*14.744*
					1919					
					Jan.-June	714,761	6,023.90	118.65	52.73	14.690
					July-Dec.	99,573	847.90	117.43	52.19	14.843
2¼	Total			1.742	Total	7,556,500	63,946.40	118.17	52.52	14.750

25-WATT BULBS—HAND: PLANT B

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1	Blower	$0.71			1923					
1	Gatherer	.54			Jan.	4,942	38.00	130.05	57.80	$13.029
⅛	Section boy		$0.28	$0.035	Feb.	6,576	49.50	*132.85*	*59.04*	*13.018*
⅛	Cutting-off girl		.27	.035	Mar.	6,589	50.50	130.48	57.99	13.027
					Apr.	11,530	88.50	130.28	57.90	13.028
					Aug.	9,902	75.00	132.03	58.68	13.021
					Nov.	53,140	424.00	125.33	55.70	13.049
					Dec.	106,262	848.00	*125.31*	*55.69*	*13.049*
2¼	Total	1.25		.070	Total	198,941	1,573.50	126.43	56.19	13.044

TABLE D.—PRODUCTION AND LABOR COST IN MAKING ELECTRIC-LIGHT BULBS BY HAND AND BY MACHINE—Continued

25-WATT BULBS—SEMIAUTOMATIC MACHINE: EMPIRE E

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1	Gatherer		$0.65	$0.650	1925	*Pieces*		*Pieces*	*Pieces*	
1	Take-out boy		.44	.440	Jan	130,267	320.00	407.08	116.31	$4.188
1	Spiffer (crack-off boy)		.44	.440	Feb	103,576	254.00	407.78	116.51	4.181
					Sept	26,691	64.00	*417.05*	*119.16*	*4.088*
½	Section boy		.35	.175	Dec	109,958	274.00	*401.31*	*114.66*	*4.249*
3½	Total			1.705	Total	370,492	912.00	406.24	116.06	4.197

25-WATT BULBS—AUTOMATIC MACHINE: EMPIRE F, WITH FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
⅙	Machine foreman		$1.00	$0.167	1925					
⅙	Feeder operator		.60	.100	Jan	973,830	495.20	1,966.54	842.80	$0.542
1	Machine operator		.40	.400	Mar	289,438	151.90	1,905.45	816.62	.560
1	Crack-off machine operator		.40	.400	July	235,348	140.10	1,679.86	719.94	.635
					Aug	481,062	275.30	1,747.10	748.76	.611
					Sept	344,589	209.30	*1,646.39*	*705.60*	*.648*
					Oct	358,817	205.40	1,746.92	748.68	.611
					Nov	867,343	420.50	*2,062.65*	*883.99*	*.517*
2⅓	Total			1.067	Total	3,550,427	1,897.70	1,870.91	801.82	.570

25-WATT BULBS—AUTOMATIC MACHINE: 24-SPINDLE WESTLAKE, OLD TYPE

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
⅙	Machine foreman		$1.25	$0.208	1925					
⅓	Mechanic		.85	.283	Jan	1,030,609	467.75	2,203.33	1,322.00	$0.567
1⅙	Machine operators		.65	.758	Feb	1,042,652	493.75	2,111.70	1,267.02	.592
					Mar	1,243,121	552.33	*2,250.69*	*1,350.41*	*.555*
					Apr	861,775	404.25	2,131.79	1,279.07	.586
					May	1,118,365	582.66	*1,919.41*	*1,151.65*	*.650*
					June	1,310,885	609.75	2,149.87	1,289.92	.581
					July	1,327,935	614.50	2,161.00	1,296.60	.578
					Aug	1,268,730	579.90	2,187.84	1,312.70	.571
					Sept	1,184,130	588.10	2,013.49	1,208.09	.620
					Oct	1,406,472	642.55	2,188.89	1,313.33	.570
					Nov	1,286,920	592.45	2,172.20	1,303.32	.575
					Dec	1,432,908	656.55	2,182.48	1,309.49	.572
1⅔	Total			1.249	Total	14,514,503	6,784.44	2,139.38	1,283.63	.584

25-WATT BULBS—AUTOMATIC MACHINE: 24-SPINDLE WESTLAKE, NEW TYPE

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
⅛	Machine foreman		$1.00	$0.125	1925					
¼	Mechanic		.90	.225	Jan	1,334,016	565.62	2,358.50	1,715.27	$0.466
1	Machine operator		.75	.750	Feb	425,088	165.84	*2,563.24*	*1,864.17*	*.429*
					Mar	86,650	38.68	2,240.18	1,629.22	.491
					Apr	614,016	268.65	2,285.56	1,662.23	.481
					May	380,712	177.61	2,143.53	1,558.93	.513
					June	329,972	144.50	2,283.51	1,660.73	.482
					July	844,416	357.60	2,361.34	1,717.34	.466
					Aug	796,086	332.46	2,394.53	1,741.48	.459
					Sept	345,024	138.55	2,490.25	1,811.09	.442
					Oct	664,128	286.00	2,322.13	1,688.82	.474
					Dec	245,376	120.97	*2,028.40*	*1,475.20*	*.542*
1⅜	Total			1.100	Total	6,066,484	2,596.48	2,336.43	1,699.22	.471

TABLE D.—PRODUCTION AND LABOR COST IN MAKING ELECTRIC-LIGHT BULBS BY HAND AND BY MACHINE—Continued.

40-WATT BULBS—HAND: PLANT A

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1	Blower		$0.882	$0.882	1916	*Pieces*		*Pieces*	*Pieces*	
1	Gatherer		.741	.741	Jan.-June	1,768,793	14,914.10	118.60	52.71	$14.696
1/8	Carry-in boy		.450	.056	July-Dec.	4,722,574	39,686.10	*119.00*	*52.89*	*14.647*
1/8	Cutting-off boy		.500	.063						
					1917					
					Jan.-June	4,164,385	35,096.10	*115.37*	*51.28*	*15.108*
					July-Dec.	3,683,929	31,042.40	118.67	52.74	14.688
					1918					
					Jan.-June	6,931,770	58,873.80	117.74	52.33	14.804
					July-Dec.	3,089,901	26,073.50	118.51	52.67	14.708
2¼	Total			1.742	Total	24,361,352	205,686.00	118.44	52.64	14.716

40-WATT BULBS—HAND: PLANT B

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1	Blower	$0.71			1923					
1	Gatherer	.54			Jan.	11,814	91.50	*129.11*	*57.38*	*$13.032*
1/8	Section boy		$0.28	$0.035	Feb.	8,184	64.50	126.88	56.39	13.042
1/8	Cutting-off girl		.27	.035	Apr.	22,332	179.00	124.76	55.44	13.051
					May	34,431	273.00	126.12	56.05	13.045
					Nov.	105,024	823.00	127.61	56.72	13.039
					Dec.	127,358	1,032.00	*123.41*	*54.85*	*13.057*
2¼	Total	1.25		.070	Total	309,143	2,463.00	125.51	55.78	13.048

40-WATT BULBS—SEMIAUTOMATIC MACHINE: EMPIRE E

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1	Gatherer		$0.65	$0.650	1925					
1	Take-out boy		.44	.440	Jan.	20,169	48.00	420.19	120.05	$4.058
1	Spiffer		.44	.440	Feb.	321,463	753.00	426.91	121.97	3.994
½	Section boy		.35	.175	Mar.	520,160	1,295.00	401.67	114.76	4.245
					June	14,405	39.00	369.36	105.53	4.616
					Aug.	106,562	312.00	*341.55*	*97.58*	*4.992*
					Nov.	341,735	800.00	*427.17*	*122.05*	*3.991*
3½	Total			1.705	Total	1,324,494	3,247.00	407.91	116.55	4.180

40-WATT BULBS—AUTOMATIC MACHINE: EMPIRE F, WITH FEEDER

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1/6	Machine foreman		$1.00	$0.167	1925					
1/6	Feeder operator		.60	.100	Jan.	1,139,317	620.00	1,837.61	787.55	$0.580
1	Machine operator		.40	.400	Feb.	1,756,933	969.70	*1,811.83*	*776.50*	*.589*
1	Crack-off machine operator.		.40	.400	Mar.	1,304,281	703.30	1,854.52	794.79	.575
					Aug.	438,305	241.90	1,811.93	776.54	.589
					Oct.	533,099	282.60	*1,886.41*	*808.46*	*.565*
					Nov.	358,744	192.40	1,864.58	799.11	.572
2⅓	Total			1.067	Total	5,530,679	3,009.90	1,837.50	787.50	.580

40-WATT BULBS—AUTOMATIC MACHINE: 24-SPINDLE WESTLAKE, OLD TYPE

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1/6	Machine foreman		$1.25	$0.208	1925					
1/3	Mechanic		.85	.283	Jan.	1,091,082	476.10	2,291.71	1,375.03	$0.545
1⅙	Machine operators		.65	.758	Feb.	643,840	278.25	2,313.85	1,388.31	.540
					Mar.	1,956,362	900.66	2,172.14	1,303.28	.575
					Apr.	1,448,148	617.16	*2,346.47*	*1,407.88*	*.532*
					May	1,679,208	754.75	2,224.85	1,334.91	.561
					June	2,163,784	1,019.90	2,121.56	1,272.94	.588
					July	1,959,355	954.25	*2,053.29*	*1,231.97*	*.608*
					Aug.	1,873,860	826.90	2,266.13	1,359.68	.551
					Sept.	2,047 874	896.16	2,285.17	1,371.10	.547
					Oct.	1,661,736	716.60	2,318.92	1,391.35	.539
					Nov.	1,293,515	620.90	2,083.29	1,249.97	.601
					Dec.	2,096,286	996.50	2,103.65	1,262.19	.593
1⅔	Total			1.249	Total	19,915,140	9,058.13	2,148.59	1,319.15	.568

TABLE D.—PRODUCTION AND LABOR COST IN MAKING ELECTRIC-LIGHT BULBS BY HAND AND BY MACHINE—Continued

40-WATT BULBS—AUTOMATIC MACHINE: 24-SPINDLE WESTLAKE, NEW TYPE

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 1,000
1/8	Machine foreman		$1.00	$0.125	1925	*Pieces*		*Pieces*	*Pieces*	
1/4	Mechanic		.90	.225	Jan	986,460	407.40	2,421.35	1,760.98	$0.454
1	Operator		.75	.750	Feb	855,640	357.29	2,394.81	1,741.68	.459
					Mar	178,596	79.96	2,233.57	1,624.41	.493
					Apr	1,104,540	505.33	2,185.78	1,589.66	.503
					May	1,193,100	545.69	2,186.41	1,590.12	.503
					June	1 091,264	450.81	2,420.67	1,760.48	.454
					July	1,242,300	571.58	*2,173.45*	*1,580.69*	*.506*
					Aug	824,100	330.86	*2,490.78*	*1,811.48*	*.442*
					Sept	1,613,268	682.63	2,363.31	1,718.77	.465
					Oct	1,485,112	600.38	2,473.62	1,799.00	.445
					Nov	119,064	47.88	2,486.72	1,808.52	.442
					Dec	1,590,516	664.29	2,394.31	1,741.32	.459
1 3/8	Total			1.100	Total	12,283,960	5,244.10	2,342.44	1,703.59	.470

BLOWN WARE: PUNCH TUMBLERS

MAKING TUMBLERS BY HAND

In the process of blowing tumblers by hand the shop is commonly made up of two skilled workers, the blower and the gatherer, and two helpers, the cracking-off boy and the carry-in boy. The process of blowing is much the same as in the case of electric-light bulbs. The gatherer picks up a bit of molten glass on the end of his pipe and by blowing and marvering it prepares it for the blower. The latter then lowers it into the automatic or dummy paste mold, which he operates by the help of a foot treadle, and while constantly rotating the pipe with his hands blows into it with sufficient force to distend the glass to the shape of the mold. The cracking-off boy then separates the blown article from the pipe and the carry-in boy takes it to the leer to be annealed.

As the tumbler emerges at the cold end of the leer, it looks more like a bottle with a broken neck than a tumbler. The blank tumbler, as it is called, must therefore undergo a series of operations before it finally assumes the shape of a tumbler.

The first operation is to remove the neck or shoulder left by the mold. This is usually done on a cutting-off machine by the flame-expansion method. The operator first marks the blank tumbler at the point where the shoulder is to be removed. The marking, a slight scratch on the surface of the glass, is done by a diamond point, which can be so adjusted as to mark exactly the size of the tumbler wanted. The marked blank is then transferred to the cutting-off machine. The latter consists of a revolving holder in which the glass article is clasped, with an adjustable narrow gas flame above it. The gas flame is so fixed as to strike the blank at the line scratched by the diamond point. As the tumbler rapidly rotates on its axis, a fracture is formed in the glass along the line of the scratch by the expansion caused by the flame.

The work of cutting off is performed almost exclusively by women. One operator usually marks the blank tumbler and takes care of one machine with two spindles or burners. The output of such a machine varies widely, according to the experience of the operator and the size and shape of the tumbler cut. It is estimated, however, that an average operator in charge of a two-spindle cutting-off machine could cut all the ware produced by five blowing shops. The equivalent of one-fifth the labor of a cutting operator must therefore be added to each shop engaged in the process of blowing tumblers by hand.

The next operation is to smooth and even off the rough edges left by the cutting-off machine. This is usually done by grinding the tumbler either by hand or by machine, nowadays predominantly the latter. There are several types of grinding machines used in this branch of the glass industry, but the principle of grinding is the same in all machines. The tumbler is inserted in a chuck at the end of a revolving spindle operated either by a system of counterweights and a

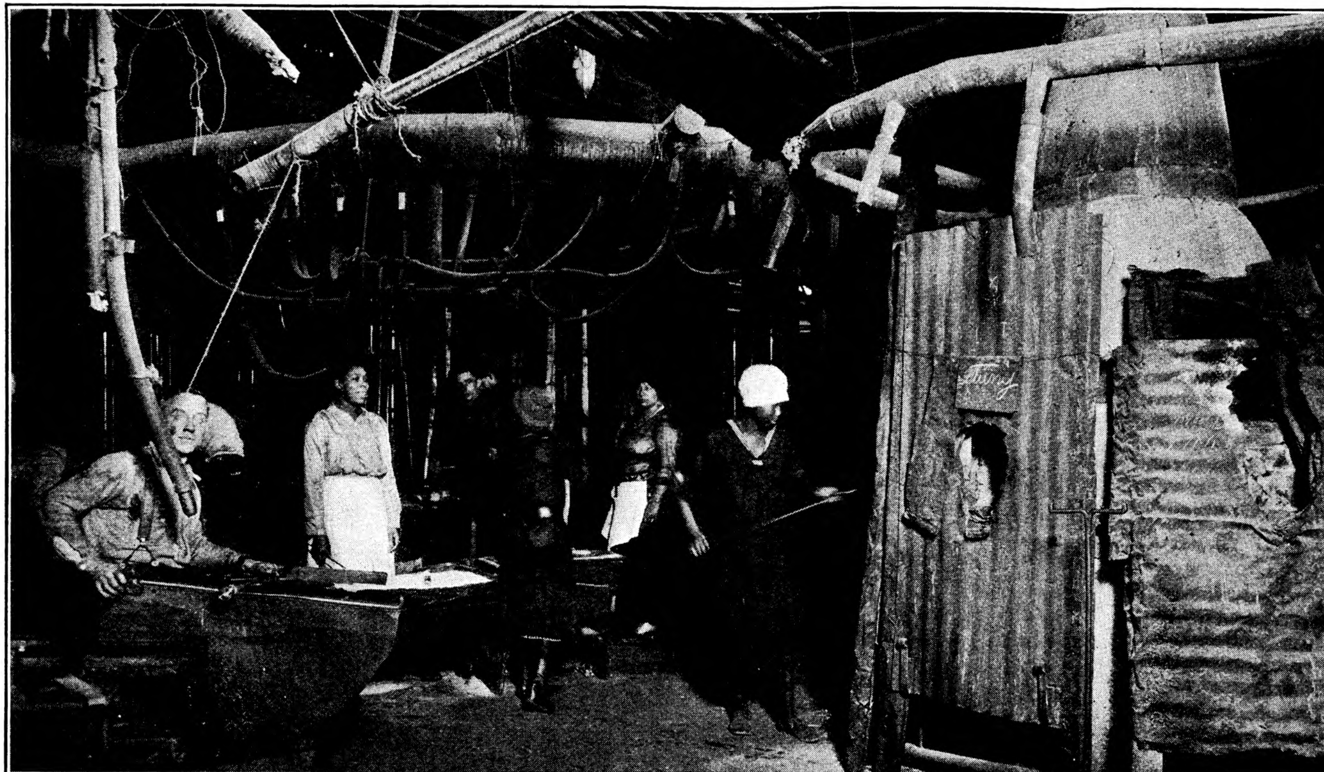

FIG. 18.—FINISHING BLOWN WARE. GLORY HOLE SHOWN AT RIGHT

foot treadle or by electric power. The rapidly rotating tumbler is pressed against a grinding stone which smooths and evens off the edges of the tumbler.

Some grinding machines carry only 3 to 4 chucks, but there are machines with 20 or more. The work of the operator consists in inserting the tumbler in the chuck and then taking it out of the machine when the edge has been smoothed. This is also done almost exclusively by women. It is estimated that an average operator could grind all of the ware blown by four shops, and the equivalent of one-fourth of the labor of a grinding operator must therefore be added to each shop.

The next step is to clean from the tumblers the glass particles and the sand left by the grinding machine. The wiping off is done by hand, either with dry rags or some cleansing powder. It is estimated that one girl is able to take care of two grinding machines, and the equivalent of one-eighth of the labor of a wiping-off girl must therefore also be added to each shop blowing tumblers by hand.

The final operation is to fire polish the edges of the tumblers. This work is done by a glazing machine similar to those used and described in the case of pressed tumblers (see p. 91). The machine is tended by two girls, one of whom places the tumblers in the revolving spindles of the machine, while the other takes them out of the machine when the glazing is finished. The two operators, working together, can thus take care of approximately four grinding machines, and the equivalent of one-eighth of the labor of a glazing operator must be added to each shop.

The total finishing labor thus to be added to each shop consists of the equivalent of one-fifth of a cutting-off operator, one-fourth of a grinding operator, one-eighth of a wiping-off girl, and one-eighth of a glazing operator. After the tumblers are finished, they are ready to be assorted and packed.

AUTOMATIC PROCESS

The Westlake machine, devised chiefly for the purpose of making electric-light bulbs, is also used to a large extent in making punch tumblers. With the exception of the difference in molds, the process of blowing is exactly the same as in the case of electric-light bulbs (see pp. 121–125).

The tumbler blown by the automatic process looks very much the same as the blank tumbler blown by hand. This blank must also undergo a finishing process before the tumbler is complete, but the finishing method used with the Westlake machine [1] is decidedly different from the process described above. From the blowing machine the blank tumblers are delivered by an automatic conveyor to the so-called burning machine. By this device [2] the process of cutting off, grinding, wiping off, and glazing are combined into one operation and the tumbler emerges from the machine completely finished but for the annealing process. One of the operators in charge of this device feeds it and the other takes the finished tumblers out of the machine and transfers them to the small leer located within reach. The amount of annealing required in this process is con-

[1] It may also be used with any other blown article, whether by hand or machine.
[2] Unfortunately the company refused to permit its description here, on account of pending patent.

siderably less than that in the hand-blown tumbler. It takes but 16 minutes to transform the bit of molten glass automatically gathered by the machine into a completely finished tumbler, ready to be assorted and packed. It takes more than two hours to accomplish the same thing in the case of a hand-blown tumbler.

MAN-HOUR OUTPUT AND LABOR COST

Table 29 contains a comparison of man-hour output of a 9–10 ounce punch tumbler made by hand and by the Westlake automatic machine. The average output of a hand shop is 25.69 tumblers per man-hour, as compared with the machine output of 364.57 tumblers. Expressed in terms of index numbers, taking the man-hour output of a hand plant as the base, or 100, the index for the Westlake automatic machine is 1419.1, or more than 14 times that for the hand process.

The table also shows a comparison of the direct labor cost of making a 9–10 ounce punch tumbler by the two processes. While the direct labor cost of blowing one hundred 9–10 ounce tumblers by hand amounts to $1.90, the corresponding cost on the Westlake machine is only 13.3 cents. For every dollar spent on production of punch tumblers by hand, it cost only 7 cents to make them by machine, a saving in labor cost of 93 cents on every dollar.

There are very few common punch tumblers still made by the hand process, those that are so made being chiefly of odd shapes and sizes. Most of the common punch tumblers are being made either on the Westlake automatic machine, or on the lamp chimney semiautomatic machine as a by-product of lamp chimneys. Not being able to compete with the machine in terms of quantity, the hand plants are specializing on a better quality tumbler, with particular emphasis on etchings and decorations to appeal to individual tastes. The situation here is similar to the novelty field in the pressed-ware branch of the glass industry.

TABLE 29.—*Comparison of man-hour output and labor cost of 9–10 ounce punch tumblers blown by hand and by machine*

Process	Man-hour output		Labor cost	
	Quantity	Index number	Amount per 100	Index number
	Pieces			
Hand production	25.69	100.0	$1.900	100.0
Westlake machine	364.57	1419.1	.133	7.0

STATISTICS OF PRODUCTION AND LABOR COST

The data given in Table E cover two plants, one where the punch tumblers are produced by hand, and the other where the older type of Westlake machine is used. In the case of hand production the labor unit chosen consists of the blowing shop, to which is added such labor of the finishing department as is needed to cut off, grind, polish, and glaze the tumblers before they are complete. The proportions of this labor have been determined by estimating the number of finishing workers needed to take care of all ware produced by all the blowing shops. The number of the different kinds of workers, such as cutters, glazers, grinders, etc., varies from plant to plant, depending largely on the sizes of the ware produced and the skill of the individual employees, but the total percentage of finishing labor needed in addition to each blowing shop, is comparatively small and varies but little from plant to plant. The figures given in the table may therefore be taken as more or less representative of all hand plants.

In the case of the automatic machine, the workers on a single machine have been taken as the production unit. Where a worker tended more than one machine, only that part of his labor has been taken which was allotted to a single machine. As each machine is provided with a single finishing device, there was no need of estimating the proportions of finishing labor needed for each blowing unit.

Each section of the table is divided into two parts—labor unit, and output and labor cost. The first part gives the number and kind of workers engaged in the process, their rates of wages per 100 pieces and per hour, and the total labor cost of operating one unit per hour. The second part gives the total number of tumblers made, the shop or machine hours used in the production of the quantity of tumblers given, the output per shop or machine hour, the man-hour output, and the labor cost of making one hundred 9–10 ounce punch tumblers.

Table E.—PRODUCTION AND LABOR COST IN MAKING PUNCH TUMBLERS BY HAND AND BY MACHINE

9–10 OUNCE PUNCH TUMBLERS—HAND

[Italicized figures represent minimum and maximum]

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
	Blowing:				1925	*Pieces*		*Pieces*	*Pieces*	
1	Blower	$0.660			Jan	22,004	176.00	125.02	26.60	$1.876
1	Gatherer	.528			Feb	3,876	30.00	*129.20*	*27.49*	*1.854*
1	Cracking-off boy		$0.325	$0.325	Mar	11,954	97.63	122.44	26.05	1.891
1	Carry-in boy		.325	.325	Apr	7,552	68.50	110.25	23.46	1.968
	Finishing:				May	5,705	49.75	114.67	24.40	1.938
1/5	Cutting-off girl		.300	.060	Aug	2,020	19.25	*105.00*	*22.34*	*2.007*
1/4	Grinding girl		.300	.075	Sept	1,468	12.25	119.84	25.50	1.906
1/8	Wiping-off girl		.300	.038	Oct	11,568	98.25	117.74	25.05	1.918
1/8	Glazing girl		.300	.038	Nov	8,946	76.25	117.32	24.96	1.921
					Dec	13,905	109.25	127.28	27.08	1.864
4 7/10	Total	1.188		.860	Total	88,998	737.13	120.73	25.69	1.900

9–10 OUNCE PUNCH TUMBLERS—AUTOMATIC WESTLAKE MACHINE

Number of workers	Occupation	Wage rates per 100	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100
1/4	Chief operator		$0.80	$0.20	1925					
1	Machine operator		.55	.55	Sept	86,064	78.17	*1,100.99*	*338.76*	*$0.143*
1	Burn-off operator		.45	.45	Oct	296,238	254.50	1,164.00	358.15	.135
1	Leer man		.37	.37	Nov	154,728	128.13	1,207.59	371.56	.130
					Dec	149,648	118.75	*1,260.20*	*387.75*	*.125*
3 1/4	Total			1.57	Total	686,678	579.55	1,184.85	364.57	.133

BLOWN WARE: GLASS TUBING

MAKING GLASS TUBING BY HAND

In the process of making glass tubing by hand the work is done by a unit of workers, the shop, consisting of eight men—four skilled workers and four unskilled or semiskilled helpers. The skilled workers, arranged in the order of their importance, are: The gaffer (blower), the marverer, the ball maker, and the gatherer. The four helpers are the carry-over boy, the punty boy, the drawing boy, and the cutting boy.

The process of drawing glass tubing by hand may briefly be described as follows: Standing in front of the pot of molten glass, the gatherer inserts his long and heavy pipe into the molten mass, and by skillful manipulation accumulates at the end of the pipe the first bit of glass. He then withdraws the pipe and shapes the glass into a round ball by first marvering it on a flat and smooth surface and then blocking it in a wooden receptacle filled with water to cool the outer surface of the ball. He then returns it to the pot and makes a second gathering of glass over the formed ball, again marvers and blocks it, and then turns it over to the ball maker. The latter makes a third and final gathering of glass, at which time the ball on the end of the pipe weighs on the average from 30 to 40 pounds. After swinging the pipe several times forward and backward, at the same time blowing lightly into the pipe, the ball maker hands it over to the marverer, who, by repeated blowing, marvering, and blocking the glass, puts it into shape to be drawn.

In the meantime the punty boy has heated his punty, consisting of a large iron disk attached to an iron rod. The gaffer, to whom the carry-over boy has brought the pipe with the ball of glass ready to be drawn, lifts it over the punty, allowing the outer surface of the glass ball to become attached to the disk of the punty. The drawing boy then lifts the punty from the floor and begins to move away from the gaffer, pulling with him the glass, which has become firmly fastened to the punty. The gaffer, while continuously blowing into his pipe to keep the inside of the tube hollow, walks slowly in the opposite direction from the drawing boy, thus drawing out the glass to the required thinness. When the drawing is finished, the cutting boy, with the help of a file, cuts the usable part of the tubing into required sizes and throws the waste into a cullet receptacle. It is estimated that only 25 to 30 per cent of the tubing thus drawn by hand is good tubing, the rest going back into the melting pot as cullet.

MAKING GLASS TUBING BY MACHINE

The Danner apparatus for the making of glass tubing may best be described as a process rather than as a single piece of machinery. As in the case of hand-made tubing the raw materials are first melted in regular furnace pots, except that the molten glass is heated to a

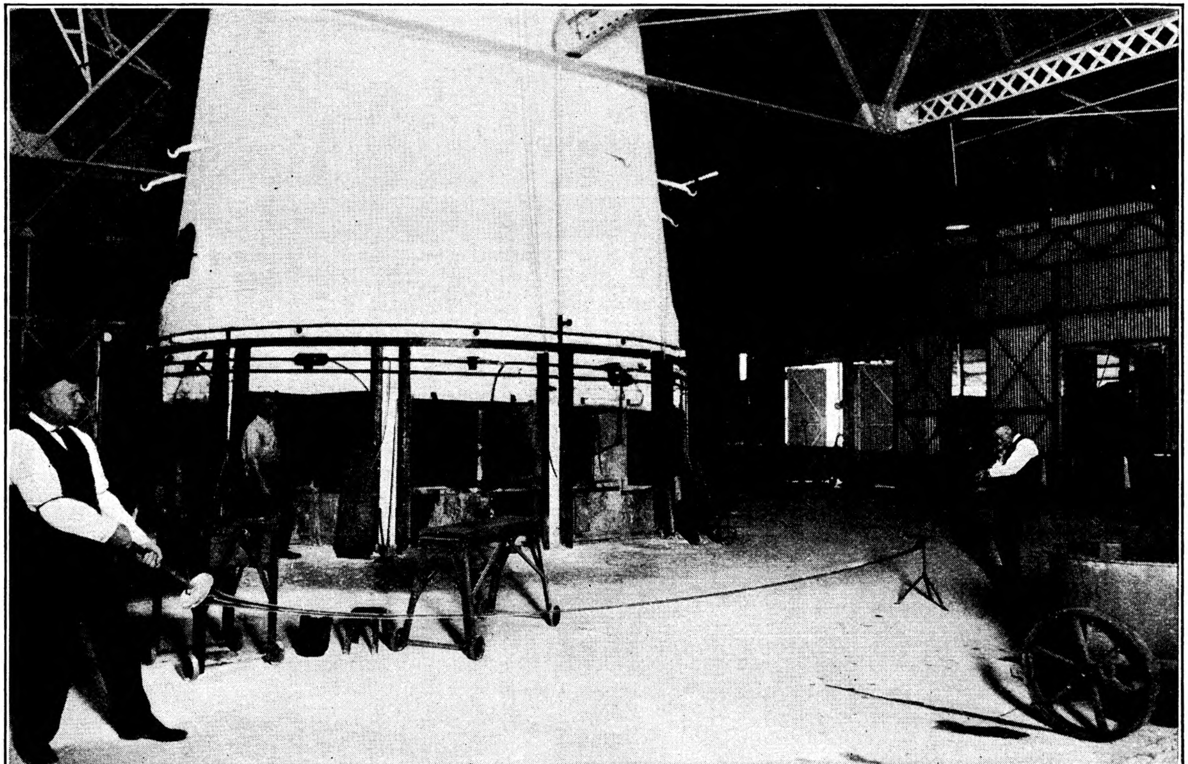

FIG. 19.—DRAWING GLASS TUBING BY HAND

higher temperature than that needed for hand production. When the glass has been sufficiently heated it is transferred by means of a large ladle from the melting pot to the drawing furnace. The ladle, which is about 13 feet long, holds from 40 to 45 pounds of molten glass. It takes a special man, a ladler, and a helper to ladle the glass from the pot into the furnace.

The drawing furnace constitutes the principal element of the Danner tube-drawing machine. It consists of two separate chambers so arranged that the glass flows from the first chamber into the second by gravity. A system of gas burners keeps the glass in the two chambers at the required temperature. Within the second chamber is located a mandrel, or iron blow pipe, one end being connected by means of valves with an air tank outside the furnace, and the other end protruding from the front opening of the furnace where the glass is drawn. The portion of the mandrel within the chamber is protected by a shell of fire clay or other suitable heat-resisting material. The clay shell is usually of a conical form, tapering gradually toward the drawing opening of the furnace. The mandrel, which inclines forward in a fixed position, is kept in constant rotation by an intricate system of cams and wheels.

As the glass flows into the second chamber from the first, some of it is caught up by the rotation of the mandrel and winds itself around the mandrel, at the same time slowly moving of its own weight down toward the tapering end of the mandrel. This double motion of the glass causes it to acquire a cylindrical form by the time it reaches the drawing opening of the furnace. By this time also it has cooled sufficiently and become sufficiently ductile to make it possible to draw it from the mandrel without breaking. The continuous and regular passing of air from the air tank through the pipe into the soft glass perforates the interior of the cylinder of glass drawn and gives it a tubular shape. The size of the tubing thus drawn depends on the amount of air passing through the mandrel, on the temperature of the glass at the point at which it leaves the mandrel, and on the speed of drawing.

The drawing apparatus is usually located some distance away from the furnace, this distance varying from 100 to 150 feet. On its route from the drawing furnace to the drawing machine, the glass tubing is supported by a trough containing a series of pulleys (see Fig. 20). The drawing machine consists of two endless chains one above and one below the tube, running on sprocket wheels. The chains are equipped with gripping pads and rollers, which serve to hold the tubing and to exert the pulling force. The space between the two chains can be easily adjusted to the diameter of the tubing to be drawn.

Upon leaving the drawing machine the tubing passes over a short table, the end of which is pressed upward by a spring. This pressure serves to hold the glass tubing against a cutting wheel, which descends periodically and cuts the glass. The movements of the wheel are synchronized with the forward movement of the glass tubing, so that the pieces cut by the wheel are uniform in length. From the cutting machine the pieces slide off automatically to a platform attached to the table, from which they are easily removed by an attendant or by the drawing operator (see Fig. 21).

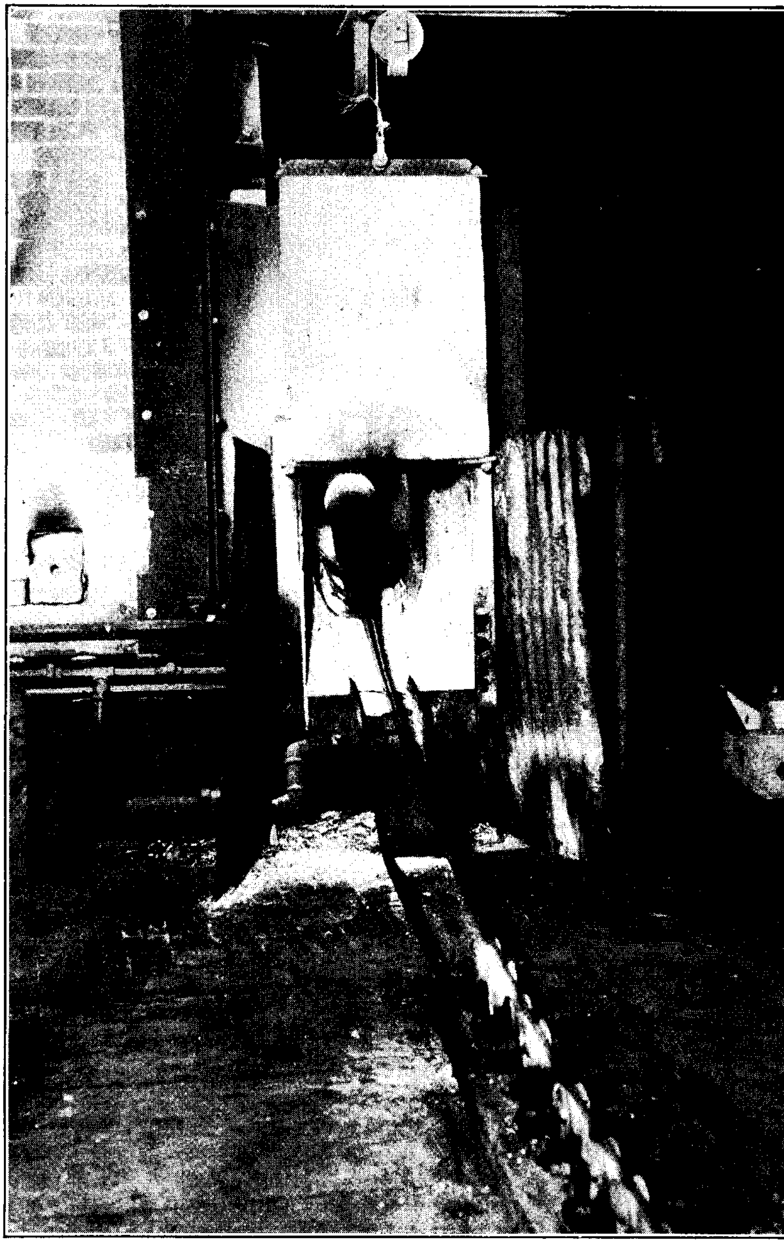

FIG. 20.—DANNER DRAWING MACHINE: DRAWING FURNACE

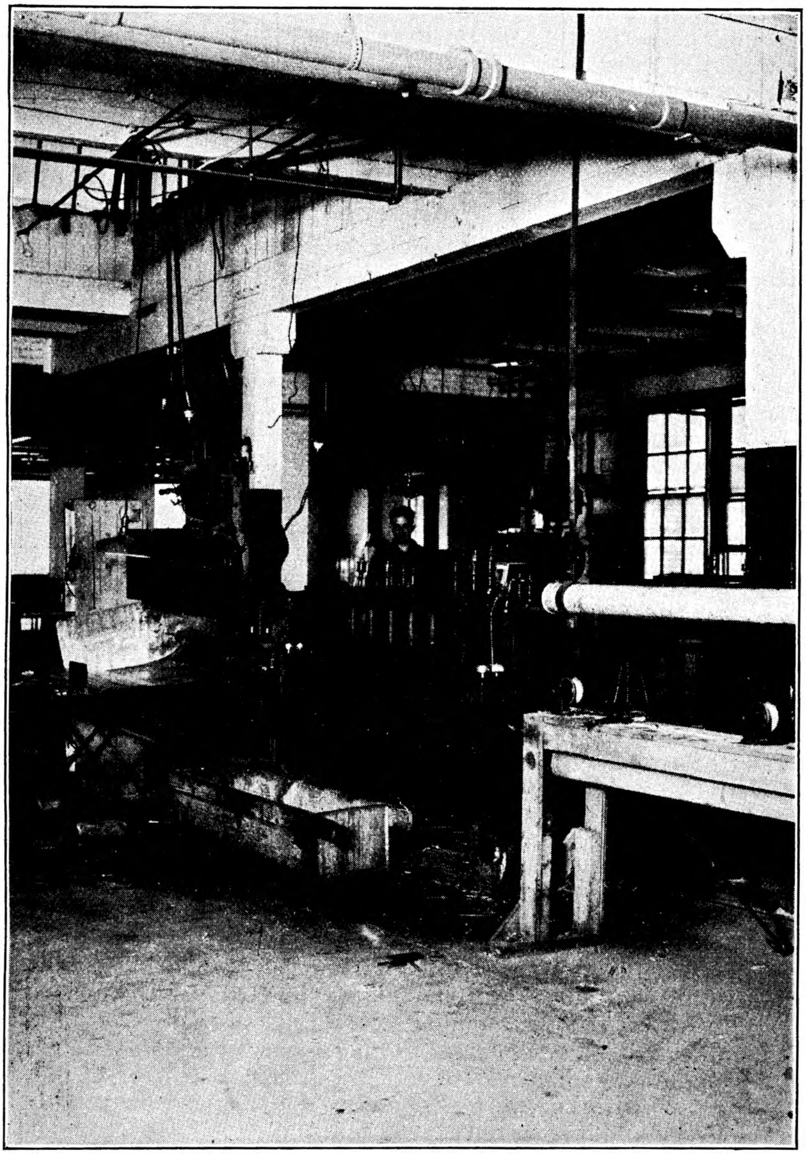

FIG. 21.—DANNER DRAWING MACHINE: DRAWING AND CUTTING APPARATUS

With the exception of the ladling of the glass from the pot to the drawing furnace, this process of drawing tubing by machine requires absolutely no skill or physical labor of any kind. The actual work of drawing and cutting the tubes is entirely automatic, the only labor required being in the nature of supervision—to see that the machine is working properly and that the drawing is resumed when a breakage occurs in the glass.

The tubing produced by the machine is far superior to and more uniform than any produced by the hand process. In spite of the increased uniformity, however, the pieces must still be gauged as to their exact sizes. This is done by a special gauging machine, which automatically grades the tubing into from six to eight sizes. The machine contains a special compartment for each size, the entrance to which is barred by two levers which are extremely sensitive as to weight. As the piece of tubing rolls along the platform on the surface of the machine it strikes the levers of the first compartment. If the piece is of the proper weight the levers give way and it enters the compartment; if it is of a different weight it is automatically propelled from compartment to compartment until it reaches its correct destination. The gauging operator periodically removes the graded tubes from their compartments to the warehouse, where they are either packed ready for shipment or subjected to any additional handling that may be needed for the special use for which they are destined.

MAN-HOUR OUTPUT AND LABOR COST

Table 30 shows a comparison of man-hour output of glass tubing made by hand and by machine. The average man-hour output of glass tubing drawn by hand is 9.967 pounds of sizes 19 to 21, ranging from 0.1371 to 0.1688 inch in diameter and 10.067 pounds of sizes 32 to 34, ranging from 0.3368 to 0.4156 inch in diameter. The man-hour output of the Danner machine is 58.932 pounds for sizes 19 to 21 and 75.169 pounds for sizes 32 to 34. Taking hand production as the base, or 100, the increase in man-hour output caused by the Danner machine ranges from 491.9 per cent in tubing of sizes 19 to 21 to 646.7 per cent in sizes 32 to 34. The big difference in increase of output in the two types of tubing is due to the fact that within definite limits the larger the diameter of the tubing, the larger the quantity of glass drawn by the machine per hour.

The table also contains a comparison of the direct labor costs of making the two types of tubing by hand and by machine. On the smaller sizes, 19 to 21, the direct labor cost of blowing tubing by hand amounts to $6.905 per 100 pounds, while by the machine process it is only $1.281 per 100 pounds. Similarly, on sizes 32 to 34, the direct labor cost of blowing the tubing by hand amounts to $6.830 per 100 pounds, as contrasted with the machine cost of $1.004 per 100 pounds. In other words, for every dollar spent on production of tubing by hand it costs only 18.55 cents on sizes 19 to 21 and 14.70 cents on sizes 32 to 34. The saving in direct labor cost thus effected by the Danner machine ranges from 81.45 to 85.30 cents for every dollar spent on blowing glass tubing by hand.

The Danner machine described above is still in a semiautomatic stage in the sense that the glass needs to be ladled by hand from the melting pot to the drawing furnace. Nevertheless, the large increase in man-hour output, coupled with a correspondingly large decrease in direct labor cost of production on the one hand, and the very great improvement in the quality of tubing effected by the machine on the other hand, have resulted in the almost complete elimination of hand production in favor of the machine. It is probably the only branch in the glass industry where, in addition to larger output and lower labor cost, the machine product is so much superior to that made by hand that no reason whatever remained for the continued existence of hand production. The Danner apparatus was patented in 1917. In 1926 production of glass tubing by hand was a thing of the past, a mere memory to the surviving tube blowers, who had been compelled either to abandon their trade or to adjust themselves to the new process.

TABLE 30.—*Comparison of man-hour output and labor cost in glass tubing made by hand and by machine*

Man-hour output

Process	Sizes 19 to 21		Sizes 32 to 34	
	Quantity or amount	Index number	Quantity or amount	Index number
	Pounds		*Pounds*	
Hand production	9.957	100.0	10.067	100.0
Machine production	58.932	591.9	75.169	746.7
Labor cost (per 100 pounds)				
Hand production	$6.905	100.00	$6.830	100.00
Machine production	1.281	18.55	1.004	14.70

STATISTICS OF PRODUCTION AND LABOR COST

Two groups of glass tubing have been used to compare the productivity of labor in making tubing by hand and by machine. The first group contains the commercial sizes 19 to 21, which are extremely thin, ranging in diameter from 0.1371 to 0.1688 inch, and averaging from 1,100 to 890 inches per pound of glass drawn. The second group contains the commercial sizes 32 to 34, which range from 0.3368 to 0.4156 inch in diameter and average from 270 to 216 inches per pound of glass drawn. Table F shows data for each group of tubing separately.

The data on machine production are given by months for the year 1925. As by that time the machine had completely displaced hand production in making glass tubing, the statistics of hand production refer to earlier periods. In all cases, however, the rates of wages shown are those prevailing in the plants during 1925.

Each section of the table is divided into two parts—labor unit, and output and labor cost. The first part contains the number and kind of workers constituting a production unit, such as a shop or a machine, the rates of wages paid, and the labor cost per hour of operating a shop or a machine. The second part gives the actual quantities of tubing made, the number of shop or machine hours worked, the output per shop or machine hour, the output per man-hour, and the labor cost per 100 pounds of glass tubing produced.

TABLE F.—PRODUCTION AND LABOR COST IN MAKING GLASS TUBING BY HAND AND BY MACHINE

SIZES 19 TO 21 (1,100 TO 890 INCHES PER POUND)—HAND

[In this table all wage rates are for 1925 and labor cost is based on 1925 wage rates regardless of year of output data. Italicized figures represent minimum and maximum]

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 lbs.
1	Gaffer (blower)	$1.00	$1.00	1917	*Lbs.*		*Lbs.*	*Lbs.*	
1	Marverer	.90	.90	Jan.-June	240,176	2,977.55	*80.662*	*10.083*	*$6.819*
1	Ball maker	.85	.85	July-Dec.	326,536	4,112.30	79.404	9.926	6.927
1	Gatherer	.75	.75						
1	Carry-over boy	.50	.50	1918					
1	Punty boy	.50	.50	Jan.-June	137,506	1,744.52	*78.822*	*9.653*	*6.978*
1	Drawing boy	.50	.50	July-Dec.	116,958	1,474.33	79.330	9.916	6.933
1	Cutting-up boy	.50	.50						
8	Total		5.50	Total	821,176	10,308.70	79.658	9.957	6.905

SIZES 19 TO 21 (1,100 TO 890 INCHES PER POUND)—DANNER MACHINE

2/5	Machine foreman	$1.25	$0.50	1925					
1	Ladler	.70	.70	Jan.	72,670	314.75	230.880	57.720	$1.308
1/5	Assistant ladler	.70	.14	Feb.	93,160	456.50	*204.074*	*51.018*	*1.471*
4/5	Furnace operator	.70	.56	Mar.	130,470	579.00	225.337	56.334	1.340
1	Drawing operator	.70	.70	Apr.	228,190	1,036.50	220.154	55.038	1.372
3/5	Gauging operator	.70	.42	May	151,280	711.25	212.696	53.074	1.420
				Aug.	19,875	73.50	270.409	67.602	1.117
				Sept.	88,200	302.25	291.820	72.955	1.035
				Oct.	76,300	262.00	291.230	72.807	1.037
				Nov.	82,823	264.50	*313.131*	*78.283*	*.965*
4	Total		3.02	Total	942,968	4,000.25	235.727	58.932	1.281

SIZES 32 TO 34 (270 TO 216 INCHES PER POUND)—HAND

1	Gaffer (blower)	$1.00	$1.00	1917					
1	Marverer	.90	.90	Jan.-June	364,064	4,558.13	79.871	9.984	$6.886
1	Ball maker	.85	.85	July-Dec.	443,565	5,574.30	79.573	9.947	6.912
1	Gatherer	.75	.75						
1	Carry-over boy	.50	.50	1918					
1	Punty boy	.50	.50	Jan.-June	409,981	4,938.92	83.010	10.376	6.626
1	Drawing boy	.50	.50	July-Dec.	212,580	2,559.99	*83.039*	*10.380*	*6.624*
1	Cutting-up boy	.50	.50	1919					
				Jan.-June	91,962	1,268.84	*72.480*	*9.060*	*7.588*
8	Total		5.50	Total	1,522,152	18,900.18	80.536	10.067	6.830

SIZES 32 TO 34 (270 TO 216 INCHES PER POUND)—DANNER MACHINE

2/5	Machine foreman	$1.25	$0.50	1925					
1	Ladler	.70	.70	Jan.	155,290	602.25	*257.850*	*64.462*	*$1.171*
1/5	Assistant ladler	.70	.14	Feb.	240,988	784.75	307.089	76.772	.983
4/5	Furnace operator	.70	.56	Mar.	163,020	520.75	313.050	78.262	.965
1	Drawing operator	.70	.70	Apr.	161,450	538.50	299.805	74.951	1.001
3/5	Gauging operator	.70	.42	May	208,745	741.75	281.422	70.355	1.073
				June	152,175	471.00	323.089	80.772	.935
				July	151,369	512.50	295.355	73.839	1.023
				Aug.	127,280	405.25	314.080	78.520	.962
				Sept.	72,865	217.00	*335.784*	*83.946*	*.894*
				Oct.	179,840	548.25	328.026	82.006	.921
				Nov.	147,239	457.50	321.834	80.458	.938
				Dec.	218,020	779.50	279.692	69.923	1.080
4	Total		3.02	Total	1,978,281	6,579.00	300.696	75.169	1.004

CHAPTER III.—WINDOW GLASS

The advent of the twentieth century found the window-glass branch of the glass industry in the United States and elsewhere still in the most primitive stage of hand production. True, the old method of making "crown glass," by first blowing the glass into a large hollow sphere and then flattening it into a disk from which the window panes were cut, had been completely abandoned, and the cylinder process had been introduced, which made it possible to produce considerably larger panes of window glass than could be accomplished by the "crown-glass" method. But this change was simply a change in the technique of blowing glass, the process itself remaining, as it had been for centuries, essentially a hand process.

MAKING WINDOW GLASS BY HAND

The process of making window glass by hand consists of three distinct operations: (1) Blowing the cylinder, (2) flattening it into sheet glass, and (3) cutting the sheet into the proper window-glass sizes. The group of workers, or the shop, engaged in the first operation of blowing the cylinder is made up of two skilled workers, the blower and the gatherer, and one unskilled or semiskilled helper, termed the "snapper." The actual process of blowing the cylinder may be described as follows: The gatherer first puts his pipe into a small furnace and heats the nose of the pipe to the temperature necessary for the molten glass to stick to it. The pipe is a heavy iron tube about 5 feet long, with a wooden sleeve and a mouthpiece at one end, while the other end is shaped like a cone with a round end and is called the nose of the pipe. Standing in front of the opening of the tank or the pot, the gatherer inserts the nose of the pipe in the molten glass and makes the first gathering, usually termed the "punny." This he carries to an iron tub with running water which stands near by, and, for the purpose of cooling the pipe, places it in the notches provided. After the pipe is sufficiently cooled he gathers another batch of glass and proceeds again to cool the pipe in the same manner as before. The second batch of glass is called the "first glass." Two or three more gatherings are necessary before the exact quantity of glass, or the "lump," is accumulated on the nose of the pipe. During these alternate gatherings of the glass and cooling of the pipe the gatherer continuously blows into the pipe while constantly rotating it with his hands, thus giving to the adhering mass of glass a shape as nearly spherical as possible. The quantity of glass gathered depends upon the strength of the window glass and the size of the cylinder wanted, and its weight varies from 25 to 40 pounds. When to this weight is added that of the iron pipe, 10 to 15 pounds, the strenuous nature of the work of making window glass by hand becomes evident.

When the lump is sufficiently cooled the gatherer takes it to the "blow block," a rounded wooden or iron block about 14 inches in diameter, hollowed to a depth of about 6 inches. The block is set in water and is lined with charcoal to prevent the surface of the glass ball from becoming marred by direct contact with the iron. Here, without ceasing to rotate the ball in the block, the gatherer turns the pipe over to the blower. The latter continues to rotate the pipe and at the same time blows enough air into the glass to distend it to the size required for the cylinder to be blown. When this is done the blower turns the pipe with the ball of glass over to the snapper, who carries it to the "blow furnace."

The blow furnace is a small furnace heated to a very high temperature. It is provided with a wide opening or door to permit the entrance of the enlarged ball of glass, while the pipe rests on a short iron bar extended from a swing door in front of the furnace. The blower again takes charge of the ball, and, keeping it in constant rotation, exposes it uniformly to the high temperature in the furnace. He then withdraws it from the furnace and lowers it into the pit, or "swing hole," which is about 2 feet wide, 8 feet long, and 6 to 8 feet deep. Continuing to rotate the pipe and at the same time blowing air into the glass, the blower permits the softened mass to run down from the end of the pipe so that it gradually assumes an elongated shape like a pear. When the glass is cooled to the proper temperature the blower swings the pipe several times back and forth in the swing hole, allowing the glass to stretch until it is thoroughly chilled. After that he swings the cylinder out of the hole, and, resting the pipe on the crane of the swing door in front of the furnace, puts the glass back into the blow furnace to be reheated. He then again stretches the glass, swinging it back and forth in the swing hole until it is too cool to stretch, and repeats the operations of reheating and stretching the glass until it finally assumes the proper dimensions for the cylinder wanted.

The cylinder is again turned over to the snapper, who returns it to the blow furnace in such a position as to expose the center of the closed end of the cylinder to the most violent heat. After blowing a few puffs of air into the glass he swings the entire cylinder into the furnace and puts his finger over the "beebe," or mouthpiece of the pipe so as to allow no air to escape. The air confined in the cylinder expands and finally bursts the cylinder at the point where the glass is most exposed to the heat—the center of the closed end of the cylinder. Then, for the last time, the blower takes charge of the pipe. When the glass cylinder in the furnace is sufficiently reheated he withdraws it from the furnace and by swinging it forward and backward in the swing hole and at the same time dexterously manipulating the pipe he widens the small hole caused by the escaped air to the exact size of the cylinder proper. This marks the end of the extremely skillful and at the same time very strenuous operation of blowing a cylinder of glass by hand. The work is performed absolutely without the aid of tools or gauging devices, and it is remarkable how uniform the circumference of the cylinder and the thickness of the glass are when the work is completed.

The snapper then lifts the cylinder from the swing hole and places it in a horizontal position upon wooden supports, termed the "horse." He touches the neck of the cylinder, or that portion of it next to the nose of the pipe, with a wet iron, which starts a crack in the glass, and by gently tapping the pipe he breaks it loose from the cylinder. With a small rod the snapper then gathers a bit of glass, draws it out

Fig. 22.—HAND PROCESS: REHEATING BLOWN CYLINDER AND SWINGING IT OVER PIT

with a pair of pincers into a thin, long thread and wraps it around the blowing end of the cylinder where the cylinder proper begins. The hot thread of glass creates a narrow zone of a temperature considerably hotter than the rest of the cylinder. By applying a cold iron to this zone the snapper easily separates the main body of the cylinder from the superfluous glass, known as the "cap." This operation is termed "capping off," and the worker performing it is sometimes called the "capper." The next operation, also performed by the snapper, is to split the cylinder open. He sprinkles some sawdust into the inside of the cylinder, and by passing a heated iron rod up and down through the sawdust he breaks the cylinder open along the course of the hot iron. This operation is called splitting, and the worker is termed the splitter.

The cylinder is now ready to be flattened, and the roller boy takes it to the flattening house and places it in a position accessible to the flattening crew.

The group of workers engaged in the operation of flattening a cylinder into a sheet of glass is made up of one skilled worker, the flattener, and two unskilled helpers, the shove-in boy and the leer tender. Briefly, the operation is performed as follows: The shove-in boy places the split cylinder on an elevated rail track and shoves it into the flattening oven, which is usually heated to a degree just sufficient to soften the glass but not to melt it. Standing in front of the opening of the oven, the flattener lifts the glass upon the heated flattening stone in the oven, and by means of a long iron rod first flattens the cylinder of soft glass into a sheet and then rubs it smooth with a "flattening block," which is a wooden block attached to a long bar. From the flattening oven the sheet is transferred to the annealing oven, which is merely a continuation of the flattening furnace. As the sheet emerges from the cold end of the leer the leer tender gives it an acid bath to clean it from the adhering alkali and then transfers it to the cutting room. There it is examined and cut into the required sizes, and then packed into wooden boxes ready for shipment.

CYLINDER-MACHINE PROCESS

Attempts to replace by a machine process the strenuous work of blowing glass cylinders by hand date back as far as 1885, but it was not until the Lubbers machine was patented in 1905 that the process became a marked success. Since then, in spite of the big inroads made by the more recent introduction of completely automatic processes of drawing flat glass directly from the tank, the cylinder machine has been the dominating factor in the window-glass branch of the glass industry of this country.

The process of making window glass by the cylinder machine can be divided into several distinct operations: (1) Ladling the molten glass from the tank into the pots; (2) blowing the cylinder; (3) capping and splitting the cylinders; (4) flattening the cylinder into sheet glass; and (5) cutting the sheets into window-glass sizes. The number of operations and of workers in the machine process is considerably larger than in the hand process. The principal advantages of this machine lie in the fact that it dispenses entirely with the highly skilled services of the gatherer and the blower and is capable

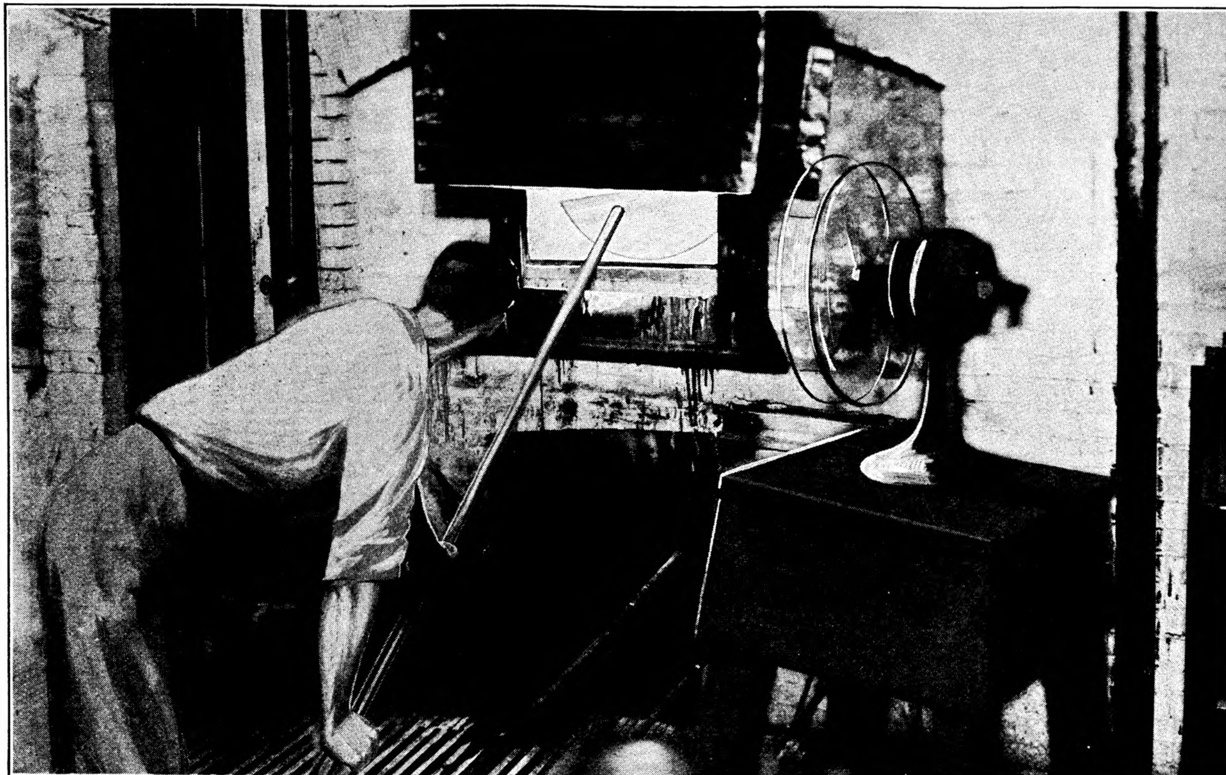

Fig. 23.—HAND AND CYLINDER MACHINE PROCESS: FLATTENING THE CYLINDER INTO SHEET GLASS

of producing cylinders more than twice as large in diameter and nearly five times as long as the cylinders made by the handworkers.

The process may briefly be described as follows:

Ladling out the glass.—The ladling crew, which cares for from four to six machines, consists of three workers—the "ladler," the "skimmer," and the "back ladler," a "pot scraper" being sometimes added to this crew. Their work is to transfer the molten glass from the refining chamber of the tank to the pot from which the glass is drawn. This is accomplished with the help of a large iron ladle, which holds from 700 to 800 pounds of molten glass. The handle of the ladle is suspended from a pulley running on a monorail, thus making it easier to handle the large quantity of glass. The ladler, with the assistance of the skimmer and the back ladler, inserts the ladle in the working opening of the furnace, dips it into the molten glass, and rapidly withdraws it from the tank. As the ladle emerges from the furnace it has strings and sheets of glass clinging to the edges and the outside of the bowl. These cool very rapidly and must be removed by the "skimmer" before the glass is delivered to the pot. After the strings have been removed with the help of a sharp tool, the glass is dumped into the drawing pot. A certain percentage of the glass adheres to the inside of the ladle, and this is transferred to a smaller ladle and delivered back to the melting end of the furnace by the "back ladler." In the meantime the other two men plunge the hot ladle into a large water container to cool and wash it off and thus prepare for another operation.

The drawing pot into which the glass is dumped is made of clay or other heat-resisting material. The pot is really a double pot, made in the form of two washbasins with their bottoms placed together. It rests over an insulated kiln and is supported on two axles, so that it can easily be reversed when the blowing is completed. The kiln is provided with a set of blast fires which keep the pot at approximately the same temperature as the glass in the tank. When the cylinder has been blown and removed from the pot, a certain amount of glass adheres to the bottom of the pot. The latter is then turned over, and the fires in the kiln which heat the pot also drain this residue of glass through a hole at the bottom of the kiln to the cellar, from which it is removed back to the melting end of the furnace by a worker known as the "cellarman." The fires in the kiln thus serve the double purpose of keeping the glass in the drawing pot at the temperature required for blowing, and at the same time of cleansing and reheating the other side of the pot for another ladleful of glass.

Blowing the cylinder.—The "bait" used in the blowing operation consists of a hollowed cast-iron cylindrical head about 12 inches in diameter and equipped with an inner annular ring or flange which, when the operation begins, fills up with glass and forms the support of the cylinder blown. The hollow head of the bait is screwed onto a hollow pipe supported in a vertical position by means of a fork resting on a cage or elevator. This elevator is raised and lowered by means of a cable fastened to a taper drum driven by an electric motor. The speed of the motor is controlled by an operator called the blower, who is the only worker directly engaged in the process of blowing the cylinder. The blowing pipe is connected to a long flexible hose, the upper end of which is in turn connected to a small fan driven by a motor also controlled by the blower. The speed of the two motors determines the diameter of the cylinder and the rate of its rising out of the drawing pot.

The actual process of blowing the cylinder is as follows: The pot having been filled with glass, the cage with the blowpipe and the bait is lowered until the cylindrical head of the bait is partially immersed in the glass. The molten material at once fills up the inner ring of the bait, and the cage is raised until the bottom of the bait is about 1 inch or so above the surface of the glass in the pot. The cage remains in this position for a few seconds, sufficient to cool off the glass inside the bait, which forms the support of the cylinder to be drawn. Upon the resumption of the upward movement of the cage the blower starts the fan, and air is blown through the flexible hose, through the pipe, and through the head of the bait into the soft mass of glass. Under the increasing pressure of air the cylinder, while slowly rising out of the pot, is gradually distended until it reaches the diameter desired. The blower then decreases the air pressure to a degree just sufficient to maintain that diameter. At this moment the speed of the cage, which has continued its upward movement, is accelerated gradually until the blowing is complete. This acceleration is effected automatically by the taper drum over which the cable of the cage travels, and is necessitated by the gradual cooling of the glass in the pot.

When the cylinder has reached the length required, the speed of the machine is suddenly increased in order to thin out the walls of the lower end of the cylinder, just above the level of the glass in the pot. Then the draw is stopped and the blowing operation is finished. A worker known as the snapper or the hooker approaches the suspended cylinder, and with a cold light iron hook touches its thinned portion. The contact of the cold iron with the hot glass produces a crack in the glass, and an upward movement of the cage easily lifts the cylinder above the crack, thus severing it from the glass remaining in the pot. The pot is then turned over on its axles, and the other side of it is ready for another operation.

Capping and splitting.—With the help of a hoop, which is fastened to a cable and passed over the lower end of the suspended cylinder, and an intricate system of pulleys, the cylinder, which averages from 35 to 40 feet in length, is brought down to a horizontal position and laid on a wooden "horse," similar to the one used in the hand process but correspondingly longer. The capper then proceeds, by means of an electrically heated wire, to cap off the narrower portion of the cylinder close to the bait, which is thus released from the cylinder and returned to the cage. In the same way he proceeds to cut the cylinder into several smaller cylinders, which are then transferred to the splitting room. These smaller cylinders are split into segments or "shawls," usually three to a cylinder. The process of splitting varies in different plants, but on the whole it is not much different from that employed in the hand process.

Flattening and cutting.—The shawls are removed to the flattening house, and from then on the procedure is exactly the same as employed in the hand-made cylinders. The shove-in boys place the shawl in the flattening oven to soften the glass. The flattener then flattens it out on a hot flat stone and pushes it over to the annealing oven, or leer. At the cold end of the leer the leer tender lifts the

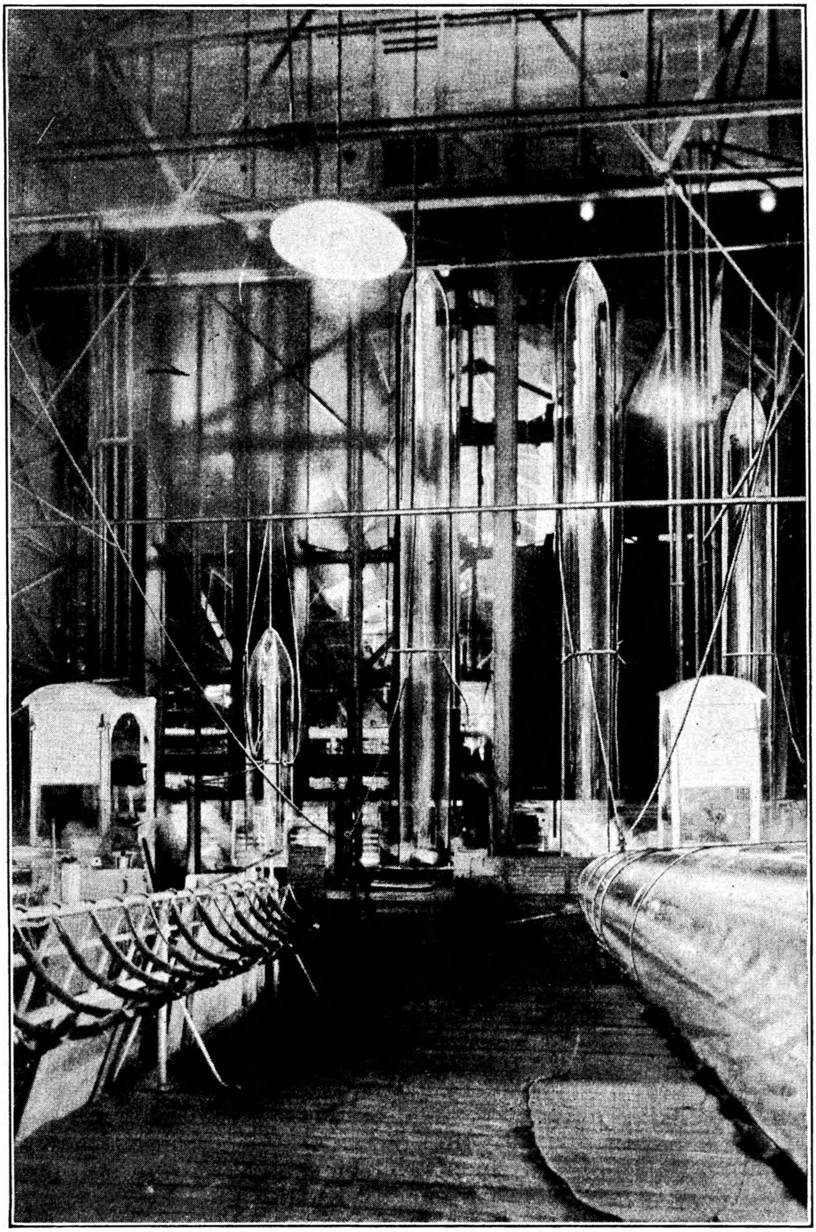

FIG. 24.—CYLINDER MACHINE PROCESS: ROW OF DRAWING MACHINES IN OPERATION

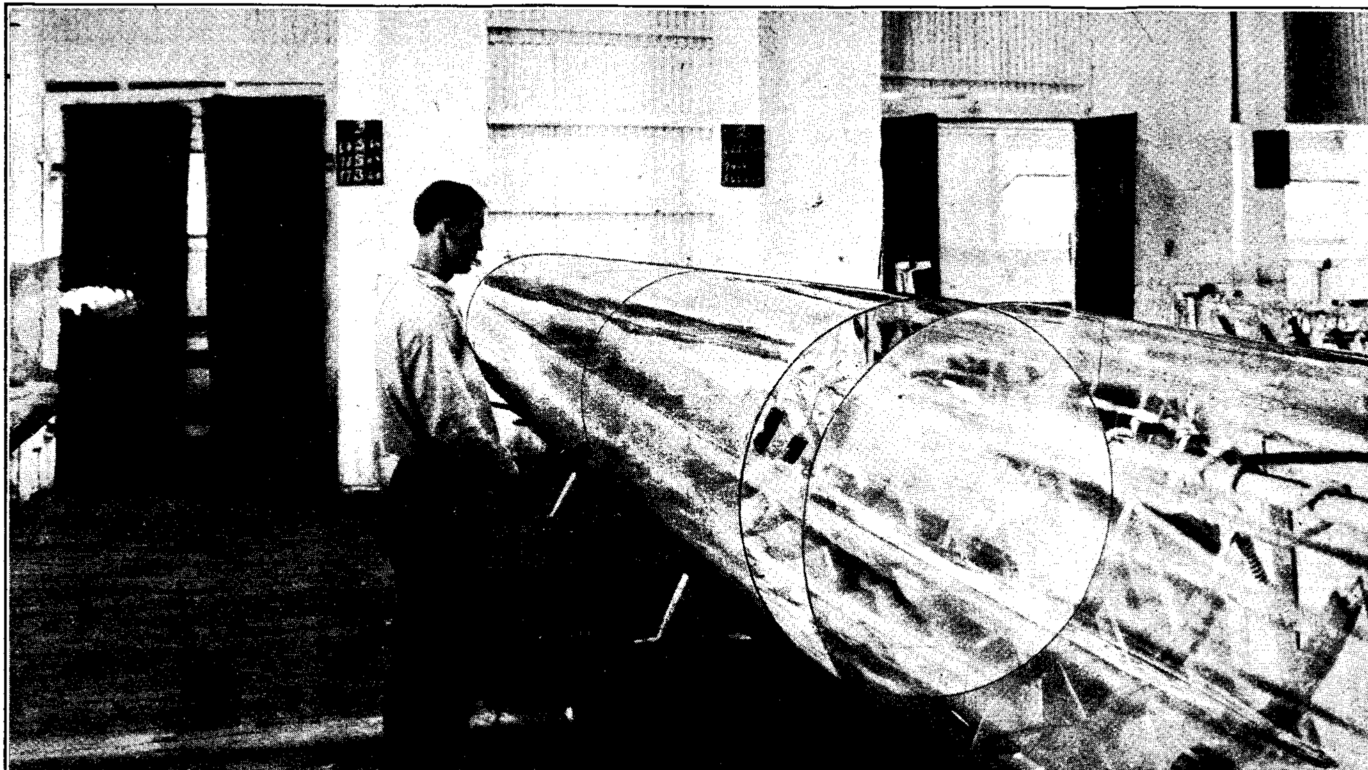

Fig. 25.—CYLINDER MACHINE PROCESS: CAPPING A LARGE CYLINDER INTO SMALLER SECTIONS

flat sheet, gives it the usual acid bath, and delivers it to the cutting department. There the sheet is examined for defects, cut into window-glass sizes, and packed in wooden boxes ready for shipment.

HAND AND CYLINDER MACHINE PROCESSES COMPARED

The essential difference between the hand and the cylinder machine processes is confined almost exclusively to the operation of blowing. The machine does away completely with the highly skilled services of the gatherer and the blower. The work of the gatherer is taken over by the ladle crew, while the blower, though the name is retained, is in reality merely a machine operator whose work and training have absolutely nothing in common with those of the hand blower. The cylinder produced by the machine is at least twice as large in diameter and more than five times as long as the hand-produced cylinder. To handle such a large cylinder requires a greater number of unskilled or semiskilled workers than is needed in hand production. For this reason the total number of workers on the cylinder machine is considerably larger than that needed in a hand shop. Where, in the hand plants, a single snapper does all the work preparatory to sending the cylinder to the flattening house, such as placing it on the "horse," capping, and splitting, in the cylinder-machine process separate workers are used for the various operations. Hence the presence of hookers, pipe hangers and cappers, splitters, and helpers in a cylinder-machine plant. However, the machines are usually arranged four or six in a row and the same group of workers has charge of all the machines, constituting a unit. The effect of the cylinder machines has thus been not only to dispense with the skill of the gatherer and the blower but also to integrate and even to a certain extent to specialize the other work involved in the process.

FLAT GLASS

Although a considerable advance over the hand process, the cylinder machine repeats essentially the same operations which are used in hand production. In both cases the glass has to be gathered and then a cylinder drawn, which must be split, flattened, and cut, before the glass can be applied to its proper uses. The process of first making a cylinder and then flattening it has always appeared roundabout, and experiments of drawing flat sheet glass directly from the furnace date back as far as 1857. It is only recently, however, that two processes have been successfully developed to make flat window glass by automatically drawing it from the tank. These two processes are the Colburn process, by which the flat glass is drawn continuously in a horizontal direction from the tank and through the leer, and the Fourcault process, by which a continuous sheet of glass is drawn in a vertically upward direction.

COLBURN PROCESS

The Colburn machine was invented in 1905, but it was not until 1917 that it became a commercial success in the production of window glass. The glass is drawn automatically from a continuous tank, which is divided into three parts—the melting tank proper, the cooling-off chamber, and the forehearth or drawing chamber. By a system of water-cooled channels the glass in the forehearth is kept at the constant temperature needed to draw the glass. A bait is lowered into the forehearth and the viscous glass adhering to it is first raised some distance in a vertically upward position, then bent at a right angle over a pair of water-cooled rollers, and pulled in the form of a continuous horizontal sheet between two endless belts into and through a long annealing leer. Just above the surface of the glass in the forehearth are located two sets of knurled water-cooled rollers, which engage the edges of the sheet of glass as soon as it emerges from the forehearth. The object of the rollers is to prevent the sheet from tapering to a point, as is characteristic of any viscous mass subject to a pulling force. During its upward movement the glass is sufficiently cooled and solidified not to be seriously affected by the subsequent bending over the rollers. The drawing force is supplied by the two endless belts, one above the other, which move in the same direction with the sheet of glass. The upper belt is provided with caterpillar feet to engage the glass surface and thus supply the tractive force. At the cool end of the leer the continuous sheet is cut into the required lengths, which are then subjected to the usual treatment of acid bathing, examining, and cutting into sizes.

Since 1917 an increasingly large quantity of window glass has been produced by this process. Unfortunately, however, the present owners of this patent declined to supply the Bureau of Labor Statistics with the data on number of workers and the output of the machine which were needed to gauge the labor productivity of this process in comparison either with hand production or the cylinder machine. In the subsequent analysis, therefore, this process has not been taken into consideration, and the Fourcault machine alone has been used to represent the automatic process of making flat glass.

FOURCAULT MACHINE

The process of automatically drawing upward a continuous wide sheet of window glass directly from the tank was invented by a Belgian engineer, Emile Fourcault. The simplicity of this process is so striking that it is surprising that it is such a recent invention.

The machine consists of two parts, the clay drawing block—the "debiteuse," as it is called in Belgium—and the drawing apparatus. The drawing block, or "floater," is made of refractory material of lesser density than the glass. It is shaped like a flat-bottomed boat, with a slit in the bottom extending its entire length, the edges of the slit being turned up to a height somewhat lower than the outer walls of the drawing block. When this floater is placed in position and sufficient pressure from above applied to it, so that it is immersed in the glass until the edges of the slit lie below the surface of the glass, the pressure on the block causes some of the glass to flow upward through the slit. If left alone the glass would merely fill up the two troughs of the block to a level with the glass in the tank, but this is prevented by seizing the glass as it emerges from the slit by means of a bait and drawing it off in sheet form. The block under its pressure is constantly forcing a sheet of molten glass through the slit, which retains the uniform size of the aperture of the block through which it is drawn. Two water-cooled tubes placed against the sides of the slit serve to cool the glass and to give it the resistance necessary in the upward pull.

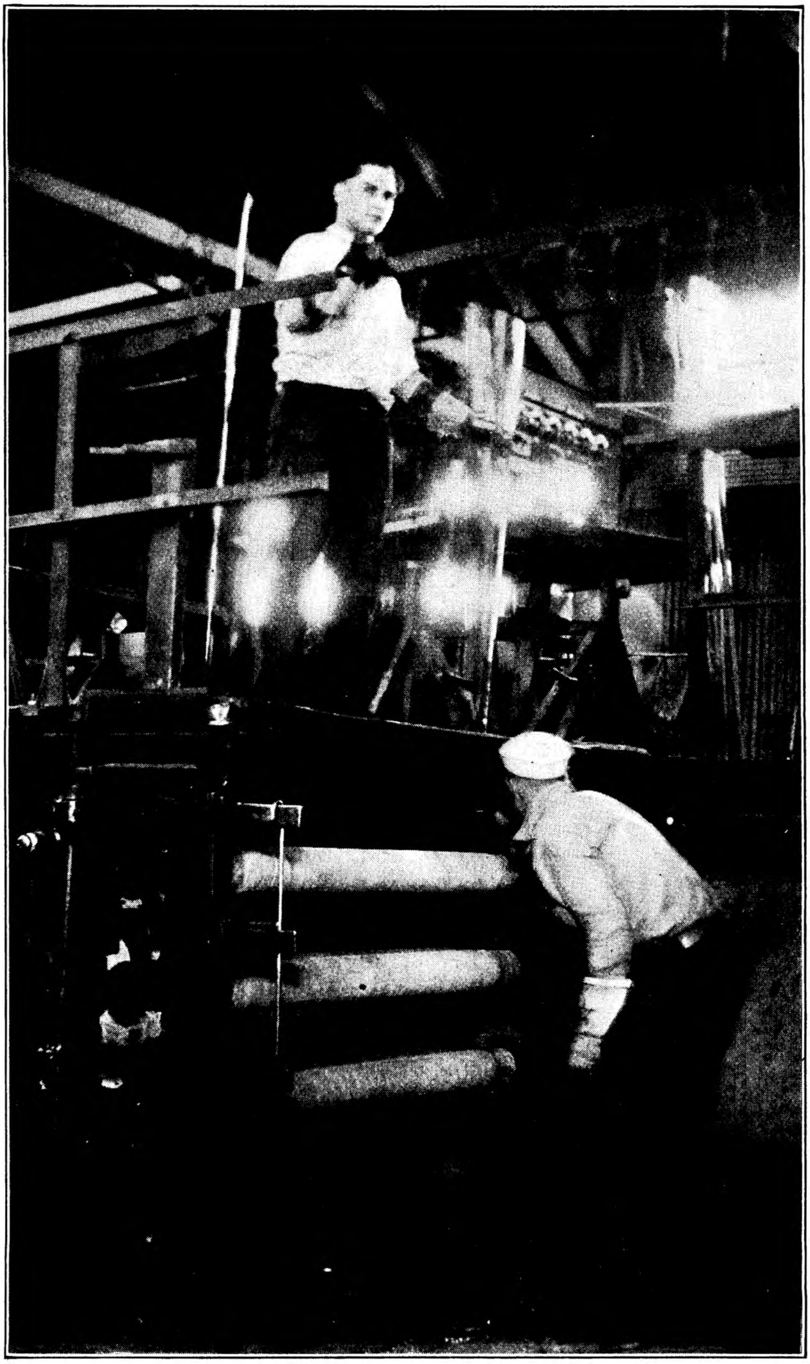

FIG. 26.—FOURCAULT AUTOMATIC MACHINE FOR MAKING WINDOW GLASS

The drawing apparatus of the Fourcault machine consists of a vertical series of asbestos-covered steel rollers placed in pairs, a certain distance apart, over the tank and directly above the drawing block, the sheet of glass drawn from the tank passing between each pair of rollers in turn. Each pair of rollers is geared together. The rollers on one side of the glass revolve in fixed bearings, but the rollers on the other side are provided with special adjustments to take care of the different thicknesses of the glass. Each of the rollers has a counterweight exerting just enough pressure on the glass to prevent it from slipping and to keep it moving upward without interruption. The rollers are kept in motion by a system of gears driven by a motor. The control of the speed is the most important factor in the process, as upon the latter and the temperature of the glass in the drawing block depend the thickness and the uniform distribution of the glass drawn.

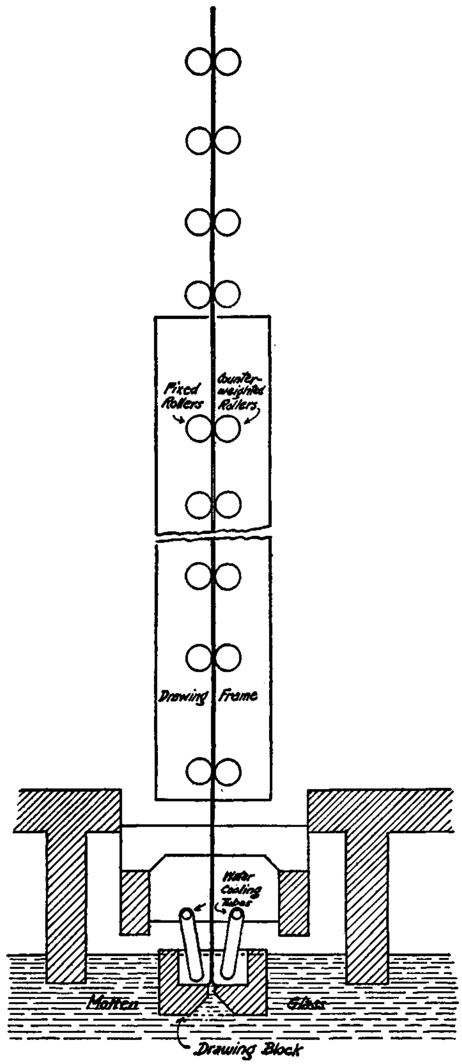

FIG. 27.—DIAGRAM ILLUSTRATING THE FOURCAULT PROCESS

Most of the rollers are incased in a chimneylike box made of steel plates with an asbestos lining. The shaft is divided into sections by partitions of sheet iron arranged in a slanting position. Each section is built to retain a constant heat temperature, which is gradually lowered as the sections rise higher and higher above the tank. As the sheet of glass in its contact with the rollers passes from one compartment into another it is thus subjected to a complete annealing process. In the event of a breakage in the glass the slanting position of the iron partitions, or deflectors as they are termed, serves to keep the pieces of glass from falling back into the drawing block.

The process of operating the Fourcault machine is as follows: First, the drawing block is placed in position under the drawing apparatus with the slit in parallel alignment with the rollers. The block is kept in position, or lowered and raised when needed, by four heavy steel bars pressing on the four corners of the block and controlled by means of a handwheel outside the machine. With the floater in position, the machine is first started in the reverse direction, and a bait, consisting of a thin steel framework, is gradually lowered through the rollers into the slit. By exerting the necessary pressure upon the drawing block the molten glass in the tank is forced to rise in the slit to meet the bait. The portion of the glass in direct contact with the cold bait cools rapidly and forms the principal support for the first drawn sheet. The machine is then set to operate in the right direction and the bait followed by a perfectly smooth sheet of glass begins to rise gradually from the slit of the drawing block. Immediately upon rising from the tank the glass passes between the water-cooled tubes located at the sides of the slit and is sufficiently solidified not to be affected by the contact and pressure of the rollers.

At the top of the machine the bait is broken off and from then on, barring unforeseen accidents, the sheet of glass continues to rise uninterruptedly until the machine is stopped. As stated elsewhere, the chambers within which the rollers are incased are heated to various temperatures, and by the time the sheet has passed through the whole shaft, which is about 15 feet high, it is also perfectly annealed. On the top of the machine is a wooden platform provided with a slit for the rising sheet of glass. When it reaches the desired height it is cut off by the cutters and breakers and is forwarded directly to the dipping department for the necessary acid treatment. It is then taken to the cutting department, where it is examined for defects and cut into the regular window-glass sizes.

The process described above is entirely automatic. The only indispensable labor in this process is that of cutting the sheet of glass as it rises over the elevated platform on top of the machine. This is the job of the cutters and breakers. In addition there are needed special watchers or peepers, as they are called, to see that the machine works in order. Their job is merely to look through special openings in the steel case provided for that purpose to see that the glass is not misshapen by the presence of stones or blisters and that the continuous upward rise is not interrupted by breakage of glass. There are, of course, also machine operators and skilled mechanics, but their work is limited entirely to starting the machine and putting it in order when a breakage or any other interference occurs.

As the glass emerges from the machine perfectly flat the services of the flattener, the last skilled worker of the hand shop, are completely dispensed with in this process. An analysis of the three processes described above, the hand process, the cylinder machine, and the Fourcault machine, reveals clearly the effects of the development of machinery on the labor in the window-glass branch of the glass industry. While the cylinder process replaces the work of the highly skilled gatherer and blower by the semiskilled ladle crew and a machine operator, retaining intact the work of the flattener, the Fourcault machine does away with all the skilled and even semiskilled glass workers, using instead unskilled laborers, supervised by one skilled mechanic or machinist.

MAN-HOUR OUTPUT AND LABOR COST

Table 31 presents a comparison of man-hour output and labor cost of making single and double strength window glass by the hand process and by the cylinder and the Fourcault machines. But before any conclusions are drawn from this comparison it must be emphasized that the labor unit used with the figures of production does not represent all the labor engaged in all the stages of making window glass. Since the object of this study is primarily to measure labor productivity as affected by the introduction of machinery and by changes in methods of production, only such labor has been included as was directly or indirectly affected by these changes. In the case of window glass this would exclude the workers engaged in mixing and melting the raw materials, whose output can not be measured in terms of cases of window glass produced. It excludes also the work of the cutters and packers, which has but a very slight, if any, relationship to the process used in making the glass.[1]

The sum total of the labor excluded is, however, very small, being in no case higher than 10 per cent of the total labor used. For this reason the figures given in the table, while accurately gauging the effects of machinery on the labor directly affected by the change, may also be used as fairly representative of the industry as a whole.

TABLE **31.**—*Man-hour output and labor cost of window glass, single and double strength, made by hand and by machine*

Man-hour output

Process and unit of production	Single strength		Double strength	
	Quantity or amount	Index number	Quantity or amount	Index number
Hand production:	*Boxes* [a]		*Boxes* [a]	
Plant A	0.705		0.554	
Plant B	.713		.567	
Average	.709	100.0	.561	100.0
Cylinder machine:				
6-machine unit	1.330		.771	
8-machine unit	1.743		.926	
12-machine unit	1.889		1.220	
Average	1.654	233.3	.972	173.4
Fourcault process:				
4-machine unit	1.820		1.249	
6-machine unit	1.939		1.462	
8-machine unit	1.793		1.129	
Average	1.851	261.1	1.280	228.4

Labor cost (per box)

Process and unit of production	Single strength		Double strength	
	Quantity or amount	Index number	Quantity or amount	Index number
Hand production:				
Plant A	$0.935		$1.278	
Plant B	.975		1.362	
Average	.955	100.0	1.320	100.0
Cylinder machine:				
6-machine unit	.475		.819	
8-machine unit	.370		.696	
12-machine unit	.377		.583	
Average	.407	42.6	.699	53.0
Fourcault process:				
4-machine unit	.298		.434	
6-machine unit	.287		.380	
8-machine unit	.306		.485	
Average	.299	31.3	.433	32.8

[a] 50 square feet.

[1] The packers are not at all affected by a change from one process to another, while the cutters disagree among themselves as to the effects of such a change on their output.

The preceding table contains a comparison of man-hour ouput of single and double strength window glass made by the three processes—hand, cylinder machine, and Fourcault. Two plants are shown to represent hand production. The average man-hour output of these plants is 0.709 box of 50 square feet of single and 0.561 box of double strength glass. To represent the cylinder-machine process, data for three plants are shown, because the variation in man-hour output by this process is larger than that in hand production. The principal cause of this variation is the number of machines used in the plant to constitute a unit, some plants using 6, others 8, and still others 12 machines in each unit. The average man-hour output of the three plants is 1.654 boxes of single and 0.972 box of double strength glass. In the Fourcault process the average man-hour output of the three plants is 1.851 boxes of single and 1.280 boxes of double strength glass. For comparative purposes the average man-hour output by the three processes is expressed in terms of index numbers. Taking hand production as the base, or 100, the cylinder machine shows an index of 233.3 for single strength, or an average man-hour output two and one-third times as large as that by hand production; and the Fourcault machine shows an index of 261.1, or a man-hour output more than two and one-half times as large as that by the hand process. For double-strength window glass the index of the cylinder machine is 173.4 or nearly one and three-fourths times that of the hand process, and that of the Fourcault machine is 228.4, or more than two and one-fourth times that of hand production.

The effects of the introduction of machinery on man-hour output of window glass, though very great, are not as phenomenal as in some of the other branches of the glass industry. However, the figures are more favorable to the machines when labor cost is considered. In single-strength window glass the direct labor cost of making a box of 50 square feet of window glass is 95.5 cents. On the cylinder machine the corresponding labor cost is only 40.7 cents, representing a reduction of 57.4 per cent, while on the Fourcault machine it is 29.9 cents, representing a reduction of 68.7 per cent. In the case of double-strength glass the direct labor cost per box of 50 square feet is $1.32 when made by the hand process. On the cylinder machine the corresponding labor cost is 69.9 cents, representing a reduction of 47 per cent, while on the Fourcault machine it is only 43.3 cents, representing a reduction of 67.2 per cent.

There is thus a decided discrepancy noticeable between the increase in man-hour output effected by the machine processes and the decrease in the direct labor cost due to the same processes. This may be explained by the fact that the introduction of machinery in this branch of the glass industry resulted not so much in decreasing the number of workers involved as in displacing highly paid skilled workers by unskilled laborers. The cylinder-machine process actually requires a larger crew per unit than is needed in hand production. (See p. 154.) Even the Fourcault machine requires almost as many attendants as the number of workers in a hand shop. On the other hand, the cylinder machine eliminates the services of the skilled gatherer and blower, while the Fourcault machine, in addition, dispenses with the skilled flattener. It is this situation which causes the discrepancy between the increase in man-hour output and the decrease in labor costs effected by the introduction of machinery.

PRESENT SITUATION IN WINDOW-GLASS BRANCH OF THE INDUSTRY

The figures of man-hour output and labor cost of making window glass by hand and by machine are sufficient to tell the story of what has been happening in this branch of the glass industry in recent years. Hand production, which less than 25 years ago constituted 100 per cent of the window glass made in this country, had by 1925 been reduced to a nominal quantity of less than 1 per cent of the glass produced. And signs are not missing which point to the complete elimination of hand production within the short period of two or three years. As a factor in the window-glass branch of the glass industry hand production is now entirely a thing of the past.

With the disappearance of the hand plants there disappears also a class of workers, gatherers and blowers by trade, who for centuries had been known as the most highly skilled and highly paid artisans. Not hampered by any progress in the industry and conscious of their skill and power, the window-glass workers had successfully developed the policy of confining their trade to a small group of workers and their families. No one but the nearest kin of a blower or gatherer could ever become an apprentice to either, and the number of apprentices in the trade had been strictly limited. With this policy also went the rigid policy of strict limitation of output on the part of workers. It was this situation, as much as the natural trend of progress, which probably hastened the advance of machinery in this branch of the industry, resulting in the almost complete elimination of hand production.

As among the several machine processes which have taken the place of hand production, the problem of survival is more difficult. Technically the Fourcault machine represents a considerable step in advance over the cylinder machine. Not only does it dispense with all the skilled labor needed in hand production but it actually reduces to a minimum the total number of workers around the machine. It is essentially an automatic process. This can not be said of the cylinder machine. In addition to retaining the services of a skilled flattener and actually increasing the number of operations needed as compared with hand production, the process itself is rather roundabout and requires much handling of the glass before the sheet finally reaches the cutting department. The statistics of man-hour output and direct labor cost, shown in Table 32, also point to an advantage in the Fourcault process over the cylinder machine.

TABLE 32.—*Comparison of direct man-hour output and direct labor cost of making window glass by the cylinder and the Fourcault machines*

Process	Man-hour output				Direct labor cost			
	Single strength		Double strength		Single strength		Double strength	
	Boxes	Index number	Boxes	Index number	Cents per box	Index number	Cents per box	Index number
Cylinder machine process	1.654	100.0	0.972	100.0	40.7	100.0	69.9	100.0
Fourcault process	1.851	111.9	1.280	131.7	29.9	73.5	43.3	61.9

Taking the man-hour output and the direct labor cost of the cylinder process as the base, or 100, the indexes for the Fourcault process are: 111.9 for man-hour output of single-strength glass, and 131.7 for double-strength glass; 73.5 for direct labor cost of single-strength glass and 61.9 for direct labor cost for double-strength glass.

Nevertheless, the largest quantity of glass in this country, especially of the better grades, is still being produced by the cylinder process. One of the reasons is, of course, the comparatively recent introduction of the Fourcault machine in the United States. The first machine was installed in this country in 1920, and the American manufacturers using this process openly admit that they do not as yet know how to work the machine to the best advantage. As a result the glass produced by this process, though absolutely flat and beautifully fire polished on both sides, is, on the average, of a somewhat lower grade than the glass produced by the cylinder machine. Its principal defects are faint lines appearing in the flat-drawn glass.

Thus both processes, the cylinder and the Fourcault, and for that matter also the Colburn machine, have their advantages and disadvantages, with no clear indication as to which of the three machines will finally prevail in the industry. One thing, however, is certain, the industry is keenly aware of this situation and expresses it in sharp competition as to both price and quality. At present more stress is laid on the quality of the glass, but the tendency is also to lower the cost of production as well as constantly to improve the quality of the product.

STATISTICS OF PRODUCTION AND LABOR COST

Table G shows statistics of production of single and double strength window glass made in separate plants by the hand process and by the cylinder and the Fourcault machines. Each section of the table is divided into two distinct parts—labor unit, and output and labor cost. The first part contains the operations involved, the number and occupations of the workers engaged in the process, and the rates of wages paid. The total number of workers constituting a labor unit is shown and also the total wages paid per hour to all the workers in the unit.

Plant A and Plant B are hand plants. The labor unit given consists of the blowing unit, the shop, which is made up of one blower, one gatherer, and one snapper, and that portion of the time of a flattening crew which is needed to flatten all the glass made by a single shop in a given period of time. A normal flattening crew consists of one flattener, one shove-in boy, and one leer tender. But it has long been the practice in all hand plants to work the flatteners and the shove-in boys on the basis of three 8-hour shifts a day, while the leer tenders are required to work two 12-hour shifts. On this basis there are only two leer tenders for every three flattening crews.

The number of flattening crews needed in a plant bears a definite relationship to the number of blowing shops operating in the plant. But this relationship is somewhat different in the separate plants. In Plant A there are three flattening crews used for every 11 blowing shops, while in Plant B two flattening crews are used for every 7 shops. On the whole, however, the total labor constituting a production unit is not much different in the two plants, and this is generally true of all hand plants.

The wage policy of the hand plants is to pay the blower, the gatherer, the snapper, and the flattener on a piece rate and the other workers on a time basis. The blower is usually considered the leader of the shop. His wage is, therefore, taken as the basis upon which the rates of the gatherer and snapper are determined, the gatherer usually getting 80 per cent and the snapper 60 per cent of the blower's rate. The rate of the flattener is fixed separately, but it, too, has a definite relationship to the blower's wage.

In the statistics of output, shown in the second part of each section, the data given are:

(1) Total quantity of salable window glass produced month by month either for a whole year or for a period of not less than six months, classified as to strength and expressed in the unit prevailing on the market—namely, boxes of 50 square feet of glass. This classification does not take into consideration the variation in brackets or sizes used to make up a single box.

(2) Total number of hours actually put in by all the labor units to produce the quantity of glass given. It is clear that these hours do not mean the total number of hours the plant was in operation, but the number of hours an average labor unit would have to work to produce the same quantity of glass produced by the whole plant in a correspondingly shorter time. The aggregate output and the aggregate time put in by all the shops in the plant—good, bad, and indifferent—enables one to escape the difficulties and the errors which are inextricably bound up with the choosing of any one shop as an average.

(3) The average hourly output of a single unit. This figure is the result of dividing the total production by the total number of unit-hours.

(4) The man-hour output, derived by dividing the unit-hour production by the total number of workers constituting the unit. This man-hour output of the plant is the standard of measurement used to compare the labor productivity in the separate plants using the various processes, hand or machine.

(5) The labor cost per unit of output—in this case, per box of 50 square feet of window glass—derived by dividing the total labor cost per hour by the hourly output of the labor unit. These figures are used to compare the labor cost of window glass made by the three processes—hand, cylinder, and Fourcault machines.

Three plants are shown using the cylinder-machine process. In these plants the labor unit is made up of three groups of workers performing the operations of ladling, blowing, and flattening the glass. Since these workers normally tend more than one machine, the entire unit is shown, the total workers, however, being shown per machine as well. The number of machines operated in each of the three plants given is different, and the average number of attendants per machine is also different. Hence, there is a larger discrepancy in the number of workers per machine in the cylinder-machine plants than per shop in the hand plants; in the hand plants the number per shop varies from $3\frac{9}{11}$ to $3\frac{181}{210}$, a difference of a little over 0.04 of the labor of one man, while the variations in the cylinder machine process range from $5\frac{1}{3}$ to $6\frac{1}{3}$ per machine, a difference of the entire labor of a single worker.

Three plants are given using the Fourcault machine. Here, too, the labor unit is that of a group of machines. Since the glass produced by this process is drawn flat directly from the tank, there is no subdivision of the workers, such as in hand production and on the cylinder machine. On the other hand, the workers in these plants are also required to tend more than one machine, and so the labor unit for the group of machines is given in the table, the total per machine also being shown. Here, too, as in the cylinder-machine plants, the variation in the total number of workers constituting the machine unit is larger than that in the shop in the hand process.

The wages paid in plants using either the cylinder or Fourcault machines are predominantly on a time basis, the sole exception being the flatteners in the cylinder-machine plants, who are paid on a piece-rate basis. There is no uniformity in the rates of wages paid in the different plants using the same machine process. The majority of workers are unskilled and the wages are determined by the general conditions prevailing in the local labor markets.

The statistics of output in the plants using the machine process are computed on the same principles as those for the hand plants. The table shows the total quantity of salable window glass produced; the total machine-hours taken by all machines in operation to produce this quantity of glass; the machine-hour output—that is, the quantity of glass produced by the average machine in an hour; the average man-hour output of the plant; and the labor cost per box of 50 square feet of window glass.

Table G.—PRODUCTION AND LABOR COST IN MAKING WINDOW GLASS BY HAND AND BY MACHINE

SINGLE-STRENGTH GLASS—HAND: PLANT A

[In this table all wage rates are for 1925 and labor cost is based on 1925 wage rates regardless of year of output data. Italicized figures represent minimum and maximum]

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per box[1]	Wage rates per hour	Labor cost per hour	Year and month	Output	Shop-hours	Output per shop-hour	Output per man-hour	Labor cost per box[1]
	Blowing:				1925	*Boxes*[1]		*Boxes*[1]	*Boxes*[1]	
1	Blower	$0.320			Jan	6,264	2,400	2.610	0.684	$0.938
1	Gatherer	.256			Feb	7,360	2,560	2.875	.753	.930
1	Snapper	.192			Mar	8,490	3,200	2.650	.694	.937
	Flattening:				Apr	6,804	3,720	*2.501*	*.655*	*.941*
3/11	Flattener	.087			May	7,572	2,720	2.784	.729	.933
1/11	Roller boy		$0.45	$0.041	June	4,234	1,440	*2.940*	*.770*	*.928*
3/11	Shove-in boy		.38	.104						
2/11	Leer tender		.38	.070	1926					
					Feb	8,302	3,040	2.731	.715	.934
					Mar	8,564	3,200	2.673	.700	.936
					Apr	8,120	3,040	2.671	.700	.936
					May	7,452	2,880	2.588	.678	.938
					June	1,284	440	2.918	.764	.929
3 9/11	Total	.855		.215	Total	74,446	27,640	2.693	.705	.935

SINGLE-STRENGTH GLASS—HAND: PLANT B

Number of workers	Occupation	Wage rates per box[1]	Wage rates per hour	Labor cost per hour	Year and month	Output	Shop-hours	Output per shop-hour	Output per man-hour	Labor cost per box[1]
	Blowing:				1925					
1	Blower	$0.325			Nov	9,884	3,560	2.776	0.719	$0.974
1	Gatherer	.260			Dec	10,818	3,880	2.788	.722	.974
1	Snapper	.195								
	Flattening:				1926					
2/7	Flattener	.087			Jan	11,420	4,160	2.745	.711	.976
1/10	Roller boy		$0.60	$0.060	Feb	7,550	2,840	*2.658*	*.688*	*.979*
2/7	Shove-in boy		.50	.143	Mar	14,504	5,280	2.747	.711	.976
4/21	Leer boy		.50	.095	Apr	10,498	3,760	*2.792*	*.723*	*.974*
					May	6,230	2,280	2.732	.707	.976
3 181/210	Total	.867		.298	Total	70,904	25,760	2.752	.713	.975

[1] 50 square feet.

Table G.—PRODUCTION AND LABOR COST IN MAKING WINDOW GLASS BY HAND AND BY MACHINE—Continued

SINGLE-STRENGTH GLASS—CYLINDER MACHINE: 6-MACHINE UNIT

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
	Ladling:			1925	*Boxes*		*Boxes*	*Boxes*	
1	Machine foreman	$0.85	$0.85	Aug	22,502	2,808	*8.014*	*1.265*	*$0.499*
1	Ladler	.80	.80	Sept	21,368	2,546	8.393	1.325	.476
1	Skimmer	.65	.65	Oct	21,635	2,530	8.551	1.350	.468
1	Pot turner	.60	.60	Nov	22,258	2,712	8.207	1.296	.487
1	Pot scraper	.60	.60	Dec	25,472	3,076	8.281	1.308	.483
1	Back ladler	.50	.50						
1	Cellarman	.50	.50	1926					
	Blowing:			Jan	27,312	3,256	8.388	1.324	.477
2	Blowers	.80	1.60	Feb	20,514	2,336	*8.782*	*1.387*	*.455*
5	Snappers	.60	3.00	Mar	32,222	3,800	8.479	1.339	.472
3	Cappers	.63	1.89	Apr	27,868	3,211	8.679	1.370	.461
2	Splitters	.50	1.00	May	25,471	3,040	8.379	1.323	.477
2	Helpers	.50	1.00	June	25,038	3,040	8.237	1.301	.485
1	Inspector	.50	.50	July	22,657	2,584	8.768	1.384	.456
2	Roller boys	.50	1.00						
	Flattening:								
6	Flatteners	.95	5.70						
4	Shove-in boys	.45	1.80						
4	Leer tenders	.50	2.00						
38	Total per unit		23.99	Total	294,317	34,939	8.424	1.330	.475
6 1/3	Total per machine		3.999						

SINGLE-STRENGTH GLASS—CYLINDER MACHINE: 8-MACHINE UNIT

	Ladling:			1925					
1	Shift foreman	$0.88	$0.880	Sept	17,899	2,040	*8.774*	*1.620*	*$0.398*
1	Machinist	.60	.600	Oct	27,323	3,000	9.108	1.681	.384
2	Ladlers	.94	1.880	Nov	25,145	2,760	9.111	1.682	.383
2	Skimmers	.50	1.000	Dec	25,971	2,760	9.410	1.737	.371
2	Back ladlers	.40	.800						
1	Cellarman	.40	.400	1926					
	Blowing:			Jan	31,015	3,200	9.692	1.789	.360
2	Blowers	.94	1.880	Feb	25,982	2,560	*10.149*	*1.874*	*.344*
6	Snappers	.50	3.000	Mar	34,783	3,456	10.065	1.858	.347
4	Cappers	.70	2.800	Apr	37,175	4,160	8.936	1.650	.391
2	Splitters	.45	.900	May	30,362	3,168	9.584	1.769	.364
2	Helpers	.40	.800	June	26,336	2,760	9.542	1.762	.366
2	Roller boys	.45	.900	July	23,205	2,520	9.208	1.700	.379
	Flattening:			Aug	27,728	2,880	9.628	1.777	.363
7	Flatteners	1.20	8.400						
4 2/3	Shove-in boys	.40	1.867						
4 2/3	Leer tenders	.40	1.867						
43 1/3	Total per unit		27.974	Total	332,924	35,264	9.441	1.743	.370
5 5/12	Total per machine		3.496						

SINGLE-STRENGTH GLASS—CYLINDER MACHINE: 12-MACHINE UNIT

	Ladling:			1925					
1	Shift foreman	$0.900	$0.900	Sept	39,635	3,822	10.370	1.944	$0.366
1	Machinist	.700	.700	Oct	37,741	3,864	9.767	1.831	.388
2	Ladlers	.975	1.950	Nov	37,763	3,976	9.498	1.781	.399
2	Skimmers	.580	1.160	Dec	36,889	3,808	9.637	1.816	.392
2	Pot turners	.580	1.160						
1	Cellarman	.500	.500	1926					
	Blowing:			Feb	36,867	3,992	*9.235*	*1.732*	*.411*
4	Blowers	.920	3.680	Mar	35,210	3,408	10.332	1.937	.367
4	Hookers	.580	2.320	Apr	37,946	3,916	9.690	1.817	.392
2	Pipe hangers	.580	1.160	May	45,796	4,544	10.078	1.890	.376
6	Cappers	.840	5.040	June	42,599	4,368	9.753	1.829	.389
4	Splitters	.670	2.680	July	48,380	4,368	11.076	2.077	.343
6	Roller boys	.500	3.000	Aug	50,714	4,544	*11.161*	*2.093*	*.340*
	Flattening:								
12	Flatteners	1.150	13.800						
8	Shove-in boys	.440	3.520						
8	Leer tenders	.440	3.520						
1	Trucker	.440	.440						
64	Total per unit		45.530	Total	449,540	44,610	10.077	1.889	.377
5 1/3	Total per machine		3.794						

TABLE G.—PRODUCTION AND LABOR COST IN MAKING WINDOW GLASS BY HAND AND BY MACHINE—Continued

SINGLE-STRENGTH GLASS—FOURCAULT AUTOMATIC MACHINE: 4-MACHINE UNIT

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
1/3	Chief foreman	$1.45	$0.483	1926	*Boxes*		*Boxes*	*Boxes*	
1	Shift foreman	1.15	1.150	Jan	3,685	504	7.312	1.720	$0.315
1	Assistant foreman	.50	.500	Feb	11,346	1,528	7.419	1.746	.311
2/3	Mechanic	.85	.570	Mar	7,915	1,000	7.915	1.862	.291
2	Platform men	.47	.940	Apr	10,845	1,336	8.118	1.910	.284
3	Peepers	.45	1.350	May	8,671	1,112	7.798	1.835	.296
2	Cutters	.47	.940	June	11,241	1,384	*8.122*	*1.911*	*.284*
4	Breakers	.47	1.880	July	5,659	712	7.948	1.870	.290
1	Checker	.50	.500	Aug	8,451	1,112	7.600	1.788	.303
2	Truckers	.45	.900	Sept	6,813	960	*7.097*	*1.670*	*.325*
17	Total per unit		9.213	Total	74,626	9,648	7.735	1.820	.298
4 1/4	Total per machine		2.304						

SINGLE-STRENGTH GLASS—FOURCAULT AUTOMATIC MACHINE: 6-MACHINE UNIT

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
1/3	Chief foreman	$1.40	$0.467	1926					
2/3	Chief mechanic	1.05	.700	Aug	10,090	1,231	*8.197*	*1.868*	*$0.298*
1	Shift foreman	.85	.850	Sept	14,870	1,724	8.625	1.965	.283
1	Shift machinist	.63	.630	Oct	12,630	1,506	8.378	1.909	.291
2	Machine operators	.59	1.180	Nov	15,745	1,807	*8.712*	*1.985*	*.280*
3	Machine tenders	.55	1.650						
3	Watchers	.50	1.500						
2	Utility men	.47	.940						
1	Relief man	.50	.500						
3	Cutters	.50	1.500						
1	Boss breaker	.56	.560						
6	Breakers	.50	3.000						
2	Dipmen	.44	.880						
1/3	Inspector	.85	.283						
26 1/3	Total per unit		14.640	Total	53,335	6,268	8.509	1.939	.287
4 7/18	Total per machine		2.440						

SINGLE-STRENGTH GLASS—FOURCAULT AUTOMATIC MACHINE: 8-MACHINE UNIT

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
1/3	Chief foreman	$1.40	$0.467	1926					
2/3	Mechanic	1.05	.700	Jan	24,800	3,813	*6.504*	*1.715*	*$0.320*
1	Shift foreman	.85	.850	Feb	10,865	1,655	6.565	1.731	.317
1	Shift machinist	.63	.630	Mar	24,080	3,622	6.648	1.753	.313
2	Machine operators	.59	1.180	Apr	18,742	2,637	7.107	1.874	.293
3	Machine tenders	.55	1.650	May	18,560	2,545	*7.293*	*1.923*	*.285*
4	Watchers	.50	2.000						
2	Utility men	.47	.940						
1	Relief man	.50	.500						
4	Cutters	.50	2.000						
1	Boss breaker	.56	.560						
8	Breakers	.50	4.000						
2	Dipmen	.44	.880						
1/3	Inspector	.85	.283						
30 1/3	Total per unit		16.640	Total	97,047	14,272	6.800	1.793	.306
3 19/24	Total per machine		2.080						

TABLE G.—PRODUCTION AND LABOR COST IN MAKING WINDOW GLASS BY HAND AND BY MACHINERY—Continued

DOUBLE-STRENGTH GLASS—HAND: PLANT A

Labor unit					Output and labor cost					
Number of workers	Occupation	Wage rates per box	Wage rates per hour	Labor cost per hour	Year and month	Output	Shop-hours	Output per shop-hour	Output per man-hour	Labor cost per box
	Blowing:				1925	*Boxes*		*Boxes*	*Boxes*	
1	Blower	$0.440			Jan	2,434	1,120	2.173	0.569	$1.275
1	Gatherer	.352			Feb	3,208	1,440	2.228	.584	1.273
1	Snapper	.264			Mar	3,734	1,640	2.277	.596	1.271
	Flattening:				Apr	4,496	2,200	2.044	.535	1.282
3/11	Flattener	.120			May	3,758	1,760	2.135	.559	1.277
1/11	Roller boy		$0.45	$0.041	June	1,052	480	2.192	.584	1.275
3/11	Shove-in boy		.38	.104						
2/11	Leer tender		.38	.070	1926					
					Feb	1,824	960	*1.900*	*.498*	*1.290*
					Mar	1,960	960	2.042	.535	1.282
					Apr	2,008	960	2.092	.558	1.279
					May	3,570	1,760	2.028	.531	1.283
					June	822	360	*2.283*	*.598*	*1.271*
3 9/11	Total	1.176		.215	Total	28,866	13,640	2.116	.554	1.278

DOUBLE-STRENGTH GLASS—HAND: PLANT B

Number of workers	Occupation	Wage rates per box	Wage rates per hour	Labor cost per hour	Year and month	Output	Shop-hours	Output per shop-hour	Output per man-hour	Labor cost per box
	Blowing:				1925					
1	Blower	$0.460			Nov	2,640	1,280	*2.065*	*0.534*	*$1.370*
1	Gatherer	.368			Dec	3,044	1,400	2.174	.563	1.363
1	Snapper	.276								
	Flattening:				1926					
2/7	Flattener	.123			Jan	2,362	1,080	2.187	.566	1.362
1/10	Roller boy		$0.60	$0.060	Feb	2,326	1,080	2.154	.558	1.364
2/7	Shove-in boy		.50	.143	Mar	3,810	1,720	2.215	.574	1.361
4/21	Leer tender		.50	.095	Apr	3,452	1,560	2.213	.573	1.361
					May	2,170	920	*2.359*	*.611*	*1.352*
3 181/210	Total	1.227		.298	Total	19,804	9,040	2.191	.567	1.362

DOUBLE-STRENGTH GLASS—CYLINDER MACHINE: 6-MACHINE UNIT

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
	Ladling:			1925	*Boxes*		*Boxes*	*Boxes*	
1	Machine foreman	$0.85	$0.85	Aug	3,477	760	4.575	0.722	$0.874
1	Ladler	.80	.80	Sept	5,476	1,102	4.960	.783	.806
1	Skimmer	.65	.65	Oct	5,836	1,140	5.119	.808	.781
1	Pot turner	.60	.60	Nov	4,197	836	5.020	.793	.797
1	Pot scraper	.60	.60	Dec	1,639	362	*4.528*	*.725*	*.883*
1	Back ladler	.50	.50						
1	Cellarman	.50	.50	1926					
	Blowing:			Jan	935	190	4.921	.777	.813
2	Blowers	.80	1.60	Feb	1,977	399	4.955	.782	.807
5	Snappers	.60	3.00	Mar	3,692	760	4.858	.767	.823
3	Cappers	.63	1.89	Apr	2,102	418	5.029	.794	.795
2	Splitters	.50	1.00	May	2,832	608	4.658	.735	.859
2	Helpers	.50	1.00	June	4,539	874	*5.193*	*.820*	*.770*
1	Inspector	.50	.50	July	4,867	1,064	4.574	.722	.874
2	Roller boys	.50	1.00						
	Flattening:								
6	Flatteners	.95	5.70						
4	Shove-in boys	.45	1.80						
4	Leer tenders	.50	2.00						
38	Total per unit		23.99	Total	41,569	8,513	4.883	.771	.819
6⅓	Total per machine		3.999						

TABLE G.—PRODUCTION AND LABOR COST IN MAKING WINDOW GLASS BY HAND AND BY MACHINE—Continued

DOUBLE-STRENGTH GLASS—CYLINDER MACHINE: 8-MACHINE UNIT

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
	Ladling:			1925	*Boxes*		*Boxes*	*Boxes*	
1	Shift foreman	$0.88	$0.880	Sept	5,833	1,200	4.861	0.897	$0.719
1	Machinist	.60	.600	Oct	7,874	1,700	*4.632*	*.855*	*.754*
2	Ladlers	.94	1.880	Nov	8,498	1,656	5.132	.947	.681
2	Skimmers	.50	1.000	Dec	8,290	1,608	5.155	.952	.678
2	Back ladlers	.40	.800						
1	Cellar man	.40	.400	1926					
	Blowing:			Jan	10,168	1,920	5.296	.978	.660
2	Blowers	.94	1.880	Feb	7,547	1,536	4.913	.907	.711
6	Snappers	.50	3.000	Mar	5,658	1,080	5.239	.967	.667
4	Cappers	.70	2.800	Apr	5,163	960	*5.397*	*.996*	*.647*
2	Splitters	.45	.900	May	6,147	1,152	5.336	.985	.655
2	Helpers	.40	.800	June	7,560	1,608	4.701	.868	.743
2	Roller boys	.45	.900	July	6,942	1,464	4.742	.875	.737
	Flattening:			Aug	8,696	1,728	5.032	.929	.694
7	Flatteners	1.20	8.400						
4⅔	Shove-in boys	.40	1.867						
4⅔	Leer tenders	.40	1.867						
43⅓	Total per unit		27.974	Total	88,376	17,612	5.018	.926	.696
5 5/12	Total per machine		3.496						

DOUBLE-STRENGTH GLASS—CYLINDER MACHINE: 12-MACHINE UNIT

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
	Ladling:			1925					
1	Shift foreman	$0.90	$0.90	Sept	16,911	2,730	6.195	1.162	$0.612
1	Machinist	.70	.70	Oct	17,934	2,760	6.498	1.218	.584
2	Ladlers	.975	1.95	Nov	17,552	2,840	6.180	1.159	.614
2	Skimmers	.58	1.16	Dec	17,000	2,720	6.250	1.172	.607
2	Pot turners	.58	1.16						
1	Cellarman	.50	.50	1926					
	Blowing:			Feb	17,294	2,824	*6.124*	*1.148*	*.620*
4	Blowers	.92	3.68	Mar	22,509	3,408	6.605	1.238	.574
4	Hookers	.58	2.32	Apr	18,671	2,900	6.438	1.207	.589
2	Pipe hangers	.58	1.16	May	15,188	2,272	6.685	1.253	.568
6	Cappers	.84	5.04	June	14,456	2,184	6.619	1.241	.573
4	Splitters	.67	2.68	July	15,489	2,184	7.092	1,330	.535
6	Roller boys	.50	3.00	Aug	16,318	2,272	*7.182*	*1.347*	*.528*
	Flattening:								
12	Flatteners	1.15	13.80						
8	Shove-in boys	.44	3.52						
8	Leer tenders	.44	3.52						
1	Trucker	.44	.44						
64	Total per unit		45.53	Total	189,322	29,094	6.507	1.220	.583
5⅓	Total per machine		3.794						

DOUBLE-STRENGTH GLASS—FOURCAULT AUTOMATIC MACHINE: 4-MACHINE UNIT

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
⅓	Chief foreman	$1.45	$0.483	1926					
1	Shift foreman	1.15	1.150	Jan	519	96	5.406	1.272	$0.426
1	Assistant foreman	.50	.500	Feb	1,826	344	5.308	1.249	.434
⅔	Mechanic	.85	.570	Mar	3,205	608	5.271	1.240	.437
2	Platform men	.47	.940	Apr	3,910	672	*5.818*	*1.369*	*396*
3	Peepers	.45	1.350	May	5,355	1,000	5.355	1.260	.430
2	Cutters	.47	.940	June	5,388	1,016	5.303	1.248	.435
4	Breakers	.47	1.880	July	3,426	640	5.353	1.260	.431
1	Checker	.50	.500	Aug	4,909	936	5.245	1.234	.439
2	Truckers	.45	.900	Sept	4,440	900	*4.933*	*1.161*	*.467*
17	Total per unit		9.213	Total	32,978	6,212	5.309	1.249	.434
4¼	Total per machine		2.304						

Table G.—PRODUCTION AND LABOR COST IN MAKING WINDOW GLASS BY HAND AND BY MACHINE—Continued

DOUBLE-STRENGTH GLASS—FOURCAULT AUTOMATIC MACHINE: 6-MACHINE UNIT

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
1/3	Chief foreman	$1.40	$0.467	1926	*Boxes*		*Boxes*	*Boxes*	
2/3	Chief mechanic	1.05	.700	Aug.	4,420	726	*6.088*	*1.387*	*$0.401*
1	Shift foreman	.85	.850	Sept.	10,720	1,653	6.485	1.478	.376
1	Shift machinist	.63	.630	Oct.	13,670	2,137	6.397	1.458	.381
2	Machine operators	.59	1.180	Nov.	9,850	1,509	*6.526*	*1.487*	*.374*
3	Machine tenders	.55	1.650						
3	Watchers	.50	1.500						
2	Utility men	.47	.940						
1	Relief man	.50	.500						
3	Cutters	.50	1.500						
1	Boss breaker	.56	.560						
6	Breakers	.50	3.000						
2	Dipmen	.44	.880						
1/3	Inspector	.85	.283						
26 1/3	Total per unit		14.640	Total	38,660	6,025	6.417	1.462	.380
4 7/18	Total per machine		2.440						

DOUBLE-STRENGTH GLASS—FOURCAULT AUTOMATIC MACHINE: 8-MACHINE UNIT

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Machine hours	Output per machine-hour	Output per man-hour	Labor cost per box
1/3	Chief foreman	$1.40	$0.467	1926					
2/3	Chief mechanic	1.05	.700	Jan.	3,400	759	4.480	1.181	$0.464
1	Shift foreman	.85	.850	Feb.	1,620	390	4.154	1.095	.500
1	Shift machinist	.63	.630	Mar.	5,116	1,273	*4.019*	*1.060*	*.517*
2	Machine operators	.59	1.180	Apr.	8,720	2,034	4.287	1.131	.485
3	Machine tenders	.55	1.650	May	3,735	820	*4.555*	*1.201*	*.456*
4	Watchers	.50	2.000						
2	Utility men	.47	.940						
1	Relief man	.50	.500						
4	Cutters	.50	2.000						
1	Boss breaker	.56	.560						
8	Breakers	.50	4.000						
2	Dipmen	.44	.880						
1/3	Inspector	.85	.283						
30 1/3	Total per unit		16.640	Total	22,591	5,276	4.282	1.129	.48
3 19/24	Total per machine		2.080						

CHAPTER IV.—PLATE GLASS

The development of the plate-glass branch of the glass industry has followed a path decidedly different from any other branch, due chiefly to the nature of the work involved in producing plate glass. Plate glass is made by first casting the rough or rolled plate and then grinding and polishing it on both sides. The number of independent operations and of workers engaged in the process of making plate glass is considerably larger than that for any other glass product. In no case, however, does the skill of the plate-glass workers even approximate the skill of other glassworkers, such as bottle or window glass blowers, for instance.

The plate-glass branch was, therefore, from the very beginning essentially a nonskill industry. The simple and repetitive nature of the work, on the one hand, and the heavy and large sizes of the individual plates handled, on the other, early suggested the development of machinery and other labor-saving devices. In Europe a grinding machine, though very crude, was invented in 1768. During the nineteenth century this machine was perfected, and smoothing and polishing machines were also invented and perfected. In the early nineties in this country the plate-glass industry had already universally adopted the grinding and polishing machines. Somewhat later, with the development of electric power, overhead cranes were installed to transfer the pot of molten glass from the furnace to the casting table, as well as tc lift and handle the large heavy plates. Thus, at a time when bottles and blown ware in general were still being made by the old hand process, harking back to the Middle Ages and even earlier, plate glass had reached a degree of development unique in the glass industry.

The steps by which this development of machinery in the making of plate glass had been accomplished were very slow and gradual. This, too, marks the difference between plate glass and other glass products. Recently, however—in fact since 1921—a change has taken place in the process of making plate glass which in its revolutionary effects can well be compared with the remarkable changes in the other branches of the glass industry.

The old process, which is still prevalent in the majority of plate-glass plants, may be described as a "discontinuous" process. The various operations which constitute this process are independent of one another and the departments or branches embracing these operations are scattered over the plant. Much handling and rehandling of the glass is necessary before the completed plate reaches the warehouse where it is packed and stored ready for shipment. The new process represents an attempt to combine the various independent departments into one continuous unit, thus eliminating all the intermediate steps between the departments. In contrast with the old, the new process is termed the "continuous" process. The differences between the two processes may best be explained by describing in detail the operations involved in each.

DISCONTINUOUS PROCESS

MELTING THE GLASS

The glass used in the production of plate glass is melted in open round pots. Each pot contains just enough of the molten glass to cast one plate table, the average weight of the glass in the pot being about 2,000 pounds. The pots are set 8 or 10 in a row on each side of a rectangular regenerative furnace, the furnace unit consisting, therefore, of 16 or 20 pots. These are made of refractive material, to withstand not only the high temperature in the furnace but also the rapid changes in temperature caused by the withdrawal of the pot from the furnace for the purpose of casting. Besides being composed of the best materials available and being built as solidly as possible, the pot is carefully annealed in a special arch kiln before it is placed in the furnace. In the kiln the temperature is gradually raised to a degree not much lower than that in the furnace, so that the pot will not suffer from a too rapid exposure to a very high temperature. In spite of these precautions the life of a pot is very short—only three to four weeks—and the cost of the pots constitutes quite a considerable item in the production cost of plate glass by the "discontinuous" process.

The batch is delivered to the pot after it has been placed in the furnace, either by hand with the help of a large iron ladle or by a special traveling batch car, equipped with an arm which is projected into the furnace in order to "charge" the pots. The latter must be charged three times during the 24-hour period needed, on the average, completely to melt the glass ready to be cast.

The workers performing all the necessary operations in the melting or furnace room are termed fillers, melters, metal tenders, and finishers, the names corresponding to the nature of the work performed. When a pot is withdrawn from the furnace it leaves a residue of molten material, the overflow of the boiling glass. This slag must be removed from the furnace before the emptied pot is returned to its position, and this is usually done by hand with the help of long hooks or bars. To protect their faces from the excessive heat emanating from the open furnace the cleaners, as these workers are termed, are furnished with leather masks. The total number of workers engaged in the furnace room varies from plant to plant, depending on the number of pots in a single furnace and the number of furnaces operated.

CASTING THE ROUGH PLATE

When a pot is ready to be cast a wagoner, or hookman as he is sometimes called, guides his heavy iron fork, suspended from an overhead traveling crane, to the furnace in which the pot is located, the overhead crane being operated by a crane motorman. The clay projection which serves as a door to the furnace is first removed. Then the iron fork is guided into the furnace in a position which permits its two movable jaws to clasp the pot just below the outer projection on the pot, this projection being provided to keep the prong from slipping off when the pot is first lifted and then withdrawn from the furnace.

The pot with the molten glass is then carried to the casting table. There it is set on a platform and the surface of the glass carefully

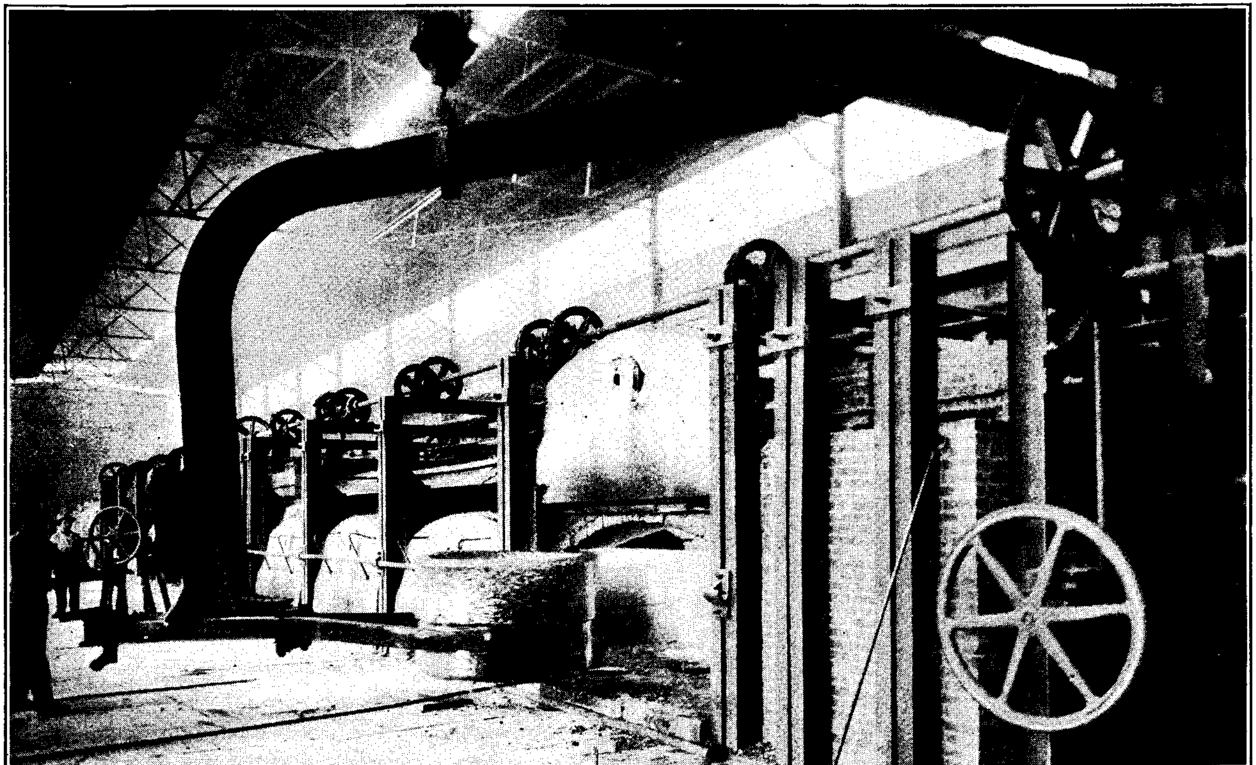

FIG. 28.—DISCONTINUOUS PROCESS: TAKING POT OUT OF FURNACE

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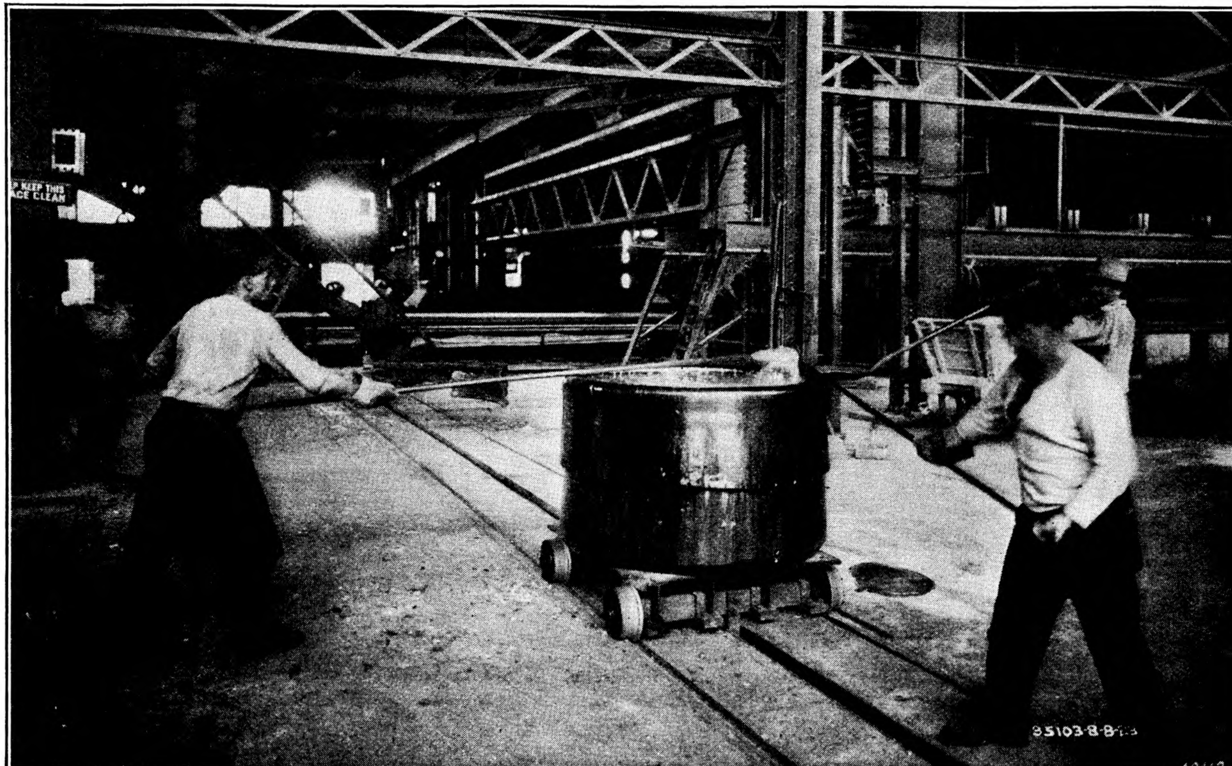

FIG. 29.—DISCONTINUOUS PROCESS: SKIMMING THE POT

skimmed to eliminate the impure and chilled glass. The pot is then lifted by another heavy hook and the bottom carefully scraped to prevent any pieces of stone or foreign matter from falling into the glass during the process of casting. Finally the pot is tilted over the table and the glass rapidly poured out of the pot onto the table in one continuous stream. Simultaneously the roller on the table is set in motion, pushing the mass of glass ahead of it and at the same time pressing the glass under it into a flat sheet. It takes but a few seconds for the roller to reach the other end of the table, when the casting operation is complete. The empty pot is returned to the furnace.

The rolling or casting table is made of heavy cast-iron bars closely bolted together to form a flat surface. The tables in use vary from 12 to 14 feet in width and from 20 to 28 feet in length. Before each operation the table is carefully cleaned and cooled with compressed air. Sand is then scattered over the surface of the table to prevent the glass from sticking to the hot iron surface. The roller, also made of cast iron, is about 18 inches in diameter. It extends over the entire width and rolls the entire length of the table. The adjustable strips or iron tracks, on both sides of the table, on which the roller travels determine the thickness of the glass and keep it uniform the whole length of the table. The motion of the roller is controlled by chains driven by an electric motor. When it reaches the other end of the table the roller strikes a lever which raises the roller up on an inclined surface and automatically stops it. There is just enough space between the inclined surface and the table to permit the rolled plate to pass between them when pushed from the casting table into the leer.

The workers engaged in the operation of casting constitute a gang, normally consisting of 11 workers: One wagoner and one overhead crane operator to transfer the pot from the furnace to the casting table and back; one teemer who is usually in charge of the table, and one teeming crane operator to pour the glass on the table and to run the roller; one skimmer, one skim cutter, and one skim catcher to clean the pot, when it is taken out of the furnace, of the impure glass on the surface and also to clean it of the chilled glass and other foreign materials just before the glass is poured on the table; three table men, or gunners as they are called, to do all the additional chores around the table, such as the cooling and cleaning of the table after each operation, and to be of general help to the other workers; and one leer controller to shove the rolled plate from the table into the several leer compartments before it reaches the leer proper. The output of such a casting gang of 11 workers averages from 60 to 70 pots per shift of 8 hours.

ANNEALING THE ROUGH PLATE

When the casting or rolling is completed the red-hot plate is left on the table until it is sufficiently cooled and solidified to be moved into the leer. This is accomplished with the aid of the "stowing tool," composed of special iron rods electrically controlled, which without lifting the plate pushes it from the casting table into the first compartment of the leer. There the sheet remains until another plate is ready to go into the leer. It is then pushed into the second compart-

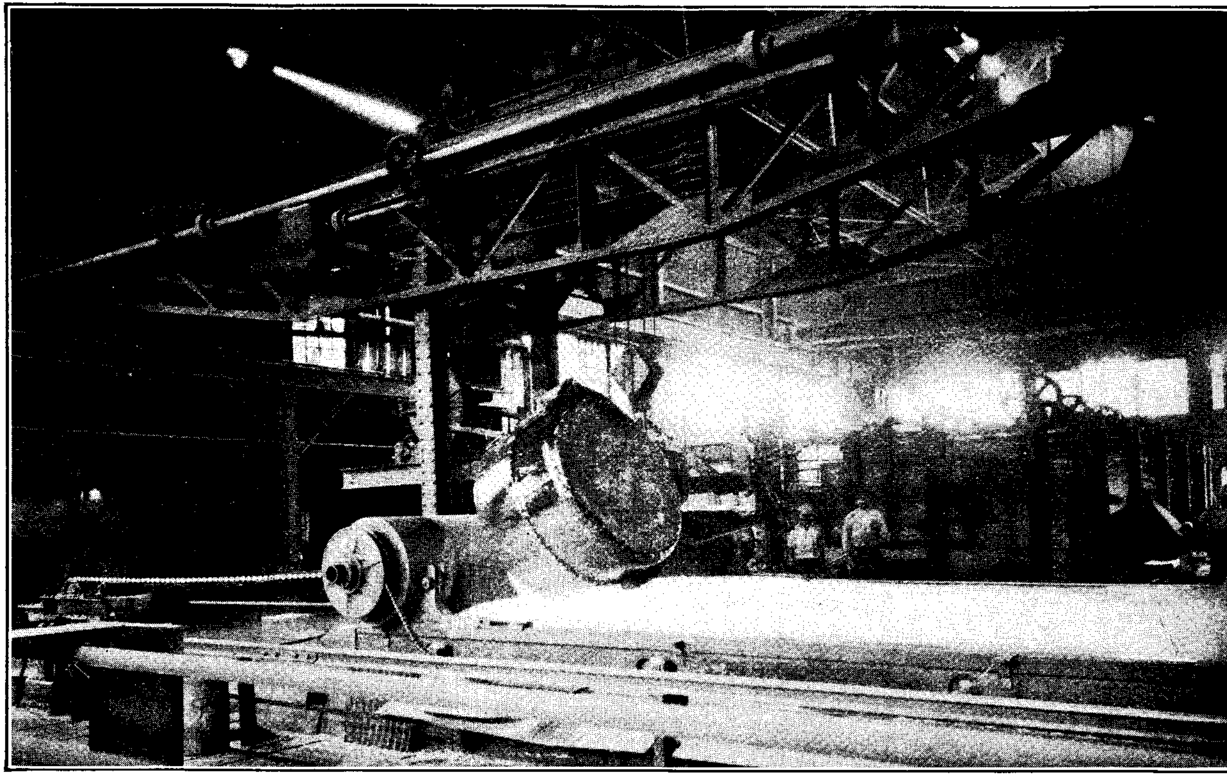

FIG. 30.—DISCONTINUOUS PROCESS: CASTING ROUGH PLATE GLASS

ment of the leer, where the temperature is somewhat lower than in the first. There are four or five such annealing compartments through which the plate must pass before it reaches the leer proper.

The principle of annealing plate glass is exactly the same as that used in the other branches of the glass industry. As the glass passes through the leer the temperature is gradually lowered until, when the cold end of the leer is reached, the temperature is not much higher than normal. The construction of a leer for plate glass, however, is different from that of any other leer used. First, it is four or five times as long as the average leer used for any other glass product, its average length being about 300 feet. Second, the floor of the leer is not continuous and does not move automatically, but is made up of separate sections, each somewhat larger than the largest sheet rolled. Each section consists of a series of rails and rollers, which together constitute a flat surface supporting the sheet when at rest. Each time a new sheet is pushed into the first annealing compartment the leer controller sounds a gong or uses some other device to notify the leer man operating at the cold end of the leer. He then starts an electric motor, which lifts all the rollers in the leer above the floor and sets them in motion, gradually sliding the sheets of plate from one section of the leer to another. The motor is timed to stop automatically when the transfer has been completed, the rollers being then lowered to their rest position. The plate thus travels intermittently from one section of the leer to another until it reaches the cold end of the leer.

From the last section of the leer the sheet is transferred by a similar process, but independently of the leer, to a large table with a surface similar to that of a leer section. The glass is first carefully examined and chalk marked for the more obvious defects, such as stones or large blisters. From the leer the table is moved on a rail track to the rough-cutting department. There the uneven and superfluous glass on the ends of the plate is cut off, and the sheet is cut into smaller sizes, the latter being necessary because of the defects in the glass marked by the examiner. The rough cutters cut out all the defects and at the same time endeavor to get as many large-size plates as possible. When cut the plates are removed, either by hand or with the help of an overhead crane, to the storage section, where they are placed in racks according to their sizes. The table is then returned to the leer for another sheet.

The number of workers engaged in annealing and cutting the rough plate varies from plant to plant. There are also variations in the exact nature of the work performed by each member of the gang, as well as in the terms used to designate the individual workers. In an average plant there are usually two workers directly in charge of the leer—the leer man and the leer motorman. There is one inspector to examine and mark the glass as it comes out of the leer. There are two more or less skilled cutters to cut the plate into smaller sizes, and two square men, each assisted by a helper or two, to cut off the superfluous glass at the ends of the plate. In addition there are about four helpers who remove the discarded glass into special cullet receivers and then join the gang in carrying the smaller plates from the table to the proper racks. In the majority of plants overhead cranes are used to lift and carry the larger plates. To this gang should also be added the "rackman," who marks the sizes of the sheets before they are taken to the racks, and a "booker," who keeps record of the number of plates produced and their sizes.

Melting, casting, annealing, and rough cutting represent the sum total of operations involved in the process of making rough plate glass. These operations are dependent upon one another and have a sufficiently close connection to form a single unit known as the casting department. On the other hand, the subsequent operations of grinding and polishing the plate glass have but very little in common with the casting department and are therefore combined to form a separate "finishing" department.

GRINDING AND POLISHING PLATE GLASS

The finishing department is composed of two groups of machines—one for grinding down the rough surface of the plate glass and the other for giving it the polish which renders the glass transparent. Both operations are performed with the glass laid out on a special round table fitting the size of the machines used. The table, averaging in size from 24 to 36 feet in diameter, is made of cast iron and has an even and polished surface. It is mounted on car wheels running on a depressed wide track, usually extending the entire length of the finishing department. From the main track the tables are easily switched over to any machine or anywhere in the department where tables have to be used.

LAYING OUT A TABLE

There are several distinct operations which rough plate glass must undergo on its way from the racks, where the rough plates are stored, through the grinding and polishing processes to the warehouse, where the polished plate glass is cut into sizes and stored ready for shipment. The first operation is to lay out the grinding table, which is a rather tedious and extremely messy performance. To insure the minimum amount of breakage during the grinding or polishing, the glass has to be firmly cemented to the table, and for this purpose plaster of Paris is spread thickly over the clean flat surface of the table. When a plate is laid on the table half a dozen workers step on it and proceed to walk or rather dance on it in unison until a maximum contact of the plate with the surface of the table is secured, and the glass adheres firmly to the table. Plate after plate is thus laid on the table, the larger sizes in the center, then smaller sizes around the larger, and then still smaller and smaller sizes until the maximum area of the table is laid out with rough plate glass.[1] The spaces between the plates and the notches in the rim of the table are filled in with scraps of glass or cullet. With the glass firmly fastened to its surface and all the crevices between plates filled in with plaster to prevent the slightest lateral movement of the plates, the table is conveyed by a small motor car to the grinding machine.

There are no set regulations determining the number of workers in a laying-out gang. The size of a single gang and the number of such gangs operating in the plant during one shift are determined by the size of the tables used, the number of grinding and polishing machines in operation, and the particular practices followed in each plant. A minimum laying-out gang, however, consists of one boss

[1] Each plant has a definite rotation of sizes, which enables the laying-out gang to proceed with the work without losing any time on measuring and calculations.

layer, one first layer, one second layer, one third layer, one fourth layer, one cullet layer, two plaster mixers, and one cleaner. To these must be added one "matcher," and in most plants also a craneman, both of whom perform services for two or more gangs. An average laying-out gang can lay out from 8 to 10 tables per shift of eight hours.

GRINDING MACHINE

The grinding machine consists of a large circular frame capable of rotating in a horizontal plane. The table, switched from the main track into the grinding machine, is caught into this frame and has imparted to it the same rotary motion as that of the machine. Over the table are suspended two grinding "rubbers," large circular disks shod with many small iron blocks. The "rubbers" also revolve and are set so as to sweep over the whole surface of the glass on the revolving table. The running bars are kept rigidly in position but are capable of being lowered as the grinding proceeds. By this method the more uneven parts of the glass are rubbed off before the general grinding begins. A uniform speed of the machine is absolutely necessary for a uniform distribution of the grinding process over the entire surface of the glass on the table.

The glass is ground with sand, at first of a very coarse grade, but as the process goes on finer and still finer grades of sand are used. The sand and water are fed to the machine automatically. Automatic devices are also used to regrade the sand which leaves the table and to send back to the table only the required grade. The sand is finally replaced with emery, which is less abrasive. It takes about 90 minutes for the machine to grind the glass on the table to an acceptable degree of smoothness.

The direct labor involved in the process of grinding consists of an operator and a helper on a single machine. One sandman and one emery man per shift must also be included in the grinding crew, but these are capable of tending all the grinding machines in the plant.

MIDDLE YARD

When the grinding is finished the table is released from the grinding frame and switched over to the so-called "middle yard" before sending it to the polishing machine. There the glass is examined, and if any breakage has occurred during the grinding process the broken glass is either completely replaced or so patched up with plaster as to prevent any further breakage by the polishing machine. The work in the middle yard is essentially of the same nature as that performed by the laying-out gang. The workers operating in the middle yard are therefore also termed examiners, layers, matchers, plaster mixers, and cleaners. The total number of workers constituting a middle-yard gang varies from plant to plant, depending on the size of tables used and the total number of tables in operation. In an average plant 13 to 14 workers are sufficient, while in the larger plants as many as 20 workers are used.

POLISHING MACHINE

From the middle yard the table is moved over to the polishing machine. This machine consists of a circular frame similar to that in the grinding machine, and the table is locked into it exactly as is done in the grinding process. The polishing apparatus, however,

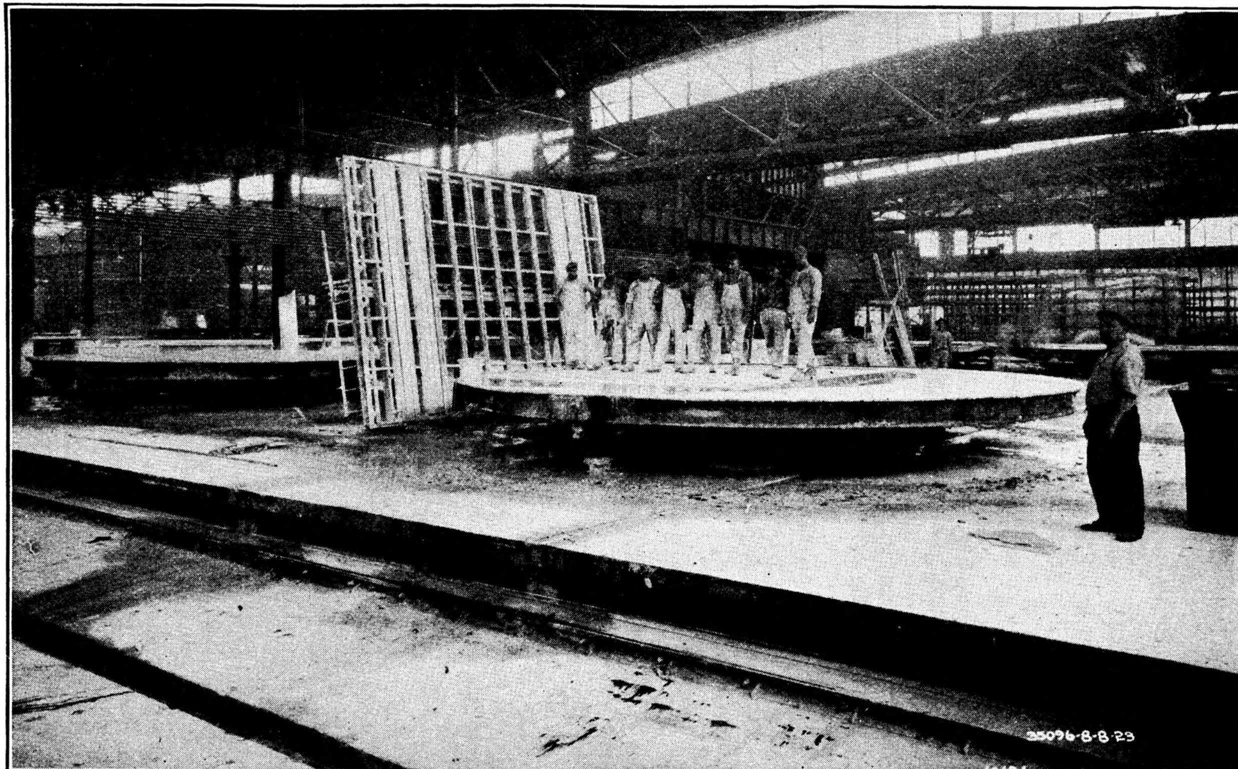

FIG. 31.—DISCONTINUOUS PROCESS: LAYING OUT TABLE PREPARATORY TO SWITCHING IT TO GRINDING MACHINE

consists of four revolving frames, each equipped with a number of disks or rubbers which rotate freely over the entire surface of the glass as the rotating frames sweep over the revolving table. The disks are padded with a thick layer of felt, which with the help of the "rouge" and water used, smooths the surface of the glass of all scratches and imparts to it the required luster. It takes about 75 minutes for the polishing machine to complete this operation.

The direct labor engaged in polishing plate glass consists of one operator or "bench boy" in charge of each machine. In addition one machinist, one or two finishing inspectors, and one or two block felters per shift are needed to tend 8 to 10 polishing machines in operation.

RELAYING OR TURNOVER GANG

After the glass has been ground and polished on one side it must be turned over or relaid for similar treatment on the other side. The work of relaying the glass is sometimes performed by a special "turnover" gang, but in the majority of plants this work is also performed by the laying-out gangs. The two operations are essentially alike, except that in the turning-over process the glass is first taken off the table and the table stripped of the hardened plaster and cleaned before the glass is laid on the other side. The table then proceeds again on its journey through the grinding machine, the "middle yard," and the polishing machine, exactly as for the first side of the glass.

STRIPPING AND WASHING THE GLASS

After both sides of the plates have been ground and polished the table is switched over to the stripping department, where the plates are removed from the table by the stripping gang. This work also is sometimes performed by the laying-out gang. Immediately upon removal from the table the sheets are washed with a diluted acid solution and when dried are marked as to sizes and placed in the racks leading to the cutting room, also known as the warehouse department.

EXAMINING AND CUTTING DEPARTMENT

Before cutting the plate glass into sizes it is again thoroughly cleaned and carefully examined, not only for the purpose of discovering and eliminating defects but also for the purpose of grading the quality of the glass. The uses of plate glass and the grades and sizes required are so numerous that it is well-nigh impossible to gauge the output of the workers in the cutting department in terms of square feet of plate glass cut. Moreover, a comparison of the work in the cutting departments of the separate plants would be entirely misleading unless the plants happen to specialize in the same sizes and grades of plate glass—such as is used in automobiles, for instance. Finally the number of workers and the hours worked in the cutting department are in no way dependent upon or related to those in the casting or finishing departments. For this reason, in the statistics of production given hereafter the cutting department is treated as an independent unit. This separation of the cutting department was also made necessary by the fact that the change from a discontinuous to a continuous process did not in any way affect the examining, cutting, or packing of the glass.

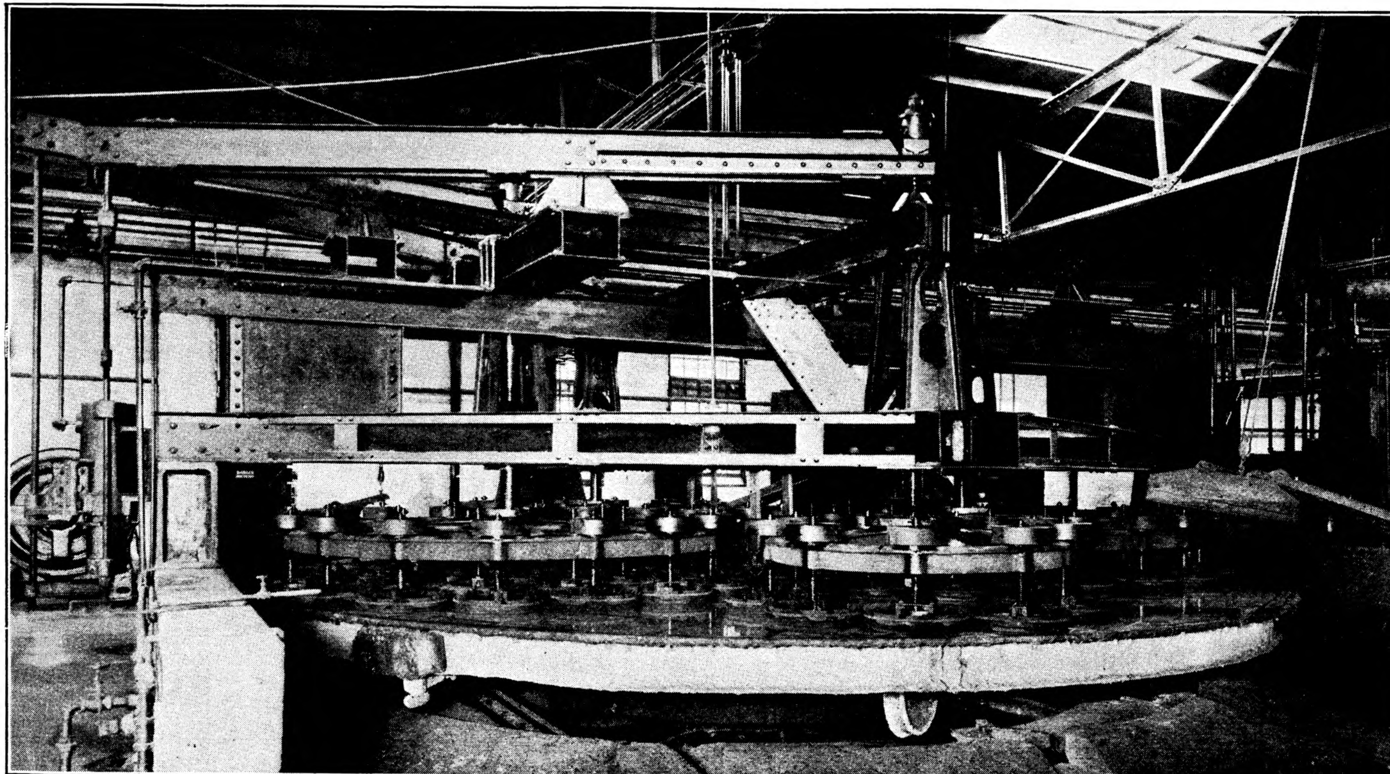

FIG. 32.—DISCONTINUOUS PROCESS: POLISHING MACHINE IN OPERATION

CONTINUOUS PROCESS

The new process of making plate glass, like the discontinuous process, may also be divided into three distinctly separate departments—casting, finishing, and cutting. This division is the more expedient since the physical continuity in the new process is actually interrupted as the glass is transferred from one department to another. Strictly, the continuity of the process applies only to the various operations constituting the casting and finishing. Literally, therefore, the new process of making plate glass may best be described as consisting of the separate but continuous processes of casting and finishing the glass, while the cutting department is in no way different from that in plants using the discontinuous process.

CASTING DEPARTMENT

In the continuous process the glass is melted in large continuous tanks similar to those used in the bottle industry. The tank is divided into three parts—the "dog house," an extension where the raw materials, or the "batch," are delivered to the furnace either on wheelbarrows or through a batch bin hanging directly over the "dog house"; the melting chamber proper, where the glass ingredients are diffused to form a uniform mass of molten glass; and the refining or working chamber from which the glass is drawn for the necessary operations. The refining chamber is usually separated from the melting section by a wall, with an opening near the bottom of the tank to permit only the heavier and therefore the better quality glass to flow from the melting section into the working chamber.

In front of the refining chamber, somewhat lower than the level of the glass in the tank, is located the discharge spout, an opening through which the glass is permitted to flow out of the tank in a continuous stream. The spout is equipped with a special refractory gate, intended to regulate the flow of the glass. From the spout the molten metal passes downward along an inclined plane to a moving table and under a roller, from whence it emerges in the form of a flat continuous sheet of the required width and thickness. It then enters a very long annealing leer, at the other end of which it is cut into plates of the required length, which are then transferred to the finishing department.

The table upon which the molten glass falls as it leaves the discharge spout is made up of several connected sections traveling on an endless chain. The motion of the table is so timed that the portion of it passing between the spout and the leer, a distance of 6 feet, presents to the glass which travels over it a continuous smooth surface. The roller is suspended over the table, at a distance of about 15 inches from the spout. It is made of cast iron, is about 13 inches in diameter, and is constantly revolving on its axis at a speed synchronized with the forward motion of the table. The elevation of the roller above the surface of the table forms a pass and determines the thickness of the sheet emerging on the other side of the roller.

The discharge spout is situated midway of the length of the roller and the width of the table. The ribbon of glass, which is only about 8 inches wide as it leaves the spout, spreads over the table and widens on both sides symmetrically while being carried to the pass. The speed of the table and the roller can be controlled so that the glass may

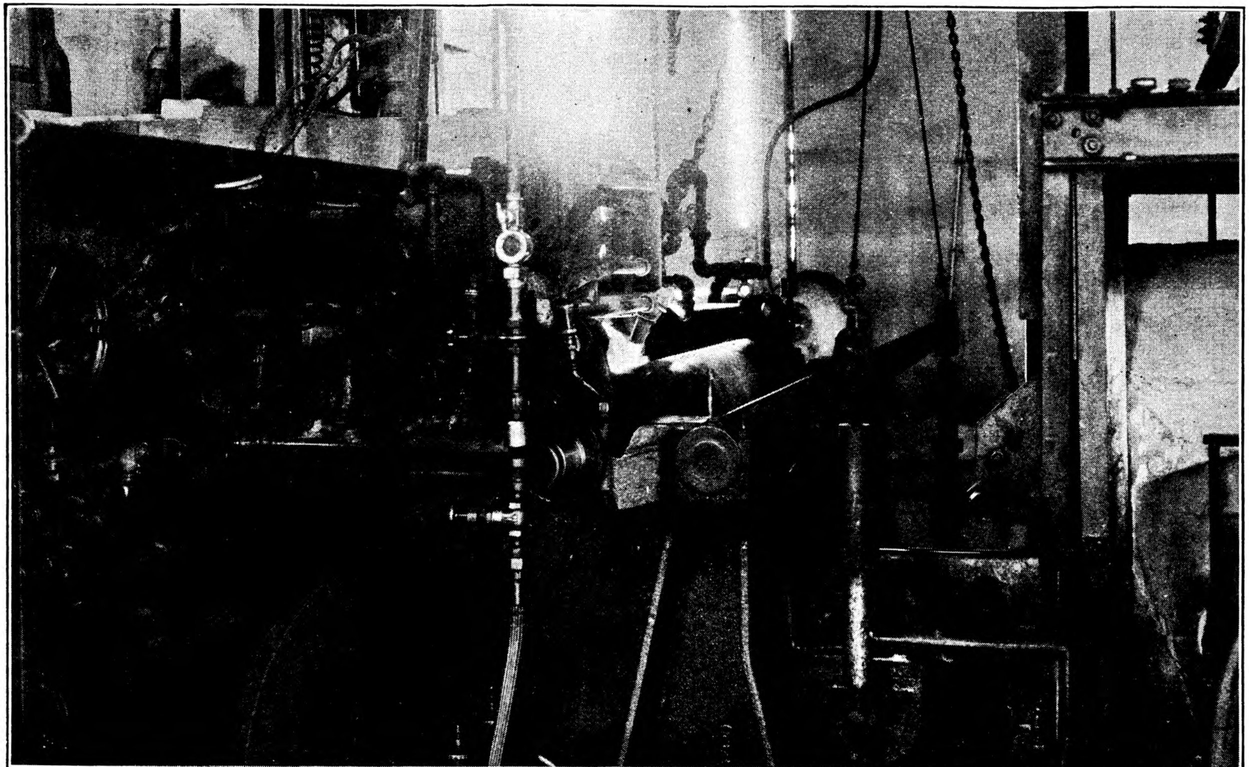

FIG. 33.—CONTINUOUS PROCESS: GLASS AUTOMATICALLY FLOWS FROM TANK UNDER ROLLER AND INTO LEER

acquire the right width just before it reaches the pass between the roller and the table. The same control serves to keep the edges of the sheet from becoming thinner than the elevation of the pass. Both the table and the roller are kept constantly cool by an intricate system of water sprinklers. This serves to keep the glass from sticking to the metal and also to cool it sufficiently to enable the emerging sheet to retain its shape on its subsequent journey from the pass over the table and through the leer.

Within the leer the continuous sheet of rolled plate glass is supported on a series of rollers. These have a uniform speed and are so spaced throughout the length of the leer as to preclude the piling up or stretching of the glass in the sheet. The leer is 450 feet long, and it takes nearly two and a half hours for the glass to flow from the discharge spout of the tank to the exit of the leer. There the glass is carefully examined and the sheet is cut into plates of the required lengths. These are then transferred to the finishing department to be ground and polished.

The entire operation, from the back end of the melting tank where the batch is automatically fed into the "dog house" to the cold end of the leer where the endless sheet emerges to be cut into plates, is absolutely continuous and automatic. The labor engaged in a casting unit consists of two batch mixers, to prepare and weigh the batch and deliver it to the automatic mixing apparatus; one furnace man for each furnace and one glass skimmer for two furnaces, to supervise the proper melting of the glass in the continuous tank; one roller operator to control the speed of the casting table and the roller; and one oiler to keep all the machinery involved in proper working trim. At the end of the leer there is a cutter who examines the glass for defects and cuts the continuous sheet into sizes of required length. Two transfer men then deliver the separate plates to the finishing department. The total number of workers thus involved in the continuous process of casting plate glass is somewhat less than 10, including the portion of the labor of the chief foreman and his assistants which is allotted to the casting unit, as compared with the fifty-odd workers constituting a casting shift in the discontinuous process. Although the total output of a shift in the discontinuous process is considerably larger than that of a casting unit in the continuous process, the productivity of the workers, expressed in terms of man-hour output, is much higher in the continuous process.

FINISHING DEPARTMENT

The principles and the actual operations of grinding and polishing plate glass by the continuous process are exactly the same as in the discontinuous process. But while in the discontinuous process the plates are laid out on individual round tables, which are then moved around from one section of the finishing department to another, in the continuous process the tables on which the plates are laid travel continuously on a very long and narrow conveyor, and the various operations involved are performed with the glass "on the go."

The laying-out operation is very much simpler than in the discontinuous process. The tables used are rectangular and comparatively small, so that only one plate is laid out on each table. As in the discontinuous process, plaster of Paris is used to fasten the glass firmly to the surface of the table. The latter is then locked into the conveyor and started on its journey toward the grinding section or zone. The actual grinding is performed by a series of separate "rubbers" or grinding disks made exactly like the grinders in the discontinuous process. Each disk revolves independently of the others, is operated by a separate motor, and is supported by a separate iron frame built over the conveyor. The diameter of the disk is equal to the width of the glass on the conveyor, so that the grinding iron bars of the rotating disk cover the entire surface of the plate as it slowly passes under the rubber. There are 43 such rubbers under which the rough plate has to pass before the grinding operation is complete. The rubbers are divided into several groups in accordance with the grade of sand used for the grinding. Rough sand is used first, then finer and still finer grades. Each time a new grade of sand is used the previous grade is automatically washed off, automatically regraded, and the finer grade automatically delivered to the table.

After the glass emerges from under the last grinder it has to pass a short distance before it enters into the polishing zone. During this interval the glass is automatically cleansed of any sand or other particles left over from the grinding process. Also, if any breakage has occurred during the last operation, the plate is either completely replaced or the glass patched up with plaster to avoid further breakage in the polishing zone. This short interval corresponds to the "middle yard" of the discontinuous process.

The polishing zone is built exactly like the grinding zone, each polishing machine constituting an independent unit and rotating about its central axis with an independent speed controlled by a separate motor. Each machine is equipped with four revolving smaller disks covered with a thick layer of felt. The iron rust or rouge and the water used for polishing are supplied automatically as the glass passes from under one polishing unit to another. Thirty-six of these polishing machines are used to give to the plate glass the required smoothness and transparency. After emerging from under the last polishing machine the table travels but a short distance before the end of the long conveyor is reached, during which time it is stripped of the plate which has been ground and polished on one side and then switched over a semicircular track pivot to another conveyor similar to and as long as the first conveyor. The table is washed and the plate is reversed on it and proceeds on a similar journey to be ground and polished on its other side. At the end of the second conveyor the plate, now ground and polished on both sides, is stripped from the table, washed in a dilute acid solution, and transferred to the cutting department. By means of another semicircular track pivot the table is moved to the beginning of the first conveyor where another plate is waiting to repeat the journey. The two conveyors and the two pivotal tracks form a circuit which every rough and opaque plate must travel to be converted into polished transparent plate glass.

The total number of workers in a grinding and polishing unit consists of 9 layers and relayers, 2 sandmen, 2 pump and tank men, 1 garnet man,[2] 2 polishers, 4 strippers, 1 block felter, and 1 utility and repair man. In the washing room 2 carriers, 1 brush man, 1

[2] Garnet instead of emery is used as the last abrasive in the grinding process.

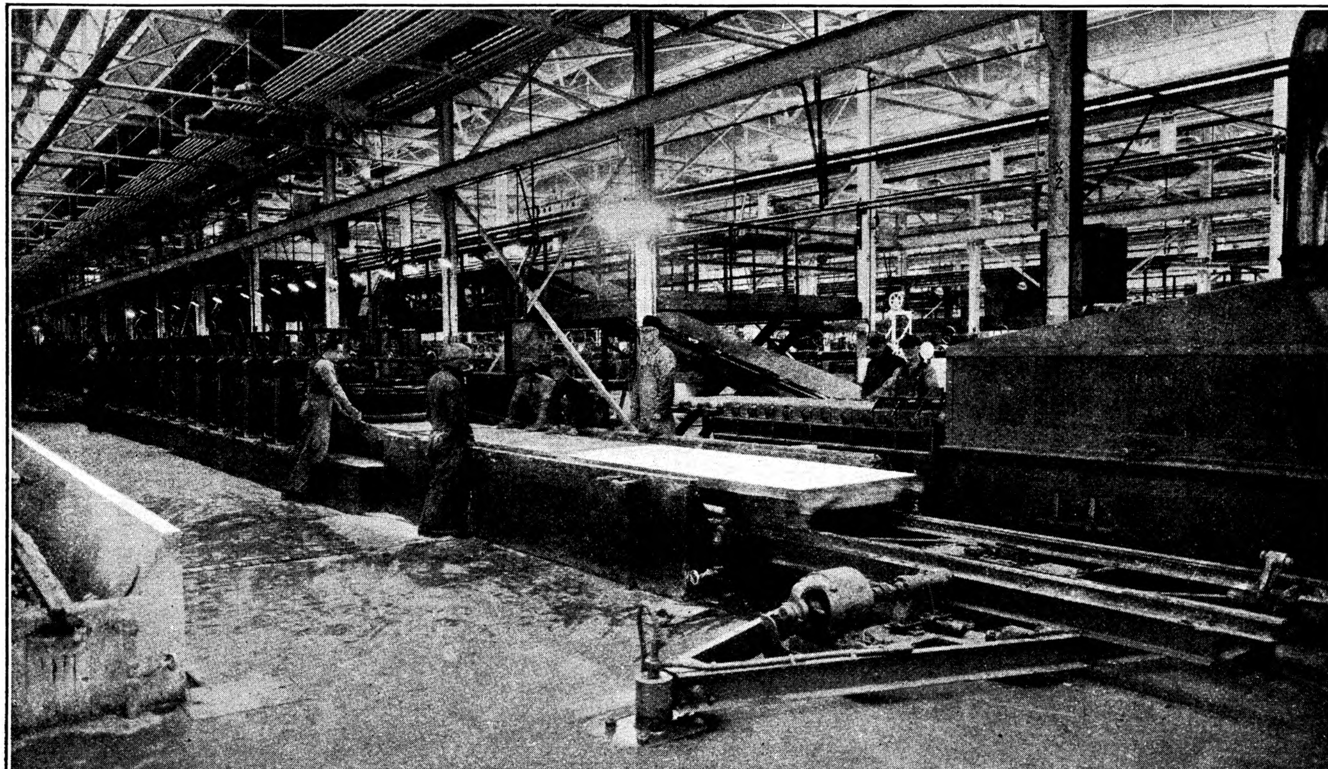

FIG. 34.—CONTINUOUS PROCESS: END VIEW OF GRINDING AND POLISHING CONVEYOR

washing-machine man, and 2 stackers take care of all the glass produced by 4 units. To these must be added 1 grinding and 1 polishing foreman and 2 assistant foremen in charge of 4 units. It takes, therefore, an average of 24½ workers to man a single complete finishing unit.

CUTTING DEPARTMENT

As already mentioned, the cutting department has not been directly affected by the change from the discontinuous to the continuous process of making plate glass. As in the discontinuous process, the glass on reaching the cutting department is first examined for defects and then cut into standard smaller sizes. But because the plates made by the continuous process are absolutely uniform in size the labor efficiency of the cutting department is higher than that in plants using the discontinuous process. Another cause of the increased efficiency in the cutting department of the plant used to represent the continuous process is the fact that this plant specializes in automobile glass, and the rough plates are cut into smaller sizes in such a way as to require the minimum amount of labor and a minimum quantity of waste in the cutting department.

DISCONTINUOUS AND CONTINUOUS PROCESSES COMPARED

The most striking difference between the continuous and the discontinuous processes of making plate glass is the great reduction in the number of workers and of operations effected by the continuous process. This reduction occurs in both the casting and the finishing departments. Before proceeding with an analysis of this change in quantity and kind of labor used it must be clearly understood that a reduction in the number of workers engaged in the process does not per se mean an actual saving in labor used. The latter can be determined only by the figures representing man-hour output, and this will be discussed later. (See p. 189.)

There is nothing in the discontinuous process to correspond to what is known as a "production unit" in the continuous process. This unit is made up of a single furnace, a continuous tank, and a continuous leer in the casting department and a double line of long conveyors in the finishing department. A plant may consist of only one unit. It may have two or more units, but the inherent structure of any one unit is not at all affected by the number of units in the plant. To all intents and purposes, therefore, a number of units in one plant merely represents so many smaller plants built side by side, parallel to one another, and confined in one large structure. The unit remains the same and is more or less constant, except for such inherent differences as the size of the tank or the width of the glass drawn.

With the discontinuous process the situation is entirely different. There the whole plant, no matter how large or small, represents a single production unit in the sense given above. The individual operations are more emphasized and the division is vertical rather than horizontal—the melting room, the laying-out section, the grinding machines, the polishing machines, etc. No matter how large the plant, all the pots are located in the one melting room, which is large or small according to the size of the plant. The same holds true with the other sections. A large plant merely means a combination of large sections or departments, a small plant a combination of small sections or departments. In neither plant is there any definite connection between any one section of one department and another section in another department. No one set of pots melt the glass to be used on any one grinding machine or any one polishing machine. Even the two sides of a plate laid on a table are not necessarily ground or polished on the same machines.

There is, therefore, no way of gauging the output of the plant except by taking the whole plant as a production unit, and even then care must be taken to correlate the number of shifts and hours of work prevailing in the different departments.[3] Besides, the size of such a unit varies directly with the size of the plant, and it can not be compared with the uniform size of a production unit in the continuous process.

For a strict comparison of the two processes a plant must be found which in a given time produces by the discontinuous process exactly the same quantity of plate glass produced by a unit of the continuous process in the same time. The same end can be accomplished by determining how many productive units of the continuous process it would take to equal the output of a given plant using the discontinuous process. Such a comparison really amounts to a comparison of output which is exactly what has been done in the statistics of production given hereafter. (See pp. 189 to 204.) What is intended here is merely to show the number and kind of workers that have been entirely eliminated or replaced by other workers through the change from the discontinuous to the continuous process.

In the melting of the glass in the discontinuous process the pots in which the glass is melted must first be gradually annealed in the pot arch kiln before they can be placed in the furnace. This work is done by the pot leer tenders. Then the batch has to be delivered to the pot by the fillers. The melters, the metal tenders, the finishers, and the helpers are needed to watch the pot during the 24 hours it takes the glass to reach the casting stage. After the pot has been removed to the casting table the cleaners clear the furnace of the slag left by the pot. All these operations and with them the workers performing them are eliminated in the continuous tanks. The batch is automatically delivered to the "dog house"; it is melted in the tank, flows in a continuous stream into the refining chamber, and from there through the discharge spout onto the casting table. The place of the pot leer tenders, the fillers, the melters, the metal tenders, the finishers, and the cleaners is taken by one furnace man, assisted by a skimmer, whose duty it is to watch the temperature and the melting of the glass in the tank, and also to regulate the flow of the glass through and out of the tank.

In casting plate glass by the discontinuous process the pot must be transferred from the furnace to the casting table. This work is done by the wagoner, assisted by a craneman. At the table the skimmer, the skim cutter, and the skim catcher skim the surface of the pot of the impure and chilled glass; the teemer and the teem crane

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[3] In one plant, for instance, the melting department works two 10-hour shifts; the casting department, two or three 8-hour shifts; the finishing department, two 12-hour shifts; and the cutting department, one 10-hour shift.

operator tilt the pot over the table and cast the glass, while the helpers or the "gunners" do the other chores directly connected with the casting table. Finally, the leer controller moves the cast sheet of glass from the table into the first leer compartment and then from one compartment into another until the sheet enters the leer proper.

In the continuous process the whole casting crew is eliminated. The glass flows automatically from the tank onto the moving table, passes automatically under the revolving roller, and then in the form of a continuous sheet into and through the continuous leer. It takes but one roller operator to watch and time the synchronous movements of the glass, the table, and the roller, and one oiler to see that the mechanism of the machinery involved is in good working order.

In the discontinuous process the separate sheets of rough plate glass emerging at the cold end of the leer are first inspected by an examiner and then transferred to the rough cutting department by the leer motorman. It takes cutters, square men, cullet men, carriers, an overhead crane operator, a matcher, and a booker to cut the large single sheets of rough plate glass into smaller sizes and to deliver them to the rough plate storage racks. In the continuous process there is need only for a single cutter to examine and cut the continuous sheet of plate glass emerging from the leer. Two transfer men deliver the plates to the finishing department. These three men take the place of the 13 to 15 people doing the corresponding work in the discontinuous process.

In the finishing department the story is the same, but the changes are not so extreme as in the departments just outlined. The laying-out gang, the car men, the grinders, the middle-yard men, the polishers, the relaying gang, and the stripping and washing gang of the discontinuous process—the total ranging from 84 workers in the smaller to 126 and more in the larger plants—are all replaced in the continuous process by a single finishing gang of about 25 workers, scattered along the line of the two long conveyors on which the opaque rough plates travel while being converted into transparent polished plate glass.

MAN-HOUR OUTPUT AND LABOR COST

Before proceeding with an analysis of the statistics of production of plate glass a number of points must first be made clear which throw additional light on the nature of the data in general as well as on the method used in handling the statistics. The continuous process of making plate glass is of very recent date, being only a few years old, and at present there are but three plants, all operated by one company, which are successfully exploiting this process. Another very large plate-glass concern has been for some time experimenting with the continuous process, gradually increasing the capacity of the plant in which this process is in operation, but there is no authentic information available which would prove the success or failure of this experiment. It therefore became necessary to limit this study of the continuous process to the first company mentioned. This company, however, specializes in the production of automobile glass, and for this reason it is often argued that the continuous process is not capable of producing plate glass for any other use. It is further argued that the discontinuous and the continuous processes can not be compared, as their products are not homogeneous. It is not intended in this report to prove or to disprove the validity of such arguments. In all fairness it must be admitted that not until the continuous process is successfully applied to the production of all kinds and all sizes of plate glass will the force of such arguments be completely dispelled.

On the other hand, the largest single demand by far for plate glass in this country is for the kind produced by the continuous process. The demand for automobile glass is so large that many of the plants using the discontinuous process also specialize in this kind of glass and are frequently compelled to cut larger sizes of plate glass to supply this need. In fact, automobile glass constitutes the major product of two of the three plants here taken to represent the discontinuous process. A large percentage of the output of the third plant is also used for the same purpose. The objection of incomparability of the two processes may therefore be set aside, as a large enough proportion of plate glass used for the same purpose is produced by both the discontinuous and the continuous processes to constitute a fair basis of comparison for the two processes.

Of the plants here taken to represent the discontinuous process Plant A is of average size, Plant B is somewhat smaller than Plant A, and Plant C is a comparatively large plant. Besides varying in size, the three plants differ widely not only in their methods of coordinating the work of the several departments constituting the plant but also in their wage policies. In one plant all of the departments work on an 8-hour-shift basis. In another plant one department works on a basis of two 10-hour shifts, a second department three 8-hour shifts, and a third two 12-hour shifts. Again, in one plant the average rate of wages is exceedingly high—nearly twice as high as in another plant. There are still other differences which, together with those mentioned above, are sufficient to make an average of the data for the three plants anything but representative of any one of the plants used. Such an average can not, therefore, be used for a comparison with data for the continuous process, where the principal object is to determine the changes in human productivity effected by the transition from one process to the other. There are too many unknown factors entering into the average to make it a satisfactory standard of measurement.

Fortunately, however, Plant A, using the discontinuous process, and the plant taken to represent the continuous process are operated by the same company. Both are used primarily for the making of automobile glass. The same efficiency policy and the same system of wage rates prevails in both plants. Fundamentally, the only difference between the two plants is that one uses the discontinuous and the other the continuous process of making plate glass. Therefore, nothing could better serve the purpose of this study in human productivity as affected by a change from one process to another than a comparison of these two plants. This is the reason why in the following statistics Plant A, using the discontinuous process, rather than the average of the three plants, has been selected as the basis of comparison with the continuous process. The other two plants, as well as the average of the three plants, are also given to show the variations in labor output and labor cost due to factors other than a change in the process of production.

Table 33 shows a comparison of man-hour output and labor cost of casting rough plate glass by the discontinuous and the continuous processes. Taking the man-hour output in Plant A as the base, or 100, the index of man-hour output by the continuous process is 145, representing an increase of 45 per cent over the discontinuous process. This increase would have been still larger if the continuous process had been compared with the other two plants, especially with Plant B, where man-hour output is 14.4 per cent less than in Plant A. This lower output is due primarily to a lower productivity in the casting department, as witnessed by the fact that the average hourly output of the casting unit is only 1,972,456 square feet as compared with 2,156,346 square feet in Plant C and 2,347,964 square feet in Plant A.

As to labor cost of casting rough plate glass, the continuous process shows a decrease of 25.1 per cent from that of the discontinuous process in Plant A. But this decrease would have been much smaller if the comparison had been made with the other two plants, and especially with Plant B, where the labor cost of casting rough plate glass is 12.3 per cent lower than in Plant A. Plant B, indeed, presents the anomalous condition of lower labor productivity coupled with lower labor cost. Normally, the reverse is true, i. e., lower labor productivity is expected to be coupled with higher labor costs and higher productivity with lower cost. A glance at the rates of wages in Plants A and B (see pp. 199 to 204) will at once reveal the cause of the abnormal situation in the two plants. In Plant A wages are very high, probably higher than in any other plate-glass plant. On the other hand, wages in Plant B are extremely low, on the average less than two-thirds of the wages in Plant A. This very large variation in the rates of wages is sufficient to overbalance the comparatively small difference in the labor productivity of the two plants, resulting in the abnormal situation explained above. It will be noticed that the same conditions prevail in all other departments of the two plants and are therefore also present when the plants as a whole are considered.

TABLE **33**.—*Man-hour output and labor cost of casting by the discontinuous and the continuous processes—rough plate glass*

Process and plant	Man-hour output		Labor cost per 100 square feet	
	Square feet	Index number	Amount	Index number
Discontinuous process:				
Plant A	43.887	100.0	$1.812	100.0
Plant B	37.571	85.6	1.589	87.7
Plant C	39.206	89.3	1.714	94.6
Average	40.221	91.6	1.705	94.1
Continuous process	63.630	145.0	1.357	74.9

In the grinding and polishing and the cutting a considerable percentage of the rough plate glass is broken, and therefore the total polished plate glass produced is always smaller than the quantity of rough plate used in its production. This diminution in the quantity of glass is known in the industry as the "shrinkage." The loss of glass through shrinkage varies from plant to plant, depending on the size and variety of the plates made and the general conditions within the plant. Due to this loss, the man-hour output and labor cost of casting polished plate glass is considerably different from those for rough plate glass. The figures of Table 33 must be corrected for this difference. The correction factor is determined separately for each plant by dividing the total quantity of polished glass produced by the quantity of rough plate used in its production. This is shown in Table 34. The percentage of shrinkage in the continuous process is smaller than in any of the plants using the discontinuous process. There are several reasons for this difference: (1) In the continuous process the plates are generally smaller and more uniform than in the discontinuous process; (2) the rough plates are cut of such a length as to insure the minimum loss of glass in the cutting department; and (3), due to the continuous conveyors, there is a minimum amount of handling and rehandling of the glass.

TABLE 34.—*Quantity of rough plate glass used and of polished plate glass produced therefrom, by the discontinuous and the continuous processes, 1925, and per cent polished glass was of rough glass*

Process and plant	Rough glass used (square feet)	Polished glass produced	
		Square feet	Per cent of rough glass used
Discontinuous process:			
Plant A	10,330,122	7,769,348	75.21
Plant B	8,685,155	6,994,015	80.53
Plant C	18,611,455	13,636,532	73.27
Average	12,542,244	9,466,632	75.48
Continuous process	10,581,723	9,549,216	90.24

To determine the man-hour output of casting in terms of polished plate glass it is necessary to multiply the man-hour output of rough plate by the per cent representing the relationship between the polished plate produced and the rough plate used in its production. Similarly, to determine the corresponding labor costs, it is necessary to divide the cost of casting rough plate by the same factor. The results are shown in Table 35, which presents a comparison of man-hour output and labor cost of casting polished plate glass by the two processes. The continuous process shows an increase in man-hour output of 74 per cent over that of the discontinuous process as represented by Plant A. In labor cost of casting the continuous process marks a decrease of 37.6 per cent from the corresponding cost by the discontinuous process. The larger increase in man-hour output and larger decrease in labor cost shown in Table 35 as compared with those shown in Table 33 are due solely to the smaller percentage of shrinkage in the continuous process.

TABLE 35.—*Man-hour output and labor cost of casting by the discontinuous and the continuous processes—polished plate glass*

Process and plant	Man-hour output		Labor cost per 100 square feet	
	Square feet	Index number	Amount	Index number
Discontinuous process:				
Plant A	33.007	100.0	$2.409	100.0
Plant B	30.260	91.7	1.973	81.9
Plant C	28.726	87.0	2.340	97.1
Average	30.664	92.9	2.241	93.0
Continuous process	57.420	174.0	1.504	62.4

Table 36 presents a comparison of man-hour output and labor cost of grinding and polishing, or what is known as finishing, the plate glass. Taking the man-hour output of Plant A as the base, or 100, the man-hour output by the continuous process shows an index of 153.5, or an increase of 53.5 per cent over that of the discontinuous process. Again, Plant B shows a lower productivity than Plant A, but Plant C shows a larger productivity than either, due chiefly to the larger size of tables used in the plant.[4]

TABLE 36.—*Man-hour output and labor cost of grinding and polishing plate glass by the discontinuous and the continuous processes*

Process and plant	Man-hour output		Labor cost per 100 square feet	
	Square feet	Index number	Amount	Index number
Discontinuous process:				
Plant A	12.873	100.0	$6.178	100.0
Plant B	12.080	93.8	4.207	68.1
Plant C	14.361	111.6	4.315	69.8
Average	13.105	101.8	4.900	79.3
Continuous process	19.757	153.5	4.297	69.6

In the case of labor cost, the continuous process registers a decrease of 30.4 per cent as compared with the discontinuous process in Plant A. The lower cost in Plant B, in spite of the lower productivity, is due to very low wage rates combined with a 12-hour-shift policy, while in Plant C the cost is lower partly because of the larger size of tables used but mainly because of the rates of wages, which, though higher than in Plant B, are still considerably lower than in Plant A.

As explained elsewhere (p. 187) the casting and the finishing departments are the only departments which have been directly affected by the change from a discontinuous to a continuous process. To determine the direct effects of this change on labor productivity and on labor cost in making plate glass, it is necessary merely to combine the data for these two departments, excluding altogether for the time being the cutting department. This is done in Table 37.

[4] The diameter of the tables used in Plant C is 36 feet as compared with a diameter of 28 feet in the other two plants.

The method used to measure the man-hour output and labor cost of the two departments combined must first be explained. The term "man-hour," used in this study to measure labor productivity in general, is a purely theoretical unit, representing as it does the work of one man, irrespective of skill or occupation, performed during the period of one hour. So defined, this unit has the merit of being uniform not only for all branches of any one industry, but also for all industries. Because of its uniformity, the term "man-hour" offers a means of concretely measuring the combined output of two or more departments, provided the unit of output remains the same. This is exactly the situation as regards plate glass. Tables 35 and 36 show the man-hour output of casting and of finishing polished plate glass. Both are expressed in terms of square feet of polished plate glass per man-hour. The man-hour output of the two departments combined is merely the reciprocal of the man-hours needed to cast and finish 1 square foot of polished glass.[5] The labor cost of the two departments combined is the sum of the labor costs in each.

With the data for the casting and the finishing departments thus combined, the increase in man-hour output due directly to the change from the discontinuous to the continuous process is 58.7 per cent, if the man-hour output of Plant A is taken as the base, or 100. The corresponding decrease in labor cost for the two departments combined is 32.4 per cent of the cost in Plant A. For Plant B the index number for the casting and the finishing departments combined is 93.2 for man-hour output and 72 for labor cost, which was to be expected because of the peculiar conditions in that plant.

TABLE 37.—*Man-hour output and labor cost of casting, grinding, and polishing plate glass by the discontinuous and the continuous processes*

Process and plant	Man-hour per square foot of polished glass			Man-hour output		Labor cost per 100 square feet	
	Casting	Finishing	Casting and finishing	Square feet	Index number	Amount	Index number
Discontinuous process:							
Plant A	0.03030	0.07768	0.10798	9.261	100.0	$8.587	100.0
Plant B	.03305	.08278	.11583	8.633	93.2	6.180	72.0
Plant C	.03481	.06963	.10444	9.575	103.4	6.655	77.5
Average				9.156	98.9	7.141	83.2
Continuous process	.01742	.05061	.06803	14.699	158.7	5.801	67.6

While the transition from the discontinuous to the continuous process of casting and finishing plate glass has not directly affected the cutting department, in the sense that the method of cutting the polished plate glass into sizes remains essentially the same, the indi-

[5] This method is illustrated by an example taken from Plant A. The man-hour output in the casting department in this plant was 33.007 square feet of polished glass. It takes, therefore, $\frac{1}{33.007}$ or 0.03030 man-hour to cast 1 square foot of polished glass. In the same plant the man-hour output of the finishing department was 12.873 square feet of polished glass, and it takes, therefore, $\frac{1}{12.873}$ or 0.07768 man-hour to grind and polish 1 square foot of polished glass. For similar reasons it takes 0.03030+0.07768=0.10798 man-hour to cast and finish 1 square foot of polished glass, and the reciprocal thereof will represent the man-hour output of the casting and the finishing departments combined.

rect effects of the change on the output of the cutting department have been very great. This is shown in Table 38, where a comparison is given of the man-hour output and the labor cost of cutting plate glass. The continuous process shows an increase of 69.8 per cent in man-hour output and a decrease of 37.1 per cent in labor cost, as compared with those of the discontinuous process in Plant A. This difference is due primarily to the fact that the plates reaching the cutting department in the continuous process are uniform in size and of such dimensions as to require the minimum amount of labor to cut them into the required standard sizes. In the discontinuous process all sizes and all grades of plate glass reach the cutting department, and it requires a good deal of judgment on the part of the examiners and cutters to get the maximum percentage of larger sizes and better grades of plate glass. Hence the resulting low output as compared with the continuous process.

TABLE 38.—*Man-hour output and labor cost of cutting plate glass in plants with the discontinuous and the continuous processes*

Process and plant	Man-hour output		Labor cost per 100 square feet	
	Square feet	Index number	Amount	Index number
Discontinuous process:				
Plant A	44.438	100.0	$1.810	100.0
Plant B	44.541	100.2	1.028	56.8
Plant C	48.919	110.1	1.216	67.2
Average	45.966	103.4	1.351	74.6
Continuous process	75.438	169.8	1.138	62.9

To measure the man-hour output and the labor cost of the industry as a whole one need but add the figures for the cutting department to those of the other two departments. The results are shown in Table 39, the method used to combine the three departments being the same as that used in Table 37.

TABLE 39.—*Man-hour output and labor cost of making polished plate glass by the discontinuous and the continuous processes*

Process and plant	Man-hour per square foot of polished plate glass				Man-hour output		Labor cost per 100 square feet	
	Casting	Finishing	Cutting	Total	Square feet	Index number	Amount	Index number
Discontinuous process:								
Plant A	0.03030	0.07768	0.02250	0.13048	7.664	100.0	$10.397	100.0
Plant B	.03305	.08278	.02245	.13828	7.232	94.4	7.208	69.3
Plant C	.03481	.06963	.02044	.12488	8.008	104.5	7.871	75.7
Average					7.635	99.6	8.492	81.7
Continuous process	.01742	.05061	.01327	.08130	12.300	160.5	6.939	66.7

Taking the man-hour output of Plant A as the base, or 100, the man-hour output in the continuous process shows an index of 160.5, or an increase of 60.5 per cent over the discontinous process. In the case of labor cost the continuous process registers a decrease of 33.3 per cent from the corresponding cost in the discontinuous process of

Plant A. Of the other two plants, Plant B shows a smaller labor productivity throughout the plant, due probably to the 12-hour-shift system practiced in the major portion of the plant. Directly connected with this policy are the extremely low wage rates, with the resulting abnormal combination of a low labor productivity with a very low labor cost. In Plant C the man-hour output for the plant is somewhat larger than in Plant A, due to a large extent to the size of tables used in the finishing department. The labor cost of production in this plant is also considerably lower than in Plant A, partly because the labor productivity is higher but mainly because the rates of wages in this plant, though higher than in Plant B, are still much lower than in Plant A.

It is clear from the above that the variations in output and in labor cost, as shown by Plants B and C, are due to factors other than changes in the method of production. But these variations are so large as at times completely to overshadow the variations due to such a change. This is especially true with labor cost, which is more affected by the rate of wages than by the labor output. It is therefore absolutely imperative in comparing the two processes to select plants which differ as little as possible in all other respects than the method of production. This is the reason why Plant A, which has the same management and the same wage rates as the plant representing the continuous process, has been selected as a basis of comparison with that process. Such a comparison, with the other plants eliminated, is shown in Table 40, which contains a comparison of man-hour output of the two processes in (*a*) the casting department; (*b*) the finishing department; (*c*) the casting and finishing departments combined; (*d*) the cutting department; and (*e*) all departments combined. The increase in man-hour output effected by the continuous process varies from 53.5 per cent in the finishing department to 74 per cent in the casting department, with an increase of 60.5 per cent for all departments combined. The table also shows a comparison of the labor cost in the same departments. The decrease in labor cost effected by the continuous process varies from 30.4 per cent in the finishing department to 37.6 in the casting department, with a decrease of 33.3 per cent in all departments combined.

TABLE 40.—*Comparison of man-hour output and labor cost in making plate glass by the discontinuous and the continuous processes, by departments*

Department and process	Man-hour output		Labor cost per 100 square feet	
	Square feet	Index number	Amount	Index number
Casting:				
Discontinuous process	33.007	100.0	$2.409	100.0
Continuous process	57.420	174.0	1.504	62.4
Grinding and polishing:				
Discontinuous process	12.873	100.0	6.178	100.0
Continuous process	19.757	153.5	4.297	69.6
Casting, grinding, and polishing:				
Discontinuous process	9.261	100.0	8.587	100.0
Continuous process	14.699	158.7	5.801	67.6
Cutting:				
Discontinuous process	44.438	100.0	1.810	100.0
Continuous process	75.438	169.8	1.138	62.9
All departments:				
Discontinuous process	7.664	100.0	10.397	100.0
Continuous process	12.300	160.5	6.939	66.7

PRESENT SITUATION IN THE PLATE-GLASS BRANCH OF THE INDUSTRY

In view of the statistics of man-hour output and of labor cost heretofore shown it can hardly be denied that, at least so far as labor productivity and labor cost are concerned, the continuous process marks a decided step forward in plate-glass making. It is also a more integrated and at the same time a simpler process than the discontinuous process. Nevertheless, while admitting that the continuous process is still very young—only four to five years—it must also be admitted that it has not made the progress which might be expected from the figures of man-hour output and of labor cost. There are other factors which must be taken into consideration in order to give a complete picture of the present situation in the plate-glass branch of the industry. They are as follows:

1. The continuous process so far has been successfully used in the production of automobile glass only, and it is still an open question whether the same process can be applied to the manufacture of all grades and all sizes of plate glass.
2. The glass produced in the continuous tanks is admittedly of a lower grade than pot glass. Besides, a large tank of 400 or more tons of molten material is harder to control than a single pot with less than a ton of glass, and the danger of loss is more serious when the glass in a whole tank "goes wrong."
3. There is the problem of plant reconstruction, which is inextricably bound up with the introduction of the continuous process. In spite of the similarity of the actual operations performed, there is such a difference in the kind of plants needed for the two processes that a change from the discontinuous to the continuous process would mean a complete abandoning of the old plant and the construction of a new one. It is even a question if the building housing the old process could be retained for the new one.

The situation is such, therefore, that it would require much consideration on the part of manufacturers before they would decide to abandon the discontinuous in favor of the continuous process. Even if it were possible to produce all grades and all sizes of plate glass by the new process, and even if the glass produced by the tank were as good as pot glass, the question would still remain whether the increase in labor productivity and the decrease in labor cost are sufficient to compensate for the expenses entailed in a change from the old to the new process. The continuous process has certainly come to stay, and has become an important factor as to at least one kind of plate glass—automobile glass—but the discontinuous process has more than held its ground during the same period, and the indications are that as long as tne demand for plate glass keeps growing as fast as it has in the last decade, and as long as there is no serious shortage of labor, the two processes will continue to exist side by side.

STATISTICS OF PRODUCTION AND LABOR COST

The statistics of production of plate glass are somewhat more complicated than those in any other branch of the glass industry. This is especially true of the discontinuous process as represented in Plants A, B, and C. First, the data for each plant has to be divided into that for three separate departments, the labor and the output of which are very little, if at all, related to one another. The casting department produces rough plate glass; the finishing department grinds and polishes the rough plate; and the cutting department cuts the polished plates into sizes. Each department is an independent unit, not only because of the differences in the nature of the work performed but also because there are separate wage and hour conditions in each. Hence separate data are given for each department.

In the casting department the casting gang was selected as the nucleus of the labor unit. The selection was prompted partly by the fact that this group of workers actually performs the operation of casting the rough plate, but chiefly because it is more or less uniform in size and composition in all plate-glass plants using the discontinuous process. To these workers was added the equivalent of that portion of the labor of the other groups in the casting department which could be allotted to a single casting gang. For instance, in one plant the casting gang is normally operating on a three 8-hour-shift basis, while the batch room of the same plant is operating on a two 10-hour-shift basis. For this reason the equivalent of five-sixths of the labor in the batch room was added to the casting gang, as this constitutes the fraction of the batch-room labor needed to keep one casting gang in operation. The same method was used to determine the relations between the casting gang and the other groups in the casting department, the resulting total representing a complete casting unit with its constituent parts proportionally related to one another. That such a unit is significant can be seen from the fact that in spite of considerable differences in the size and regulations in the three plants given the variation in the number of workers constituting a casting unit is very small. Plant A shows 53½ workers per unit, Plant B 52½ workers, and Plant C 55 workers.

This method of selecting a single group of workers around which the other workers could be so arranged as to form a complete production unit can not be applied either to the finishing or the cutting department. There is no way to determine the proportions of the separate operations needed in connection with the process of grinding and polishing plate glass or in cutting the polished plates into sizes. For this reason all the workers employed in each of these departments during one shift were taken as constituting the unit in that department. No comparison can therefore be made between these units in one plant and the corresponding units in any other plant. A larger unit merely signifies a larger plant and a smaller unit a smaller plant.

In the continuous process, as represented in the plant chosen, the problem of determining the labor attendance in the separate departments is comparatively simple. There the three departments constitute a single definite production unit, or a "line," as it is officially termed. The workers engaged in the batch room and those in charge of the casting operations, including the workers whose duty it is to transfer the rough plates from the leer to the finishing conveyor, constitute the casting department. On the same basis, all the workers in charge of the two grinding and polishing conveyors, including the workers who deliver the polished plates to the cutters, constitute the finishing department. The other workers of the "line" belong to the cutting department.

There is no definite wage policy which can be described as characteristic of plate-glass plants. Nor is there any uniformity in the number of shifts in operation in each plant or the hours of work prevailing in the plant. The labor is essentially nonskilled, and the rates of wages are largely determined either by conditions prevailing in the community or by the policy pursued in the individual plants. The 8-hour shift predominates in most plants, especially in the casting departments, but in Plant B its finishing department operates on two 12-hour shifts and its cutting department on one 10-hour shift. Similar or other variations can be found in other plants.

The statistics of output as shown in the second part of each section of Table H are prepared on the same principle as those for other branches of the glass industry. They give the quantity produced in square feet, the unit of the market; the total number of hours the plant, if reduced to a single labor unit or a single machine, would have to operate to produce such output; the output of a labor unit per hour; the man-hour output; and the labor cost per hour.

Table H.—PRODUCTION AND LABOR COST IN MAKING PLATE GLASS BY THE DISCONTINUOUS AND THE CONTINUOUS PROCESSES

ROUGH PLATE GLASS—DISCONTINUOUS PROCESS: PLANT A

[In this table all wage rates are for 1925 and labor cost is based on 1925 wage rates regardless of year of output data. Italicized figures represent minimum and maximum]

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
3	Batch room: Batch			1925	*Sq. ft.*		*Sq. ft.*	*Sq. ft.*	
	mixers	$0.75	$2.25	Jan	972,543	384.0	*2,532.664*	*47.340*	*$1.680*
1	Pot leer: Pot-leer tender	.75	.75	Feb	909,810	364.0	2,499.478	46.719	1.702
	Furnace room:			Mar	980,084	416.0	2,355.971	44.037	1.806
1	Foreman	1.05	1.05	Apr	1,022,733	416.0	2,458.493	45.953	1.731
1	Boss finisher	.90	.90	May	938,332	390.0	2,405.979	44.972	1.769
4	Finishers	.85	3.40	June	912,306	416.0	*2,193.043*	*40.991*	*1.940*
4	Melters	.80	3.20	July	995,042	426.0	2,335.779	43.659	1.822
1	Metal tender	.85	.85	Aug	1,040,916	452.0	2,302.912	43.045	1.848
1	Blocker	.75	.75	Sept	923,271	402.0	2,296.694	42.929	1.853
2	Hoist-ups	.75	1.50	Oct	991,725	432.0	2,295.660	42.910	1.853
6	Cleaners	.75	4.50	Nov	874,300	384.0	2,276.823	42.557	1.869
	Casting room:			Dec	892,306	396.0	2,253.298	42.118	1.888
½	Shift foreman	1.20	.60						
1	Teemer	.90	.90						
1	Skimmer	.85	.85						
1	Skim cutter	.85	.85						
1	Pot craneman	.80	.80						
1	Wagon man	.85	.85						
1	Teeming craneman	.80	.80						
1	Skim catcher	.80	.80						
3	Table men	.75	2.25						
1	Leer controller	.80	.80						
	Annealing leer:								
1½	Leer men	.80	1.20						
1½	Leer motormen	.80	1.20						
	Rough cutting room:								
1	Examiner	.80	.80						
1	Booker	.75	.75						
2	Cutters	.80	1.60						
2	Square-up men	.75	1.50						
4	Carriers	.75	3.00						
3	Helpers	.75	2.25						
1	Rackman	.80	.80						
1	Craneman	.80	.80						
53½	Total		42.55	Total	11,453,368	4,878.0	2,347.964	43.887	1.812

TABLE H.—PRODUCTION AND LABOR COST IN MAKING PLATE GLASS BY THE DISCONTINUOUS AND THE CONTINUOUS PROCESS—Continued

ROUGH PLATE GLASS—DISCONTINUOUS PROCESS: PLANT B

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
	Batch room:			1925	*Sq. ft.*		*Sq. ft.*	*Sq. ft.*	
½	Boss mixer	$0.6750	$0.3375	Jan	215,344	112.0	1,922.714	36.623	$1.631
1	Mixer	.6125	.6125	Feb	716,136	384.0	*1,864.937*	*35.523*	*1.681*
1½	Helpers	.5700	.8550	Mar	779,146	416.0	1,872.947	35.675	1.674
1½	Pot leer: Leer tenders	.4000	.6000	Apr	796,862	416.0	1,915.534	36.486	1.637
	Furnace room:			May	829,551	416.0	1,994.113	37.983	1.572
1	Foreman	.7500	.7500	June	803,246	416.0	1,930.880	36.779	1.624
4	Fillers	.6125	2.4500	July	811,371	392.0	2,069.824	39.425	1.515
3½	Finishers	.5700	1.9950	Aug	805,730	416.0	1,936.851	36.892	1.619
3½	Melters	.4850	1.6975	Sept	856,276	432.0	1,982.120	37.755	1.582
1	Metal tender	.5250	.5250	Oct	816,436	416.0	1,962.587	37.383	1.597
7	Cleaners	.5250	3.6750	Nov	316,978	400.0	2,042.445	38.904	1.535
	Casting room:			Dec	699,985	320.0	*2,187.453*	*41.666*	*1.433*
1	Shift foreman	1.0000	1.0000						
1	Teemer	.8500	.8500						
1	Skimmer	.7500	.7500						
1	Skim cutter	.7000	.7000						
1	Pot craneman	.7000	.7000						
1	Wagon man	.7000	.7000						
3	Table men	.6700	2.0100						
1	Teeming craneman	.8750	.8750						
1	Leer controller	.7000	.7000						
	Annealing leer:								
1½	Leer men	.5000	.7500						
1½	Leer motormen	.5000	.7500						
	Rough cutting room:								
1	Examiner	.5375	.5375						
1	Booker	.3500	.3500						
4	Cutters	.7000	2.8000						
6	Helpers	.5375	3.2250						
1	Rackman	.4550	.4550						
1	Craneman	.7000	.7000						
52½	Total		31.3500	Total	8,947,061	4,536.0	1,972.456	37.571	1.589

ROUGH PLATE GLASS—DISCONTINUOUS PROCESS: PLANT C

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
	Batch room:			1925					
¼	Boss mixer	$0.80	$0.20	Jan	1,534,841	648.0	*2,368.582*	*43.065*	*$1.560*
3	Mixers	.55	1.65	Feb	1,716,227	768.0	2,234.671	40.630	1.654
2	Pot leer: Pot-leer tenders.	.55	1.10	Mar	1,786,064	832.0	2,146.712	39.031	1.722
				Apr	1,776,477	800.0	2,220.596	40.374	1.664
	Furnace room:			May	1,808,817	832.0	2,174.060	39.528	1.700
¾	Foreman	1.00	.75	June	1,667,500	832.0	2,004.207	36.440	1.845
4	Finishers	.73	2.92	July	1,635,717	832.0	*1,966.006*	*35.746*	*1.881*
5	Melters	.66	3.30	Aug	1,808,870	864.0	2,093.600	38.065	1.766
6	Fillers	.60	3.60	Sept	1,444,242	664.0	2,172.320	39.497	1.702
3	Cleaners	.60	1.80	Oct	1,407,173	648.0	2,171.563	39.501	1.702
¾	Craneman	.63	.47	Nov	1,344,439	600.0	2,240.761	40.741	1.649
¾	Fill-hopper operator	.63	.47	Dec	1,718,256	792.0	2,169.515	39.446	1.704
1½	Mud-ups	.70	1.05						
	Casting room:								
1	Teemer	.92	.92						
1	Skimmer	.76	.76						
1	Skim cutter	.76	.76						
1	Skim catcher	.70	.70						
1	Pot tongs man	.76	.76						
1	Pot craneman	.72	.72						
1	Teeming craneman	.76	.76						
3	Gunners	.70	2.10						
1	Leer motorman	.72	.72						
	Annealing leer:								
1	Leer man	.73	.73						
1	Leer motorman	.65	.65						
	Rough cutting room:								
2	Cutters	.82	1.64						
1	Examiner	.65	.65						
1	Booker	.66	.66						
1	Rackman	.60	.60						
10	Helpers and carriers	.65	6.50						
55	Total		36.95	Total	19,648,623	9,112.0	2,156.346	39.206	1.714

TABLE H.—PRODUCTION AND LABOR COST IN MAKING PLATE GLASS BY THE DISCONTINUOUS AND THE CONTINUOUS PROCESSES—Continued.

ROUGH PLATE GLASS—CONTINUOUS PROCESS

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
2	Batch room: Mixers	$0.800	$1.6000	1925	*Sq. ft.*		*Sq. ft.*	*Sq. ft.*	
	Furnace room:			Aug.	1,050,262	1,704.0	616.351	66.633	$1.296
1/4	Chief foreman	1.250	.3125	Sept.	1,235,227	1,944.0	630.261	68.136	1.267
1/2	Assistant foreman	1.100	.5500	Oct.	1,016,491	1,584.0	*641.724*	*69.376*	*1.245*
1	Furnace man	.850	.8500	Nov.	901,160	1,440.0	625.806	67.655	1.276
1/2	Skimmer	.900	.4500	Dec.	905,241	1,560.0	580.283	62.733	1.377
1	Roller	.925	.9250						
1	Oiler	.850	.8500	1926					
1	Stripper or cutter	.850	.8500	Jan.	986,269	1,800.0	547.927	59.235	1.458
2	Transfer men	.800	1.6000	Feb.	984,305	1,848.0	*532.633*	*57.582*	*1.500*
				Mar.	717,964	1,200.0	598.303	64.681	1.335
				Apr.	762,638	1,377.6	553.599	59.849	1.443
				May	1,054,434	1,826.4	577.329	62.414	1.384
				June	1,053,895	1,800.0	585.497	63.297	1.364
				July	593,225	1,048.0	565.623	61.148	1.412
9 1/4	Total		7.9875	Total	11,261,111	19,132.8	588.576	63.630	1.357

GRINDING AND POLISHING PLATE GLASS—DISCONTINUOUS PROCESS: PLANT A

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
	Laying-out and turnover gangs:			1925					
				Jan.	620,152	568.0	1,091.817	12.998	$6.118
1	Shift foreman	$1.20	$1.20	Feb.	649,991	564.0	*1,152.466*	*13.720*	*5.796*
2	Matchers	.90	1.80	Mar.	706,990	624.0	1,132.997	13.488	5.896
1	Boss layer	.90	.90	Apr.	658,979	624.0	1,056.056	12.572	6.326
4	First layers	.90	3.60	May	632,984	600.0	1,054.973	12.559	6.332
4	Second layers	.80	3.20	June	604,759	600.0	1,007.932	11.999	6.628
4	Third layers	.75	3.00	July	701,278	624.0	1,123.843	13.379	5.944
4	Fourth layers	.75	3.00	Aug.	712,137	624.0	1,141.245	13.586	5.853
4	Fifth layers	.75	3.00	Sept.	685,580	600.0	1,142.633	13.603	5.846
4	Cullet men	.75	3.00	Oct.	606,470	600.0	1,010.783	12.033	6.609
4	Plaster mixers	.75	3.00	Nov.	597,705	557.0	1,073.079	12.775	6.225
4	Cleaners	.75	3.00	Dec.	592,323	600.0	*987.205*	*11.752*	*6.767*
	Table transfer gangs:								
6	Carmen	.75	4.50						
	Grinding machines:								
1	Machinist	.85	.85						
8	Operators	.80	6.40						
4	Helpers	.75	3.00						
1	Sandman	.75	.75						
1	Emory man	.80	.80						
	Middle-yard gangs:								
1	Foreman	1.20	1.20						
1	Examiner	.95	.95						
2	Matchers	.90	1.80						
1	First layer	.90	.90						
1	Second layer	.80	.80						
1	Third layer	.75	.75						
1	Plaster mixer	.75	.75						
5	Helpers	.75	3.75						
1	Cleaner	.75	.75						
	Polishing machines:								
1	Machinist	.85	.85						
1 2/3	Block felters	.80	1.33						
4	Operators	.80	3.20						
	Stripping[1] and washing gangs:								
1/3	Bookers	.80	.27						
2	Cranemen	.75	1.50						
2	Washers	.75	1.50						
2	Cleaners	.75	1.50						
84	Total		66.80	Total	7,769,348	7,185.0	1,081.329	12.873	6.178

[1] Stripping is done by laying-out gangs.

TABLE H.—PRODUCTION AND LABOR COST IN MAKING PLATE GLASS BY THE DISCONTINUOUS AND THE CONTINUOUS PROCESSES—Continued.

GRINDING AND POLISHING PLATE GLASS—DISCONTINUOUS PROCESS: PLANT B

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
	Laying-out and turnover gangs:			1925	*Sq. ft.*		*Sq. ft.*	*Sq. ft.*	
				Jan	226,346	216.0	1,048.898	12.401	$4.098
1	Shift foreman	$0.900	$0.900	Feb	541,534	576.0	*940.163*	*11.126*	*4.567*
1	Boss layer	.675	.675	Mar	603,797	624.0	967.623	11.451	4.437
2	First layers	.650	1.300	Apr	627,042	624.0	1,004.875	11.892	4.273
6	Second layers	.575	3.450	May	624,328	624.0	1,000.526	11.841	4.292
3	Third layers	.560	1.680	June	604,714	588.0	1,028.425	12.171	4.175
11	Fourth layers	.540	5.940	July	658,264	624.0	1,054.910	12.484	4.070
3	Plaster mixers	.560	1.680	Aug	660,774	624.0	1,058.933	12.532	4.055
3	Cleaners	.375	1.125	Sept	694,195	648.0	1,071.289	12.678	4.008
2	Cranemen	.420	.840	Oct	633,174	624.0	1,014.702	12.008	4.232
1	Matcher	.650	.650	Nov	605,206	600.0	1,008.677	11.937	4.257
	Table transfer gangs:			Dec	514,641	480.0	*1,072.169*	*12.688*	*4.005*
1	Carman	.520	.520						
2	Rope pullers	.475	.950						
	Grinding machines:								
1	Machinist	.520	.520						
8	Operators	.485	3.880						
4	Helpers	.370	1.480						
1	Sandman	.370	.370						
1	Emery man	.400	.400						
	Middle-yard gangs:								
1	Examiner	.665	.665						
1	First layer	.650	.650						
1	Second layer	.575	.575						
1	Third layer	.560	.560						
1	Fourth layer	.540	.540						
6	Helpers	.520	3.120						
1	Plaster mixer	.570	.570						
1	Cleaner	.375	.375						
	Polishing machines:								
1	Foreman	.900	.900						
2	Finishers	.520	1.040						
4	Operators (bench boys)	.370	1.480						
1½	Block felters	.455	.683						
	Stripping and washing gangs:								
1	Booker	.370	.370						
1	First stripper	.600	.600						
2	Second strippers	.520	1.040						
3	Third strippers	.490	1.470						
1	Craneman	.420	.420						
2	Washers	.380	.760						
2	Cleaners	.380	.760						
84½	Total		42.938	Total	6,994,015	6,852.0	1,020.726	12.080	4.207

GRINDING AND POLISHING PLATE GLASS—DISCONTINUOUS PROCESS: PLANT C

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
	Laying-out and turnover gangs:			1925					
				Jan	1,103,689	664.0	*1,662.182*	*13.192*	*$4.698*
1	Boss layer	$0.785	$0.785	Feb	1,098,261	592.0	1,855.171	14.724	4.209
1	Turnover boss layer	.785	.785	Mar	1,182,954	648.0	1,825.546	14.488	4.277
3	Matchers	.645	1.935	Apr	1,189,622	648.0	1,835.836	14.570	4.253
5	First layers	.775	3.875	May	1,176,084	640.0	1,837.631	14.584	4.249
10	Second layers	.680	6.800	June	1,136,876	640.0	1,776.369	14.098	4.396
5	Third layers	.610	3.050	July	1,136,068	600.0	*1,893.447*	*15.027*	*4.124*
5	Fourth layers	.595	2.975	Aug	1,193,899	640.0	1,865.467	14.805	4.186
5	Cullet matchers	.610	3.050	Sept	1,172,246	640.0	1,831.634	14.537	4.263
10	Plaster mixers	.595	5.950	Oct	1,149,338	640.0	1,795.841	14.253	4.348
5	Cleaners	.545	2.725	Nov	1,053,278	592.0	1,779.186	14.121	4.389
	Table transfer gangs:			Dec	1,044,217	592.0	1,763.880	13.999	4.427
1	Boss carman	.620	.620						
6	Carmen	.610	3.660						
	Grinding machines:								
1	Machinist	.785	.785						
9	Operators	.665	5.985						
9	Helpers	.555	4.995						
1	Sandman	.500	.500						
1	Emery man	.500	.500						

Table H.—PRODUCTION AND LABOR COST IN MAKING PLATE GLASS BY THE DISCONTINUOUS AND THE CONTINUOUS PROCESSES—Continued

GRINDING AND POLISHING PLATE GLASS—DISCONTINUOUS PROCESS: PLANT C—Continued

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
	Middle yard:			1925	*Sq. ft.*		*Sq. ft.*	*Sq. ft.*	
1	Middle yard boss	$0.775	$0.775						
1	Examiner	.725	.725						
2	Matchers	.635	1.270						
2	First layers	.595	1.190						
2	Second layers	.595	1.190						
1	Third layer	.560	.560						
2	Plaster mixers	.560	1.120						
7	Helpers	.555	3.885						
2	Cleaners	.545	1.090						
	Polishing machines:								
1	Machinist	.785	.785						
2	Finishing inspectors	.710	1.420						
10	Machine operators	.630	6.300						
1	Block felter	.560	.560						
1	Helper	.500	.500						
	Stripping yard and washing gangs:								
1	Boss stripper	.775	.775						
1	Second stripper	.680	.680						
1	Third stripper	.610	.610						
1	Fourth stripper	.595	.595						
2	Fifth strippers	.580	1.160						
3	Helpers	.560	1.680						
2	Washers	.560	1.120						
2	Cleaners	.560	1.120						
126	Total		78.085	Total	13,636,532	7,536.0	1,809.519	14.361	$4.315

GRINDING AND POLISHING PLATE GLASS—CONTINUOUS PROCESS

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
¼	Grinding foreman	$1.20	$0.300	1925					
¼	Polishing foreman	1.20	.300	Aug	949,892	1,896.0	500.998	20.449	$4.152
½	Assistant foreman	1.00	.500	Sept	897,860	1,584.0	566.830	23.136	3.670
9	Layers	.85	7.650	Oct	906,928	1,464.0	*619.486*	*25.285*	*3.358*
2	Sandmen	.85	1.700	Nov	596,286	1,248.0	477.793	19.502	4.353
2	Pump and tank men	.85	1.700	Dec	1,069,738	2,256.0	474.175	19.354	4.387
1	Garnet man	.80	.800						
2	Polishers	.90	1.800	1926					
4	Strippers	.80	3.200	Jan	958,408	1,968.0	486.996	19.877	4.271
1	Repair man	.85	.850	Feb	808,958	1,992.0	*406.103*	*16.576*	*5.122*
1	Block felter	.80	.800	Mar	647,086	1,476.0	438.405	17.894	4.744
½	Carrier	.80	.400	Apr	632,878	1,521.6	415.929	16.977	5.001
¼	Brushman	.80	.200	May	792,115	1,680.0	471.497	19.245	4.411
¼	Washing-machine man	.80	.200	June	642,028	1,358.4	472.635	19.291	4.401
½	Stacker	.80	.400	July	647,039	1,284.0	503.924	20.568	4.128
24½	Total		20.800	Total	9,549,216	19,728.0	484.044	19.757	4.297

CUTTING POLISHED PLATE GLASS—DISCONTINUOUS PROCESS: PLANT A

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
1	Chief foreman	$1.25	$1.25	1925					
2	Assistant foremen	.95	1.90	Jan	620,152	189.0	3,281.228	44.948	$1.789
28	Cutters	.80	22.40	Feb	649,991	188.0	*3,457.398*	*47.362*	*1.698*
24	Helpers and cleaners	.75	18.00	Mar	706,990	208.0	3,398.990	46.562	1.727
16	Examiners	.85	13.60	Apr	658,979	208.0	3,168.168	43.400	1.853
1	Booker	.75	.75	May	632,984	200.0	3,164.920	43.355	1.855
1	Craneman	.80	.80	June	604,759	200.0	3,023.795	41.422	1.941
				July	701,278	208.0	3,371.529	46.185	1.741
				Aug	712,137	208.0	3,423.736	46.900	1.715
				Sept	685,580	200.0	3,427.900	46.958	1.712
				Oct	606,470	200.0	3,032.350	41.539	1.936
				Nov	597,705	186.0	3,213.468	44.020	1.827
				Dec	592,323	200.0	*2,961.615*	*40.570*	*1.982*
73	Total		58.70	Total	7,769,348	2,395.0	3,243.987	44.438	1.810

Table H.—PRODUCTION AND LABOR COST IN MAKING PLATE GLASS BY THE DISCONTINUOUS AND THE CONTINUOUS PROCESSES—Continued

CUTTING POLISHED PLATE GLASS—DISCONTINUOUS PROCESS: PLANT B

Labor unit				Output and labor cost					
Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
1	Shift foreman	$1.50	$1.50	1925	*Sq. ft.*		*Sq. ft.*	*Sq. ft.*	
1	Assistant foreman	.80	.80	Jan	226,346	90.0	2,514.956	45.726	$1.002
15	Cutters	.55	8.25	Feb	541,534	240.0	*2,256.392*	*41.025*	*1.116*
15	Table men and helpers	.40	6.00	Mar	603,797	260.0	2,322.296	42.224	1.085
3	Bookers	.39	1.17	Apr	627,042	260.0	2,411.700	43.849	1.044
19	Cleaners and examiners	.37	7.03	May	624,328	260.0	2,401.262	43.659	1.049
1	Craneman	.44	.44	June	604,714	245.0	2,468.220	44.877	1.021
				July	658,264	260.0	2,531.785	46.032	.995
				Aug	660,774	260.0	2,541.438	46.208	.991
				Sept	694,195	270.0	2,571.093	46.747	.980
				Oct	633,174	260.0	2,435.285	44.278	1.034
				Nov	605,206	250.0	2,420.824	44.015	1.041
				Dec	514,641	200.0	*2,573.205*	*46.786*	*.979*
55	Total		25.19	Total	6,994,015	2,855.0	2,449.743	44.541	1.028

CUTTING POLISHED PLATE GLASS—DISCONTINUOUS PROCESS: PLANT C

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
1	Foreman	$1.25	$1.25	1925					
2	Assistant foremen	1.10	2.20	Jan	1,103,689	216.0	*5,109.671*	*44.432*	*$1.339*
25	Cutters	.65	16.25	Feb	1,098,261	192.0	5,720.109	49.740	1.196
46	Helpers and carriers	.55	25.30	Mar	1,182,954	208.0	5,687.279	49.455	1.203
16	Examiners	.65	10.40	Apr	1,189,622	208.0	5,719.337	49.733	1.196
15	Cleaners	.50	7.50	May	1,176,084	208.0	5,654.250	49.167	1.210
10	Bookers	.55	5.50	June	1,136,876	200.0	5,684.380	49.429	1.203
				July	1,136,068	192.0	*5,917.021*	*51.452*	*1.156*
				Aug	1,193,899	208.0	5,739.899	49.912	1.192
				Sept	1,172,246	208.0	5,635.798	49.007	1.214
				Oct	1,149,338	208.0	5,525.663	48.049	1.238
				Nov	1,053,278	192.0	5,485.823	47.703	1.247
				Dec	1,044,217	184.0	5,675.092	49.349	1.205
115	Total		68.40	Total	13,636,532	2,424.0	5,625.632	48.919	1.216

CUTTING POLISHED PLATE GLASS—CONTINUOUS PROCESS

Number of workers	Occupation	Wage rates per hour	Labor cost per hour	Year and month	Output	Unit-hours	Output per unit-hour	Output per man-hour	Labor cost per 100 sq. ft.
¼	Foreman	$1.10	$0.275	1925					
2	Carriers	.80	1.600	Aug	949,892	632.0	1,502.994	78.078	$1.099
1	Examiner	.85	.850	Sept	897,860	528.0	1,700.492	88.337	.972
12	Cutters	.85	10.200	Oct	906,928	488.0	*1,858.459*	*96.543*	*.889*
4	Inspectors	.90	3.600	Nov	596,286	416.0	1,433.380	74.461	1.153
				Dec	1,069,738	752.0	1,422.524	73.897	1.162
				1926					
				Jan	958,408	656.0	1,460.988	75.895	1.131
				Feb	808,958	664.0	*1,218.310*	*63.289*	*1.356*
				Mar	647,086	492.0	1,315.215	68.323	1.256
				Apr	632,878	507.0	1,248.280	64.846	1.324
				May	792,115	560.0	1,414.491	73.480	1.168
				June	642,028	452.8	1,417.906	73.657	1.165
				July	647,039	428.0	1,511.773	78.534	1.093
19¼	Total		$16.525	Total	9,549,216	6,575.8	1,452.176	75.438	1.138

LIST OF BULLETINS OF THE BUREAU OF LABOR STATISTICS

The following is a list of all bulletins of the Bureau of Labor Statistics published since July, 1912, except that in the case of bulletins giving the results of periodic surveys of the bureau, only the latest bulletin on any one subject is here listed.

A complete list of the reports and bulletins issued prior to July, 1912, as well as the bulletins published since that date, will be furnished on application. Bulletins marked thus (*) are out of print.

Wholesale Prices.

No. 284. Index numbers of wholesale prices in the United States and foreign countries. [1921.]
No. 440. Wholesale prices, 1890 to 1926.

Retail Prices and Cost of Living.

*No. 121. Sugar prices, from refiner to consumer. [1913.]
*No. 130. Wheat and flour prices, from farmer to consumer. [1913.]
*No. 164. Butter prices, from producer to consumer. [1914.]
No. 170. Foreign food prices as affected by the war. [1915.]
No. 357. Cost of living in the United States. [1924.]
No. 369. The use of cost-of-living figures in wage adjustments. [1925.
No. 418. Retail prices, 1890 to 1925.

Wages and Hours of Labor.

*No. 146. Wages and regularity of employment and standardization of piece rates in the dress and waist industry of New York City. [1914.]
*No. 147. Wages and regularity of employment in the cloak, suit, and skirt industry. [1914.]
No. 161. Wages and hours of labor in the clothing and cigar industries, 1911 to 1913.
No. 163. Wages and hours of labor in the building and repairing of steam railroad cars, 1907 to 1913.
*No. 190. Wages and hours of labor in the cotton, woolen, and silk industries, 1907 to 1914.
No. 204. Street railway employment in the United States. [1917.]
No. 225. Wages and hours of labor in the lumber, millwork, and furniture industries, 1915.
No. 265. Industrial survey in selected industries in the United States, 1919.
No. 297. Wages and hours of labor in the petroleum industry, 1920.
No. 356. Productivity costs in the common-brick industry. [1924.]
No. 358. Wages and hours of labor in the automobile-tire industry, 1923.
No. 360. Time and labor costs in manufacturing 100 pairs of shoes. [1924.]
No. 365. Wages and hours of labor in the paper and pulp industry, 1923.
No. 371. Wages and hours of labor in cotton-goods manufacturing, 1924.
No. 374. Wages and hours of labor in the boot and shoe industry, 1907 to 1924.
No. 376. Wages and hours of labor in the hosiery and underwear industry, 1907 to 1924.
No. 377. Wages and hours of labor in woolen and worsted goods manufacturing, 1924.
No. 381. Wages and hours of labor in the iron and steel industry, 1907 to 1924.
No. 394. Wages and hours of labor in metalliferous mines, 1924.
No. 407. Labor cost of production and wages and hours in the paper box-board industry, 1925.
No. 412. Wages, hours, and productivity in the pottery industry, 1925.
No. 413. Wages and hours of labor in the lumber industry in the United States, 1925.
No. 416. Hours and earnings in anthracite and bituminous coal mining, 1922 and 1924.
No. 421. Wages and hours of labor in the slaughtering and meat-packing industry, 1925.
No. 422. Wages and hours of labor in foundries and machine shops, 1925.
No. 431. Union scale of wages and hours of labor, May 15, 1926.
No. 434. Wages and hours of labor in the men's clothing industry, 1911 to 1926.
No. 438. Wages and hours of labor in the motor-vehicle industry, 1925.

Employment and Unemployment.

*No. 109. Statistics of unemployment and the work of employment offices in the United States. [1913.]
No. 172. Unemployment in New York City, N. Y. [1915.]
*No. 183. Regularity of employment in the women's ready-to-wear garment industries. [1915.]
*No. 195. Unemployment in the United States. [1916.]
No. 196. Proceedings of the Employment Managers' Conference held at Minneapolis, Minn., January, 1916.
*No. 202. Proceedings of the conference of Employment Managers' Association, Boston, Mass., held May 10, 1916.
No. 206. The British system of labor exchanges. [1916.]
*No. 227. Proceedings of the Employment Managers' Conference, Philadelphia, Pa., April 2 and 3, 1917.
No. 235. Employment system of the Lake Carriers' Association. [1918.]
*No. 241. Public employment offices in the United States. [1918.]

Employment and Unemployment—Continued.

No. 247. Proceedings of Employment Managers' Conference, Rochester, N. Y., May 9-11, 1918.
No. 310. Industrial unemployment: A statistical study of its extent and causes. [1922.]
No. 409. Unemployment in Columbus, Ohio, 1921 to 1925

Proceedings of Annual Meetings of International Association of Public Employment Services.

No. 192. First, Chicago, December 19 and 20, 1913; Second, Indianapolis, September 24 and 25, 1914; Third, Detroit, July 1 and 2, 1915.
No. 220. Fourth, Buffalo, N. Y., July 20 and 21, 1916.
No. 311. Ninth, Buffalo, N. Y., September 7-9, 1921.
No. 337. Tenth, Washington, D. C., September 11-13, 1922.
No. 355. Eleventh, Toronto, Canada, September 4-7, 1923.
No. 400. Twelfth, Chicago, Ill., May 19-23, 1924.
No. 414. Thirteenth, Rochester, N. Y., September 15-17, 1925.

Women and Children in Industry.

No. 116. Hours, earnings, and duration of employment of wage-earning womeni n selected industries in the District of Columbia. [1913.]
*No. 117. Prohibition of night work of young persons. [1913.]
*No. 118. Ten-hour maximum working-day for women and young persons. [1913.]
*No. 119. Working hours of women in the pea canneries of Wisconsin. [1913.]
*No. 122. Employment of women in power laundries in Milwaukee. [1913.]
No. 160. Hours, earnings, and conditions of labor of women in Indiana mercantile establishments and garment factories. [1914.]
*No. 167. Minimum wage legislation in the United States and foreign countries. [1915.]
*No. 175. Summary of the report on conditions of woman and child wage earners in the United States. [1915.]
*No. 176. Effect of minimum-wage determinations in Oregon. [1915.]
*No. 180. The boot and shoe industry in Massachusetts as a vocation for women. [1915.]
*No. 182. Unemployment among women in department and other retail stores of Boston, Mass. [1916.]
No. 193. Dressmaking as a trade for women in Massachusetts. [1916.]
No. 215. Industrial experience of trade-school girls in Massachusetts. [1917.]
*No. 217. Effect of workmen's compensation laws in diminishing the necessity of industrial employment of women and children. [1918.]
No. 223. Employment of women and juveniles in Great Britain during the war. [1917.]
No. 253. Women in lead industries. [1919.]

Workmen's Insurance and Compensation (including laws relating thereto).

*No. 101. Care of tuberculous wage earners in Germany. [1912.]
*No. 102. British national insurance act. [1911.]
*No. 103. Sickness and accident insurance law of Switzerland. [1912.]
No. 107. Law relating to insurance of salaried employees in Germany. [1913.]
*No. 155. Compensation for accidents to employees of the United States. [1914.]
No. 212. Proceedings of the conference on social insurance called by the International Association of Industrial Accident Boards and Commissions, Washington, D. C., December 5-9, 1916.
No. 243. Workmen's compensation legislation in the United States and foreign countries, 1917 and 1918.
No. 301. Comparison of workmen's compensation insurance and administration. [1922.]
No. 312. National health insurance in Great Britain, 1911 to 1920.
No. 379. Comparison of workmen's compensation laws of the United States as of January 1, 1925.
No. 423. Workmen's compensation legislation of the United States and Canada as of July 1, 1926.

Proceedings of Annual Meetings of the International Association of Industrial Accident Boards and Commissions.

*No. 210. Third, Columbus, Ohio, April 25-28, 1916.
No. 248. Fourth, Boston, Mass., August 21-25, 1917.
No. 264. Fifth, Madison, Wis., September 24-27, 1918.
*No. 273. Sixth, Toronto, Canada, September 23-26, 1919.
No. 281. Seventh, San Francisco, Calif., September 20-24, 1920.
No. 304. Eighth, Chicago, Ill., September 19-23, 1921.
No. 333. Ninth, Baltimore, Md., October 9-13, 1922.
No. 359. Tenth, St. Paul, Minn., September 24-26, 1923.
No. 385. Eleventh, Halifax, Nova Scotia, August 26-28, 1924.
No. 395. Index to proceedings, 1914-1924.
No. 406. Twelfth, Salt Lake City, Utah, August 17-20, 1925.
No. 432. Thirteenth, Hartford, Conn., September 14-17, 1926.

Industrial Accidents and Hygiene.

*No. 104. Lead poisoning in potteries, tile works, and porcelain enameled sanitary ware factories. [1912.]
No. 120. Hygiene in the painters' trade. [1913.]
*No. 127. Dangers to workers from dust and fumes, and methods of protection. [1913.]
*No. 141. Lead poisoning in the smelting and refining of lead. [1914.]

Industrial Accidents and Hygiene—Continued.
*No. 157. Industrial accident statistics. [1915.]
*No. 165. Lead poisoning in the manufacture of storage batteries. [1914.]
*No. 179. Industrial poisons used in the rubber industry. [1915.]
No. 188. Report of British departmental committee on the danger in the use of lead in the painting of buildings. [1916.]
*No. 201. Report of committee on statistics and compensation-insurance cost of the International Association of Industrial Accident Boards and Commissions. [1916.]
*No. 207. Causes of death by occupation. [1917.]
*No. 209. Hygiene of the printing trades. [1917.]
No. 219. Industrial poisons used or produced in the manufacture of explosives. [1917.]
No. 221. Hours, fatigue, and health in British munitions factories. [1917.]
No. 230. Industrial efficiency and fatigue in British munitions factories. [1917.]
*No. 231. Mortality from respiratory diseases in dusty trades (inorganic dusts). [1918.]
No. 234. Safety movement in the iron and steel industry, 1907 to 1917.
*No. 236. Effect of the air hammer on the hands of stonecutters. [1918.]
No. 249. Industrial health and efficiency. Final report of British Health of Munition Workers Committee. [1919.]
*No. 251. Preventable death in the cotton-manufacturing industry. [1919.]
No. 256. Accidents and accident prevention in machine building. [1919.]
No. 267. Anthrax as an occupational disease. [1920.]
No. 276. Standardization of industrial accident statistics. [1920.]
No. 280. Industrial poisoning in the making of coal-tar dyes and dye intermediates. [1921.]
No. 291. Carbon monoxide poisoning. [1921.]
No. 293. The problem of dust phthisis in the granite-stone industry. [1922.]
No. 298. Causes and prevention of accidents in the iron and steel industry, 1916 to 1919.
No. 306. Occupational hazards and diagnostic signs: A guide to impairments to be looked for in hazardous occupations. [1922.]
No. 339. Statistics of industrial accidents in the United States. [1923.]
No. 392. Survey of hygienic conditions in the printing trades. [1925.]
No. 405. Phosphorus necrosis in the manufacture of fireworks and the preparation of phosphorus. [1926.]
No. 425. Record of industrial accidents in the United States to 1925.
No. 426. Deaths from lead poisoning. [1926.]
No. 427. Health survey in the printing trades, 1922 to 1925.
No. 428. Proceedings of the Industrial Accident Prevention Conference, held at Washington, D. C., July 14-16, 1926.

Conciliation and Arbitration (including strikes and lockouts).
*No. 124. Conciliation and arbitration in the building trades of Greater New York. [1913.]
*No. 133. Report of the industrial council of the British Board of Trade in its inquiry into industrial agreements. [1913.]
*No. 139. Michigan copper district strike. [1914.]
No. 144. Industrial court of the cloak, suit, and skirt industry of New York City. [1914.]
No. 145. Conciliation, arbitration, and sanitation in the dress and waist industry of New York City. [1914.]
*No. 191. Collective bargaining in the anthracite coal industry. [1916.]
*No. 198. Collective agreements in the men's clothing industry. [1916.]
No. 233. Operation of the industrial disputes investigation act of Canada. [1918.]
No. 255. Joint industrial councils in Great Britain. [1919.]
No. 283. History of the Shipbuilding Labor Adjustment Board, 1917 to 1919.
No. 287. National War Labor Board: History of its formation, activities, etc. [1921.]
No. 303. Use of Federal power in settlement of railway labor disputes. [1922.]
No. 341. Trade agreement in the silk-ribbon industry of New York City. [1923.]
No. 402. Collective bargaining by actors. [1926.]
No. 419. Trade agreements, 1925.

Labor Laws of the United States (including decisions of courts relating to labor).
No. 211. Labor laws and their administration in the Pacific States. [1917.]
No. 229. Wage-payment legislation in the United States. [1917.]
No. 285. Minimum-wage legislation in the United States. [1921.]
No. 321. Labor laws that have been declared unconstitutional. [1922.]
No. 322. Kansas Court of Industrial Relations. [1923.]
No. 343. Laws providing for bureaus of labor statistics, etc. [1923.]
No. 370. Labor laws of the United States, with decisions of courts relating thereto. [1925.]
No. 408. Laws relating to payment of wages. [1926.]
No. 417. Decisions of courts and opinions affecting labor, 1925.
No. 434. Labor legislation of 1926.

Foreign Labor Laws.
*No. 142. Administration of labor laws and factory inspection in certain European countries [1914.]

Vocational and Workers' Education.

*No. 159. Short-unit courses for wage earners, and a factory school experiment. [1915.]
*No. 162. Vocational education survey of Richmond, Va. [1915.]
No. 199. Vocational education survey of Minneapolis, Minn. [1916.]
No. 271. Adult working-class education in Great Britain and the United States. [1920.]

Safety Codes.

No. 331. Code of lighting factories, mills, and other work places.
No. 336. Safety code for the protection of industrial workers in foundries.
No. 350. Specifications of laboratory tests for approval of electric headlighting devices for motor vehicles.
No. 351. Safety code for the construction, care, and use of ladders.
No. 364. Safety code for the mechanical power-transmission apparatus.
No. 375. Safety code for laundry machinery and operation.
No. 378. Safety code for woodworking plants.
No. 382. Code of lighting school buildings.
No. 410. Safety code for paper and pulp mills.
No. 430. Safety code for power presses and foot and hand presses.
No. 433. Safety codes for prevention of dust explosions.
No. 436. Safety code for the use, care, and protection of abrasive wheels.

Industrial Relations and Labor Conditions.

No. 237. Industrial unrest in Great Britain. [1917.]
No. 340. Chinese migrations, with special reference to labor conditions. [1923.]
No. 349. Industrial relations in the West Coast lumber industry. [1923.]
No. 361. Labor relations in the Fairmont (W. Va.) bituminous coal field. [1924.]
No. 380. Postwar labor conditions in Germany. [1925.]
No. 383. Works council movement in Germany. [1925.]
No. 384. Labor conditions in the shoe industry in Massachusetts, 1920 to 1924.
No. 399. Labor relations in the lace and lace-curtain industries in the United States. [1925.

Welfare Work.

*No. 123. Employers' welfare work. [1913.]
No. 222. Welfare work in British munitions factories. [1917.]
*No. 250. Welfare work for employees in industrial establishments in the United States. [1919.]

Cooperation.

No. 313. Consumers' cooperative societies in the United States in 1920.
No. 314. Cooperative credit societies in America and in foreign countries. [1922.]
No. 437. Cooperative movement in the United States in 1925 (other than agricultural).

Housing.

*No. 158. Government aid to home owning and housing of working people in foreign countries. [1914.]
No. 263. Housing by employers in the United States. [1920.]
No. 295. Building operations in representative cities in 1920.
No. 424. Building permits in the principal cities of the United States, 1925.

Proceedings of Annual Conventions of Association of Governmental Labor Officials of the United States and Canada.

No. 266. Seventh, Seattle, Wash., July 12-15, 1920.
No. 307. Eighth, New Orleans, La., May 2-6, 1921.
*No. 323. Ninth, Harrisburg, Pa., May 22-26, 1922.
No. 352. Tenth, Richmond, Va., May 1-4, 1923.
No. 389. Eleventh, Chicago, Ill., May 19-23, 1924.
No. 411. Twelfth, Salt Lake City, Utah, August 13-15, 1925.
No. 429. Thirteenth, Columbus, Ohio, June 7-10, 1926.

Miscellaneous Series.

*No. 174. Subject index of the publications of the United States Bureau of Labor Statistics up to May 1, 1915.
No. 208. Profit sharing in the United States. [1916.]
No. 242. Food situation in central Europe, 1917.
No. 254. International labor legislation and the society of nations. [1919.]
No. 268. Historical survey of international action affecting labor. [1920.]
No. 282. Mutual relief associations among Government employees in Washington, D. C. [1921.]
No. 299. Personnel research agencies. A guide to organized research in employment, management, industrial relations, training, and working conditions. [1921.]
No. 319. The Bureau of Labor Statistics: Its history, activities, and organization.
No. 326. Methods of procuring and computing statistical information of the Bureau of Labor Statistics. [1923.]
No. 342. International Seamen's Union of America: A study of its history and problems. [1923.]
No. 346. Humanity in government. [1923.]
No. 372. Convict labor in 1923.
No. 386. The cost of American almshouses. [1925.]
No. 398. Growth of legal-aid work in the United States. [1926.]
No. 401. Family allowances in foreign countries. [1926.]
No. 420. Handbook of American trade-unions. [1926.]
No. 439. Handbook of labor statistics, 1924-1926.