# The Manufacture of Carbureters

By F. B. Hays

**Over one million carbureters are manufactured yearly in this country.**

**The materials used for these. Preparing the castings, and machining them. Assembling and testing the carbureters.**

Carbureters differ from mixing valves chiefly in that the latter have no floats. Carbureters are used on motor boats, automobiles, aëroplanes, tractors and stationary engines; mixing valves only on stationary engines.

The number of carbureters and mixing valves manufactured in the United States in 1910 is estimated at not less than one million. Of this number about 90 per cent. were made by manufacturers specializing in this line of work. Fig. 1 shows a few different makes and types of carbureters.

### Materials Used

The materials entering into the manufacture of carbureters are copper, tin, zinc, steel, brass, aluminum, bronze, cork and leather. Fig. 2 shows the principal parts and materials.

The bowls, mixing chambers and heating jackets are made of brass or aluminum, the latter being used only rarely. Needle valves, and most of the pins and spindles are made from gun metal or hard-drawn bronze. Bolts, nuts and screws are made of steel and brass, air valves of brass and leather, and the floats of cork. The accompanying cross-sectional view of a carbureter shows the principal parts of the average carbureter and the materials of which these parts are composed.

### Castings for Carbureters

The principal parts of a carbureter are the bowl and the mixing chamber, the other parts being built up around these. The bowls are generally cast from yellow and the mixing chambers from red brass. The first are usually simple to cast; the second, however, represent a difficult proposition from the foundry standpoint, as they are very thin and require unusually complicated cores.

Fig. 3 shows a group of castings before finishing; *A* is the heating jacket, *B* the mixing chamber, *C* the bowl.

Carbureter castings are all made in flask molds from gated patterns or follow boards. Small parts that require no cores are made from gated patterns, as shown in Fig. 4. Larger and more complicated parts, such as bowls and mixing chambers, which require cores and which must be accurately and economically made, are cast in molds made from follow boards. In the Wheeler & Schebler factory these molds are made by a special molding machine, shown in Fig. 5. The molding sand is mixed at the rear of the machine, and carried by means of the chain and bucket conveyer *A* to the hopper *B*, which discharges it into the flask through *C*. The flasks are of heavy cast iron and have dowels *F*, which fit into the sockets *D* of the follow board. The ram *W* slides on the guides *R* and is actuated by the pitman rods *P*, which are operated by eccentrics on a main shaft at the base of the machine. The belt *X* imparts the motion.

The illustration shows the machine after having just rammed up a cope. The perfectness of the mold can be readily seen. The finest lake sand is used for this work.

Cores for carbureters are made in the same manner as ordinary cores, but receive more careful treatment, due to the accuracy required. When finished they are placed on steel plates, ribbed in such a manner that they will not warp, and put in a core oven where they are kept at an even temperature until baked. The accompanying illustration, Fig. 6, shows rows of cores on ribbed-steel plates ready for baking.

Carbureter castings are made from various alloys of copper, zinc and tin, free from scrap.

### Grinding and Sandblasting the Castings

Upon leaving the foundry the castings are given a thorough sandblasting to remove the dirt and oxidized metal, and to impart a lustrous finish to the surface. A batch of rough castings about to be sandblasted is shown in Fig. 7.

After being thoroughly sandblasted the castings are broken and sheared from the gates, and sent to the grinding department, where fins and rough edges are ground off on coarse emery wheels. The castings are then ready to be machined.

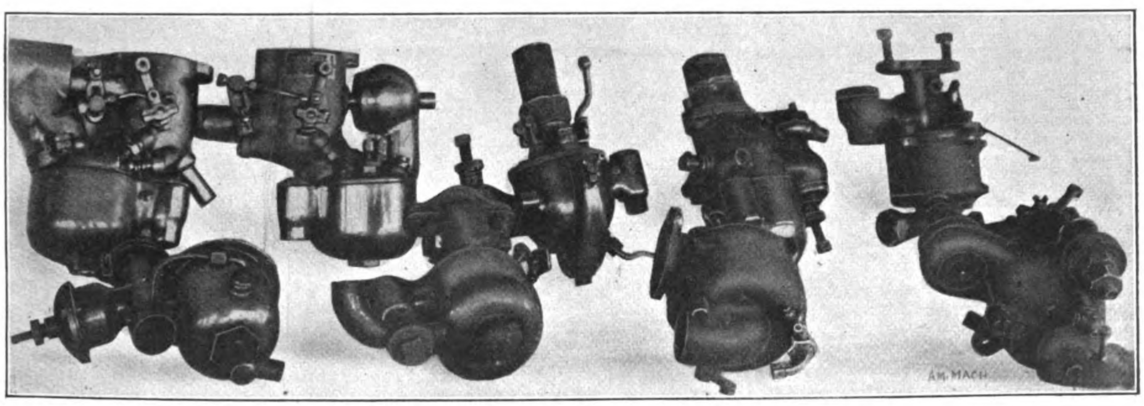

Fig. 1. A Few Different Makes and Types of Carbureters

### Machining

Every piece entering into the construction of a carbureter requires one or more machine operations.

Air and throttle valves are stamped out of plate brass, and washers and gaskets from leather and paper. These parts are made in ordinary punch presses, by means of simple dies. Similarly, screws, nuts, pins, spindles and like parts are turned out by ordinary multiple-spindle screw machines, set up for the various sizes and shapes of work to be made.

As these machines have no new or unique features, they are hardly worthy of special mention, and will be passed over for points of more peculiar interest.

All the parts of a carbureter made from rolled stock, such as screws, pins, etc., are turned out finished on screw machines, except needle valves, the bronze valve stems used for controlling the flow of gasolene into and from the carbureter. These stems (called valves) are from 1/32 inch to 1/8 inch in diameter, and from 1/4 inch to 3 1/4 inches long, as shown in Fig. 8. They are first turned up, threaded and knurled on the screw machine, and then ground on precision lathes rigged up especially for the purpose, Fig. 9. To grind them on ordinary grinding machines is impracticable, due to the smallness of the pieces, the softness and springy nature of their material, and the difficulty of holding them.

The semi-finished needle valve is placed in the lathe chuck, whose jaws are fluted to conform to the knurling of the valve head, and the chuck is tightened up. The lathe is started, and at the same time the grinding attachment, which consists of a very small fine-grained carborundum wheel, whose spindle is attached to a taper attachment on the lathe carriage. The lathe and grinding wheels revolve at high speeds and in opposite directions, the latter being operated by a separate belt. While thus revolving the taper attachment is moved back and forth longitudinally and at an angle with the valve stem, thereby bringing the grinding wheel into contact with the valve, and producing the desired needle point without twisting or bending the slender stem.

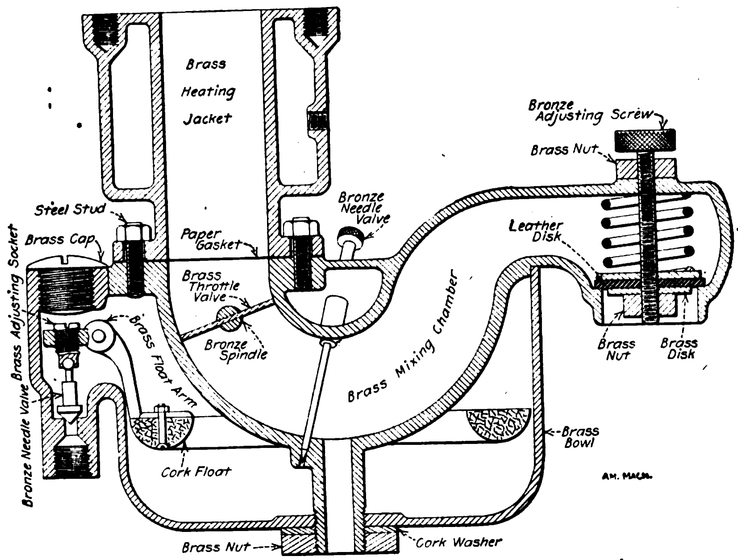


FIG. 2. THE PRINCIPAL PARTS AND MATERIALS OF A CARBURETER

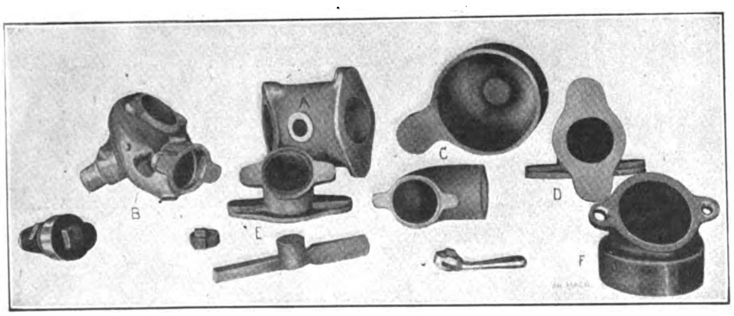


FIG. 3. SOME CARBURETER CASTINGS

Practically all other parts of carbureters are brass castings, principally float arms, throttle levers, connecting flanges, heating jackets, bowls and mixing chambers.

Float arms and throttle levers are generally similar to those shown in Fig. 10, and require only drilling operations. They are drilled in small, high-speed drillers, the pieces usually being held by hand while drilling.

Connecting flanges are faced and drilled, or faced, drilled and threaded, depending upon the type of connection. Three types of coniecting flanges *E*, *D* and *F*, are shown in Fig. 3; *E* and *D* are similar, except that *E* is a straight connection and *D* a right-angle connection. The machine operations on the two are the same, facing and drilling the flanges. Facing is accomplished by pressing the flange faces against a disk grinder until a smooth mirror-like surface is obtained. The pieces are held in a jig during this operation, to prevent their being ground unevenly. By referring to Fig. 6, it will be noticed that the face of flange *D* has been ground to almost glass-like smoothness, which is necessary to prevent leakage of gas when the carbureter is connected to the intake manifold of a motor. After being faced off the flanges are drilled for bolts, as shown by *F*. This drilling is done in ordinary high-speed drillers, the flange connections being held in drill jigs, so constructed that they

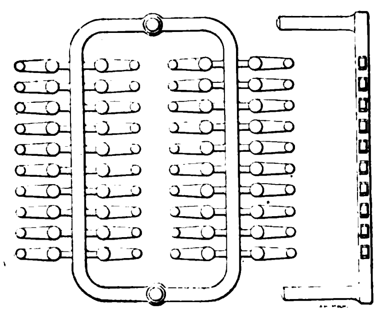

FIG. 4. A GATED PATTERN FOR THROTTLE LEVERS

not only drill the holes in the proper places, but also at angles of 30, 60 and 90 degrees with the vertical center line of the pieces (that is, vertical center line when pieces are attached to carbureter). When the connections are to be threaded, as is the lower (internal) flange of *F*, they are placed in special chucking fixtures and threaded on an ordinary lathe, the chucking fixture being held in the jaws of the regular lathe chuck.

Heating jackets, part *A*, Fig. 3, are faced and drilled in the same manner as flange connections, and then reamed and tapped. The reaming is done in a slow-speed, heavy-duty driller, with an ordinary fluted reamer, the heating jacket being held in a chucking fixture made fast to the driller-plate support, during the operation. The chucking fixture used for the purpose is similar to that shown in Fig. 11, except that it conforms to the shape of the heating jacket. Tapping is done on high-speed drillers by means of automatic tapping chucks, while the piece

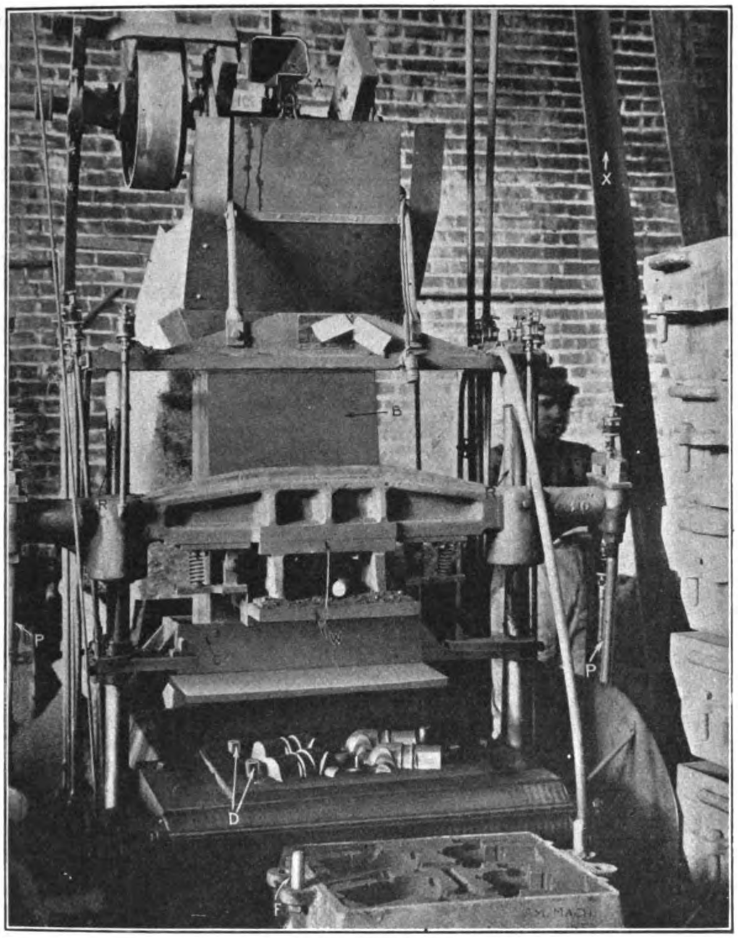

FIG. 5. ONE OF THE MOLDING MACHINES

is held by a form of box jig similar to that used for drilling it.

Carbureter bowls, part *C*, Fig. 3, are faced, bored, drilled, reamed and tapped. The top is faced off and the upper internal edge bored out to fit the mixing chamber. These two operations are completed in a turret lathe, while the bowl is held in a chucking fixture, which conforms accurately to the contour of the bowl. The bowl is then removed and drilled, reamed and tapped in a multiple-spindle, high-speed driller. Fig. 12 shows a bowl being drilled for the entrance of the base of the mixing chamber. The bowl is held in the movable jig *J* by means of the yoke *Y*, pivoted at *P*. The pressure the yoke exerts on the bowl is regulated by the lever *L*, which is eccentric at *E*, and pivoted at *P P*. After the bowl has been drilled the lever is released, the bowl quickly removed and a new one inserted. The whole operation of placing, drilling and removing the bowl requires but a few seconds.

Mixing chambers, part *B*, Fig. 3, are turned up to fit the bowls, and the stems bored, reamed and threaded in turret lathes, as shown in Fig. 13. The chucking fixture used for holding them during these operations is shown in Fig. 11. This chuck is composed of bronze and made from a plaster of paris cast to conform accurately to the contour of the piece to be held. The various holes in the mixing chambers for valve spindles, needle valves, "primers," vents and screws, are drilled and tapped on multiple-spindle drillers, the mixing chambers being tapped from several angles without changing jigs. Fig. 14 shows a jig for this purpose. The mixing chamber is inserted

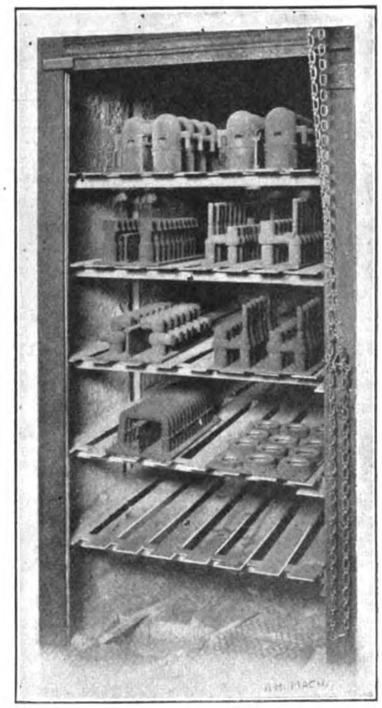

FIG. 6. BAKING THE CORES

FIG. 7. SAND BLASTING CARBURETER CASTINGS

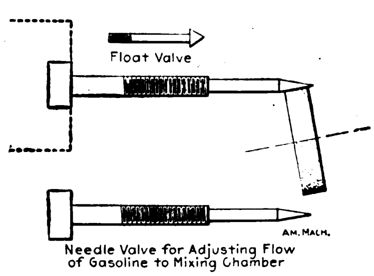


FIG. 8. NEEDLE VALVES AND METHOD OF GRINDING THEIR POINTS

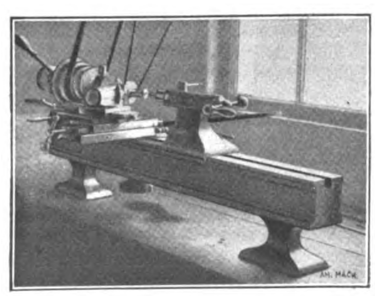

FIG. 9. PRECISION LATHE FOR GRINDING NEEDLE-VALVE POINTS

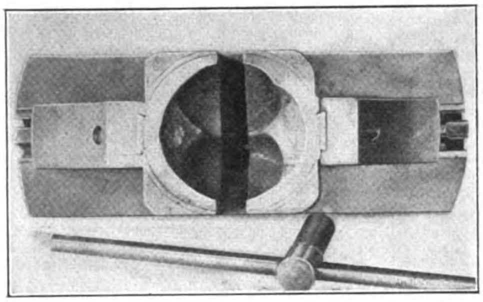

FIG. 11. CHECKING FIXTURE FOR HOLDING MIXING CHAMBERS IN TURRET LATHE

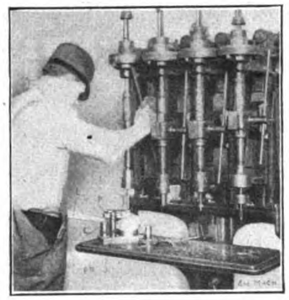

FIG. 12. DRILLING THE BASE OF BOWL

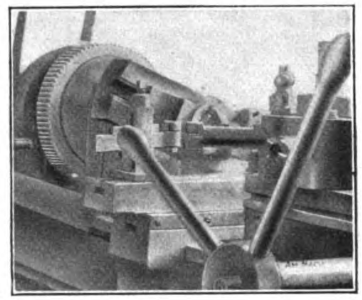

FIG. 13. TURRET LATHE "SET UP" FOR MACHINING MIXING CHAMBERS

from the top, along the center line, while the leaves *W* are removed. The chamber rests in the plates *M* and is made fast by a lock nut at *N*. The plates *W* are then put on, the dowel pins *X* holding them in position. The jig is turned over on edge *H*, and the stem drilled and primer hole, the drills being guided by the bushings *B* and *A*, respectively. The holes for flange studs are drilled, while the jig rests on edge *G*, and the needle-valve hole while it rests on edge *L*, the drills being inserted through bushings *E* and *F*. While on face *Z* the throttle-valve stem hole is drilled, the drill passing through bushing *Y*. The jig is made of machine steel and held together by the screws *S*. With the exception of the detachable leaves *W*, all the plates are recessed into each other to increase the strength and rigidity of the jig.

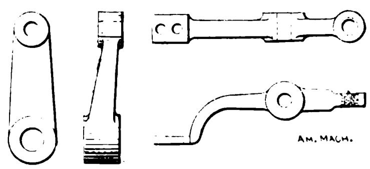

FIG. 10. THE THROTTLE LEVER AND THE FLOAT ARM

appearance, etc., and then given a gasolene test. In this test a number of carbureters are mounted on a series of tubes, connected to a gasolene reservoir, as shown in Fig. 15. Inaccuracies of float levels are here detected and remedied.

After this test one or two carbureters from each lot were given an efficiency test. This consists in placing the carbureter on a gasolene engine connected to an electric dynamometer, which registers the power output at different speeds. The comparative efficiency of a carbureter with other carbureters is determined by this test.

Fig. 16 shows the efficiency testing plant of the Marvel Carbureter Company. This plant consists of a gasolene motor, marked *E* in the figure, which is directly connected to an electric generator *C*. The dynamo *C* is electrically connected to a switchboard equipped with a rheostat, switches, cutout, etc.; a volt-ammeter *A*, and the automatic recording instruments *B*. The volt-ammeter shows directly the power developed in watts (volts × amperes), the recording instruments *B* register the speed and amperage at constant voltage, and amperage and voltage at constant speed, during any desired length of time. By this method accurate records of the power and speed of the motor, equipped with different carbureters, are made. The economy or amount of gasolene used per horsepower is computed by measuring the amount of fuel consumed for each horsepower developed by the motor at different speeds.

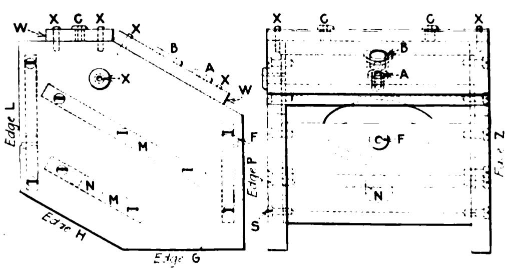


FIG. 14. JIG USED IN DRILLING AND TAPPING MIXING CHAMBERS

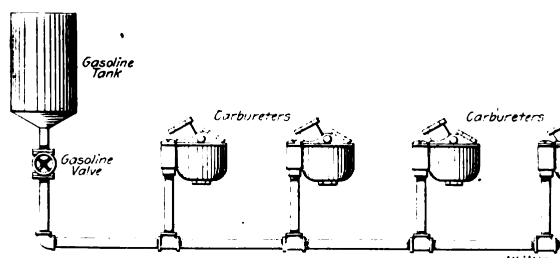


FIG. 15. OUTFIT FOR DETERMINATION OF FLOAT LEVELS AND DETECTING GASOLINE LEAKS

### ASSEMBLING AND TESTING

Carbureters are entirely assembled by hand. The work of assembling is simple, but requires considerable accuracy. The various parts are screwed and bolted together. The float, float arm and float valve are usually placed in the bowl and assembled first; then the mixing chamber is put in place and fastened to the bowl by a lock nut. The connecting flanges and levers are put on last. If the parts are properly machined, as is usually the case, no mechanical work is required in assembling them.

Assembled carbureters are inspected for loose fittings, smoothness of joints,

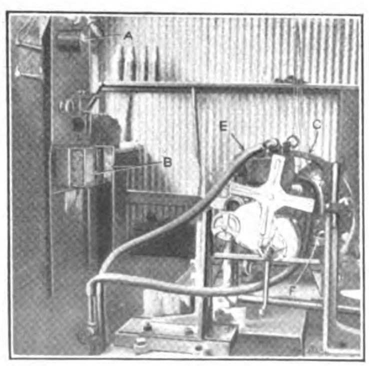

FIG. 16. THE EFFICIENCY TESTING PLANT

### POINTS OF GENERAL INTEREST REGARDING THE MANUFACTURE OF CARBURETERS

The jigs and fixtures used in carbureter work are very difficult to make, due to the complicated shapes of the pieces to be held, and the number of operations usually necessary with each jig. In making the more complicated jigs and fixtures the contour of the piece to be held is taken in plaster of paris, and the jigs and fixtures made to conform to this cast. Fig. 17 shows some of the jigs and fixtures used by the Marvel Carbureter Company.

The carbureter industry, if carefully studied, furnishes many interesting mechanical and economical facts. Carbureters are made from a number of materials having entirely different physical properties, which must be so machined that they will fit together accurately under all kinds of weather conditions and all sorts of usage. The principal parts entering into the construction of a carbureter are exceedingly complicated in form, and these must be accurately cast and machined. Fnished carbureters must be

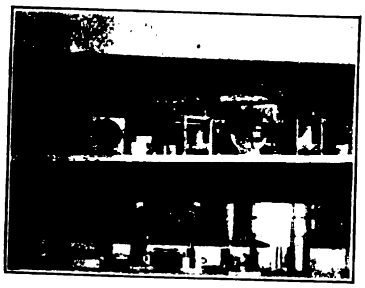

FIG. 17. SOME OF THE JIGS, TOOLS AND FIXTURES

smooth, polished and present a handsome appearance, and be free from gasolene and air leaks. Special tools and in many instances special machinery are required for most of the operations taking place in making them.

The cost of material in the average carbureter is from $1.25 to $2.50. To meet competition the average total production cost of a carbureter must not be more than from two to four dollars. Subtract from this the cost of material and consider the requisites of a good carbureter and you will have some idea of the scientific shop methods necessary to produce carbureters that can be readily sold.

## Why One Concern Went Out of Business

BY JAMES G. DORNBIRER

"Now," said the old mechanic, "I worked for these people nearly fifty years, and I believe I can tell you why they went out of existence.

"Frequently we notice that concerns that had every semblance of prosperity 20 or 25 years ago have gone out of existence, and we wonder what the difficulty was. We inquire from their banker and he tells one story; from the people knowing the concern and its owner and we hear another; the sons, if there are any, have another. This was the case with this concern, that was well known throughout the Central West for 70 years, but has been out of existence nearly 15 years; and since you want to know my opinion, I believe I can give it to you straight.

### UNBELIEVER IN ADVERTISING

"You see, when the Old Man started in business he had the only shop for miles around, and I was a boy learning the trade. The amount of work to be done in what we called our territory was very little, so he told me one day to take the horse and wagon and go out in the country and show some of the fellows where they needed repairs, and let them know that he was still in business. In those days we had practically no means of advertising and the boss could not see, even a great many years later, that it was necessary, and discovered it only when it was too late.

"I went out, and came back in four or five days with quite a load of machinery to be repaired, and more promised. The Old Man kept this up for several years, and, as the country developed, he started to make cane rolls, cider presses and treadmills. In the foundry the principal things made were bells, plows and kettles, and in the course of five or ten years he had a decent business. Later on and up to the time he went out of business, he made traction engines, sawmills, and steam engines up to 200 horsepower, and in the eighties he got to doing what everybody believed to be a fine business. But I worked for him all of my life and I knew that the Old Man was on the down grade during the ten years of his apparently greatest prosperity.

### MISTAKEN ECONOMY

"You see, he never bought a tap, a reamer nor a twist drill; always made these things. You know a flat drill never was a success on deep holes; yet I have seen flat drills used in this shop to drill 3/16 holes 3 inches deep in wrought iron. He also made reamers and taps without a miller or a decent shaper. Keeping this up after it would have been cheaper to buy them helped him out of business as much as anything. The lathes could not be classed as lathes even 40 years before I went there, and the planer was better adapted for producing warped surfaces than plane ones.

"When he built the new shop he made no provisions for handling the castings, which at that time were getting pretty heavy. He could have placed the big lathes and planers within the radius of a jib crane, as traveling cranes were then practically unknown, but he used rollers, crowbars, lots of muscle, profanity and a great amount of time, to handle the heavy stuff.

"Then when he used to make up stock he would finish 25 connecting rods, 10 cylinders and 5 crank shafts. He made every cap screw and machine bolt, and used hand torches for lighting. And say, the apprentice boys used to have a good time when the days were short, for, with the exception of a torch here and there, the shop looked darker than the boss' future. You never had to bait the boys into the shop; they thought it an honor if they were chosen from a large list of applicants. And I notice that a large percentage of them, in a few years after their time was finished, became shop owners, superintendents or foremen.

### LOST OPPORTUNITY TO PRESERVE A GOOD BUSINESS

"One day one of the boys thought he would like to own an interest in the plant, since the Old Man had no male heir and was getting old. So he saved his money and took a course in a technical school, and after several years he came back and applied for a job. He expressed a desire to become superintendent, since it was often rumored that the boss desired to step out of that position if he could find someone to take his place. Well, the Old Man certainly jumped on the applicant for the job. He got so mad that he chewed twice his usual allowance of tobacco, started to swear whether the occasion demanded it or not, and talked to himself for about six weeks after the above event took place.

"The young man then asked for a job as machinist, which was readily granted, since the Old Man knew his ability. It was not long, however, before the young man got a job as superintendent in the shop of one of the boss' competitors, where he made good. It was not more than five years after that the Old Man began to realize that he needed a successor, if the business was to continue. So, upon looking around for one, he came to the conclusion that opportunity had rapped on his door and that the man most able to take up his life's work had been most shamefully turned down.

"In a few years the place was offered for sale, but he held it too high. Then he became sick and desperate, and the shop had to be closed, so he offered it to another man for one-half his former price and found that would not sell it. Then he wrote the young man who wanted to get in with him as superintendent, and offered it to him at one-fourth of his former price, but could not get him, since he had started in business for himself.

"When he died, a number of business men of the town purchased it from the widow for a small sum, probably one-twentieth of its value, and offered it for nothing to anyone who would take it for a period of years and keep the business in town, but found no taker. Thus a concern passed out of existence that might be doing business today."