

**MECHANIZATION
IN INDUSTRY**

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(Resolution of October 25, 1926, revised February 6, 1933)

MECHANIZATION IN INDUSTRY

HARRY JEROME

NATIONAL BUREAU OF ECONOMIC RESEARCH

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HARRY JEROME

Madison, Wisconsin

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INTRODUCTION

THE machine has been the foremost factor making for economic and social change in the western world during the past hundred and fifty years. It has impinged upon man's modes of living in diverse ways. The means by which his productive energies have been utilized, and the directions in which those energies have been expended, have been substantially altered. The productivity of his labor has been increased; his standard of living has been advanced. The physical features of the world in which he works and lives have been changed, and a transformation has occurred in the character of the commodities entering into daily consumption and use. After generations of slow change, the skills essential to economic survival have been profoundly modified. Under the pressure of mechanization men have had to learn to do new things in new ways.

All this is commonplace enough. That the machine has worked great changes in human life is no discovery of the past few years. For more than a century social observers have commented on the progress of machine industry. All men alert to the currents of social change have known that major shifts in the modes and manners of living were in process. But the prevailing conceptions of what, precisely, was taking place have been vague and inadequate. In spite of the universality of the process of change, it was a move-

ment difficult to see and appraise as a whole. Here a new invention brought a striking change in productive procedure, and threatened the displacement of thousands of men. There a new application of power promised a ten-fold increase in output. A movement marked by wide diversity of attributes and by almost infinite ramifications was known to man, individually, only through isolated instances of technical change. It is not strange, therefore, that wild fears paralleled wild hopes in contemporary appraisals of the growth of machine technology. One man saw it as a Frankenstein monster, threatening the very life of its creator. Another saw a dawning millennium of ease and plenty in a world of push-buttons and buzzers through which man controlled his millions of yoked and mechanized horsepower.

In the face of these vague conceptions we have had sore need of an account in realistic detail, but presenting these details in a broad economic setting, and interpreting them with reference to the mechanization process as a whole, and to related processes of economic life. For in dealing with the characteristics and consequences of mechanization, as in many other economic fields, a part, to be truly appraised, must be seen in its place in the whole working of the economic system.

It is a great virtue of Dr. Jerome's study that he has tried to do this difficult job and has, indeed, done it better than it has ever been done before. We find here a wealth of detail as to the actual changes which mechanization has involved, over a wide area of industrial activity. Conveyors, electric hoists, mechanical stokers, concrete mixers, steam ditchers, steam-jet weed destroyers, rotary ballast sweepers, power tie tampers, portable escalators, trench excavators—these are the stuff of modern industry. Here is realism about the industrial process. But Dr. Jerome sees beyond his details. He has emphasized, as has no one before him, the wide range of

consequences which must be traced if one is accurately to measure the effects of a mechanical change. In doing so he provides an effective corrective alike for the visions of doom and for the prophecies of a mechanical millennium.

The mechanization process in its countless manifestations reacts upon the volume of employment, the skills and the working methods of the human factor in production. Dr Jerome's treatment of one point, the effect of technical change upon the saving of labor time, furnishes an excellent example of careful technique and, by contrast with procedures confined to obvious consequences, illustrates the necessity of trying to see these movements in their broad relations to the working of the entire economic system.

To begin with, we must note the distinction drawn by Dr Jerome between 'productivity-increasing' changes (those which increase the units of output per hour of labor) and 'labor-displacing' changes (those which reduce the number of workers required). The two concepts are closely related, of course, but the distinction refines our tools of analysis in the study of technological improvement. We do not stop here, however. A given change in technique may affect the productivity of *operating labor* (that required directly in a particular process), of *auxiliary labor* (plant labor necessitated by the use of a machine, but not engaged directly in its operation), of *embodied labor* (labor applied to the production of the machine itself, or to the production of power, oil, or some other commodity used in its operation), or of *indirectly required labor* (that is, all additional labor required, as for transportation, advertising or merchandising in putting the given commodity in the hands of the final consumer ready for use). Furthermore, with reference to labor displacement, Dr. Jerome insists that we take account of labor requirements in the specific operations directly

affected, in the occupation in question, in the plant, in the industry, and in the economic system as a whole.

The mere citing of these diverse channels along which the effects of a given change may be felt is sufficient to indicate how fatuous it is to confine ourselves to the direct and immediately observable results of technical improvement. Technical change has brought striking advances in the efficiency of human labor, and has given rise to real problems of adjustment and adaptation, but we secure only a grotesquely distorted picture of the consequences of technical improvements if we take a microscopic view of that small industrial area in which the direct mechanical change happens first to appear. Dr. Jerome's study should improve our perspective.

The results of this investigation are made available at the end of a decade of intense interest in the processes of mechanization, and in their economic consequences. Before the beginning of the present *dépression* 'technological unemployment' was a subject of wide discussion, and the machine has been given a prominent place in many explanations of the current industrial crisis. Dr. Jerome does not undertake a precise definition of the part played by the mechanization process in the economic developments of the post-War era, but there is rich material here for the student of this period. That mechanization always involves some disturbance of an existing situation, in the markets for goods or in the markets for labor, or in both, is clear enough. Was the degree of disturbance intensified during the post-War years? Were the consequences of mechanization during this period materially different, in kind or degree, from the consequences of earlier mechanical changes in industry? These questions arise, inevitably, in any survey of recent industrial movements.

As to the relative speed of the mechanization process during the post-War period, in comparison with earlier periods,

it is difficult to give any precise figures. Dr. Jerome's general results accord with other evidence in indicating that mechanical improvements were being applied more generally throughout the industrial system, and probably more rapidly, during the years following the War than during the years preceding the War. The speed with which, in post-War years, a perfected technical innovation was introduced throughout an industry was not approached during the earlier phases of the Industrial Revolution. Taking account of the area, industries and occupations affected, it is a safe conclusion that the rate of technological change was high in post-War years, in relation to previous experience.

But the economic and social consequences of technical innovations do not depend on the speed of mechanization alone. It is probable that in post-War years certain other conditions contributed to accentuate the problems arising out of the widening scope of machine technology. In appraising these conditions we shall do well to recognize the distinction Dr. Jerome has drawn between changes that increase output and changes that displace labor. This distinction is highly useful in tracing the incidence of mechanization and in distinguishing different stages of industrial development.

One of the major factors determining the economic effects of a given technical change is the degree of elasticity of demand for the products of the process affected. With highly elastic demand lower prices stimulate new buying. Under these conditions mechanical improvements leading to lower per-unit costs and lower selling prices will make possible the marketing of a much larger volume. Output will be increased, and the net effect of the innovation may well be a substantial rise in the amount of labor employed. The growth of the automobile industry is a concrete manifestation of a series of such improvements in the making of a commodity for which the demand is elastic. Improvements in industries pro-

affected, in the occupation in question, in the plant, in the industry, and in the economic system as a whole.

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ducing commodities of inelastic demand, on the other hand, may be expected to lead to actual displacement of labor or, under certain conditions, to an uneconomic expansion of output. For such commodities may not be disposed of in much larger quantities, in a given market, even though costs and prices are reduced materially by technical changes. Given a labor supply without fixed job tenure, and therefore subject to ready reduction, real labor displacement may be expected to result from technical improvement. If the labor supply be tied to the productive processes in question (as it is in agriculture, to a large extent) an expanding output, produced under conditions of lower cost and without much regard to the ability of the market to absorb the increased supply, may be expected. Marketing troubles, price weakness, social distress and reduced living standards may result from this combination of circumstances.

With the widening, in recent decades, of the area within which mechanical improvements were being applied, it is probable that the proportion of technical changes affecting commodities of inelastic demand was greater than in earlier periods of mechanization. Retail coal handling, street cleaning, train operation, stevedoring provide examples of occupations the products or services of which are not marked by high elasticity of demand. But the outstanding example of such a shift is furnished by agriculture. The mechanization process in this important field lagged for years, and still lags, in comparison with the changes machine technique has brought in manufacturing industries. But recent years have seen a substantial advance in the use of mechanical methods and new sources of power in farming. Tractors, combine harvesters, potato-digging machines, milking machines, the application of gas engines and electric motors to agricultural operations—these are but examples of a process which has been going forward at accelerated speed in the last decade

and a half. Dr. Jerome cites figures compiled by the United States Bureau of Labor Statistics indicating that technical improvements in agricultural production were sufficient to have displaced 2,530,000 workers between 1919 and 1927, had volume of output been unchanged. Actually, only some 800,000 workers were displaced, because these improvements, in the main, were used to increase output rather than to reduce the number of workers employed.

Normally, increased efficiency in the production of goods of inelastic demand would tend to displace labor, rather than to increase output. The great technical advance in agricultural production during the decade in question did not have this result. One reason for this is that agricultural producers are, traditionally, tied to the soil. They do not react to innovation as would a market-conscious manufacturer, with a relatively mobile labor supply at his disposal. The effects of mechanization in this field, therefore, have been quite different from the effects experienced in other industrial areas, at earlier periods. A glutted market, with prices abnormally low even when account is taken of lowered costs of production, has resulted.¹

In part, however, mechanization in agricultural industries displaced labor during this period, and probably contributed to the volume of unemployment which characterized the post-War years. Mechanization in other economic areas marked by inelastic demand for commodities produced tended also to displace labor, rather than to increase production, and so to widen the margin of unemployment which

¹ Other factors, of course, contributed to the agricultural situation that has prevailed in the United States since 1920. Reduced demand in foreign markets, after the War-time stimulus, and declining demand for animal feeds, resulting from the increased use of motor power on farms, have re-enforced certain of the tendencies due to mechanization. The industrial depression was a major factor in the agricultural distress following 1929.

has always been a feature of an industrial economy. It is true that the purchasing power released when consumers are able to buy certain commodities at lower prices may be expected, ultimately, to find an outlet in increased demand for other commodities, and so to lead to the absorption elsewhere of the displaced labor. But this may be a very slow process, mitigating but slightly the immediate evils of labor displacement. Some portion of the increased unemployment which characterized the post-War years in the United States may be attributed to the mechanization of industries producing commodities of inelastic demand.

But other factors, as well, contributed to this widening margin of unemployed men. Among these we must include the pricing policies followed in those industries in which rapid technical improvement occurred in the post-War years. For whether a given technical advance shall be 'labor-displacing' or 'productivity-increasing', in Dr. Jerome's terms, depends not alone upon the relative elasticity of demand for the commodities affected. With demand elastic the given innovation may still displace labor, rather than increase output, if the reduction of costs is not passed on in the form of correspondingly lowered prices to buyers. If the reduction of costs served exclusively to swell profit margins or, conceivably, to increase wage rates, the final effects of the innovation might be to yield higher profits or earnings to producers, to leave the volume of production substantially where it was before the change in productive methods was made, and to displace a quantity of labor corresponding to the enhanced efficiency of the manufacturing process. Here, again, the increased purchasing power represented by higher dividends or other disbursements might be expected to offset the reduction of purchasing power due to the displacement of labor and to lead, ultimately, to increased demand in other economic areas and to increased employment elsewhere. But

the time lag between displacement and ultimate re-employment might be a very long one indeed.

The actual effects of mechanization, at any time, are undoubtedly a blend of the various possible consequences. To some extent profits may be increased, to some extent wage rates may be advanced, to some extent prices may be lowered and the volume of output increased, and to some extent labor may be displaced. The state of competition, the bargaining position of labor, the character of the demand for the product and the pricing policies of management all combine to determine the relative importance of these possible consequences. During post-War years these different effects of mechanization were all present, in varying degree. Although the physical volume of production was substantially increased, it is probable that in certain manufacturing industries full advantage was not taken of opportunities for increased production at lower prices. This was partly due to relative inelasticity of demand for the products of some of the industries in which advances in mechanization occurred. It was probably also due, in part, to the observance of policies of price maintenance, even where lowered prices might have served materially to stimulate demand. The existence of relatively high prices for manufactured products was a characteristic feature of this post-War period. To some extent, then, mechanization during post-War years was manifest through labor displacement as well as through increased output. The margin of unemployment which has persisted since the industrial system came into being, and which tends to expand during a period of rapid technical change, was widened still further by the special conditions characteristic of the post-War years. The focusing of public interest on 'technological unemployment' was a consequence of this combination of circumstances.

In appraising some of the results of the mechanization process which Dr. Jerome illuminates in the following pages we should take account, also, of the relative ease, or difficulty, of the industrial readjustment which any innovation necessitates. The concept of general economic equilibrium remains a somewhat vague one, in so far as the actual processes of economic life are concerned, and the conditions of such equilibrium in an industrial society have not been defined. Yet, even without such definition, it is a fair assumption that technological changes disturb in greater or less degree the equilibrium, or the tendencies towards equilibrium, which prevailed prior to such innovations. The more rapid the rate of technical change, the more thoroughly mechanized and integrated the economic system, and the more rigid its parts, in relation to one another, the more difficult adaptation to such changes must be. On all these counts we should expect the problems arising out of the mechanization processes of the post-War years in the United States to be of exceptional difficulty. Dr. Jerome's studies indicate that the rate of technical change was relatively high during this period. Furthermore, our national economic system and the world economic system had become more thoroughly mechanized and more highly integrated than in earlier eras. The increasing importance of fixed costs in industrial operations, and other forces operating both within and without the industrial system proper, had probably tended to lessen the flexibility of the industrial structure. Post-War mechanization broke with exceptional force, then, upon this system, and involved greater difficulties of adaptation than had similar mechanical innovations in earlier stages of our industrial development.

The process of mechanization described in the following pages is thus not merely a technical affair, of interest only to production engineers and factory managers. It needs no

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argument to establish its relevance to the major problems of the day, and its bearing on the central processes of contemporary economic life. When exaggeration and fantasy about the machine are duly discounted it remains, it is safe to say, the most compelling factor in the changing culture of modern man. It is the story of the machine, in its recent and mature development, which Dr. Jerome tells in the pages of this book.

FREDERICK C. MILLS

New York
August, 1934

APPENDIX A

MACHINE SALES AND OTHER
MEASURES OF MECHANIZATION,
BY YEARS

(For similar data, see also text tables 5, 6, 7, 8 and 13)

TABLE 36
IRON AND STEEL: 1911-31

YEAR	MACHINE CASTING OF PIG IRON						
	NUMBER OF MACHINES INSTALLED BY LEADING MANU- FACTURERS ¹	PERCENTAGE OF OUT- PUT MACHINE CAST			PERCENTAGE OF STACKS MECHANI- CALLY CHARGED ⁴	NEW IN- STALLATIONS OF ELECTRIC MAIN ROLL DRIVES (HORSE- POWER) ⁵	GROWTH OF THE CONTINUOUS PROCESS ⁶
		MERCHANT BLAST FURNACES ²	ALL PIG IRON NOT DELIVERED ³	MOLTEN ³			
1911	5	45	7	57	3,100	7	
1912	6	50	47	57	27,700	7	
1913	3	42	47	56	37,650	79.7	
1914	1	31	51	64	42,775	76.7	
1915	13	31	54	75	96,980	81.5	
1916	8	50	51	73	158,660	83.5	
1917	7	50	50	49	98,525	87.9	
1918	5	56	54	54	37,900	85.8	
1919	4	58	62	56	107,750	83.3	
1920	9	63	63	56	102,420	87.1	
1921	2	71	83	68	31,300	78.4	
1922	3	75	73	73	80,555	88.0	
1923	5	72	74	71	94,800	86.1	
1924	3	75	79	84	120,350	85.2	
1925	7	82	81	88	243,975	88.8	
1926	1	85	83	87	198,440	87.9	

MECHANIZATION IN INDUSTRY

TABLE 36 (cont.)
IRON AND STEEL: 1911-31

YEAR	MACHINE CASTING OF PIG IRON						
	NUMBER OF MACHINES INSTALLED BY LEADING MANU- FACTURERS ¹	PERCENTAGE OF OUT- PUT MACHINE CAST			PERCENTAGE OF STACKS MECHANI- CALLY CHARGED ⁴	NEW IN- STALLATIONS OF ELECTRIC MAIN ROLL DRIVES (HORSE- POWER) ⁵	GROWTH OF THE CONTINUOUS PROCESS ⁶
		MERCHANT BLAST FURNACES ²	IRON NOT DELIVERED MOLTEN ³	ALL PIG IRON			
1927	7	81	85	91	134,150	87.8	
1928	7	7	85	7	188,150	89.5	
1929	7	7	89	7	890,600	91.1	
1930	7	7	91	7	146,740	87.5	
1931	7	7	93	7	95,325	91.7	

¹ Based on U. S. *Census of Manufactures* for 1914 and 1919, and lists of installations by manufacturers. The installations in the successive years 1895-1910 were: 1, 1, 3, 3, 4, 13, 7, 6, 12, 3, 4, 10, 6, 7, 10, 7. The average number of strands per listed installation varied from 2.0 to 2.4 in the period 1898-1916, and from 1.7 to 1.9 in the period 1917-26.

² Based upon survey reported in Bul. 474 (Ref. 37). The list of plants included is not completely identical from year to year. In 1890 no pig machines were used.

³ Computed from data in *Statistical Reports* of the American Iron and Steel Institute. The percentage was zero in 1890; 40 in 1904.

⁴ Same source of information as ².

⁵ Computed from lists published in January issues, 1926-32, of *Iron and Steel Engineer*. Corresponding figures for the successive years 1905-10 are: 10,600, 25,640, 26,600, 8,050, 27,450, 30,700.

⁶ The measure of growth utilized is the percentage of steel-making pig iron used by makers which is cast in molten condition. Computed from *Statistical Reports* of the American Iron and Steel Institute.

7 No data available.

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TABLE 37
COMMERCIAL PRINTING: 1913-28¹

YEAR	NUMBER SOLD		RATIO OF CUMULATIVE SALES OF MACHINE- FED PRESSES TO TOTAL PRESSES SOLD, 1913-28 ⁴
	JOB- AUTOMATICS ²	AUTOMATIC FEEDING ATTACHMENTS ³	
1913	. . .	328	8.7
1914	14	490	11.8
1915	82	555	14.9
1916	209	938	19.6
1917	271	1,924	28.2
1918	259	2,857	41.3
1919	277	3,948	53.6
1920	499	5,163	64.6
1921	325	2,021	64.7
1922	685	2,060	62.8
1923	1,199	2,238	62.5
1924	1,133	1,915	63.2
1925	1,738	1,348	63.7
1926	1,542	1,215	64.5
1927	1,461	1,217	65.7
1928	1,439	1,048	66.8

¹ Baker (Ref. 4), pp. 201, 204.

² Computed from cumulative annual sales as compiled by Dr. Baker, pp. 201, 204.

³ Automatic feeding attachments for platen and flat-bed cylinder presses.

⁴ Includes platens, job-automatics, small and large cylinders, and two-color and perfecting presses. For cumulative annual sales of each type see Ref. 4, p. 201.

This computation does not cover presses sold prior to 1913.

TABLE 38
SELECTED MANUFACTURING EQUIPMENT: 1914-1929

I

YEAR	FOUNDRY EQUIPMENT			MACHINE TOOLS ³ (NUMBER IN 1925: 100)	WOOD-WORKING MACHINERY (SHIPMENTS) ⁴		YARN-WORKING MACHINES (NUMBER SOLD) ⁵		
	ALL TYPES ¹ (SHIPMENTS, VALUE IN 1925: 100)	MOLDING MACHINES ² (NUMBER)			VALUE		WARP TYING	AUTOMATIC SPOOLERS	HIGH SPEED WARPERS
		HAND	POWER		(THOUSAND DOLLARS)	NUMBER			
		TYPE	TYPE						
1914	6	364	6	81	6	6	43	7	7
1915	6	435	6	167	6	6	50	...	...
1916	6	886	6	209	6	6	71	...	...
1917	6	640	6	233	6	6	66	1	1
1918	6	380	200	219	6	6	67	1	1
1919	6	567	710	174	14,798	6	67	2	1
1920	6	707	625	135	21,320	6	38	8	4
1921	27	112	65	25	10,595	6	26	16	8
1922	70	180	304	51	15,644	6	18	5	3
1923	100	282	351	89	19,913	18,173	43	14	7
1924	79	136	119	63	18,179	13,725	22	22	15
1925	100	142	107	100	19,213	13,697	23	33	23
1926	106	127	79	108	19,004	14,521	24	53	45
1927	94	53	24	92	15,504	12,243	35	63	56
1928	131	89	31	158	16,212	12,022	22	75	69
1929	148	112	52	187	19,316	13,488	20	101	99

¹ Obtained by converting to 1925 base an index on 1922-24 base given in the *1932 Annual Supplement, Survey of Current Business*, p. 218. The series is said to represent from 65 to 70 per cent of the industry.

² The foundry molding machine data represent sales of single manufacturers, the hand series being of the plain squeezer type, for use on the lighter classes of work; the power series, the squeezer and jolt-squeezer types operated by compressed air.

³ Index of number of machines, based on shipments, 1914-19, and new orders, 1919-28. The data were compiled by the National Machine Tool Builders' Association, and are published in the *Survey of Current Business*. The shipments were "reported by 29 firms representing about 20 per cent of the membership and believed to be fairly typical of the industry, as standard machines and the larger firms are represented". The data on 'new orders' include quantity reports "from between 50 and 60 firms, said to represent about one-third of the industry". We have spliced the two index numbers at 1919 and converted the resulting series to a 1925 base.

⁴ From *1932 Annual Supplement, Survey of Current Business*, pp. 222-3; originally compiled by the Association of Manufacturers of Wood Working Machinery from reports of its members, averaging about 23 each month and varying from 20 to 27. The total shipments for 1925 represented 48 per cent of the value of wood-working machinery produced that year, according to the *Census of Manufactures*.

⁵ Data from Barber-Colman Company, the sole manufacturers of these three types. Sales of the warp-tying machine in the successive years 1904-13 were: 24, 31, 64, 72, 21, 35, 27, 21, 44 and 40.

⁶ No data for these years.

⁷ No sales prior to 1917.

MECHANIZATION IN INDUSTRY

TABLE 38 (cont.)

SELECTED MANUFACTURING EQUIPMENT: 1914-1929

II 8

(number sold in 1925: 100)

YEAR	CLOTH AND GARMENT- WORKING MACHINES ⁹				CRUSHING, MIXING, AND FILTERING EQUIPMENT ¹⁰				PACKING AND FILLING MACHINES ¹¹			
	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES	SERIES
	A	B	C	D	E	F	G	H				
1914	17	...	4	31	13	13	13	...				
1915	29	...	15	46	13	13	13	...				
1916	39	...	54	62	13	13	13	...				
1917	53	¹²	80	100	17	126	13	...				
1918	46	14	96	116	34	130	13	...				
1919	66	0	104	58	45	126	13	...				
1920	74	43	174	112	44	122	13	...				
1921	70	0	39	38	43	56	13	...				
1922	89	43	73	44	62	52	151	¹²				
1923	90	100	127	72	62	108	127	16				
1924	95	57	83	52	82	80	105	32				
1925	100	100	100	100	100	100	100	100				
1926	109	114	130	121	112	104	122	100				
1927	116 ¹⁵	100	125	118	160	¹⁴	100	111				
1928	¹⁴	86	144	116	212	¹⁴	100	¹⁴				
1929	88 ¹⁵	29	158	134	191	¹⁴	102	14				

⁸ Each series in this division is based on the sales of only one or two establishments.

⁹ The comparable figures for 1908-13 for Series A are: 3, 5, 7, 7, 10 and 15.

¹⁰ Series B, C and D represent, respectively, a type of heavy crushing machinery, sand mixers, and continuous filtering systems.

¹¹ Series E, F, G and H represent, respectively, filling and capping machines for milk bottles, labeling and casing machines for cylindrical containers, bag-filling machines, and butter-wrapping and cartoning machines.

¹² No sales made prior to the first year for which data are given.

¹³ Sales began before 1914 but data for the early years are not available.

¹⁴ Data not available for these years.

¹⁵ Estimated from value of machines of this type as reported in *Census of Manufactures*.

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TABLE 38 (cont.)
SELECTED MANUFACTURING EQUIPMENT: 1914-1929

III

YEAR	NUMBER SOLD IN 1925: 100			GLASS BOTTLE MACHINES	
	PERCENTAGE RATIO OF MACHINE- MADE CIGARS TO TOTAL ¹⁶	AUTOMATIC PAPER-STOCK PROPORTIONING AND METER- ING SYSTEM		ESTIMATED PERCENTAGE OF JARS MADE ON AUTOMATICS ²¹	
		TOBACCO- PREPARING MACHINERY ¹⁸		SEMI- AUTOMATICS IN USE ²⁰	AND BOTTLES MADE ON AUTOMATICS ²¹
1914	...	84	...	22	22
1915	...	119	...	22	22
1916	...	94	...	459	22
1917	¹⁷	135	...	428	50
1918	0.1	287	...	417	22
1919	2.6	387	...	22	22
1920	4.6	219	...	315	22
1921	6.0	132	¹⁹	288	22
1922	7.1	177	74	164	80
1923	9.1	155	105	130	22
1924	10.9	152	95	72	90
1925	14.8	100	100	98	22
1926	22.3	181	89	22	22
1927	28.0	171	121	26	22
1928	32.0	123	53	22	22
1929	35.1	126	42	22	22

¹⁶ Computed from total production of cigars weighing more than 3 pounds per thousand and estimated production of machine-made cigars (Ref. 47). The ratio was 47.0 in 1930.

¹⁷ Less than one-tenth of one per cent.

¹⁸ Five series. Sales of these types began before 1914.

¹⁹ Few or no sales made prior to 1922.

²⁰ The number of machines in use as reported by the union, which had practically complete control over these machines. Data for 1897-1924 from Barnett (Ref. 3, p. 110); for 1925 and 1927 from annual proceedings of the Glass Bottle Blowers Association. We are informed by the secretary of the Association that by 1929 there were none in use (letter to the writer, January 23, 1934). See Ch. III, especially Table 5, for other data pertaining to machines in the glass industries.

²¹ Barnett (Ref. 3), p. 85. Estimates are for production years 1917, 1922-23 and 1924-25, respectively.

²² Data not available for these years.

TABLE 39
DOMESTIC SALES OF SELECTED TYPES OF FARM EQUIPMENT:
1920-1929¹

	(number in thousands)									
	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
<i>Tractors</i>	163.0	4	101.2 ⁶	117.7 ⁶	99.0 ⁶	122.0 ⁶	126.7 ⁷	160.7 ⁷	103.9 ⁷	160.0 ⁷
Wheel ²	4	4	96.4	110.7	92.2	114.2	116.9	147.1	86.9	136.3
Tracklaying ³	4	4	3.7	4.4	4.4	4.6	6.0	8.8	12.9	19.0
<i>Tractor-drawn equipment</i>										
Moldboard plows	122.0	24.7	52.4	54.1	40.7	53.9	66.2	70.7	79.8	90.9
Disk plows	22.6	6.2	7.5	7.4	7.3	10.7	11.2	11.8	15.9	26.1
Listers	2.2	.7	1.3	1.0	2.5	2.7	6.5	8.0	8.9	4
Grain drills	3.2	.9	.9	.4	.2	.7	2.4	5.9	9.2	15.8
Disk harrows	59.7	28.6	27.3	30.3	26.0	29.8	39.8	39.8	44.3	46.0
<i>Other power equipment</i>										
Internal-combustion engines	216.1	116.6 ⁵	90.6	129.0	104.1	147.8	141.7	106.8	105.7	111.8
Corn shellers	6.5	3.3	5.3	5.5	3.3	3.4	3.	3.7	3.5	3.7
Hay presses	4.3	1.6	2.5	2.0	2.2	1.7	1.8	1.8	1.2	1.7
Feed grinders and crushers	52.3	15.4	46.0	49.5	32.5	35.3	41.8	37.4	44.4	46.8
Spraying outfits	10.7	2.2	10.7	10.4	8.0	8.8	10.0	11.3	11.9	10.7
Water systems	4	4	29.5	20.7	58.5	98.2	91.2	101.2	126.0	130.7
Milking machines	28.1	8	9.4	11.1	11.2	14.3	14.5	15.3	19.9	21.3
<i>Other equipment⁴</i>										
Combines (harvester-thresher)	2.7	2.3	1.6	1.1	1.6	3.6	6.3	11.2	18.0	19.7
Corn huskers and shredders	5.1	3.0	3.3	3.5	1.6	3.8	2.8	1.5	1.7	1.0
Potato diggers, plow type	6.8	3.2	5.1	2.6	2.5	2.6	2.7	3.4	3.5	3.0

Potato diggers, elevator type	10.5	7.4	14.2	8.1	5.8	4.9	7.8	10.9	13.7	7.9
Farm elevators, portable and stationary	10.3	.6	4.9	7.5	4.6	7.0	6.6	7.0	11.3	11.0
Ensilage and fodder cutters	23.9	10.6	13.8	13.9	12.1	13.0	13.5	13.9	12.7	10.8
Overhead feed and litter carriers	14.3	.9	6.8	9.9	8.4	9.9	8.3	9.7	9.6	9.8

¹ Based upon data contained in (1) U. S. Bureau of Public Roads, Circular 212, *The Manufacture and Sale of Farm Equipment in 1920*; (2) U. S. Bureau of the Census, *Census of Manufactures, 1921*, and annual bulletins entitled *Manufacture and Sale of Farm Equipment*, 1922-29, inclusive. Although the number of reporting concerns varies somewhat, it is believed that each year all but a small part of the total production is included.

² Not including garden tractors and motor cultivators.

³ Not including tracklaying attachments (used to convert the wheel type to the tracklaying type). In 1926, 2,234 were sold in the United States.

⁴ No data available.

⁵ These figures are the number manufactured, rather than sold, and probably exceed the domestic sales.

⁶ Includes the garden type tractor.

⁷ Includes the garden type tractor and motor cultivators.

⁸ Data for domestic sales not available.

⁹ All power driven.

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TABLE 40
COAL MINING: 1914-1929

YEAR	UNDERCUTTING MACHINES ¹				PERCENTAGE OF TONNAGE MINED BY STRIPPING WITH POWER SHOVELS ¹		PERCENTAGE OF BITUMINOUS COAL LOADED WITH SELF-FEEDING DEVICES ²
	NUMBER IN USE		PERCENTAGE UNDERCUT BY MACHINE		ANTHRA-CITE	BITUMI-NOUS	
	BITUMI-NOUS	ANTHRA-CITE	BITUMI-NOUS	ANTHRA-CITE ³			
1914	16,507	⁴	51.7	⁴	⁴	0.3	...
1915	15,692	⁴	55.0	⁴	⁴	0.6	...
1916	16,198	⁴	56.5	⁴	1.4	0.8	...
1917	17,235	⁴	55.5	⁴	2.5	1.0	...
1918	18,463	176	55.9	2.1	2.6	1.4	...
1919	18,959	⁴	59.2	1.9	2.4	1.2	...
1920	19,103	139	59.8	1.1	2.5	1.5	...
1921	19,618	114	65.6	1.1	2.3	1.2	...
1922	20,436	82	63.2	1.0	1.9	2.4	...
1923	21,229	162	66.9	1.4	2.7	2.1	0.3
1924	18,660	212	69.5	1.7	2.2	2.8	0.7
1925	17,551	159	70.6	1.6	2.7	3.2	1.2
1926	17,466	90	71.7	1.2	3.0	3.0	1.8
1927	17,388	138	72.2	1.5	2.8	3.6	⁴
1928	15,261	193	73.8	1.8	3.4	4.0	2.9
1929	14,731	137	75.4	1.6	2.7	3.8	3.6

¹ Data for undercutting machines and stripping operations from *Mineral Resources* (Ref. 32), Pt. II: 1923, p. 582; 1927, pp. 374-5; 1929, pp. 751-5.

² Computed from coal production and tonnage of coal mechanically loaded as reported in *Mineral Resources of the United States* (Ref. 32) 1929, II, 701, 758-9. In 1930 the percentage mechanically loaded was 5.0; in 1931, 5.9 (computed from data in U. S. Bureau of Mines *Coal in 1931*), pp. 427, 451.

Mechanically loaded coal includes that "loaded by mobile machines, scrapers, and duckbills and other self-loading conveyors" but not coal loaded by hand-fed pit-car loaders and other hand-loaded conveyors or by power shovels in strip pits.

³ Percentage of fresh mined coal.

⁴ No data available.

SALES BY YEARS

TABLE 41
SELECTED NON-MANUFACTURING EQUIPMENT: 1914-1929

I

YEAR	PRODUCTION OF POWER AND HEAT					
	EXCAVATING AND GRADING		HEAVY INDUSTRIAL STOKERS ³ (NEW ORDERS)		LOCOMOTIVE STOKERS ⁴	SPECIAL ANNEALING AND DRYING SYSTEMS ⁵
	POWER SHOVELS ¹	NARROW TRENCHERS ²	NUMBER	TOTAL HORSE-POWER	(number sold in 1925: 100)	(number sold)
	(number sold)	(number sold in 1925: 100)		(thousands)		
1914	181	...	...	...	23	...
1915	197	...	...	...	36	2
1916	366	...	...	...	86	3
1917	431	...	...	...	100	9
1918	392	...	...	...	171	8
1919	536	...	2,809	633	19	20
1920	641	...	2,195	791	122	22
1921	465	...	871	327	9	4
1922	876	...	1,563	725	130	12
1923	1,147	14	1,464	730	179	16
1924	1,105	33	1,128	514	100	15
1925	6	100	1,348	553	100	16
1926	6	114	1,361	546	164	19
1927	6	109	1,374	484	6	14
1928	6	82	1,490	509	6	7
1929	6	94	1,716	600	6	9

¹ Power shovels of contractors' sizes, 1/2 to 1 3/4 yd., of steam, gasoline and electric types, sold by a group of manufacturers including 3 firms in 1914; 5 in 1915; 6 in 1921; 8 in 1922; and 10 in 1924. In each instance the increase in numbers represents establishments just beginning the manufacture of this type of shovels in the given year. The sales in earlier years are:

1900	14	1904	45	1908*	69	1912	195
1901	16	1905	49	1909	95	1913	165
1902	27	1906	45	1910	105		
1903	35	1907	90	1911	147		

² Data from manufacturers of narrow trenchers.

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TABLE 41 (cont.)

SELECTED NON-MANUFACTURING EQUIPMENT: 1914-1929

II

YEAR	AUTOMATIC TELEPHONE SWITCHBOARDS ⁷		MOTORIZED RAILWAY SECTION-CREW CARS ⁸	STREET AND CATCH-BASIN CLEANING MACHINES ⁹
	NUMBER OF STATIONS SERVED	PERCENTAGE OF TOTAL STATIONS	(number sold by reporting manufacturers)	
	(thousands)			
1914	10	10	3,103	4
1915	10	10	2,971	7
1916	10	10	2,706	19
1917	10	10	2,885	22
1918	10	10	2,447	33
1919	130	1.7	2,735	49
1920	157	1.9	3,634	53
1921	236	2.7	1,808	47
1922	338	3.6	2,541	33
1923	575	5.5	3,227	68
1924	969	8.6	2,429	68
1925	1,496	12.4	2,596	74
1926	1,975	15.4	2,954	107
1927	2,550	18.6	2,941	104
1928	3,147	21.7	3,776	106
1929	4,014	26.0	4,119	10

⁸ From 1919 through 1922 compiled by the Stoker Manufacturers' Association; thereafter by the Bureau of the Census, U. S. Department of Commerce, and published in the *Survey of Current Business* and mimeographed press releases. In the latter the data are classified as installed under fire-tube or water-tube boilers. The series represents practically the entire industry, changes in the number of plants being due, apparently, to consolidations. The 1929 compilations cover ten plants.

⁴ Data from two manufacturers.

⁵ Six series covering metal annealing furnaces and clay-burning kilns of the continuous tunnel type and automatic drying systems for clay products.

⁶ Comparable data not available for these years.

⁷ The telephone data cover Bell-owned stations, as of the close of the specified year, and are furnished by the American Telephone and Telegraph Company.

⁸ From three manufacturers. The exact distribution by years of about 600

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cars sold, 1914-17, is an estimate. A relatively small number of cars used for inspection purposes is included. Comparable data for 1911, 1912 and 1913 are 600, 900 and 2,294 respectively.

⁹ Two types.

¹⁰ No data available.

TABLE 42
EQUIPMENT FOR THE COMMERCIAL PREPARATION OF FOOD
AND DRINK: 1914-1929¹

(number sold by reporting establishments in 1925: 100)

YEAR	BOTTLE- WASHING MACHINES	BREAD- AND CAKE-MIXING MACHINES	DISH- WASHING MACHINES	VEGETABLE- PARING MACHINES
1914	92	³	²	22
1915	102	...	...	19
1916	81	...	...	37
1917	66	...	...	51
1918	87	...	58	74
1919	121	79	63	61
1920	129	82	67	70
1921	71	86	65	53
1922	66	97	76	60
1923	76	98	85	82
1924	88	93	79	93
1925	100	100	100	100
1926	80	109	111	90
1927	⁴	114	111	86
1928	⁴	112	138	⁴
1929	⁴	102	143	⁴

¹ The index for bottle-washing machines covers five models sold by three manufacturers, the total number in 1925 being 548; the index for bread- and cake-mixing machines covers the sales of two manufacturers; for dish-washing machines, one manufacturer; for vegetable-paring machines, six models sold by two manufacturers.

² On market prior to 1918, but data not available.

³ Sales in this series began before 1914 but are available only for 1919-29.

⁴ No data available for these years.

MECHANIZATION IN INDUSTRY

TABLE 43
NUMBER OF ELECTRIC HOUSEHOLD APPLIANCES SOLD, BY
SELECTED TYPES: 1923-1930¹

(thousands)

ELECTRIC APPLIANCE	1923	1924	1925	1926	1927	1928	1929	1930
Irons	2,250		² 2,750	3,000	3,000	3,000	3,150	2,363
Vacuum cleaners	1,016	904	958	1,065	1,195	1,219	1,253	978
Washing machines ²	554	612	733	844	790	810	956	802
Ironing machines	50		² 40	60	68	92	126	100
Sewing machines	625		² 170	200	350	380	399	319
Floor polishers	²	²	50	90	47	49	53	33
Dishwashers	²	²	4	7	9	10	12	15

¹ Except where otherwise stated, the estimates in this table are compiled from the issues of *Electrical World* for March 1, 1924, p. 461, and April 2, 1927, p. 736, and of *Electrical Merchandising* for January 1927, p. 77; 1928, p. 70; 1929, p. 62; 1930, p. 52; and 1931, p. 22. The data for vacuum cleaners were originally compiled by the Vacuum Cleaner Manufacturers' Association.

² According to a letter from the American Washing Machine Manufacturers' Association, February 23, 1928, the sales of the electric washing machine industry in the United States and Canada were 566,000 in 1920; 289,000 in 1921; and 423,000 in 1922. They also report the number of engine-driven washing machines (in thousands) as follows:

1920	58	1922	20	1924	17	1926	67
1921	16	1923	20	1925	36	1927	85

² No data available.

TABLE 44
NUMBER OF USERS OF ELECTRIC HOUSEHOLD APPLIANCES, BY
SELECTED TYPES: 1924-1930¹

(estimates as of December 31, in thousands)

ELECTRIC APPLIANCE	1924	1926	1927	1928	1929	1930
Irons	10,200	12,800	15,300	17,700	18,538	20,001
Vacuum cleaners	5,000	5,900	6,828	7,700	8,600	9,086
Washing machines	3,500	4,250	5,000	5,735	6,585	7,185
Ranges	268	480	590	725	875	1,000
Cookers	²	750	950	1,050	1,175	²
Ironing machines	210	280	348	480	580	680

¹ Compiled from the files of *Electrical Merchandising* and supplements, 1925 to 1931.

² No data available.

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TABLE 45
 PERCENTAGE OF WIRED HOMES EQUIPPED WITH SPECIFIED
 ELECTRIC APPLIANCES: 1924-30¹

(estimates as of December 31)

ELECTRIC APPLIANCE	1924	1926 ²	1927	1928	1929	1930
Irons	77.0	80.0	87.0	93.0	94.0	97.8
Vacuum cleaners	37.7	37.1	38.8	40.7	43.6	44.4
Washing machines	26.4	26.7	28.4	30.2	33.4	35.1
Ranges	2.0	3.0	3.4	3.8	4.4	4.8
Cookers	³	4.7	5.4	5.5	5.9	³
Ironing machines	1.6	1.7	2.0	2.5	2.9	3.3

¹ Compiled from the files of *Electrical Merchandising*: February 1925 (supplement); January 1928, p. 71; January 1929, p. 63; January 1930, p. 53; and January 1931, p. 24.

² The year 1925 is omitted because the available data do not appear to be comparable with the data for the other years.

³ No data available.

TABLE 46
 HANDLING EQUIPMENT, MOBILE TYPES: 1914-1929

YEAR	MOTOR TRUCKS		ELECTRIC			LUMBER
	NUMBER PRODUCED IN THE U. S. ¹	REGISTRA- TIONS ²	INDUSTRIAL	PORTABLE	SELF-FEED-	CARRIERS
			TRUCKS AND TRACTORS, ³ DOMESTIC SHIPMENTS (NUMBER)	CON- VEYORS (NUMBER SOLD BY REPORTING FIRMS IN 1925: 100)	ING WAGON LOADERS ⁴	AND PILERS ⁵ (NUMBER SOLD BY REPORTING FIRMS)
1914	25,375	85,600	200	20	4	3
1915	74,000	136,000	350	23	16	16
1916	92,130	215,000	750	25	31	24
1917	128,157	326,000	1300	46	51	9
1918	227,250	525,000	1800	106	54	18
1919	275,943	794,372	1300	88	73	46
1920	321,789	1,006,082	1914	119	111	47
1921	143,712	1,118,520	351	60	67	23
1922	269,991	1,375,725	793	91	88	54
1923	409,295	1,612,569	1340	100	125	139
1924	416,659	2,134,724	849	103	98	99

MECHANIZATION IN INDUSTRY

TABLE 46 (cont.)

HANDLING EQUIPMENT, MOBILE TYPES: 1914-1929

YEAR	MOTOR TRUCKS		ELECTRIC INDUSTRIAL TRUCKS AND TRACTORS, ³ DOMESTIC SHIPMENTS (NUMBER)	PORTABLE CON- VEYORS (NUMBER SOLD BY REPORTING FIRMS IN 1925: 100)	SELF-FEED- ING WAGON LOADERS ⁴ (NUMBER SOLD BY REPORTING FIRMS)	LUMBER CARRIERS AND PILERS ⁵ (NUMBER SOLD BY REPORTING FIRMS)
	NUMBER PRODUCED IN THE U. S. ¹	REGISTRA- TIONS ²				
	1925	530,659					2,440,854	1312	100	100	109
1926	516,947	2,764,222	1317	107	125	136
1927	464,793	2,914,019	1129	104	113	112
1928	543,342	3,113,999	1321	95	82	160
1929	771,020	3,379,854	1857	101	80	156

¹ *Survey of Current Business*, June 1927, p. 22, and 1932 *Annual Supplement*, pp. 274-5. The figures for 1922-29 include foreign assemblies.

² Registrations from Ref. 19, 1931, p. 16.

³ Data for 1914-19 are rough estimates based on reports from establishments producing about 50 per cent of the total number in 1920. It is assumed that the fraction produced by these establishments decreased gradually from 1914 to 1920. Data for 1920-24, from the Industrial Truck Association; for subsequent years, from press releases of the U. S. Department of Commerce, based upon reports from the 9 to 11 leading manufacturers. Similar estimates for the successive years 1906-13 are: 5, 10, 10, 25, 45, 75, 130, 200.

⁴ Three models, comprising the major portion of the industry. These machines pick up loose material such as sand, gravel or snow and convey it to the box of wagon or truck.

⁵ Four models, gasoline and electric types. The total number sold to 1929, inclusive, was 1,151.

TABLE 47
HANDLING EQUIPMENT, FIXED AND SEMIMOBILE TYPES: 1920-1929
(annual value in thousands of dollars)

YEAR	ELECTRIC HOISTS (NEW ORDERS) ¹	ELECTRIC OVERHEAD CRANES ²		ELECTRIC INDUSTRIAL LOCOMOTIVES ³		ELECTRIC MINING LOCOMOTIVES ³		INSTALLED HANDLING SYSTEMS, SAMPLE ⁴
		SHIPMENTS	NEW ORDERS	TROLLEY	STORAGE BATTERY	TROLLEY	STORAGE BATTERY	(VALUE IN 1925: 100)
1920	3,194	...	...	...	...	...	...	114
1921	1,590	6,893	2,708	...	...	...	...	26
1922	1,590	3,796	6,898	...	...	...	...	68
1923	2,118	10,567	9,168	...	...	...	...	81
1924	1,673	9,420	8,900	...	...	...	...	82
1925	2,016	9,742	10,770	...	...	...	...	100
1926	1,920	11,722	11,688	286	305	3,210	752	119
1927	1,620	9,308	7,976	190	329	2,867	805	95
1928	2,448	7,126	7,598	796	436	1,718	518	143
1929	3,102	12,290	14,619	1,344	267	2,720	806	129

¹ Compiled by the Electric Hoist Manufacturers' Association from the reports of nine firms. Data for 1925-30 in *Survey of Current Business*, August 1929, p. 42, and February 1931, p. 26. Issues of the *Survey* since March 1931 have carried revised and larger figures for this series, without explanation of the revision. We have used the unrevised figures as probably more comparable with the data for the years prior to 1925.

² "Compiled by the Electric Overhead Crane Institute, from reports of eleven manufacturers, estimated to cover 98 per cent of the output of electric overhead cranes for factories, etc." Published in *Survey of Current Business*, 1932 *Annual Supplement*, pp. 218-19.

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* Shipments as reported to the U. S. Department of Commerce by ten firms, comprising practically the entire industry. Mimeographed press releases, March 2, 1929 and January 17, 1930. Number of locomotives also given. In 1929, there were shipped 56 industrial locomotives of the trolley type and 13 storage battery type; 468 mining locomotives of trolley type and 288 storage battery.

* Based on reports from a small number of firms, whose total installations ranged from \$1,500,000 to \$2,000,000 in the peak years. The effect of changes in the list of reporting firms has been eliminated so far as possible by constructing the index from year-to-year percentage changes in installations of identical firms.

APPENDIX B

**ESTIMATES OF THE EXTENT OF USE IN
THE UNITED STATES OF SELECTED
LABOR-SAVING DEVICES**

Explanation of abbreviations and footnote references

MD = Data furnished by one or more manufacturers of the specified device and believed to be exact or approximately so

ME = Estimates by one or more manufacturers of the specified equipment and believed to be reasonably accurate

MRE = Estimates by one or more manufacturers of the specified equipment and believed to have a wide margin of possible error

RE = Rough estimate

T = Based upon data given in the specified table in this report or in the sources from which it was prepared

The numbered references are to footnotes to the respective tables, with the exception that those prefaced with 'Ref.' refer to the serially numbered bibliography in Appendix D.

TABLE 48

AGRICULTURE

I. GENERAL PURPOSE EQUIPMENT

EXTENT OF USE IN THE UNITED STATES, YEAR TO WHICH
ESTIMATE APPLIES AND SOURCE OF INFORMATION

TYPE		1920	1930
Motor trucks	Number on farms ¹	139,169	900,385
	Percentage of farms reporting trucks	2.0	13.4
Automobiles	Number on farms ¹	2,146,362	4,134,675
	Percentage of farms reporting automobiles	30.7	58.0

MECHANIZATION IN INDUSTRY

TABLE 48 (cont.)

AGRICULTURE

I. GENERAL PURPOSE EQUIPMENT (cont.)

TYPE	EXTENT OF USE IN THE UNITED STATES, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION	
	1920	1930
Tractors	Number on farms ¹ (1925, 505,933) ⁴	246,083 920,021
	Percentage of farms reporting tractors	3.6 13.5
	Domestic sales of tractors, 1922-29, (for both agricultural and industrial uses): all types, 991,000; tracklaying type, 64,000. ⁵	
	Percentage ratio of value of tractors to all farm equipment sold in 1929, 33.9 (T. 6)	
Stationary gas engines	Number on farms ¹	7 1,131,108
	Percentage of farms reporting gas engines	7 15.0
	Total domestic sales, 1920-29, 1,270,309 (sales in 1921 not known but estimated as equal to the number produced, T. 39)	
Electrification	Electric motors on farms ¹	7 386,191
	Percentage of farms reporting electric motors	7 4.1
	Farm dwellings lighted by electricity (including those lighted by gas in 1920):	
	Number	452,620 841,310
	Percentage	7.0 13.4
	In 1931, of approximately 1,000,000 farms using electricity, 644,500 had high-line service, and between 300,000 and 400,000 had independent or unit farm-lighting plants (Ref. 24, p. 449). Of a group of farms surveyed in 1925-26, 23 per cent had stationary engine power, 28.5 per cent had electric power available	

EXTENT OF USE

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TABLE 48 (cont.)

AGRICULTURE

I. GENERAL PURPOSE EQUIPMENT (cont.)

EXTENT OF USE IN THE UNITED STATES, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION

and 16 per cent of the reporting farms without electricity were within one mile of a transmission line (T. 51).

II. SOIL PREPARATION AND GRAIN HARVESTING

TYPE OF EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Tractor-drawn plows	Total domestic sales (for use in the U. S.), 1920-29: moldboard, 655,319; disk, 126,822 (T. 39). Percentage of total value of moldboard plows sold which are tractor-drawn (1929) 66; of disk plows, 83. No pronounced trend in these ratios (T. 6). In 1928 on 25 per cent of Illinois farms surveyed most of the plowing was done with tractor-drawn plows. ²
Tractor-drawn disk harrows	Total domestic sales (1920-29) 371,513 (T. 39). Percentage ratio to dollar value of all disk harrows sold (1929) 60. No pronounced trend in this ratio. 28 per cent of Illinois farms had tractor-drawn disk harrows in 1928. ²
Harvester-thresher combines	Total number, domestic sales (1920-29), 68,013. Percentage ratio to dollar value of all harvesting machinery sold (1929), 51.9. Sharp increases in this ratio in 1926, 1927 and 1928. Estimated that 30 per cent of wheat acreage in Kansas was harvested with combines in 1926. ³ Used on only 0.2 per cent of Illinois farms (1928). 13 per cent of Illinois farms used tractor-drawn binders in 1928; 62 per cent used the horse-drawn type. ²
Tractor-drawn binders Small-size threshing machines	On 63 per cent of Illinois farms (1928) threshing was hired, but 11 per cent of threshing machines were farmer-owned, 77 per cent of these being 28-inch cylinders or less (most of which can be powered by tractors sufficiently small for field work). 88 per cent of separators sold in 1929 were 28-inch or less, as compared with 73 per cent in 1921.

TABLE 48 (cont.)

III. ROW CROPS

TYPE OF EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Tractor-drawn listers	Total number, domestic sales, 1920-29, over 37,000. Percentage ratio to dollar value of all listers sold: 14.2 in 1920; 34.9 in 1928. Sharp increases in this ratio in 1926, 1927 and 1928 (T. 6).
Tractor-drawn cultivators	Percentage ratio to dollar value of all cultivators sold: 16.6 in 1929. Sharp increases in this ratio in 1927, 1928 and 1929.
Motor cultivators	Not extensively used. It is estimated that most of the cultivation was done with motor cultivators on only 0.7 per cent of Illinois farms in 1928. ²
Rotary hoes	Use relatively small but increasing. Domestic sales in 1929 were 14,504. Used for most of the cultivation on 4.3 per cent of Illinois farms in 1928.
Multiple-row corn planters	Use of more than two-row planters limited. For example, in 1928, 87 per cent of Illinois farms had two-row planters; 0.2 per cent, three-row; and 0.02 per cent, four-row.
Mechanical corn pickers	Use small but increasing. Domestic sales of mechanical picker-huskers totalled 25,381 in 1927-29. In 1928, they were in use on 11,000 Illinois farms or 4.9 per cent of farms over 50 acres.
Corn huskers and shredders (usually belt-driven at barn)	Practically all power. Sales stationary or declining (T. 39). Used on 9.4 per cent of Illinois farms in 1928.
Cotton sleds and pickers	Cotton sleds used for a portion of the crop in western Texas and Oklahoma in late 'twenties, especially when prices were low. Also there has been some experimental use of mechanical cotton pickers.
Potato diggers	Total domestic sales, 1920-29: plow type, 35,343; elevator type, 91,130.

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TABLE 48 (cont.)

IV. STOCK AND DAIRY FARMING

TYPE OF EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Milking machines	<p>Total domestic sales (1920-29), 188,415, assuming domestic sales in 1921 were the same as the number manufactured (T. 39).</p> <p>In use on 3.1 per cent of Illinois farms of over 50 acres (1928), and on 9 per cent of Wisconsin farms (1928).³ Sampling surveys found milking machines on 10 per cent of 204 farms in southeastern Pennsylvania; on 23.6 per cent of 318 farms in northeastern New Jersey (1930-31); on 23.2 per cent of 414 farms in Grafton County, N. H. (1930); on 34.5 per cent of 863 farms in Connecticut; and on 50.6 per cent of 83 farms in Coos County, N. H. (1931).⁶</p>
Cream separators	<p>Percentage ratio of value of power-driven separators to value of all cream separators sold (1928), 7.4 (T. 6). No distinct trend in this ratio, 1922-28.</p>
Water systems	<p>Total domestic sales (1922-28), 655,976, mostly power operated.</p> <p>Percentage of farms with water piped into the dwelling house: 10.0 in 1920; 15.8 in 1930.</p> <p>Percentage of farms in Wisconsin with running water in barns (1927), 30.⁵</p> <p>Mechanically operated water systems on Illinois farms (1928): electric on 5.7, gas engine on 12.2 and wind-mills on 16.1 per cent of the number of farms.²</p>
Overhead feed and litter carriers	<p>Total domestic sales (1920-29), 87,528.</p>
Power hay presses	<p>Constituted 71 to 84 per cent of value of all hay presses sold, each year 1920-29. No marked trend.</p>
Power feed grinders and crushers	<p>Total domestic sales (1920-29), 401,539. In value, over 90 per cent of all feed grinders sold. No distinct trend.</p>
Ensilage and fodder cutters	<p>Total domestic sales (1920-29), 137,993.</p>
Power corn shellers	<p>83 per cent of all corn shellers sold (1929) were power-driven. No trend in this ratio, 1920-29.</p>
Power spraying outfits	<p>Percentage ratio of power type to total value of all spraying outfits sold (1929), 69.0. No marked trend.</p>

MECHANIZATION IN INDUSTRY

TABLE 48 (cont.)

IV. STOCK AND DAIRY FARMING (cont.)

TYPE OF EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Farm elevators, portable and stationary	Total domestic sales (1920-29), 70,244.

¹ U. S. Bureau of the Census, *15th Census of the U. S., 1930, Agriculture*, Vol. II, Pt. 1.

² All data given for Illinois in Table 48 are from mimeographed report of estimates based on a survey made by A. J. Surratt and R. K. Smith, *Illinois Farm Equipment Survey*, and are for 1928.

³ All data for Wisconsin in Table 48 are from Bulletin No. 90, U. S. Department of Agriculture and Wisconsin Department of Agriculture, *Wisconsin Agriculture—A Statistical Atlas, 1926-27*.

⁴ U. S. Bureau of the Census, *Census of Agriculture, 1925*.

⁵ Based upon data in Table 39 or given in the sources listed in footnote ¹ thereto. Unless otherwise specified, the sales data in Table 48 are in terms of the number of machines sold for use in the U. S.

⁶ U. S. Department of Agriculture, *Yearbook of Agriculture, 1932*.

⁷ Comparable data for 1920 not available.

TABLE 49

EXCAVATING AND HIGHWAY CONSTRUCTION ¹

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Power shovels, contractors' sizes (½-1¼ yds.)	Widely used in excavation for buildings and in deep cuts for highway grading. Number sold, 1900-13, by 2 leading manufacturers, 1,097; 1914-24, by 3 to 10 manufacturers, 6,337 (MD). Total production in census years 1925, 1927 and 1929: \$102,063,000 (T. 13).
Trenching	Large ditching almost entirely a machine process. Total production of trench excavators in 1925, 1927 and 1929: \$9,068,584 (T. 13). Narrow trenchers for pipe lines, gas mains, telephone conduits, etc., relatively new. 1,089 machines sold by leading manufacturers, probably representing at least 50 per cent of the industry, 1923-29. By 1925

TABLE 49 (cont.)

EXCAVATING AND HIGHWAY CONSTRUCTION ¹

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Central proportioning plants	about 30. per cent of work for which they are adapted was handled by these machines; by 1929, about 70 per cent (MRE). In general use on larger highway jobs by 1925, as a substitute for wheelbarrow proportioning at point of construction (Ref. 20-a).
Subgrader, in highway construction	Introduced in 1920. In 1926 in use on 80 to 90 per cent of larger jobs, where its use is most clearly advantageous (MRE). In use on 79 per cent of those construction operations inspected in 1925 where the subgrader was feasible (Ref. 20-a).
Machine finishers on cement highway construction	Used on 80 to 90 per cent of larger jobs (1926, MRE). In use on 84 per cent of 1925 field inspections (Ref. 20-a).

¹ For further detail concerning sales of selected types of excavating machinery, see Tables 13 and 41.

TABLE 50

SELECTED HOUSEHOLD APPLIANCES ¹

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
<i>Availability of power</i> (see also Table 48, I)	Number of wired homes, December 1930, 20,438,774, with 70.5 per cent of the total population in dwellings with electric current. ²
<i>Laundrying</i>	
Electric washing machines	7,185,000 users, December 1930; in 35 per cent of wired homes (T. 44 and 45).
Gasoline-power washing machines	Number sold, 1920-27, 318,000 (T. 43, footnote).
Electric irons	Users, December 1930, 20,000,000; in 98 per cent of wired homes (T. 44 and 45).
Electric ironing machines (flat work)	Users, December 1930, 680,000; in 3.3 per cent of wired homes (T. 44 and 45).
Stationary laundry tubs	Percentage of dwellings equipped, 1925-26: urban, 28; rural, 6 (T. 51).

MECHANIZATION IN INDUSTRY

TABLE 50 (cont.)
SELECTED HOUSEHOLD APPLIANCES¹

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
<i>House cleaning</i>	
Electric vacuum cleaners	Users, December 1930, 9,086,000; in 44.4 per cent of wired homes (T. 44 and 45).
Electric floor polishers	Number sold, 1925-30, 322,000 (T. 43).
<i>Sewing</i>	Electric sewing machines, number sold, 1925-30, 1,818,000 (T. 43). In 1925-26, 4 per cent of urban and 2 per cent of rural reporting homes had electric ma- chines; 80 per cent of rural homes had hand or power type (T. 51, note).
<i>Food preparation</i>	
Electric dishwashers	Number sold, 1925-30, 57,000 (T. 43); in 1925 used in less than one per cent of urban homes (T. 51).
Electric cookers	Users, December 1929, 1,175,000; in 5.9 per cent of wired homes (T. 44, 45).
Electric ranges	Users, December 1930, 1,000,000; in 4.8 per cent of wired homes (T. 44, 45).
Electric refrigerators	Users, December 1930, 2,625,000; in 12.8 per cent of wired homes. ⁴
Bread mixers	Percentage of reporting farm homes equipped, 1926, 8.9 (WCS). ³
<i>Heating</i>	Estimated number of oil burners in homes, 1928, 600,000 to 650,000. ⁵ Sales of mechanical stokers of the residential type totalled 6,915 in 1931, 6,783 in 1932 and 9,507 in 1933. ⁶

¹ For further detail concerning the extent of use of household appliances, see Tables 43, 44, 45 and 51.

² *Electrical World*, January 3, 1931.

³ WCS = Women's Club Survey (see T. 51).

⁴ *Electrical Merchandising*, January 1931, p. 24.

⁵ Letter to author from H. F. Tapp, Assistant Secretary, American Oil Burner Association, March 12, 1928.

⁶ U. S. Department of Commerce press release, *Mechanical Stokers*, December, 1933.

TABLE 51
 PERCENTAGE OF RURAL AND URBAN HOMES EQUIPPED WITH
 SPECIFIED LABOR-SAVING DEVICES

(based on a sampling survey made in 1925-1926)¹

TYPE OF EQUIPMENT	PERCENTAGE OF REPORTING HOMES EQUIPPED WITH SPECIFIED DEVICE	
	RURAL	URBAN
Electricity available		
Central station service	19.6	²
Individual plant	8.9	²
Electric or gas lighting	30.6	87.0
Laundry equipment		
Electric washing machines ²	13.1	23.0
Hand washing machines	17.5	²
Other power washing machines	11.7	²
Electric irons	20.3	63.6
Gas irons	7.4	²
Flat-work ironers	²	1.9
Laundry tubs	6.0	28.3
Vacuum cleaners, electric ²	9.1	34.6
hand	8.4	²
Sewing machines, electric ²	2.0	4.0
foot	72.1	²
Electric dish washers	²	0.5
Heating, furnaces other than oil oil-burning furnaces	12.9 ²	46.8 1.8
Water and sanitary equipment		
Water piped to house	47.2	²
Stationary kitchen sink	33.3	83.9
Stationary wash bowl	16.3	71.3
Stationary bath tub	21.3	68.3

¹ Based on mimeographed reports of surveys made under the direction of the Industrial Survey and Research Service for the General Federation of Women's Clubs, one covering urban home equipment (1925-26), the other farm home equipment (1926).

² No information given.

³ Of the rural homes for which reports on washing machines were obtained, 44.3 per cent in all had some type of washing machine, though only 42.3 per cent specified whether the machines were hand, electric or other power. Likewise, the percentages for vacuum cleaners and sewing machines, irrespective of whether hand or electric types, were 18.3 and 80.1.

TABLE 52
HANDLING EQUIPMENT

I. MOBILE TYPES

EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Electric industrial trucks and tractors	Shipments, domestic, 1914-29, 19,742 (T. 46). Number in use, June 1928, 14,103, including 2,133 tractors (T. 12). Leading users: metal products, marine and railway terminals, iron and steel mills, automotive industries (T. 11). Used in one-fourth to one-half of potential market (MRE, 1926).
Gasoline tractors in industrial use	About 50,000 to 70,000 sold for non-farm uses by 1926 (MRE).
Lumber carriers and pilers, electric and gasoline	Total number sold, four models, 1914-29, 1,151 (MD). In the Northwest, used for probably 75 per cent of lumber cut and by 90 per cent of mills where use is feasible. Probably used for 65 per cent of lumbering in South and on West Coast (MRE, 1929).
Portable conveyors	Use in large wholesale and retail yards increasing rapidly. Number of users, 1929, about 11,000 (MRE). Estimated percentage of total work for which they are adapted actually done with aid of these machines: 1920, 15; 1925, 30; 1929, 40 (MRE).
Portable elevators or tiering machines, hand and power	Widely used in such industries as wholesale paper, large newspapers, oil in barrels, etc. for from 15 to 20 years. One firm sold over 2,000 (1921-25); peak in sales 1917-20 (MD). Increasing demand for power types.
Hand lift trucks	Estimated 30,000 users, or 50 per cent of potential market (MRE, 1926).
Motor trucks	Registrations, 1929, 3,380,000. Number produced in the United States, 1914-29, 5,211,000 (T. 46).
Self-feeding wagon or truck loaders for	Use in bituminous coal mines small but increasing; 3.6 per cent of output so handled.

TABLE 52 (cont.)
HANDLING EQUIPMENT

EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
handling loose materials in piles	in 1929 (T. 40). Percentage ratio of actual to potential use in fields for which its practical feasibility had been demonstrated: 1920, 10; 1925, 40; 1930, 25. The 1930 decline arises, not from less extensive use, but from a widened field as the machine was improved (MRE, 1930). Over 3,000 of 3 models sold, 1914-29 (MD).
II. FIXED AND SEMIMOBILE TYPES	
EQUIPMENT	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Electric hoists	About 44,300 sold, 1920-29. ¹ Dollar value of new orders, 1920-29, 9 firms, over \$21,000,000.
Electric overhead cranes	Shipments and new orders, for about 98 per cent of total output, each over \$80,000,000, 1921-29. Peak in 1929 (T. 47).
Cupola charging hoists, for foundries	In use in a small proportion of work for which suitable (MRE, 1926).
Electric locomotives (See also Table 53)	Shipments, 1926-29, by 10 firms, representing the bulk of the industry (T. 47): For industrial use Trolley type, aggregate value \$2,600,000 Storage battery type, aggregate value \$1,300,000. For mining use Trolley type, aggregate value \$10,500,000 Storage battery type, aggregate value \$2,900,000.
Installed handling systems	Installations by 3 reporting firms, chiefly in the automotive and tire industries, totalled \$6,800,000, 1922-25 (MD). Not over 25 per cent of potential market for package conveyors equipped (MRE, 1926). For conveyors of all types, see T. 13.

¹ Letter to author from Secretary of Electric Hoist Manufacturers' Association, March 10, 1930.

MECHANIZATION IN INDUSTRY

TABLE 53

COAL MINING

PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
<i>Bituminous coal</i> Stripping	Percentage of total tonnage produced by stripping with power shovels: 1.5 in 1920; 3.8 in 1929, varying from below 1 per cent in some Pennsylvania counties to 100 per cent in Wallace County, Georgia (Ref. 32).
Undercutting	Percentage of total tonnage undercut by machine: 59.8 in 1920; 75.4 in 1929 (T. 40). Percentage of tonnage of underground mines undercut by machine varied, in 1929, from 2.1 in Texas to 97.9 in Michigan (Ref. 32).
Loading into mine cars	Percentage of total tonnage loaded with self-feeding loading devices: 0.3 in 1923; 3.6 in 1929; 5.9 in 1931 (T. 40). Percentage handled on pit-car loaders and hand-loaded conveyors: 3.5 in 1929. Percentage of product of underground mines loaded by machine varied in 1929 from 0.8 in Kentucky to 39.9 in Wyoming (Ref. 32).
Drilling shot holes	Power drilling of shot holes with portable electric drills being rapidly introduced (Ref. 32, 1928, Pt. II, p. 482). In a sample group of 100 mines surveyed in 1929, 94 were using electric or compressed-air drills (Ref. 2, pp. 122-24).
Underground haulage	"Mines equipped with one or more electric locomotives now supply 85 per cent of the output, and 33 per cent is produced by mines in which even the gathering is done electrically and no animals whatever are employed" (Ref. 32, 1928, Pt. II, pp. 481-2). In 1925 percentage of deep-mined bituminous coal moved by animal haulage only, 12.0; locomotives only, 34.1; locomotives and animal haulage, 53.9 (U. S. Bureau of Mines, <i>Coal in 1925</i> , p. 445).
Cleaning	Percentage of total tonnage cleaned mechani-

TABLE 53 (cont.)

COAL MINING

PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
<i>Anthracite coal</i>	<p>ally by wet washing or pneumatic methods: 3.3 in 1920; 6.2 in 1929 (Ref. 32).</p> <p>Percentage mined by stripping with power shovels: 2.5 in 1920; 2.7 in 1929 (T. 40).</p> <p>Percentage of tonnage undercut by machine: 1.1 in 1920; 1.6 in 1929.</p> <p>Percentage mechanically loaded: about 3 in 1928 (Ref. 2, p. 47).</p> <p>Tonnage cleaned mechanically: very large, and additional mechanical cleaning facilities total- ling almost 8,200 tons per hour were under construction in 1929 (Ref. 32).</p>

TABLE 54

OTHER NON-MANUFACTURING INDUSTRIES

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION						
Adding and calculating machines (See also T. 7)	<p>Number manufactured by principal manu- facturers to March 1928¹</p> <table border="1"> <tr> <td>Full keyboard types</td> <td>1,707,400</td> </tr> <tr> <td>10-key keyboard types</td> <td>326,500</td> </tr> <tr> <td>Miscellaneous non-listers</td> <td>314,000</td> </tr> </table>	Full keyboard types	1,707,400	10-key keyboard types	326,500	Miscellaneous non-listers	314,000
Full keyboard types	1,707,400						
10-key keyboard types	326,500						
Miscellaneous non-listers	314,000						
Motorized railway section-crew cars	<p>Number sold by 3 makers, 1914-29, 49,727 (MD). In 1927, approximately 55,000 were in use, representing about 83 per cent motori- zation of railway section cars (special inquiry by makers). Used in practically all cases where conditions are suitable.</p>						
Street cleaning	<p>Motorization increasing. Over 700 of one type of motorized sweeper sold, 1914-28, with highest sales in 1926-28 (MD).</p> <p>Sales of mechanical catch-basin cleaners, 1922- 28, reached peak in 1928 (MD).</p>						
Automatic equipment in the commercial preparation of food	<p>Bottle-washing machines have long been used. Sales of 5 models totalled 6,348 in 1914-26 (MD).</p>						

MECHANIZATION IN INDUSTRY

TABLE 54 (cont.)

OTHER NON-MANUFACTURING INDUSTRIES

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
<i>Note: in these estimates of use, an estimated total of 8,500 hotels over 50 rooms in size, and 120,000 restaurants, is taken as 100 per cent, as of 1928²</i>	Dish-washing machines extensively used; in about 50 per cent of the larger hotels and 20 per cent of restaurants in 1928 (RE). Total number sold, 1918-29, about 44,000, with heaviest sales in 1929 (MRE). Aggregate production of dish-washing machinery in the census years 1925, 1927 and 1929: \$6,915,500 (T. 8).
	Dish-drying machine, for blowing water off dishes, just entering commercial marketing in 1926 (MD).
	Vegetable peelers: used in about 40 per cent of the larger hotels and 15 per cent of restaurants (RE). Total sales of 2 makers, 1914-27, over 16,500, power and hand types (MD).
	Slicers used in about 60 per cent of the larger hotels and 30 per cent of restaurants (RE).
	Fruit-juice extractors used in 25 per cent of the larger hotels and 30 per cent of restaurants (RE).
	Dough mixers used in about 45 per cent of the larger hotels and 20 per cent of restaurants (RE). Total sales of 2 makers, 1919-29, over 54,000, with peak in 1927 (MD).
Coal stoking	Heavy industrial mechanical stokers: total new orders, 1919-29, over 17,000, with 6,412,000 horsepower (T. 41).
	Locomotive stokers: sales of 2 makers, 1922-26, over 5,000 (MD).
	Steam grate shakers: introduction began in 1914 and was rapid in 1916-20.
Automatic signals at railway grade crossings	"Automatically controlled crossings constituted 61.3 per cent of all protected grade crossings in 1930" (Ref. 61, p. 1,050).
Retail merchandising by coin device. vending machines	Value of vending machines produced in the census years 1919 to 1929: \$27,971,000 (T.8). "It is said that 25 million dollars worth of cigarettes are sold through coin machines

TABLE 54 (cont.)

OTHER NON-MANUFACTURING INDUSTRIES

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
	each year; that Automat restaurants feed 500,000 people a day in New York, Philadelphia and other cities; that there are 10,000 handkerchief vending machines in the United States; and it is well known that hundreds of millions of pieces of gum and candy are sold in this way." ³

¹ Estimates made available by courtesy of Equipment-Research Corporation, Chicago, publishers of *The Business Machines and Equipment Digest*.

² Rough estimates of extent of use suggested by J. O. Dahl, Manager, Service Department, Ahrens Publishing Company, Inc., in letter to the author, February 23, 1928.

³ L. D. H. Weld, *The Cost of Marketing, Taylor Society Bulletin*, April 1933, pp. 26-30.

TABLE 55

MANUFACTURING INDUSTRIES

I

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Glass manufacture	98 per cent of window glass was machine-made in 1926 (Ch. III, footnote 39). 90 per cent of bottles and jars were made on automatics in 1924 (T. 38). 95 per cent of electric light bulbs were made by automatic processes by 1926 (Ref. 36, p. 6).
Continuous kilns in clay products industries	Used in the production of approximately 50 per cent of high-grade clay products, but for only 3 to 5 per cent of crude clay products (MRE, 1929).
Automatic cigar machines	Used by most or all large cigar manufacturers (ME). Over 4,400 machines installed or ordered by principal manufacturers, 1918-29.

MECHANIZATION IN INDUSTRY

TABLE 55 (cont.)

MANUFACTURING INDUSTRIES

I

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Automatic paper-stock proportioning and metering system, in paper mills	35 per cent of cigars were machine-made in 1929 (T. 38). In use for about 90 per cent of newsprint production, as a substitute for the intermittent-batch method (1929, ME). Most new mills equipped.
Continuous filters, in place of the intermittent type, for separation of liquids and solids	Used for from 50 to 70 per cent of materials in beet sugar factories and 100 per cent in wood-pulp mills (1928, ME), and for from 20 to 30 per cent of materials in the heavy chemicals industry (MRE). Over 5,000 sold by 1929.
Garment pressing machines, used in garment manufacturing and by tailors in pressing	Probably over 100,000 sold 1921-29 (author's estimate, based upon data for a substantial fraction of the industry). Aggregate value of machines produced in 1925, 1927 and 1929 was \$24,702,800 (T. 8).
<i>Metal and wood-working equipment</i> Blast furnaces	81 per cent of output of merchant blast furnaces and 85 per cent of all pig iron not delivered molten was machine-cast (1927, T. 36); and 91 per cent of merchant blast furnace stacks were mechanically charged (1927, T. 36).
Machine tools	Ceaseless change in types and uses. Peak of production, 1917 and 1918 (Chart 2). Aggregate production in the census years 1925, 1927 and 1929: \$383,075,000 (T. 8).
Wood-working machines	Shipments by reporting group of manufacturers, 1918-29, totalled approximately \$190,000,000; and the number shipped 1923-29, 97,568 (T. 38).
Electric portable drills and valve grinders	It is estimated that 360,000 were sold in 1924-26 (<i>Electrical Merchandising</i> , January, 1928).

TABLE 55 (cont.)
MANUFACTURING INDUSTRIES

I

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Tire building	The core process predominated prior to 1926, the flat-drum process thereafter (U. S. Bur. of Labor Statistics, <i>Bul.</i> 585, p. 7).
Job printing presses	Two-thirds of presses sold, 1913-28, were machine-fed (T. 37).

II

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
<i>Foundry equipment</i>	
Molding machines	37 per cent of workers in the molding process in 80 foundries inspected were machine workers, 68 of 77 foundries inspected had some power molding machines, 9 had hand molding only (1925, Ref. 20-a).
Power types in general	In use for 50-100 per cent of small, and for 90 per cent of the medium and heavy work for which power machines are suitable (MRE, 1926).
Sandslinger type	Over 140 units installed, in 65 or more plants, by close of 1924. Used in 7 of 79 plants inspected (T. 3).
Hand types	One maker sold 1,900 to 2,000 of the hand squeezer type, 1920-29 (3,300 in the 6 preceding years), but chiefly as replacements or for new foundries rather than in displacement of other methods (T. 38). In 1927, molding machines constituted, in value, three-sevenths of total foundry equipment produced (1929 <i>Census of Manufactures</i> , p. 1100).
Core-making machines for cores, 3/8" to 7", hand and power	Used for about 80 per cent of suitable work (MRE, 1926). 23 of 79 foundries inspected reported their use. One maker sold about 5,000 in the quarter century ending 1925.

TABLE 55 (cont.)

MANUFACTURING INDUSTRIES

II

EQUIPMENT OR PROCESS	EXTENT OF USE, YEAR TO WHICH ESTIMATE APPLIES AND SOURCE OF INFORMATION
Sand mixers	Core and facing-sand mixers used for 75 per cent of suitable work (MRE, 1926). 61 of 79 foundries had power sand-conditioning equipment (1925, Ref. 20-a).
<i>Textile equipment</i> Automatic looms Cotton goods	Plain cotton goods made mostly on automatics, except in a few localities. In 1925, in the sample of New England mills inspected, 52 per cent of looms of all types were automatic; in the southern sample, 79 per cent (Ref. 20-a). In 1929, 74 per cent of plain looms were automatic; of fancy, 47. In the southern cotton states, 80 per cent of plain looms were automatic; in the New England states, 59 per cent (1929 <i>Census of Manufactures</i>).
Other textiles	Used quite extensively in worsteds, and getting into the silk field (1926, ME).
Tying-in and drawing-in machines, in cotton goods manufacturing	808 tying-in machines in use at end of 1925; about 100 more sold, 1926-29 (MD). Approximately 450-460 drawing-in machines in use, 1919; about 100 sold, 1920-25 (MD). Possibly 80 per cent of cotton goods market equipped. A few used on finer grades of worsteds (ME, 1926).
Automatic spoolers and high speed warpers	Total number sold, 1917-29: 394 spoolers and 332 warpers. Only a small fraction of potential market equipped (ME).
Hand knotters, in spooling	Used in the majority of cotton mills by 1910; about 50,000 of one make sold in the quarter century after introduction in 1900 (ME).

APPENDIX C

HORSEPOWER PER WAGE EARNER IN MANUFACTURING,
CENSUS YEARS 1899-1929

HORSEPOWER PER WAGE EARNER IN MANUFACTURING, CENSUS YEARS 1899-1929, FOR INDUSTRIAL
GROUPS AND INDIVIDUAL INDUSTRIES, ARRAYED IN ORDER OF HORSEPOWER
PER WAGE EARNER IN 1925 ^{1a}

1925 RANK	1929	1927	1925	1923	1919 ADJUST- UNAD- ED ^{1a} JUSTED ^{1a}		1914	1909	1904	1899	HORSEPOWER PER WAGE EARNER 455	
1 Blast furnaces		⁵	⁵ 47.29*	45.94	37.28	36.78	41.64	30.53	22.04	12.67		
2 Ice, manufactured	33.47	43.68	37.07	31.41	19.06	18.97	20.09	19.74	18.98	14.55		
3 Cement	35.48	29.46	22.70	18.31	19.17	19.17	17.58	13.87	8.55	¹		
4 Flour-mill and grain-mill products	23.73	21.39	20.93	20.17	19.33	19.26	20.72	21.61*	19.83	20.83		
5 Paper and wood pulp	23.18	21.42	19.60	18.05	16.25	16.26	18.32	17.16	16.57	15.36		
6 Coke	19.13	21.42	17.66	11.71	7.68	7.68	5.55	2.14	3.51	2.05		
7 Minerals and earths, ground or otherwise treated	²	14.08	14.50*	9.60	8.83	8.83	9.38	10.45	7.86	8.76		
8 Smelting and refining	17.49	14.33	13.21	13.65	11.11	11.18	7.28	6.81	4.81	3.84		
9 Steel works and rolling mills	⁵	⁵	12.85*	11.11	10.18	10.99	10.88	8.75	7.95	6.01		
10 Oils	16.58	12.91	12.51	13.39	9.64	9.66	10.88	10.33	9.04	6.16		
11 Malt liquors, including cereal beverages	²	²	12.28 ⁸	13.97* ⁸	9.39	9.46	6.54	6.37	5.53	5.01		
12 Sugar, beet and cane, and its refining	13.14	12.26	12.16	11.28	7.81	7.81	10.46	10.52	10.06	10.37		
13 Paving materials, other than brick or granite	12.80	13.67	11.59	10.17	12.20	11.89	7.08	4.14	2.74	¹		

HORSEPOWER PER WAGE EARNER IN MANUFACTURING, CENSUS YEARS 1899-1929, FOR INDUSTRIAL GROUPS AND INDIVIDUAL INDUSTRIES, ARRAYED IN ORDER OF HORSEPOWER PER WAGE EARNER IN 1925

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1925 RANK	1929	1927	1925	1923	1919 ADJUST- ED 12	UNAD- JUSTED 12	1914	1909	1904	1899
14 Glucose and starch	12.58	11.57	11.17	9.97	6.67	6.77	9.24	5.90	7.66	4.51
15 Chemicals and acids ^a	13.74	11.02	9.44	7.66	6.24	6.24	8.68	8.28	6.18	5.16
16 Gas, manufactured, illuminating and heating	12.63	10.23	9.11	8.48	5.57	5.56	4.87	3.45	2.39	1.41
17 Locomotives, not made by railroad companies	8.92	11.46	8.92	2.97	3.61	3.64	2.90	2.36	1.20	1
18 Cereal preparations	10.22	8.50	8.48	9.58	6.18	6.24	4.96	1	1	1
19 Chocolate and cocoa products other than confectionery	10.12	9.80	8.21	6.84	3.67	3.67	4.69	3.79	2.48	2.15
20 Fertilizers	7.98	8.40	7.76	8.70*	4.79	4.79	5.01	3.54	3.38	3.34
21 Condensed and evaporated milk	12.07	8.65	7.59	5.82	3.59	3.59	3.33	2.76	1.76	1
22 Wire	6.69	7.68	7.45	5.82	6.04	6.05	4.77	3.98	5.46	6.22
23 CHEMICAL AND ALLIED PRODUCTS— Group	8.80	7.89	7.40	6.68	4.79	4.78	4.90	3.84	3.21	2.34
24 Butter and cheese	8.41	7.07	6.97	6.04	5.53	5.54	6.48	6.28	7.20	6.88 ^b
25 Shipbuilding, steel	1	1	6.78*	5.39	1.38	1.38	2.50	2.05	1.39	1.26
26 IRON AND STEEL AND THEIR PROD- UCTS—Group	7.58	7.50	6.76	5.85	5.10	5.10	5.22	4.44	3.83	2.94
27 STONE, CLAY AND GLASS PRODUCTS— Group	8.79	7.80	6.70	5.52	5.29	5.26	4.46	3.62	2.72	2.20
28 Explosives	9.19	6.59	6.63	5.50	5.61	5.61	7.27	4.54	5.12	4.27
29 Marble and stone work	8.09	7.29	6.56	5.31	5.24	5.18	3.78	2.86	2.01	1.99 ^b
30 Petroleum refining	9.80	7.76	6.03	5.86	4.06	4.06	5.06	6.50	2.74	2.96

MECHANIZATION IN INDUSTRY

31 Brass, bronze and copper products	6.39	6.30	5.74	4.73	3.54	3.54	3.04	2.61	2.09	1.74
32 PAPER AND PRINTING—Group	6.45	6.12	5.70	5.21	4.67	4.61	4.53	4.02	3.72	3.06
33 Other rubber goods *	7.41	7.41	5.63	5.19	3.02	2.96	3.02	2.98	2.28	2.00
34 Paint and varnish	6.17	5.81	5.61	5.01	3.94	3.96	4.38	3.96	3.56	3.13
35 Lumber and planing-mill products not in planing mills connected with sawmills	7.52	6.53	5.36	4.79	4.83	4.79 ³	4.26 ³	3.66 ³	3.17 ³	3.11 ³
36 Cordage and twine	5.04	4.96	5.04*	4.41	3.78	3.78	3.51	3.24	2.81	2.57
37 Cotton goods and cotton lace	5.28	5.00	4.97	4.52	4.22	4.23	4.07	3.46	3.15	2.65
38 Tires and inner tubes	5.56	5.77	4.94	5.01	1	1	1	1	1	1
39 Cars, steam and electric railroad	5.96	6.22	4.84	3.10	3.03	3.03	2	2	2	2
40 RUBBER PRODUCTS—Group	5.52	5.58	4.65	4.39	2.71	2.71	2.70	2.49	1.98	1.95
41 FOOD AND KINDRED PRODUCTS—Group	4.94	4.82	4.64	4.41	4.05	4.04	4.32	4.44	4.15	4.03
42 Engines, steam, gas and water	4.69	4.45	4.39	3.40	2.45	2.45	2.12	1	1	1
43 Lumber and timber products, n.e.s.	4.74	4.30	4.39	3.90	5.02	4.90*	4.57	4.23	3.68	3.33
44 Structural and ornamental ironwork	4.84	4.80	4.38	3.98	3.76	3.76	2.32	2.00	1.65	0.79
45 Aluminum manufactures	5.08	4.86	4.33	3.58	2.65	2.66	2.67	1	1	1
46 Carriages and wagons ¹⁰	5.19	5.35	4.25	3.26	2.29 ¹⁰	2.25 ¹⁰	1.30 ¹⁰	1.50 ¹⁰	1.04 ¹⁰	.89 ¹⁰
47 ALL INDUSTRIES—combined	4.86	4.65	4.27	3.77	3.25	3.24	3.19	2.82	2.47	2.11
48 Roofing materials, n.e.s.	5.61	5.71	4.12	5.14	4.40	4.42	2.85	3.76	2.61	2.39
49 Boxes, wooden packing, except cigar boxes	4.49	4.40	4.12	3.81	3.39	3.40	3.29	3.18	2.84	2.50
50 Leather, tanned, curried, and finished	4.60	4.17	4.12	3.86	3.00	3.01	3.09	2.38	2.05	1.71
51 Brick, tile, pottery, and other clay products *	4.66	4.28	4.09	3.78	4.19	4.17	3.70	3.40	3.04	2.39
52 Phonographs	2.67	3.42	4.05*	2.01	1.40	1.40	1.24	1.23	0.74	0.85
53 Agricultural implements	3.08	3.54	4.02*	3.94	2.36	2.36	2.50	1.99	1.89	1.52
54 MISCELLANEOUS INDUSTRIES—Group	3.91	4.22	3.98	3.51	2.25	2.25	2.32	2.10	1.79	1.22
55 NON-FERROUS METALS AND THEIR PRODUCTS—Group	4.76	4.22	3.96	3.70	2.90	2.91	2.19	1.86	1.46	1.33
56 Glass	5.06	4.84	3.91	3.28	2.67	2.68	2.19	1.79	1.43	1.00

HORSEPOWER PER WAGE EARNER

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HORSEPOWER PER WAGE EARNER IN MANUFACTURING, CENSUS YEARS 1899-1929, FOR INDUSTRIAL GROUPS AND INDIVIDUAL INDUSTRIES, ARRAYED IN ORDER OF HORSEPOWER PER WAGE EARNER IN 1925

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1925 RANK	1929	1927	1925	1923	1919 ADJUST- ED 12	UNAD- JUSTED 12	1914	1909	1904	1899
57 LUMBER AND ITS REMANUFACTURES— Group	4.39	4.02	3.88	3.71	4.11	4.07	3.82	3.56	3.02	3.15
58 Machine tools	2.99	3.73	3.86*	3.27	1.89	1	1	1	1	1
59 Shipbuilding, wooden, including boat building	1	1	3.70*	3.62	1.79	1.80	2.87	2.45	1.94	1.45
60 Soap	4.59	4.63	3.68	4.40	1.65	1.65	2.51	2.18	1.84	1.84 ⁸
61 Slaughtering and meat packing, wholesale	4.29	4.11	3.67	2.88	2.23	2.23	2.56	2.30	1.56	1.24
62 Foundry and machine-shop products 7	3.97	3.87 ⁷	3.58	2.75	2.16	2.12	2.12	1.70	1.40	1.08
63 Dyeing and finishing textiles	3.83	3.89	3.57	3.22	2.86	2.86	2.68	2.45	2.38	2.32
64 Photographic materials 11	3.44	2.78	3.56*	3.08	1.68	1.68	1.90	1.65	1.34	1.00
65 Woolen and worsted goods	3.86	3.60	3.45	2.77	2.79	2.81	2.40	2.13	1.95	1.86
66 Screw machine products	3.26	3.18	3.39*	3.19	2.28	2.28	2.22	1.94	1.60	.88
67 Confectionery, chewing gum, and ice cream	4.01	3.73	3.35	3.02	1.89	1.88	1.58	.80 ⁸	.67 ⁸	.72 ⁸
68 Mineral and soda waters	2	2	3.33	3.58*	2.50	2.40	1.62	1.48	1.12	.91
69 Pumps	3.57	3.46	3.16	2.62	2.01	2.02	2.07	1	1	1
70 Cutlery, not including silverware and plated cutlery	3.33	2.52	3.15	2.59	1.95	1.96	2.10	1.89	2.23	2.21
71 Tools, not elsewhere specified	3.42	3.41	3.11	2.58	1.91	1.92	2.28	2.26	1.90	1.55
72 Motor cycles, bicycles and parts	2.53	2.77	3.00*	2.24	1.32	1.36	1.31	1.34 ⁸	1.73	1.13
73 Ammunition and related products	2.36	2.26	2.99*	2.21	1.71	1.71	.99	1.18	.69	.58
74 Automobile bodies and parts	3.73	3.04	2.90	2.60	1.94	1.94	1.44	1.02	1.39	1
75 Cooperage	3.17	2.92	2.68	2.79	2.34	2.32	2.24	2.18	1.85	1.39

MECHANIZATION IN INDUSTRY

76 Paper goods, n.e.s.	3.32	2.90	2.63	2.57	2.51	2.52	2.03	1.72	1.34	1.30
77 Automobiles	3.16	3.86	2.58	1.80	1.34	1.36	1.32	.99	.74	1.45
78 Plumbers' supplies, n.e.s.	3.61	3.09	2.54	2.20	2.18	2.19	1.53	1.35	1.17	.95
79 Coffins, burial cases, and undertakers' goods	3.04	2.66	2.54	2.35	1.86	1.87	2.00	1.77	1.55	1.31
80 VEHICLES FOR LAND TRANSPORTATION INCLUDING RAILROAD REPAIR SHOPS	3.30	3.14	2.53	1.95	1.50	1.51	1.48	1.29	.94	.79
81 Steam fittings, steam and hot water heating apparatus	3.47	3.09	2.52	2.06	1.84	1.84	1.46	1.41	.91	.70
82 TEXTILES AND THEIR PRODUCTS-- Group	2.43	2.47	2.46	2.21	2.03	2.03	1.82	1.58	1.50	1.36
83 Electrical machinery, apparatus and supplies	2.72	2.74	2.46	2.04	2.06	2.06	1.93	1.82	1.74	1.04
84 Cast iron pipe	3.53	2.76	2.38	2.19	2.28	2.28	2.06	1.53	1	1
85 Boots and shoes, rubber	2.44	2.55	2.38	1.91	1.50	1.50	1.32	1.47	1.37	1.74
86 Mattresses and bed springs, n.e.s.	2.94	2.44	2.28	2.15	1.87	1.86	1.78	1.57	1.27	1.05
87 Pickles, preserves and sauces	1	1	2.27	2.38*	1.35	1.36	1.49	1.33	1.20	.92
88 Sewing machines and attachments, including cases	2.83	3.56	2.26	1.68	1.67	1.67	1.34	1.00	1.00	.75
89 Furniture	2.61	2.39	2.22	2.05	1.89	1.90	1.88	1.71	1.49	1.31
90 Textile machinery and parts	2.46	2.46	2.21	1.58	1.31	1	1	1	1	1
91 Steam-railroad repair shops	2.92	2.61	2.20	1.51	1.22	1.23	1.28	1.04	.71	.55
92 Electric-railroad repair shops	2.59	2.32	2.17	1.79	1.72	1.72	1.70	1.60	1.12	.91
93 Stamped and enameled ware, n.e.s.	2.45	2.33	2.16	1.94	1.50	1.50	1.21	1.09	.74	1.66
94 Stoves and hot-air furnaces	1	1	2.16*	1.98	1.50	1.50	1.40	1.25	.96	1
95 Canning and preserving fruits and vegetables	1	1	2.16	2.43*	2.21	2.17	1.76	1.48	1.11	.72
96 Printing and publishing newspapers and periodicals	2.56	2.40	2.03	1.76	1.69	1.61	1.59	1.60	.98	.74
97 Hardware, n.e.s.	2.15	2.09	1.88	1.58	1.58	1.59	1.30	1.08	1.05	.86

HORSEPOWER PER WAGE EARNER

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HORSEPOWER PER WAGE EARNER IN MANUFACTURING, CENSUS YEARS 1899-1929, FOR INDUSTRIAL GROUPS AND INDIVIDUAL INDUSTRIES, ARRAYED IN ORDER OF HORSEPOWER PER WAGE EARNER IN 1925

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1925 RANK	1929	1927	1925	1923	1919 ADJUST- ED 12	UNAD- JUSTED 12	1914	1909	1904	1899
98 Canning and preserving—fish and oysters	1.59	1.46	1.86	1.93	2.08	2.09*	1.15	.85	.73	.40
99 Boot and shoe cut stock	1.67	1.59	1.86*	1.80	.87	.93	.87	.72	.76	.52
100 Carpets and rugs, wool other than rag	2.00	2.01	1.86	1.53	1.64 ⁴	1.67	1.40	1.16	1.02	.94
101 Stoves, gas and oil	1	1	1.79*	1.33	1.07	1.07	1.02	1.06	.97	.68
102 Druggists' preparations, patent medicines, perfumery and cosmetics	1.99	1.79	1.72	1.51	1.20	1.19	1.27	1.22	.93	.88
103 Lithographing	1.87	1.75	1.68	1.65	1.19	1.19	1.00	.87	.65	.55
104 Tinware, n.e.s.	2.46	2.15	1.63	1.35	.88 ³	.89 ³	.84	.79	.53	.1
105 Silk goods, including throwsters	1.69	1.73	1.60	1.64	1.37	1.39	1.08	.99	.90	.88
106 Toys and games	1.54	1.29	1.46	1.11	1.02	1.01	.86	1.00	1.12	.97
107 Instruments, professional and scientific	1.35	1.56	1.45	1.32	.82	.82	.96	1.02	.62	.89
108 Bread and other bakery products	1.77	1.65	1.42	1.19	1.18	1.17	.87	.65	.46	.37
109 Copper, tin, sheet-iron work, including galvanized iron, n.e.s.	1.88	1.46 ³	1.41 ³	1.18	.89	.87	.74	.66	.50	.43 ³
110 Buttons	1.62	1.66	1.37	1.29	1.02	1.04	.99	.78	.66	.48
111 Musical instruments, pianos	2.73	1.79	1.34	1.21	1.25	1.25	1.09	.91	.83	.98 ³
112 Bags other than paper	1.62	1.41	1.34	1.21	.85	.84	1.11	.86	.79	.46
113 Boxes, paper and other, n.e.s.	1.44	1.44	1.33	1.08	.98	.98	.84	.59	.47	.34
114 Cash registers, adding and calculating machines	1.68	1.53	1.32	1.99*	.88	.89	1.18	.92	1.00	.62
115 LEATHER AND ITS FINISHED PROD- UCTS—Group	1.37	1.32	1.31	1.20	1.10	1.11	1.04	.91	.77	.64

MECHANIZATION IN INDUSTRY

116 Optical goods	1.61	1.63 [*]	1.28	1.10	1.06	1.07	.99	.89	.79	.68
117 Printing and publishing, book and job	1.40	1.37	1.27	1.17	1.08	1.07	1.01	.90	.64	.55
118 Hats, fur felt	1.20	1.29	1.18	1.11	1.10	1.10	.98	.76	.75	.62
119 Tobacco, chewing and smoking, and snuff	1.43	1.27	1.17	1.14	1.03	1.03	.82	.71	.77	.61
120 Saddlery and harness	1.41	1.22	1.09	1.18	.82	.79	.80	1.18	.49	.42
121 Typewriters and supplies	1.38	1.07	1.04	.77	.84	.83	.98	.71	.72	.53
122 Stationery goods, n.e.s.	1.04 ³	.99 ³	.96 ³	.86	.74	.73	.74	1.10	.79	.57
123 Knit goods	.87	.93	.94	.94 [*]	.87	.88	.84	.80	.76	.68
124 Watches and watch movements	.94	.77	.88	.64	.45	.45	.53	.52	.30	.26
125 Signs and advertising novelties	.98	.90	.83	.91	.75	.74	.77	.69	¹	¹
126 Trunks, suitcases and bags	.90	.87	.77	.64	.68	.67	.77	.62	.55	.47
127 Bookbinding and blank-book making	.88	.87	.77	.75	.55	.54	.52	.51	.32	.29
128 Jewelry	.98	.71	.73	.64	.49	.53	.55	.37	.36	.33
129 Boots and shoes, other than rubber	.68	.68	.67	.57	.55	.57	.52	.46	.37	.35
130 Fancy articles, n.e.s.	.59	.64	.62	.60	.62	.64	.62	.48	.52	.46
131 Collars and cuffs, men's	.43	.94	.62	.48	.47	.47	.39	.26	.22	.13
132 Corsets	.44	.56	.58 [*]	.37	.38	.39	.35	.26	.30	.29
133 TOBACCO MANUFACTURES—Group	.56	.40	.32	.30	.28	.28	.20	.17	.15	.17
134 Fur goods	.35	.34	.30	.30	.39	.39 [*]	.36	.18	.21	.12
135 Furnishing goods, men's	.30	.32	.29	.31	.32	.32	.26	.25	.19	.10
136 Shirts	.28	.26	.28	.27	.38 [*]	.38 [*]	.34	.26	.24	.19
137 Clothing, men's, n.e.s.	.28	.24	.26	.27	.23	.23	.20	.16	.15	.11
138 Millinery and lace goods, n.e.s.	.34	.30	.22	.29	.25	.24	.28	.20	.17	.11
139 Tobacco, cigars and cigarettes	.47	.31	.21	.19	.18	.18	.09	.07	.04	.04
140 Clothing, women's, n.e.s.	.19	.20	.19	.21 [*]	.20	.20	.17	.14	.13	.12
141 Turpentine and rosin	.05	.08	.10	.06	.08	.08	.07	.10 [*]	.04	.02

^{*}=maximum, if prior to 1927.

n.e.s.=not elsewhere specified.

¹ Not shown separately.

² Not canvassed, or comparable statistics not available.

³ Scope of industry in these years not strictly comparable with other years.

⁴ Includes wage earners in establishments with value of product under \$5,000.

⁵ Because the power equipment is sometimes common to blast furnaces and rolling mills under common ownership, in the 1927 and 1929 Censuses of Manufactures, the horsepower in blast furnaces and rolling mills is combined, though at the former censuses it was distributed by means of estimates.

⁶ Data for 'Other Rubber Goods' in 1923, 1925, 1927 and 1929 not comparable with the data for earlier years because tires and inner tubes were included prior to 1921.

⁷ The following industries are included in 'Foundry and machine-shop products' only at the stated censuses, and thereafter treated as separate industries or omitted: 'Machine tools', 'Steel barrels, drums, and tanks', 'Textile machinery and parts', and the tempering and welding of iron and steel—prior to 1919; 'Engines—steam, gas, and water', and 'Pumps, steam and power', prior to 1914; 'Automobile repairing'—in 1909 and 1904; 'Iron and steel—cast iron pipe', prior to 1909; 'Locomotives', and 'Stoves and furnaces', prior to 1904.

⁸ Includes sand-lime brick.

⁹ 'Coal-tar products' and 'Ferro-alloys' included.

¹⁰ Repairing included prior to 1923.

¹¹ Includes 'Photographic apparatus' and 'motion pictures'.

¹² The 1919 'unadjusted' figures cover plants with value of product \$500 or more, and include rented power other than electric; the 1919 'adjusted' figures are based upon wage earners in plants with value of product \$5,000 or more, and exclude rented power other than electric. The 'unadjusted' data are comparable with those for the earlier censuses; the 'adjusted' figures have been made comparable as far as possible with the subsequent censuses, but the horsepower data used still include the small amount of power in establishments with products less than \$5,000.

¹³ Computed from horsepower and wage-earner data originally compiled in the *Censuses of Manufactures*, and rearranged by Day and Thomas in *The Growth of Manufactures*, Tables 29 and 30 for 1899–1923, and Table 43 for 1925. The data for 1927 and 1929 are taken directly from the *Census of Manufactures for 1927 and 1929*, respectively; and the data for 1925, 1927 and 1929 are adjusted to make the classifications comparable as far as possible with those for 1923 and earlier years.

APPENDIX D

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