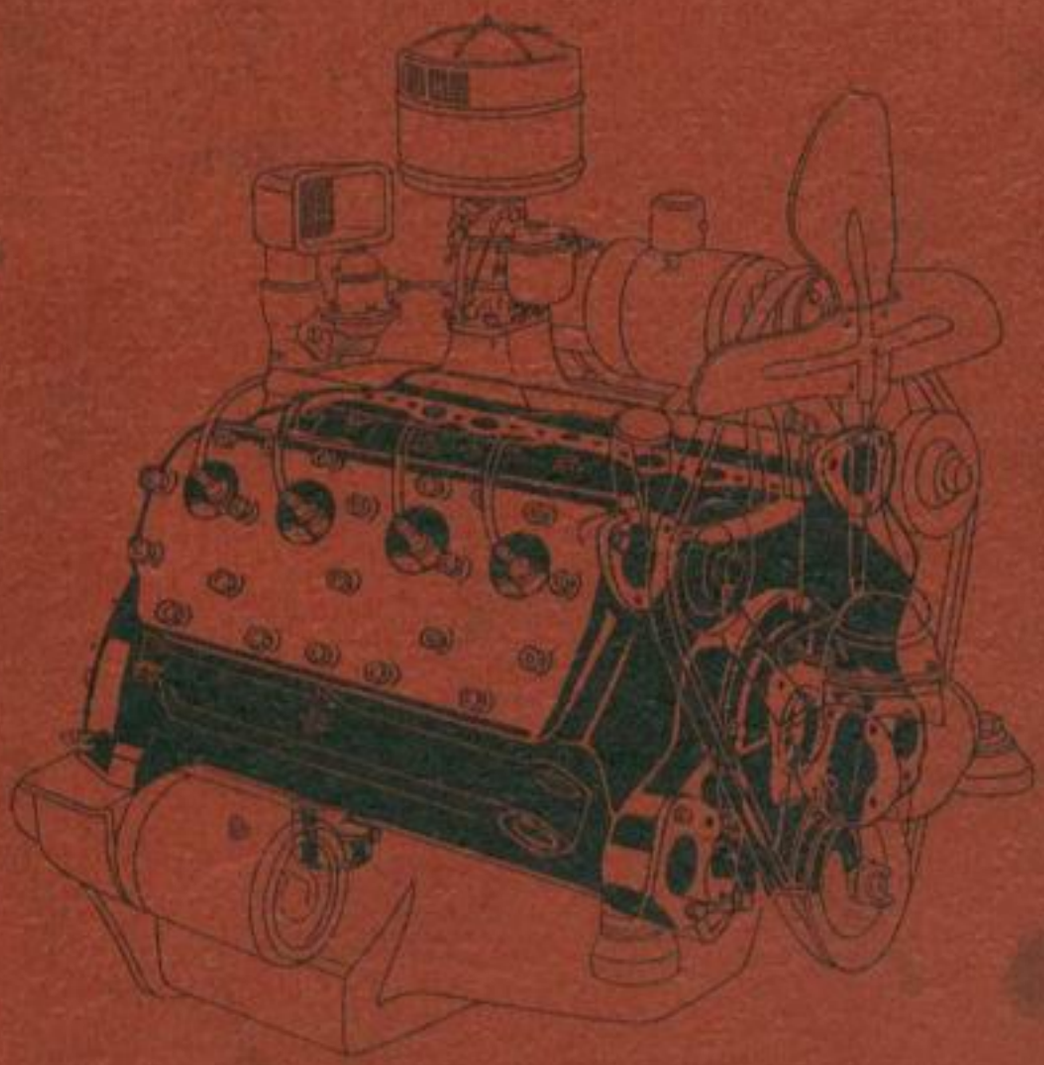
Ford

ENGINE PARTS RECONDITIONING



Ford Motor Company
DEARBORN, MICHIGAN

ENGINE PARTS RECONDITIONING

Ford Motor Company

Foreword

This book is intended to provide a medium for the interchange of experiences and ideas between Ford parts reconditioners. The scope of the book has been limited to include the methods of handling those particular phases of the work that appear to present problems in the establishment and operation of the reconditioning department. Many of the practices described in this book can be considered as emergency methods compared with practices in normal times, because the nation's transportation system must be kept in operation in spite of the scarcities of materials and equipment. This does not necessarily mean that there should be a letdown of quality but merely that some different methods must be used in order to equal the results previously obtained as nearly as possible.

Throughout this book various pieces of equipment are illustrated merely to show what some reconditioners are using or is available for their use. The fact that this equipment is illustrated in this book must not be construed as an indication that the Ford Motor Co. indorses, authorizes or sanctions the use of this equipment by Ford Dealers.

This book consists of five chapters. Chapter 1 deals with most of the phases of the management of the reconditioning departments, including the selection of the site, equipment and personnel, the physical layout, bookkeeping and records, as well as the care of the equipment. Chapters 2 through 5 present actual procedures followed by some successful reconditioners and can be used as a guide for all reconditioners subject, of course, to changes made necessary by the peculiarities of layout and equipment of each.

FORD MOTOR COMPANY

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CHAPTER I

MANAGEMENT OF RECONDITIONING DEPARTMENTS

A—PHYSICAL LAYOUT

1. SELECTION OF LOCATION FOR RECONDITIONING DEPARTMENT.

The building and floor plan should provide for good loading and unloading facilities for the engine assemblies. Select a location where traffic conditions are favorable and where sufficent space is available, so that several customers can be handled at one time. In many cases, new car show rooms are being used to good advantage. While not as desirable, second and third story floors are also suitable when there is good elevator service or a ramp. The building should be well lighted.

The heating and ventilating system should be adequate for the space area, a well lighted and ventilated shop, where uniform temperature can be maintained, will reduce employee fatigue and increase efficiency in the assembly of parts. The heating system should be modern and in good repair. The light fixtures, wiring and power lines should be in good condition.

2. LEASE AND INSURANCE.

Examine your lease and determine the responsibility for the repair and maintenance of the building and heating system: also who is responsible for the fire insurance covering the building. In one case of a heating system failure, the responsibility for repairs was found to be the dealer's. In another case of fire loss, it also was discovered that the responsibility for fire insurance on the building was that of the dealer. Therefore, it is suggested that competent legal advice be sought relative to your lease and insurance.

3. FLOOR SPACE IN THE SHOP.

Choose a reconditioning space which is not cut up with partitions, posts, low ceilings or interfering beams and so located that the engine assemblies can be received or delivered through a separate entrance, so that it will not be necessary to go through the dealership service department.

The best plan is to have one door designated as RECEIVING and another as SHIPPING or DELIVERY. However, where there is only one door, the traffic problem can be overcome by erecting a loading dock outside the building to accommodate several customers at one time. The engines can be transported by two-wheeled trucks to and from the customers' delivery trucks.

The floor space should permit production to start from a given point and move in one direction by progressive steps. The space selected should be ample to provide for an increase of production without a major rearrangement of physical set-up.

There also should be ample sewage and drainage outlets. It is well to remember that the cleaning of cylinder blocks, etc., will add a heavy burden to the drainage system. The floor should be in good condition and easy to keep clean.

4. EQUIPMENT LAYOUT.

Equipment should be properly placed to avoid employee congestion and lost motion. Adequate space should be provided for parts bins, new cylinder blocks, crankshafts, camshafts and finished and unfinished engine assemblies. Housing the reconditioned parts in the same building where the reconditioning is carried on saves time, adds to efficiency and reduces production cost.

5. FLOOR PLANS.

The following illustrations show typical floor plans being used by reconditioners producing ten or more reconditioned engines daily.

Figure 1 shows the engine stand operated on a floor track. This plan keeps the work in

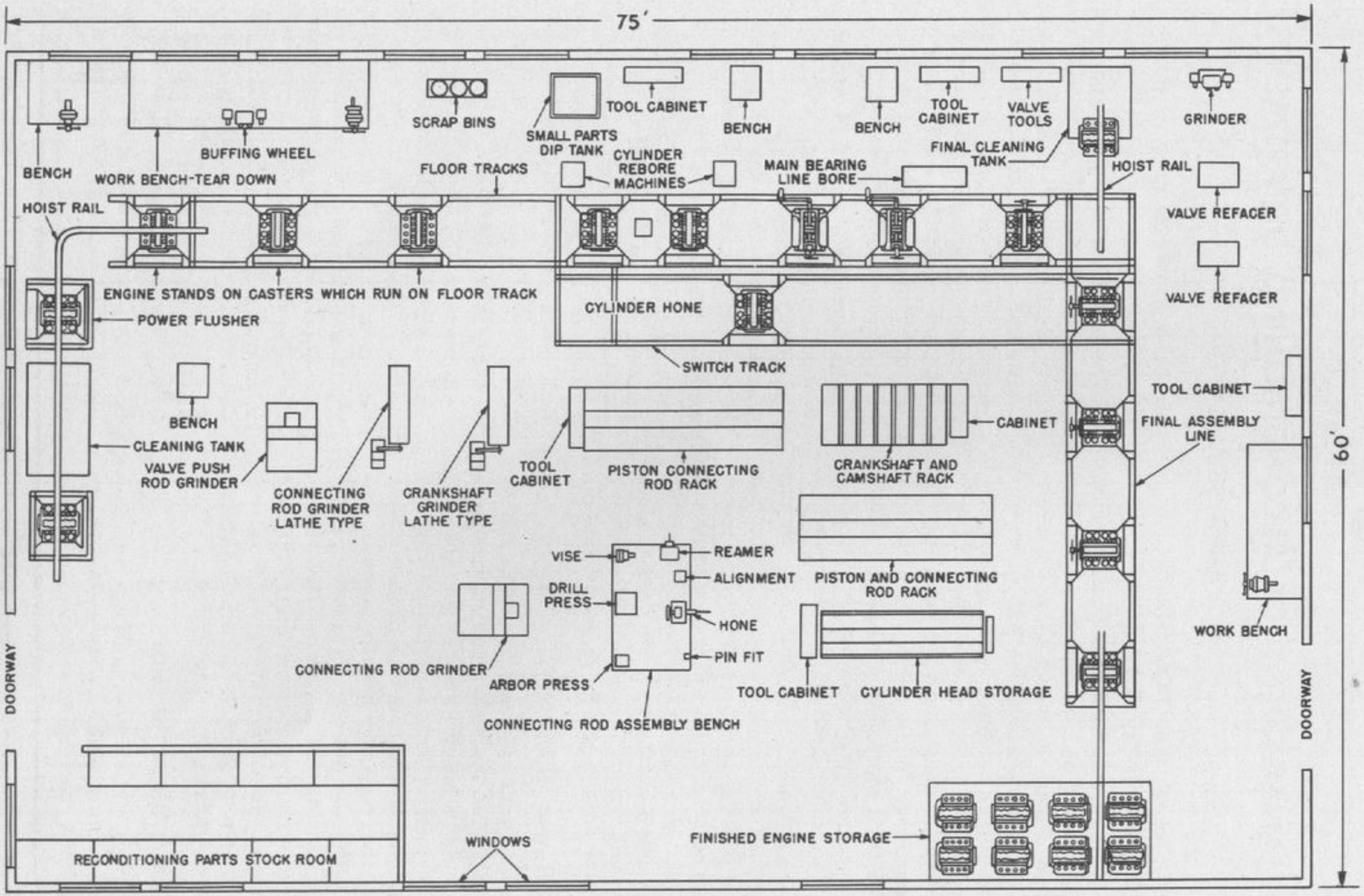

Figure 1—Floor Plan Number One, Showing Floor Tracks

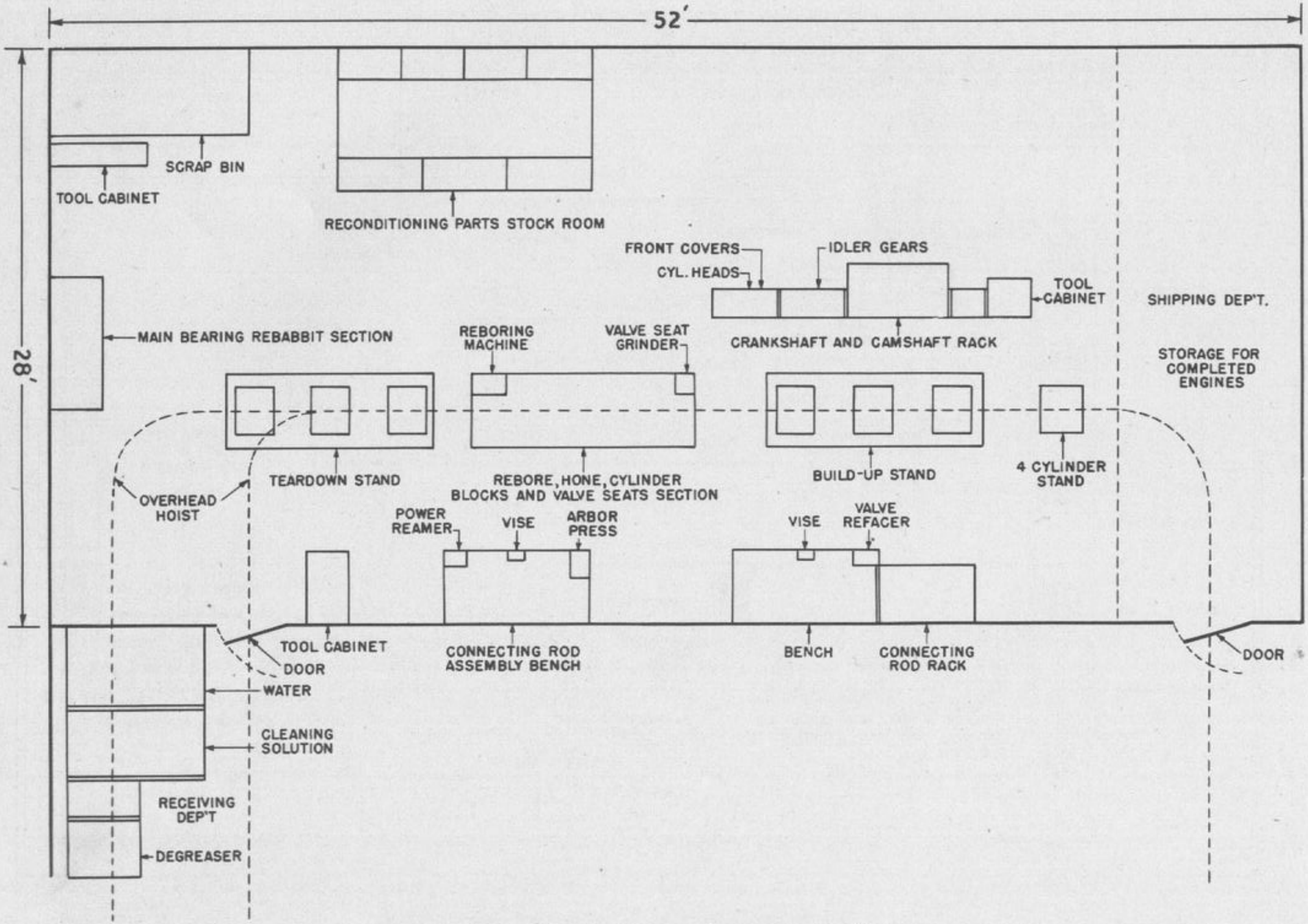

Figure 2—Floor Plan Number Two, Showing Overhead Hoists

ENGINE PARTS RECONDITIONING

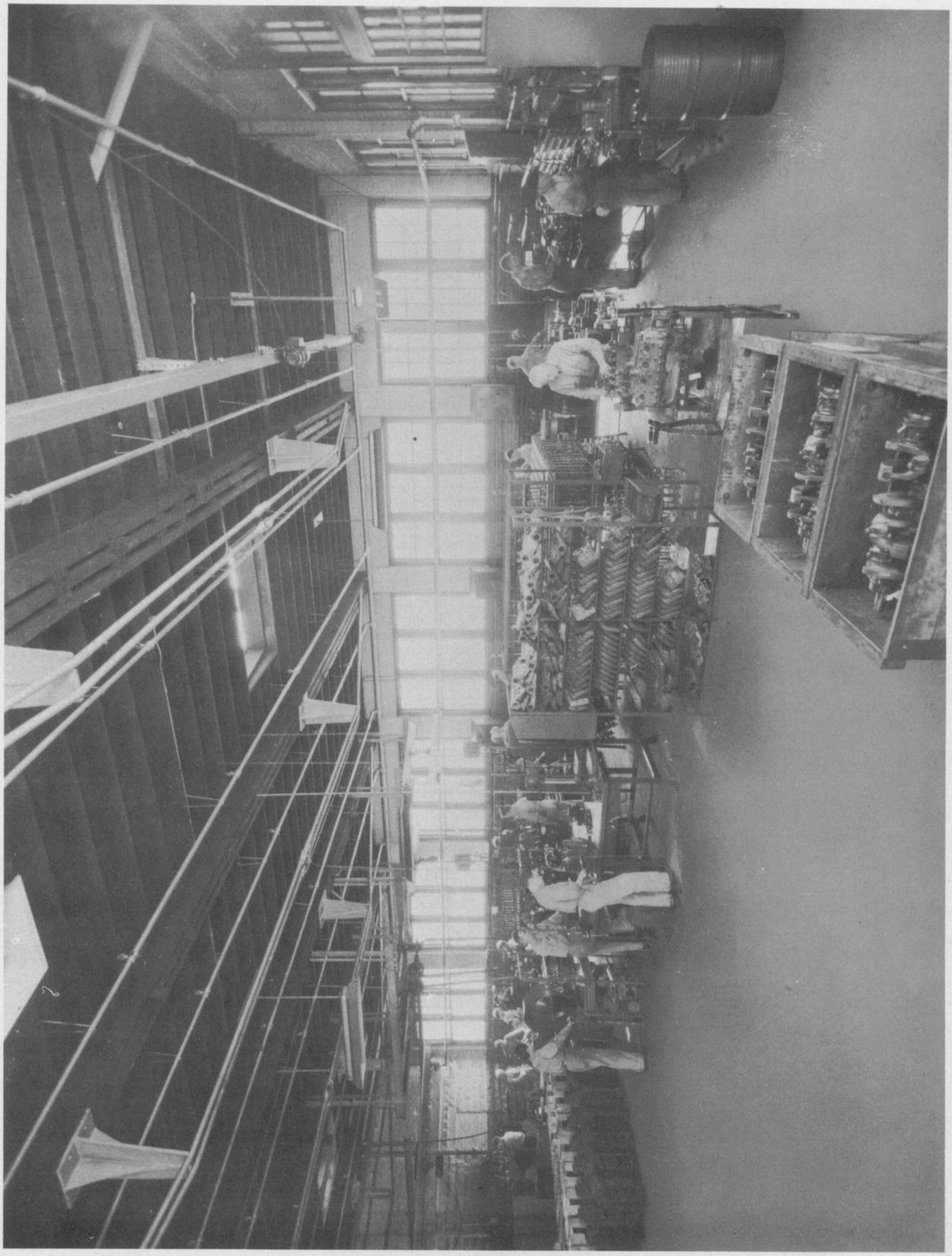

Figure 3—General View of Reconditioning Department, Plan Number One

Figure 4—Cleaning and Inspection Section

a progressive line with each step being performed at a designated location. An orderly operation is thus maintained thereby reducing congestion and simplifying supervision.

It will be noted that a switch track is also shown in connection with the floor track. The switch track starts at the cylinder boring section and runs parallel to the main track. The purpose of the switch track is to shunt the blocks that only need sleeves directly to the final assembly section and permits switching blocks from the boring section that do not require rebabbitting. Figures 3 through 11 show various views of the reconditioning departments laid out following the general plan shown in floor plan number one.

Figure 2 shows the engines moved by an overhead hoist on a monorail to stationary stands that accommodate three engines each. By working on three engines at a time, much labor is saved as the worker can remove or assemble similar parts on all three engines

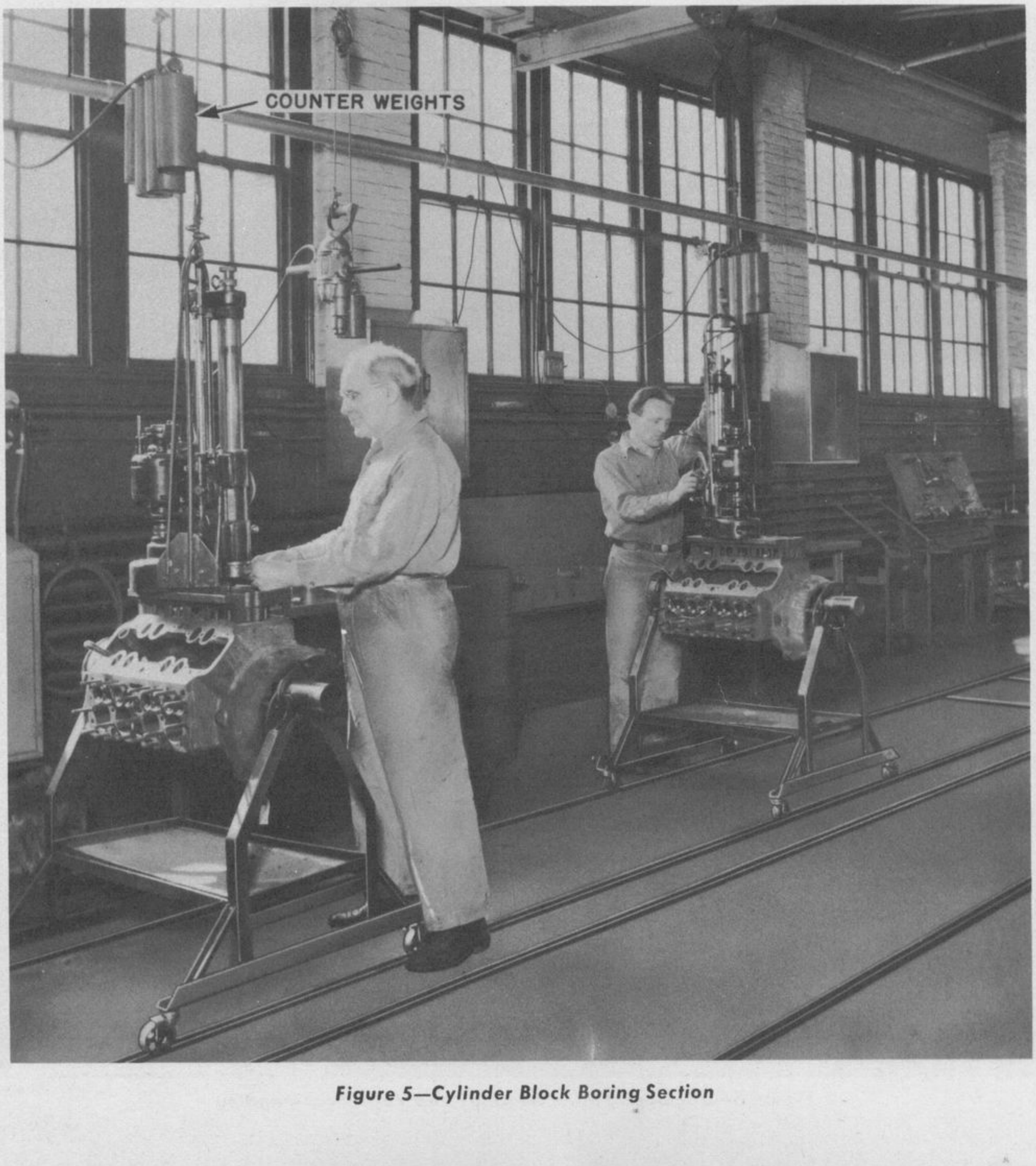

Figure 5—Cylinder Block Boring Section

while he has the particular wrench or tool in his hand.

6. CLEANLINESS.

The first steps in maintaining cleanliness is an orderly arrangement of the shop, with bins, racks, boxes, etc. for all parts and tools. With the possible exception of engine assemblies and cylinder blocks, the floor should be free from all parts to permit easy, frequent sweeping or scrubbing without heavy labor.

Eliminate dark corners by adequate lighting, arranging the lighting to eliminate glare in the worker's eyes. Avoid the use of dark paints that have little or no light reflecting value. Avoid the use of red or other colors that will contribute to eye strain. Avoid the use of white or other too light colors that will tend to amplify the unavoidable "working" dirt.

Provide receptacles for scrap parts and dispose of this scrap regularly. Provide receptacles for soiled wiping rags or waste and don't permit them to accumulate.

Allow a few minutes at the close of each working period for each employee to wipe his machine or bench and arrange his tools and parts in an orderly manner and insist on this being done.

Sweep the floor every day and scrub it at least once each week. If it is found that dirt accumulates around bench and machine legs or in corners, paint a small area of the floor white at these points. The Ford Motor Company has achieved a world wide reputation for shop cleanliness by following a similar plan, and there is little reason why any reconditioner should not enjoy a like reputation.

The psychological effects of a clean shop are manifold. Your pride of ownership, the

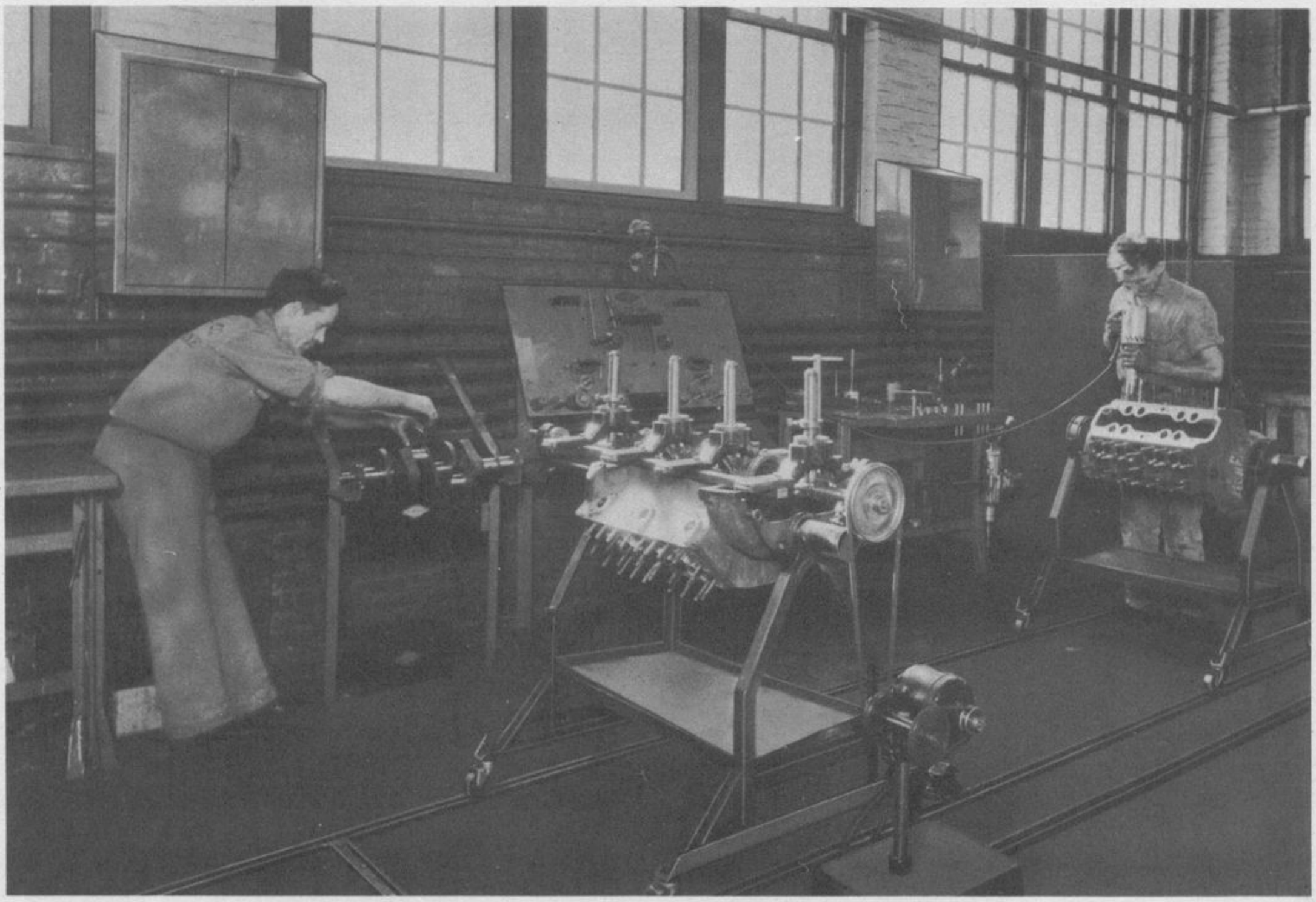

Figure 6—Line Boring Main Bearings and Valve Seat Grinding

A - Cylinder block to be immersed in final cleaning solution, after which the block will be cleaned with compressed air.

B - Racks containing camshafts, crankshafts, push rods, valves, valve guide bushings, and connecting rods in sets, are located close to the assembly line.

C - Valve refacing and valve stem clearance operations are performed along-side the block to which they will be assembled. Note the trays of inspected valves on the valve refacing stand.

D - After the pistons have been fitted to the bore, the connecting rods, piston pins and the correct size piston rings are assembled to them on the bench. These assemblies are then placed in trays equipped with hooks for hanging.

E - The engine stands are equipped with a shelf to hold the piston and rod assemblies in the order that they are to be installed. The shelf is large enough for connecting rod caps, liners, nuts, tools, etc.

Figure 7—Final Assembly

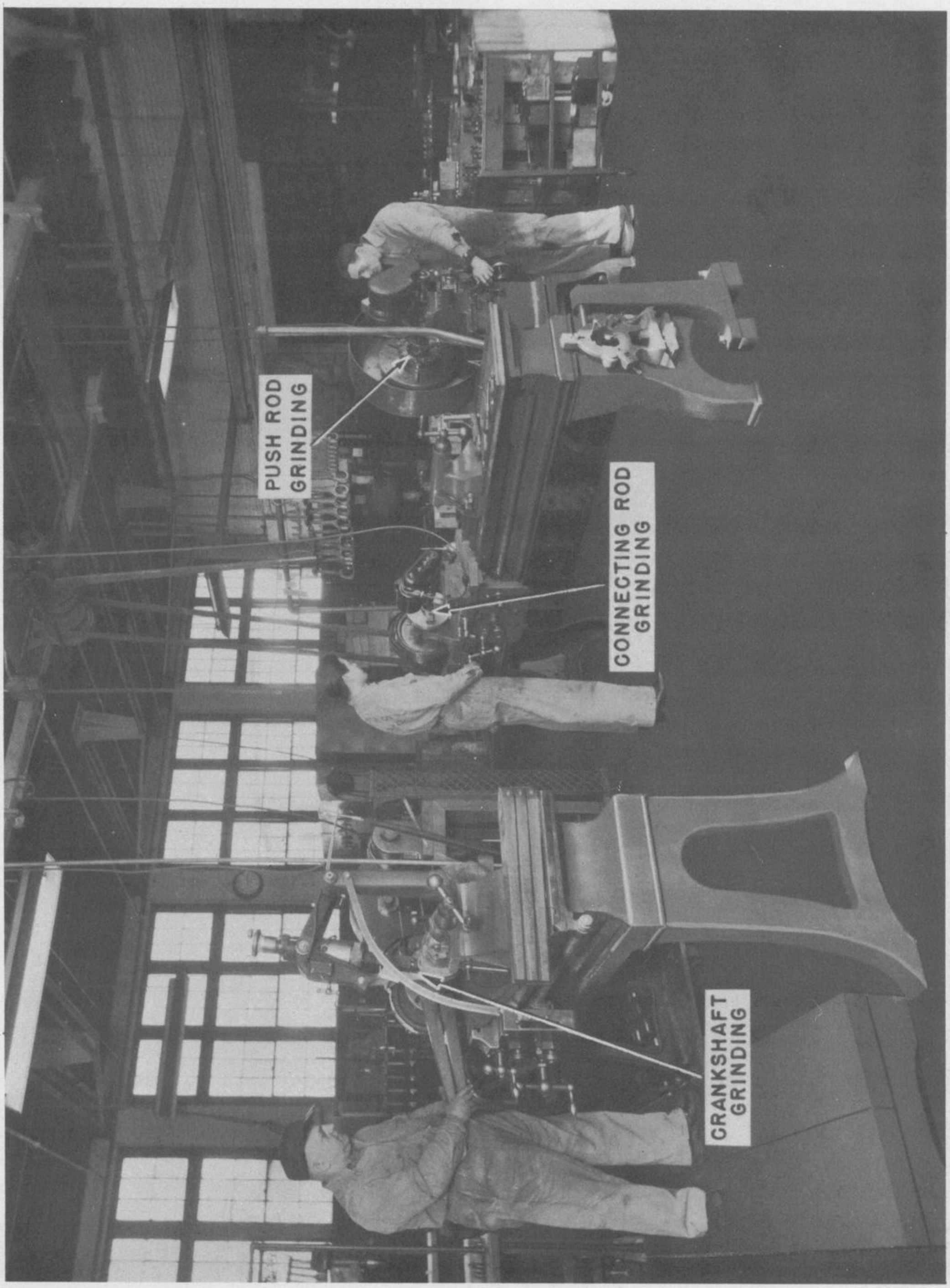

Figure 8—Machining Section

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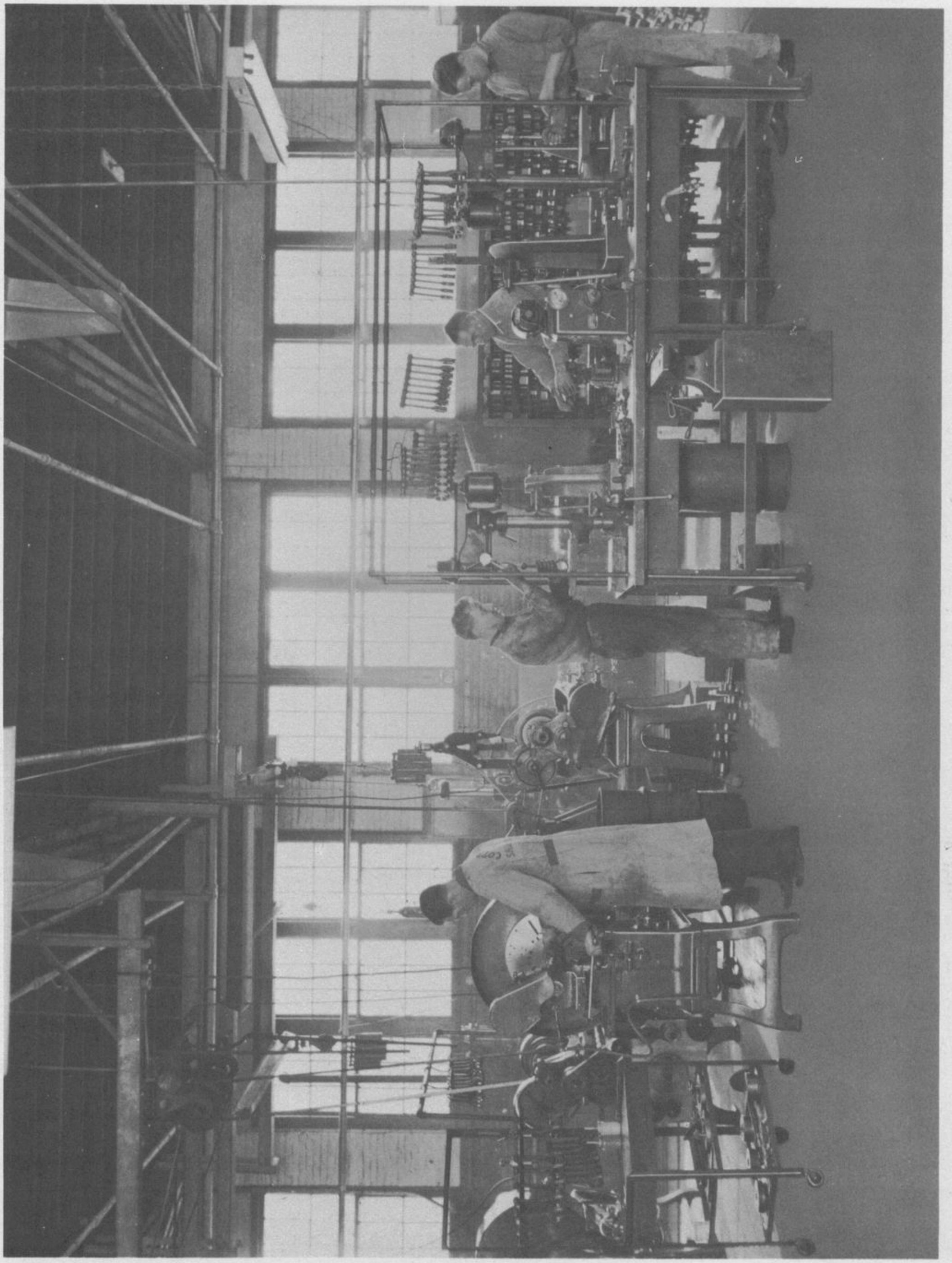

Figure 9—Connecting Rod Reconditioning Section

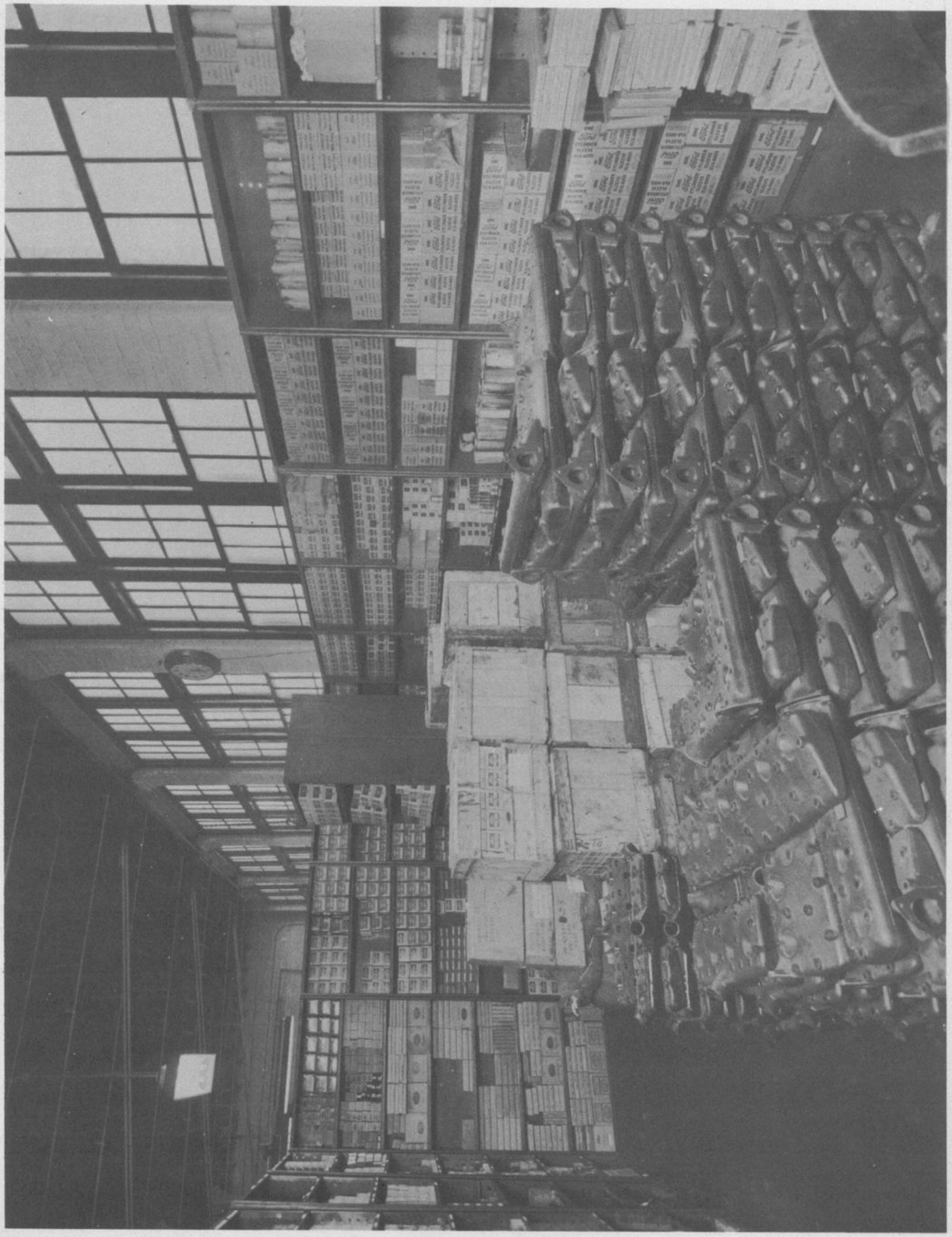

Figure 10—Reconditioning Parts Stock Room

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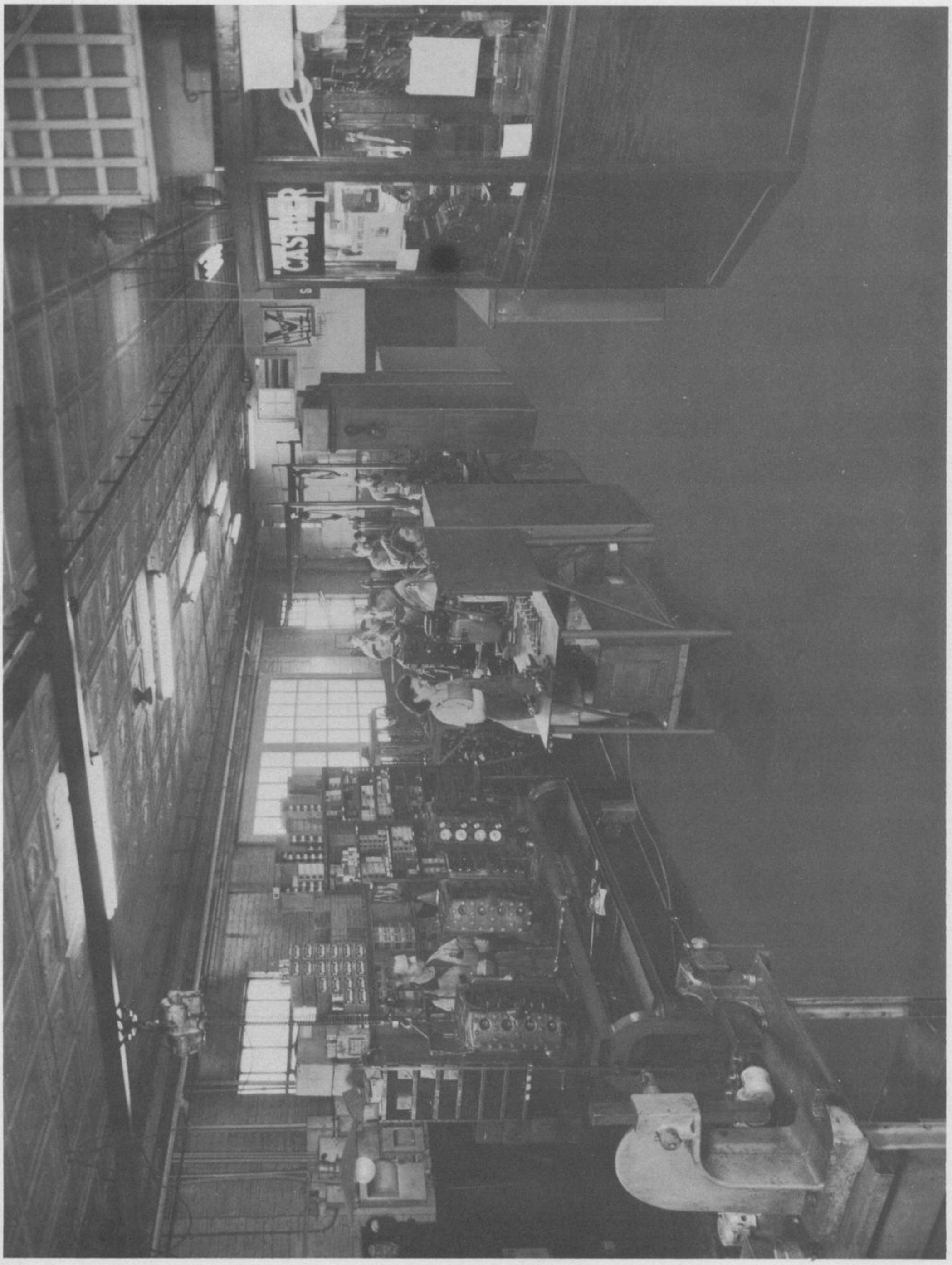


Figure 11—Partial View of Reconditioning Department, Plan Number Two

increased confidence that customers will have in the ability of your shop, the better moral and pride of craftsmanship that will be instilled in your employees, though these are intangible benefits, they are of real value more than offsetting the cost of cleanliness.

B—EQUIPMENT

1. GENERAL.

The equipment illustrated in this section is typical of equipment being used by some reconditioners with satisfactory results.

2. ENGINE CLEANING TANKS AND EQUIPMENT.

Various types of satisfactory cleaning tanks are available. In the type shown in figure 4, the cleaning solution is power agitated and has a solution capacity of one thousand gallons and permits the soaking of ten engine assemblies at the same time. This type of tank can be equipped for using either a hot or cold cleaning solution.

A high pressure washer (Fig. 4) is used to flush the cylinder assemblies after they are removed from the cleaning tank. It has been found advantageous to use an additional smaller tank of two hundred gallon capacity for cleaning the small engine parts. The cleaning solution is heated by a blower type gas burner.

3. CARBURETOR AND FUEL PUMP CLEANING EQUIPMENT.

In most cases, the equipment being used is that which is available through K. R. Wilson (Catalog Number 9350, Fig. 12). This equipment consists of a set of four, five gallon tanks, two perforated baskets and a ten gallon crock with a 19 inch inside diameter for the chromic acid.

When cleaning distributors in caustic cleaning solution, it will be necessary to place a rubber plug in the vacuum brake cylinder bore to protect the highly polished surface from corrosive action of the solution.

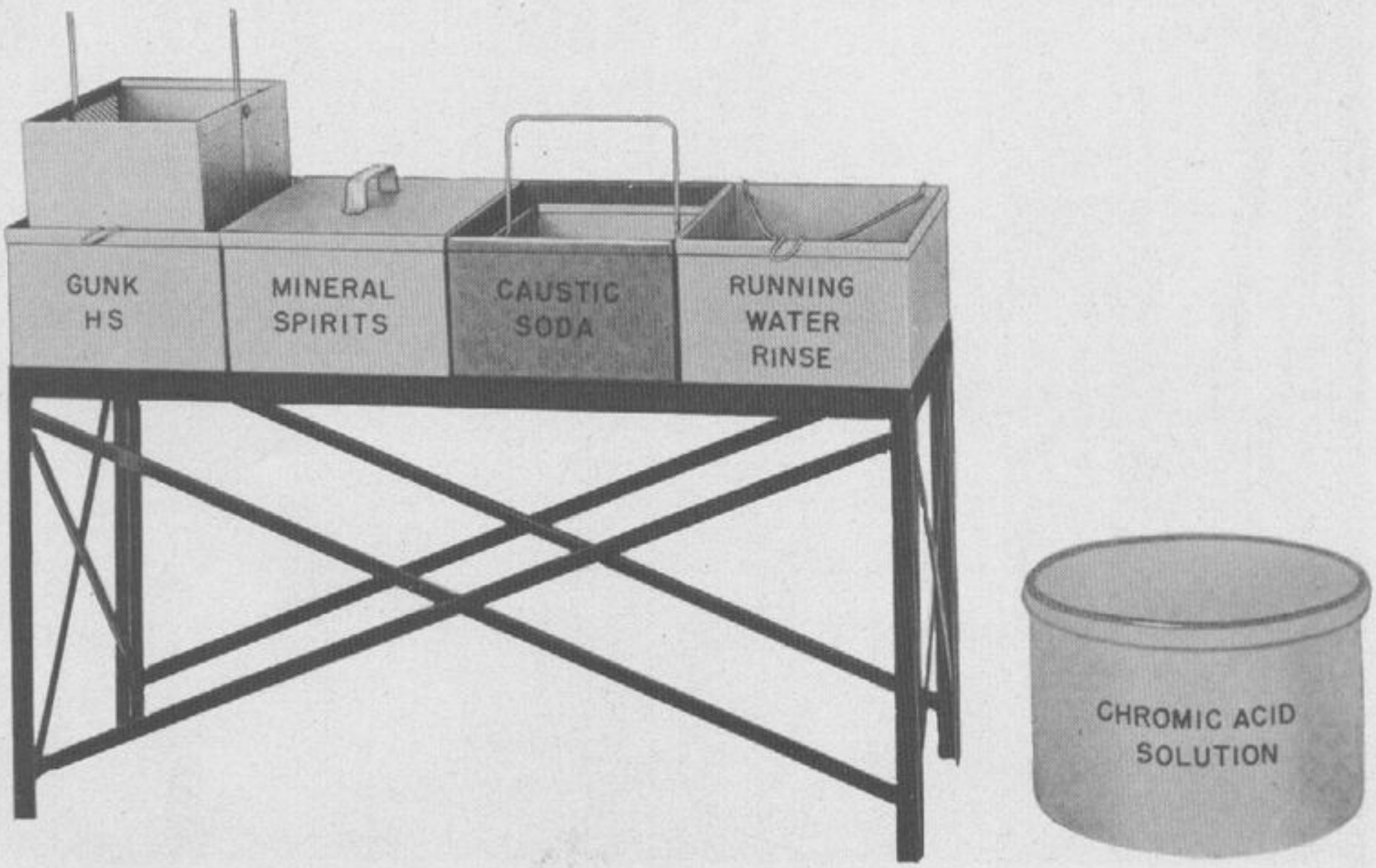


Figure 12—Carburetor and Fuel Pump Cleaning Equipment

4. CRANKSHAFT GRINDING EQUIPMENT.

Generally speaking, if a satisfactory price can be agreed upon, it is better to "farm out" crankshaft regrinding to some local machine shop rather than to make the heavy investment required to purchase a crankshaft grinder. Several types of crankshaft grinders are available. The preferable type is one in which the periphery, rather than the side, of the grinding wheel is used to grind the journals.

A second type consisting of an oscillating attachment for a lathe, as shown in figure 13, uses the side of the grinding wheel to grind the journals. This type usually requires a smaller investment and permits rapid shifting from one journal to the other.

The conventional crankshaft grinder shown in figure 14 uses the periphery of the wheel and requires a change of fixtures when shifting from crankpins to main bearings. For this reason it is recommended that the mains or crankpins of a number of crankshafts be ground at one time, rather than to change the fixtures for each crankshaft.

5. CRANKSHAFT JOURNAL BURNISHER.

It is the accepted crankshaft reconditioning procedure to burnish all crankshafts after grinding. The use of the burnisher shown in

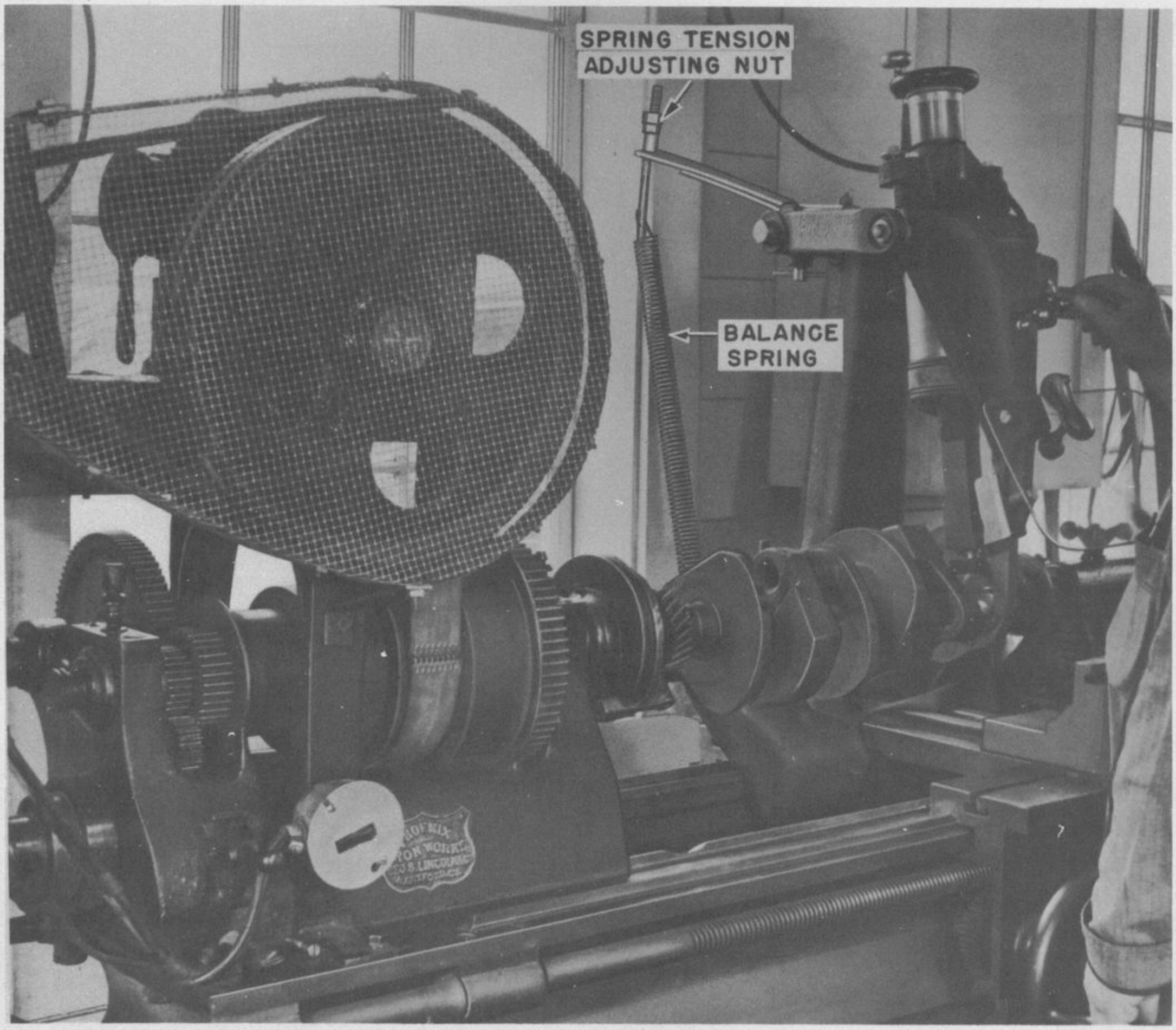


Figure 13—Lathe Attachment Grinder

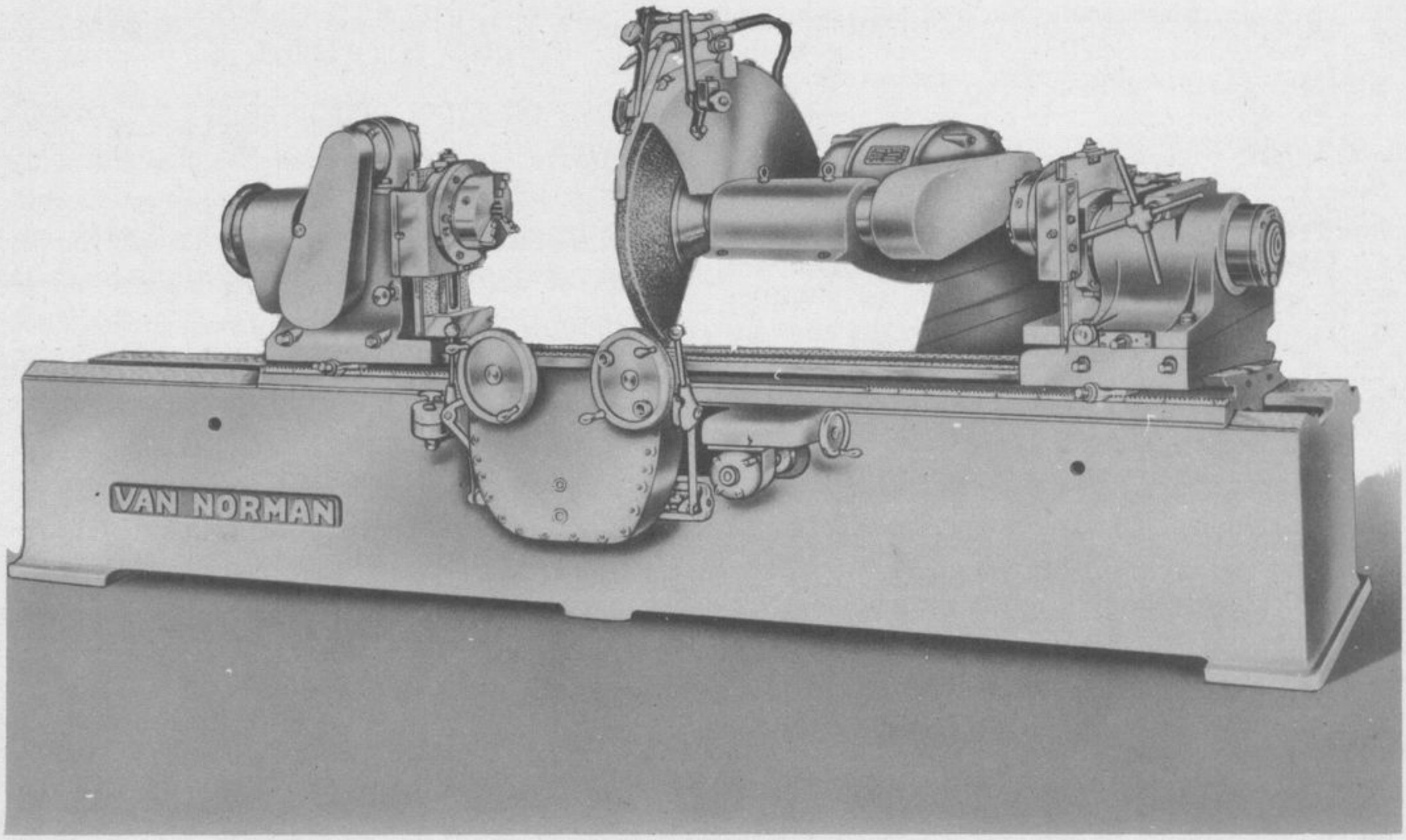


Figure 14—Conventional Crankshaft Grinder

figure 15 assures greater precision in polishing the crankshaft journals after grinding. Several burnishers should be made with openings of various sizes to fit different size crankshaft journals.

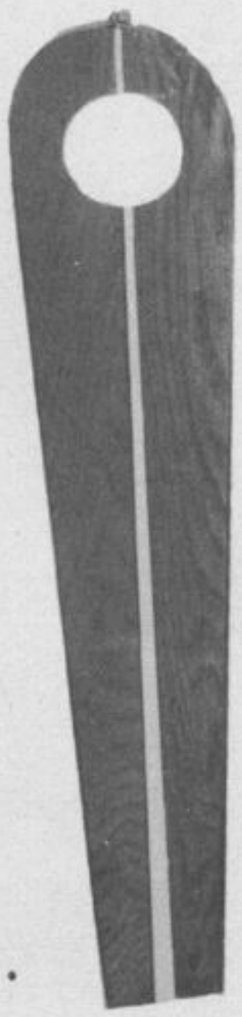


Figure 15—Crankshaft Journal Burnisher

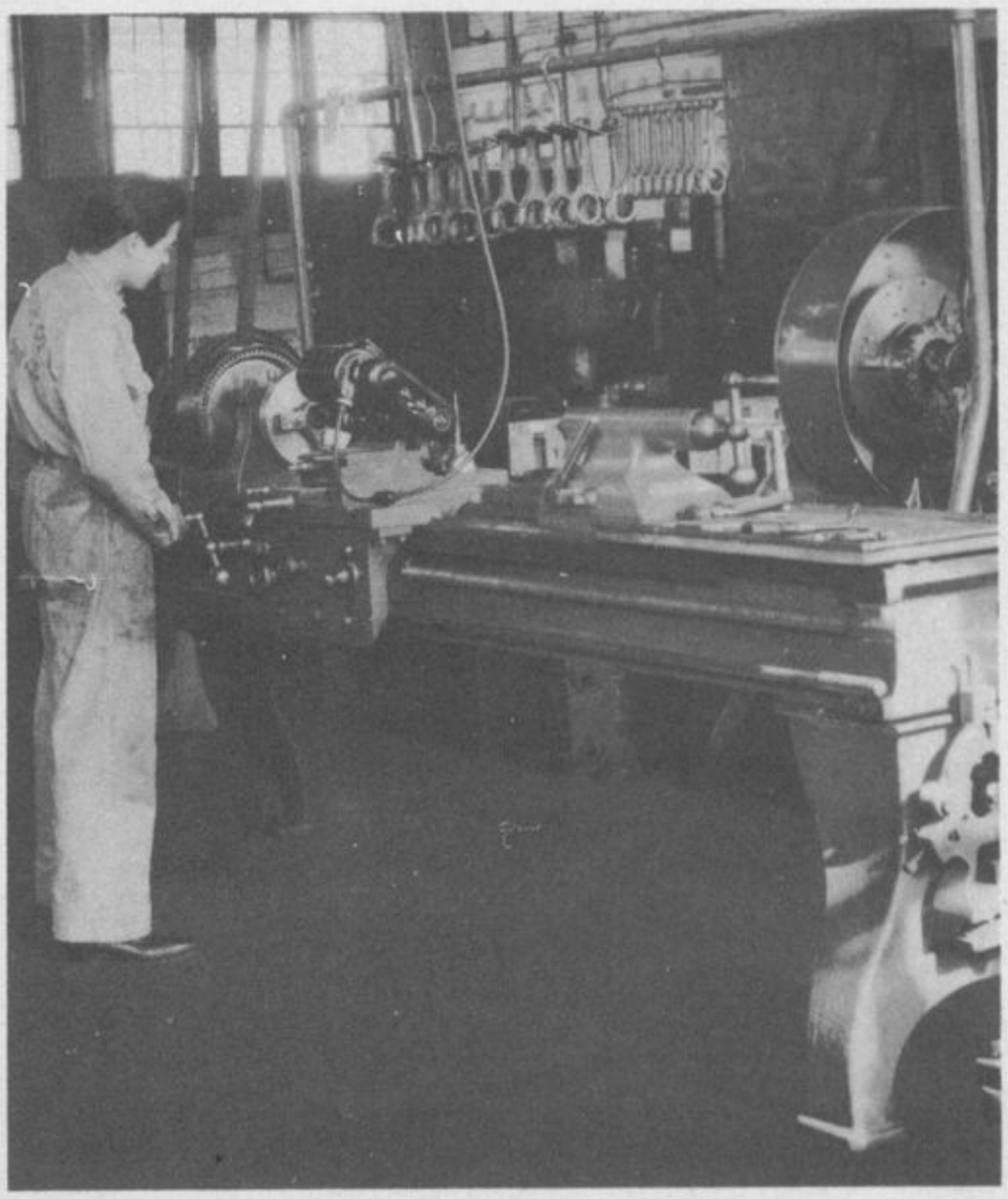


Figure 16—Connecting Rod Grinder, Lathe Attachment Type

These burnishers are made of two pieces of hard wood 24 inches long, 1½ inch thick, and hinged together with a strap hinge.

Grit cloth strips are lined inside the openings provided for the journals and held in place by tacking the ends to the burnishers. Figure 8 illustrates the burnishers in operation. On the lathe type grinder, use number 150 to number 240 grit cloth; on the conventional type grinder, use number 280 to number 360 grit cloth.

6. CONNECTING ROD GRINDING AND HONING EQUIPMENT.

Several types of equipment for reconditioning the crankpin end of the connecting rods are available.

The lathe attachment type (Fig. 16) consists of a high speed motor driven internal grinder attached to the tool post of the lathe. The connecting rod is clamped by a fixture to the lathe face plate.

Figure 17—Connecting Rod Internal Grinder

The conventional internal grinder shown in figure 17 has a hand lever attached to the feed head instead of the conventional hand wheel, and a small internal grinder attachment located to the right and rear of the grinder housing. The hand lever speeds up the shifting of the grinder wheel and permits more room to check rod measurements.

The small internal grinder attachment grinds the "relief" at the parting line between cap and rod. This saves a change of grinding wheels which would be required to do the same operation by standard type grinder. The addition of these two features by one reconditioner has doubled the production output of the grinder.

Figure 18 illustrates a hone for the crankpin end of the connecting rod.

7. CONNECTING ROD ALINER AND STRAIGHTENER.

All connecting rods must be checked for alinement. Many bent connecting rods can be reclaimed by employing alining and straightening equipment. Figure 19 shows the equipment used by some dealers.

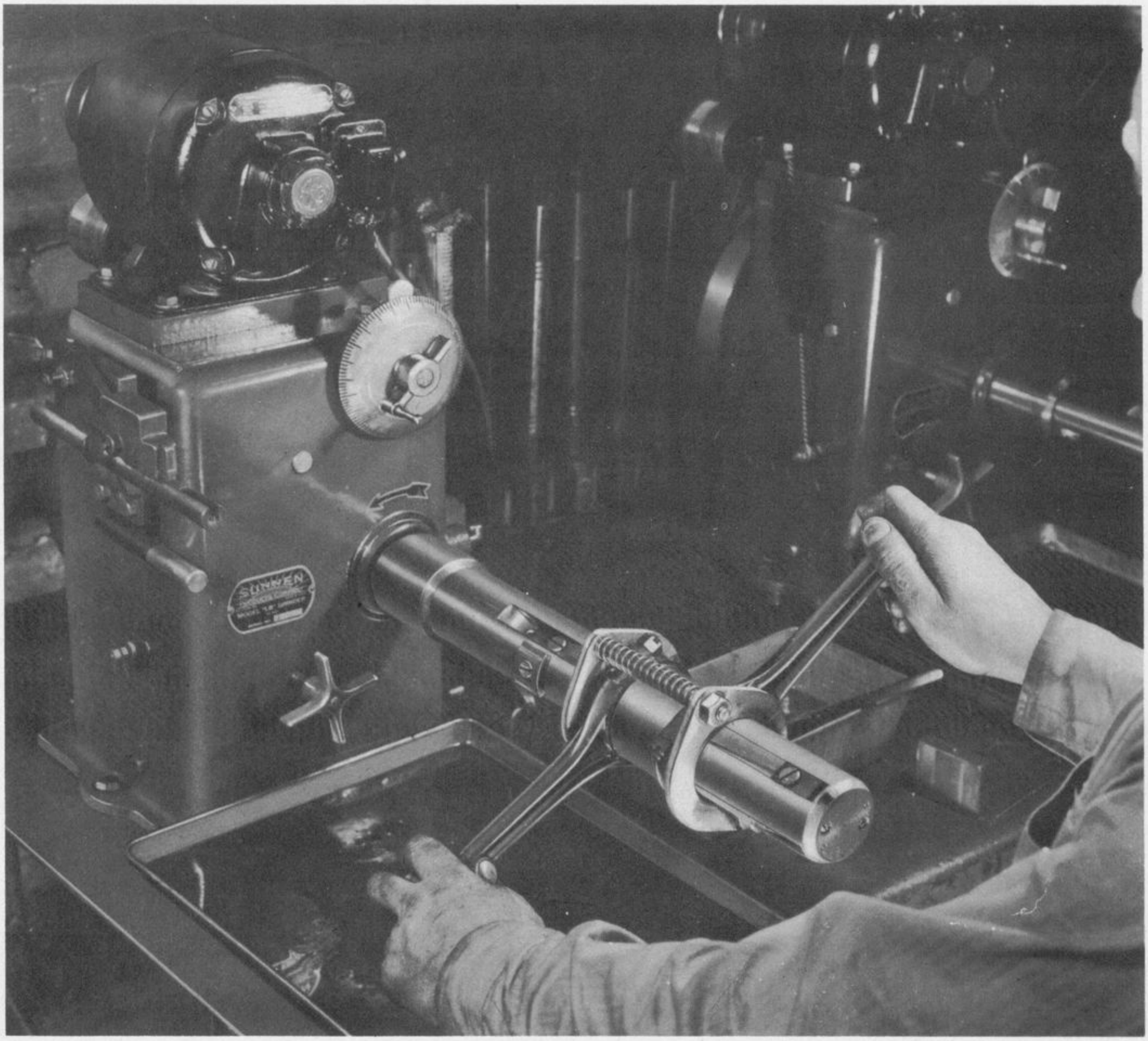


Figure 18—Connecting Rod Hone

8. CYLINDER BLOCK BORING BARS.

Various types and makes of boring bars are available and the selection is a matter of choice and opinion. However, in making a selection, consideration should be given to the service and availability of spare parts. Make sure the boring bar will stand up in continuous service.

Referring to figure 5, it will be noted that the boring bar is counterbalanced by a weight which is approximately 15 pounds less than the weight of the boring bar, thus reducing the physical effort required when lifting the boring bar from one cylinder block to another. Also this arrangement permits the boring bar to be swung out of the way when not in use and prevents the possibility of it being upset.

9. BORING BAR STAND. (Fig. 20).

When ceiling space does not permit suspending the bar as outlined above, a stand the same height as the cylinder block (Fig. 20) can be built, so the operator can slide the boring bar from the stand to the cylinder block with very little effort.

10. BORING BAR SURFACE PLATE.

This fixture eliminates the necessity of re-

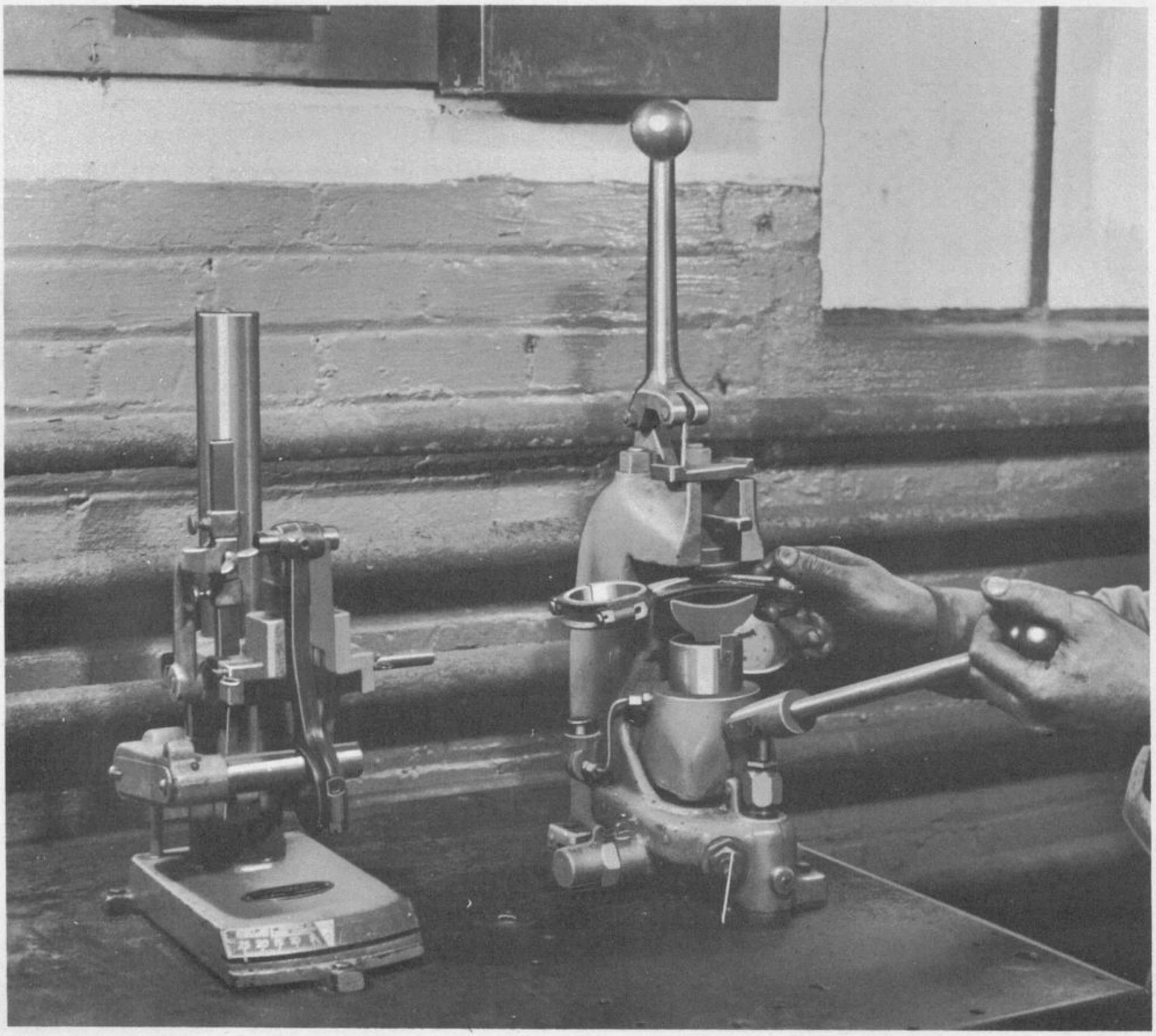
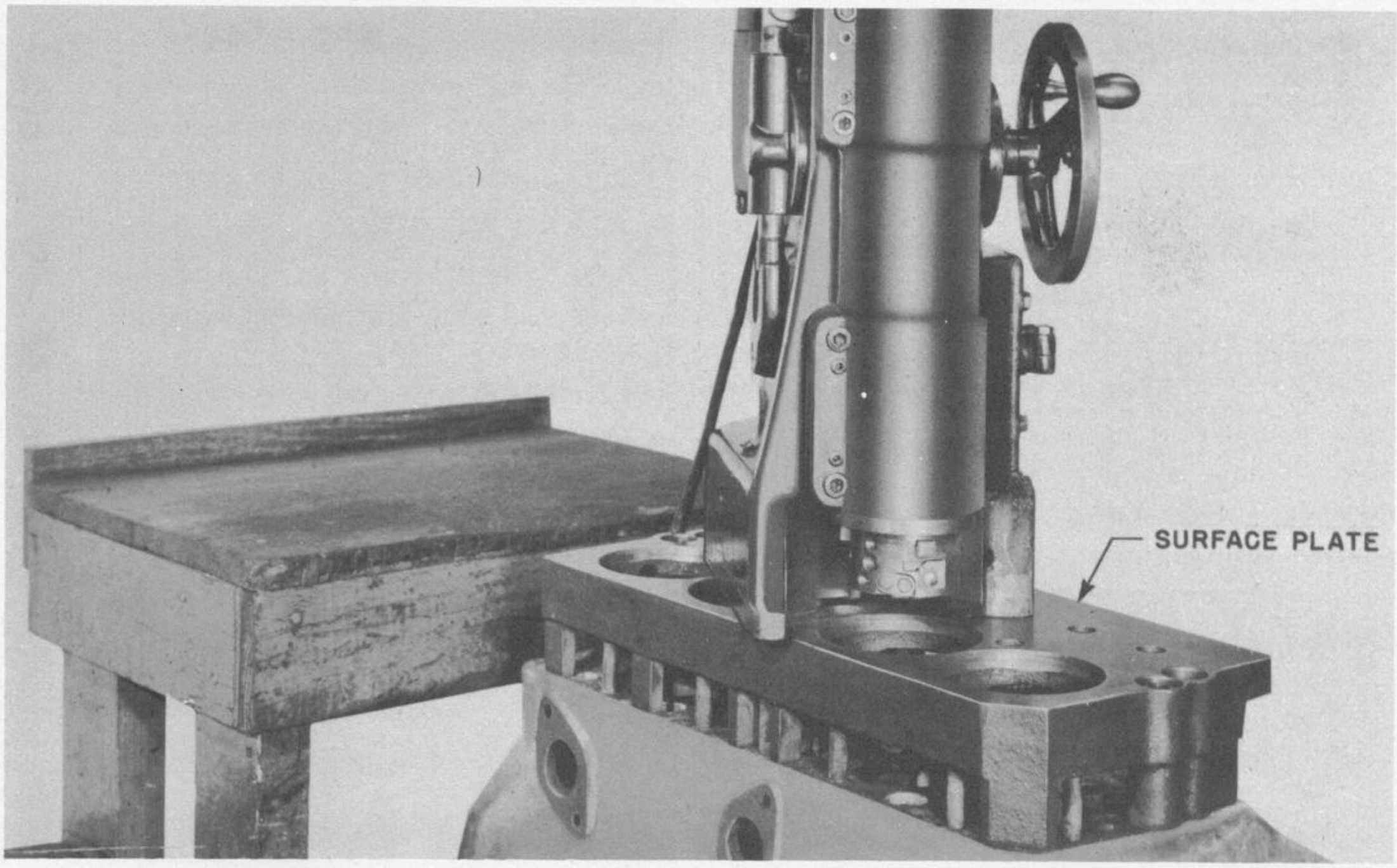


Figure 19—Connecting Rod Aliner and Straightener



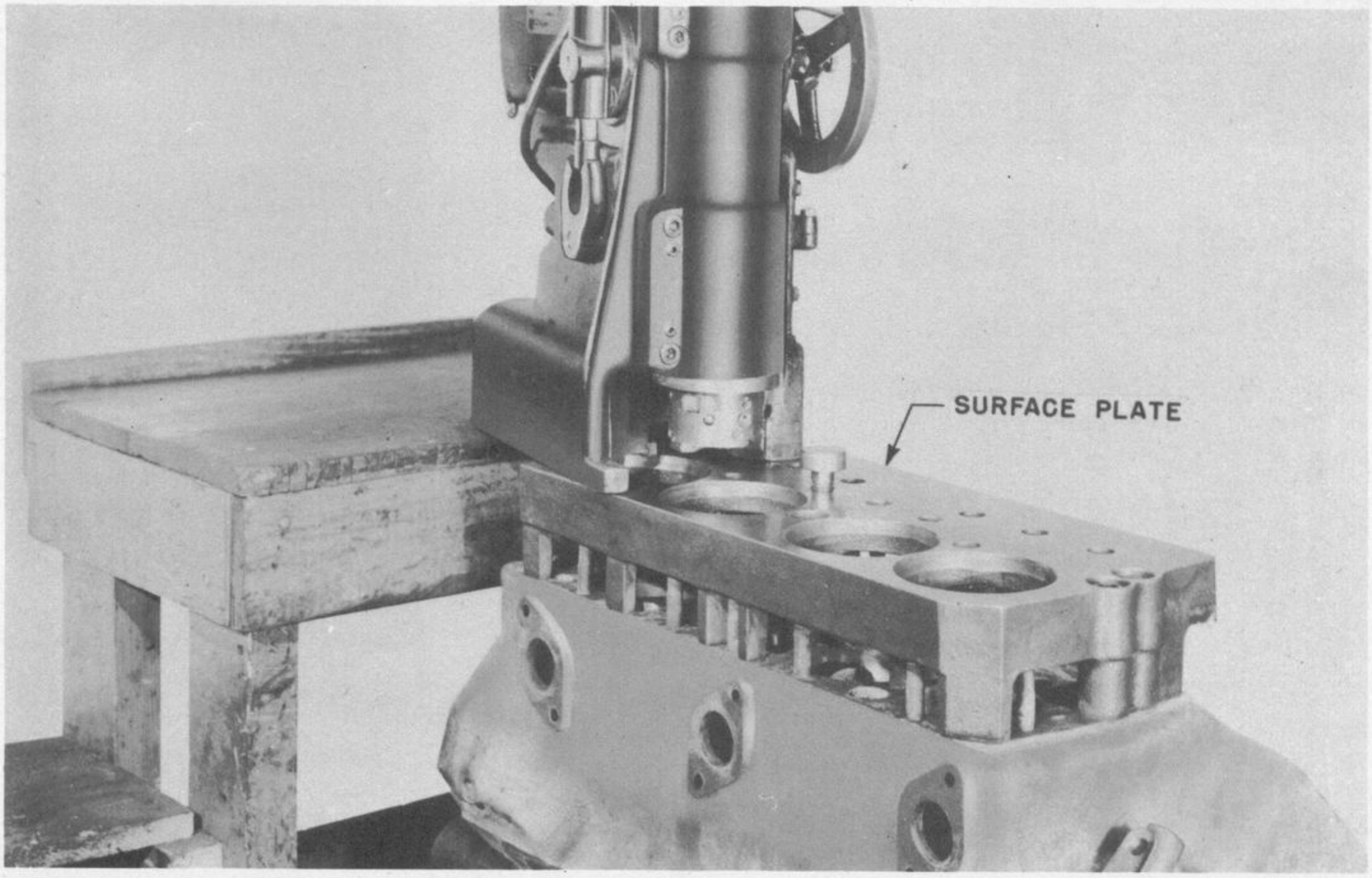


Figure 20—Boring Bar Stand and Surface Plate

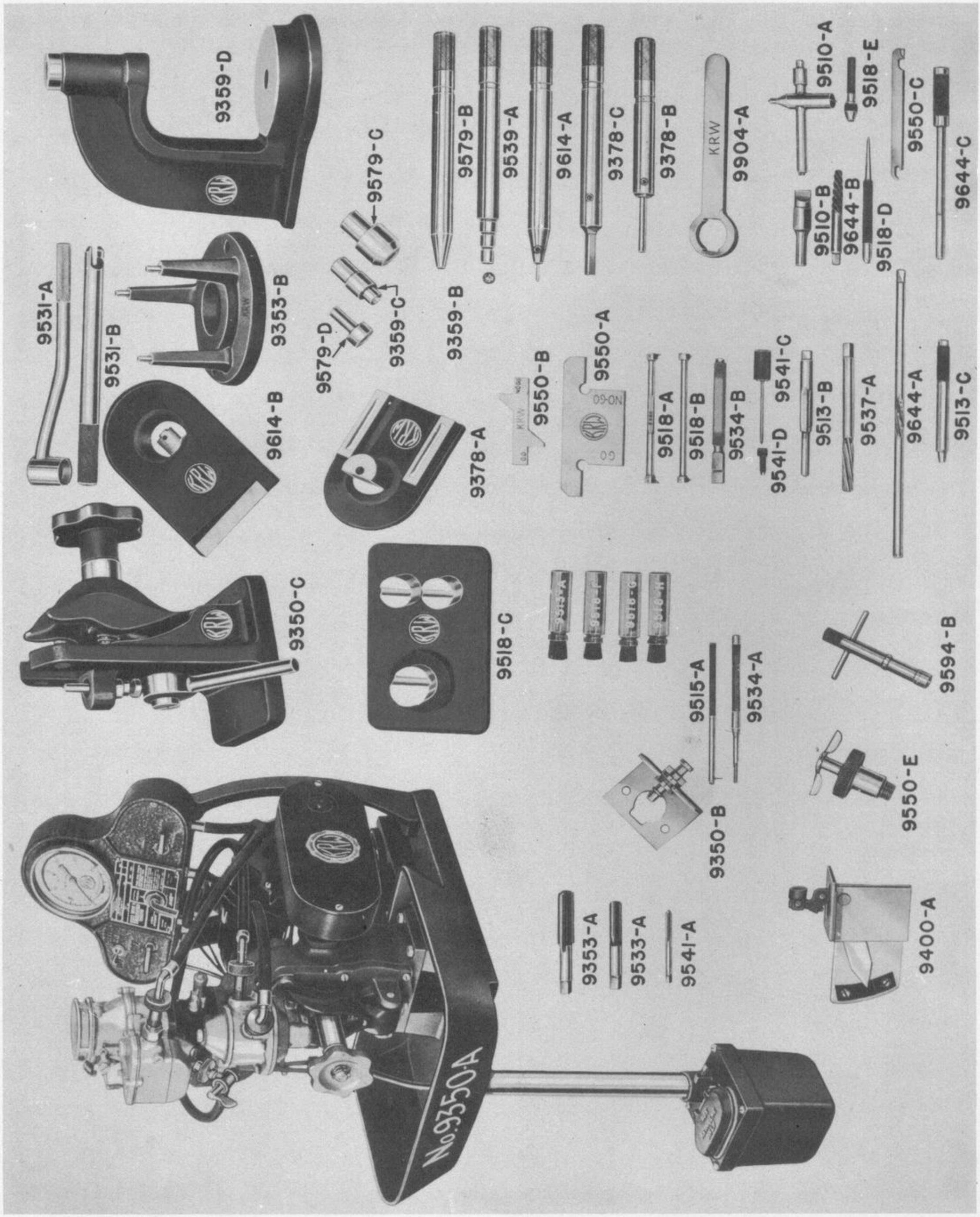


Figure 21—*Fuel Pump and Carburetor Reconditioning Tools*

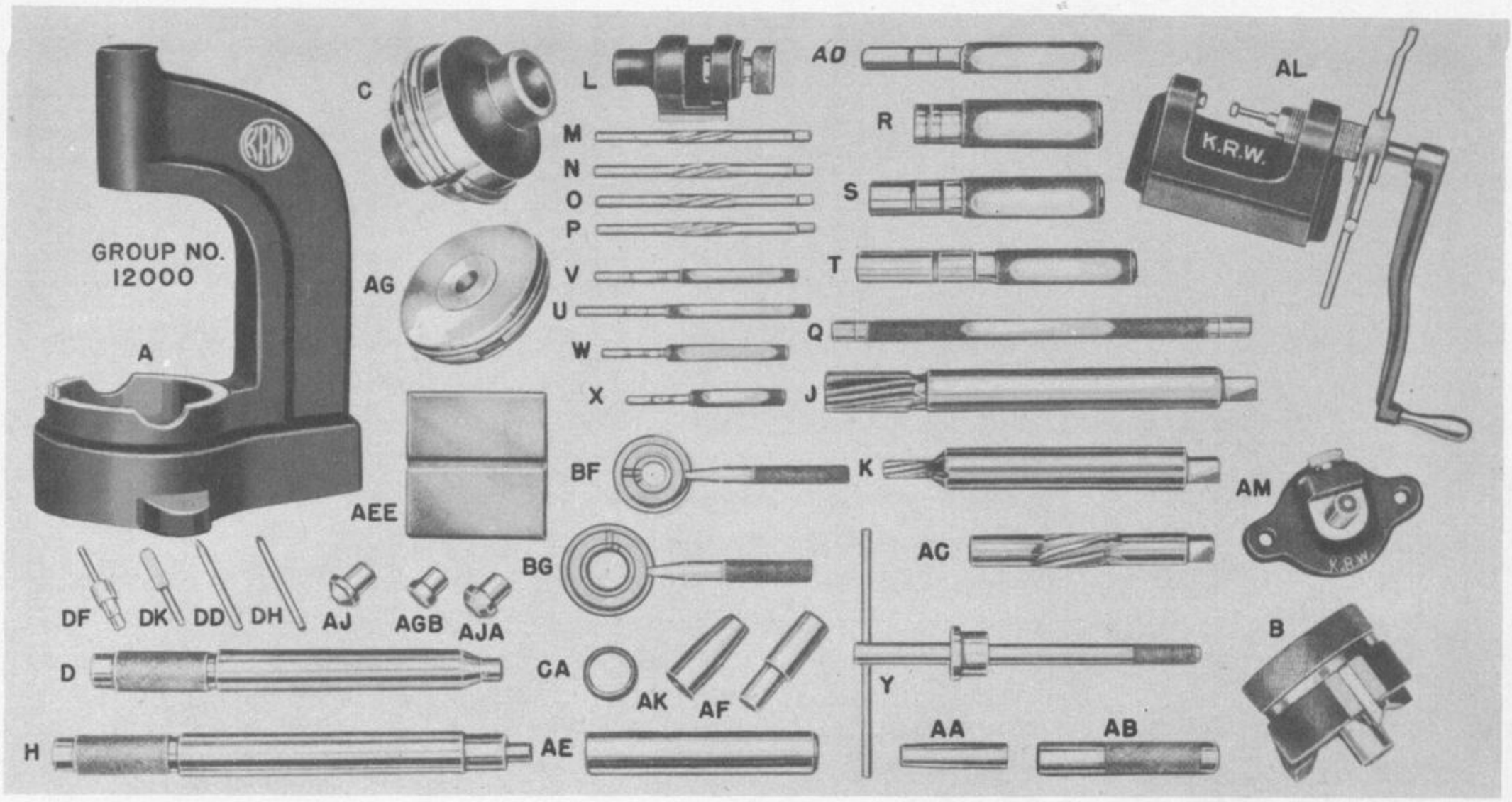


Figure 22—Distributor Reconditioning Tools

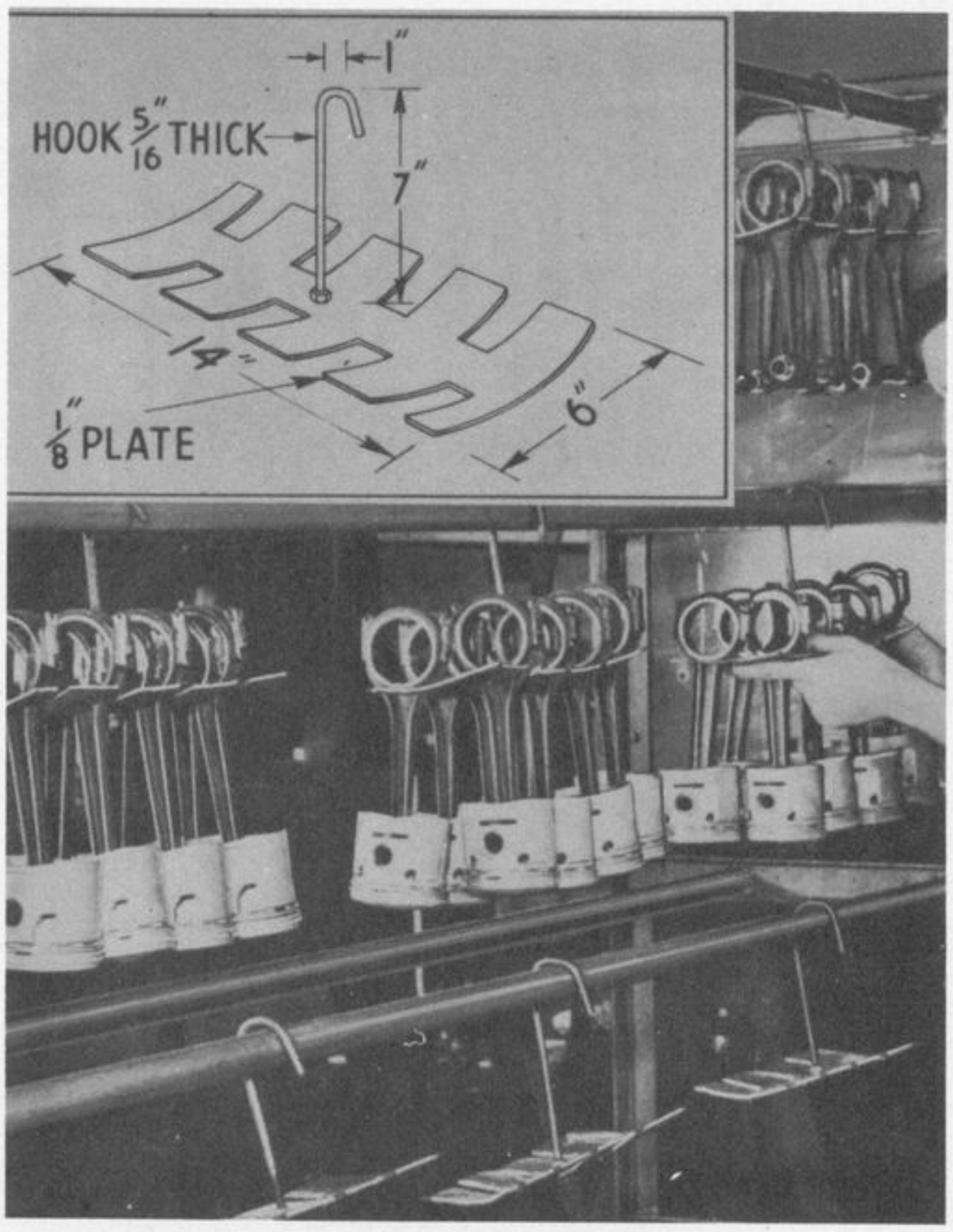


Figure 23—Connecting Rod Trays

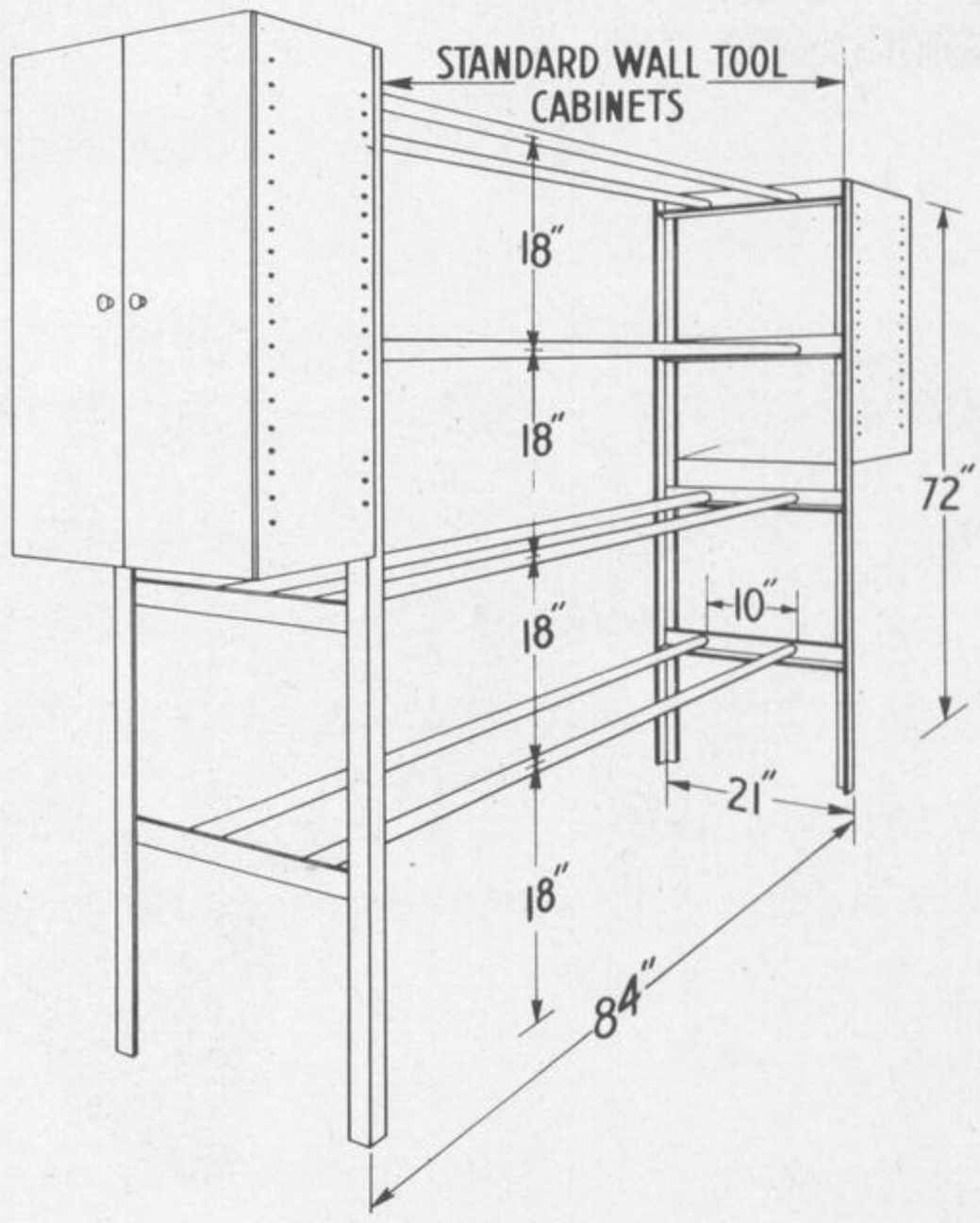


Figure 24—Connecting Rod Rack

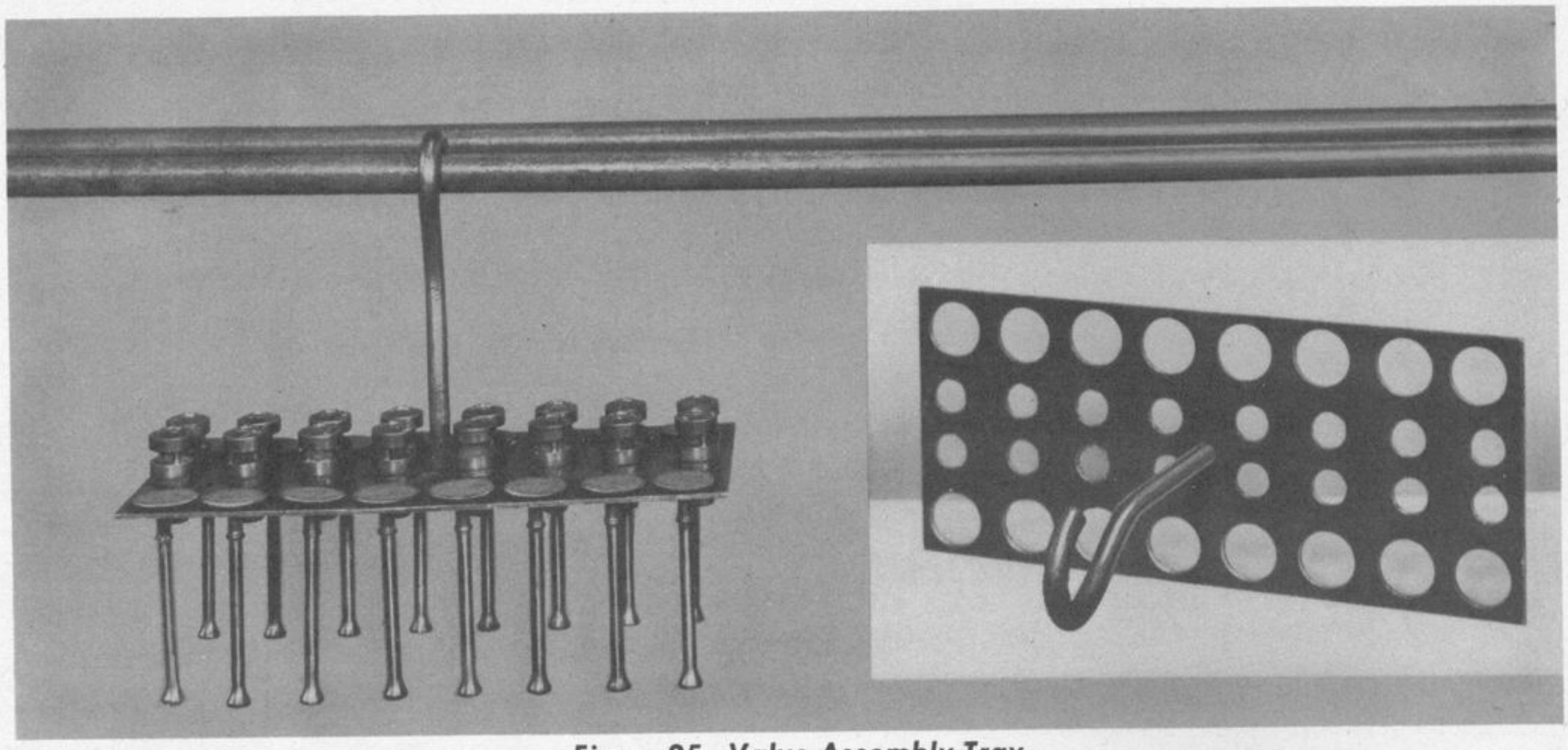


Figure 25—Valve Assembly Tray

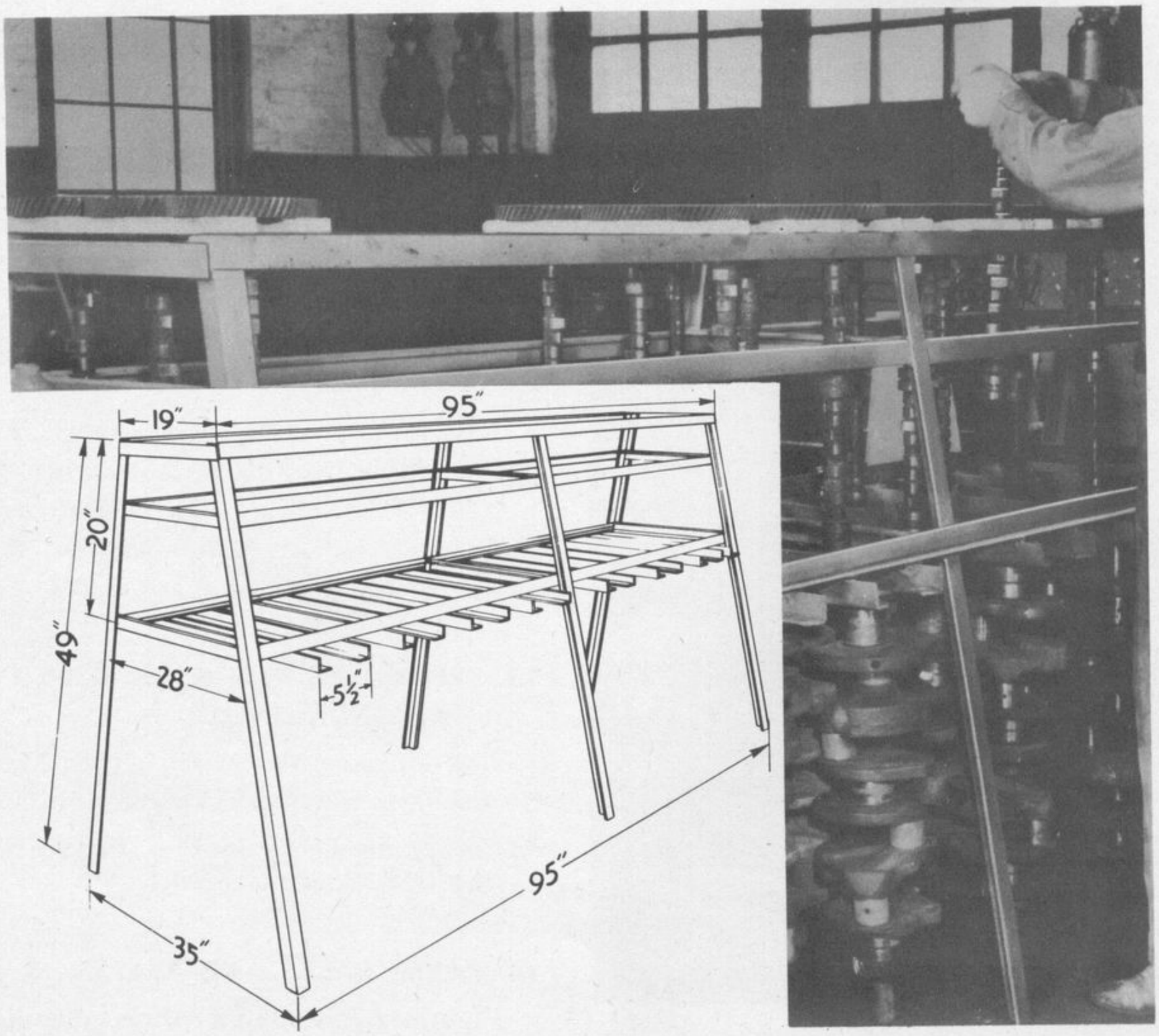


Figure 26—Camshaft and Crankshaft Rack

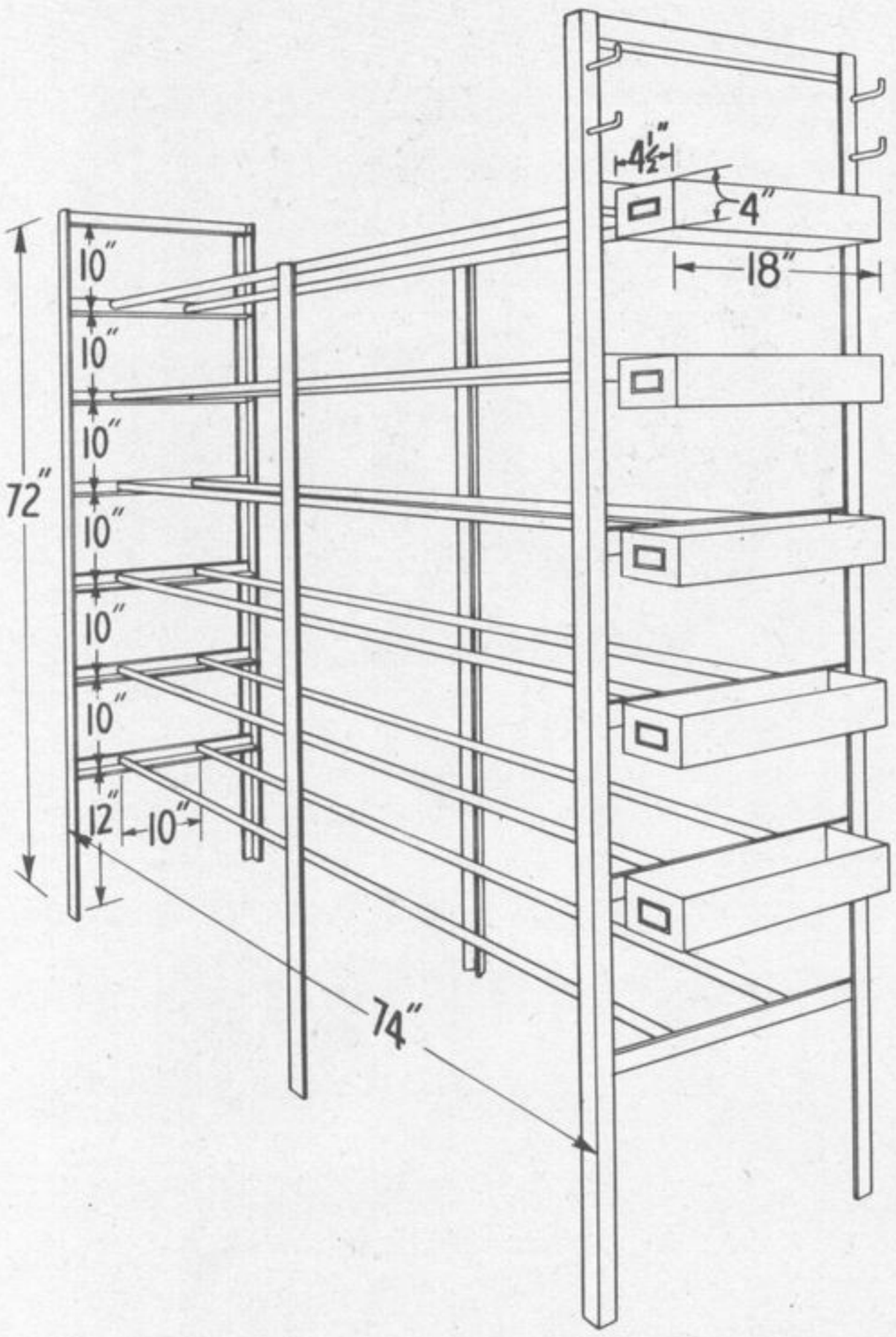


Figure 27—Cylinder Head Rack

moving the cylinder head studs. The use of this plate causes the boring bar spindle to be extended farther out of its housing, how-

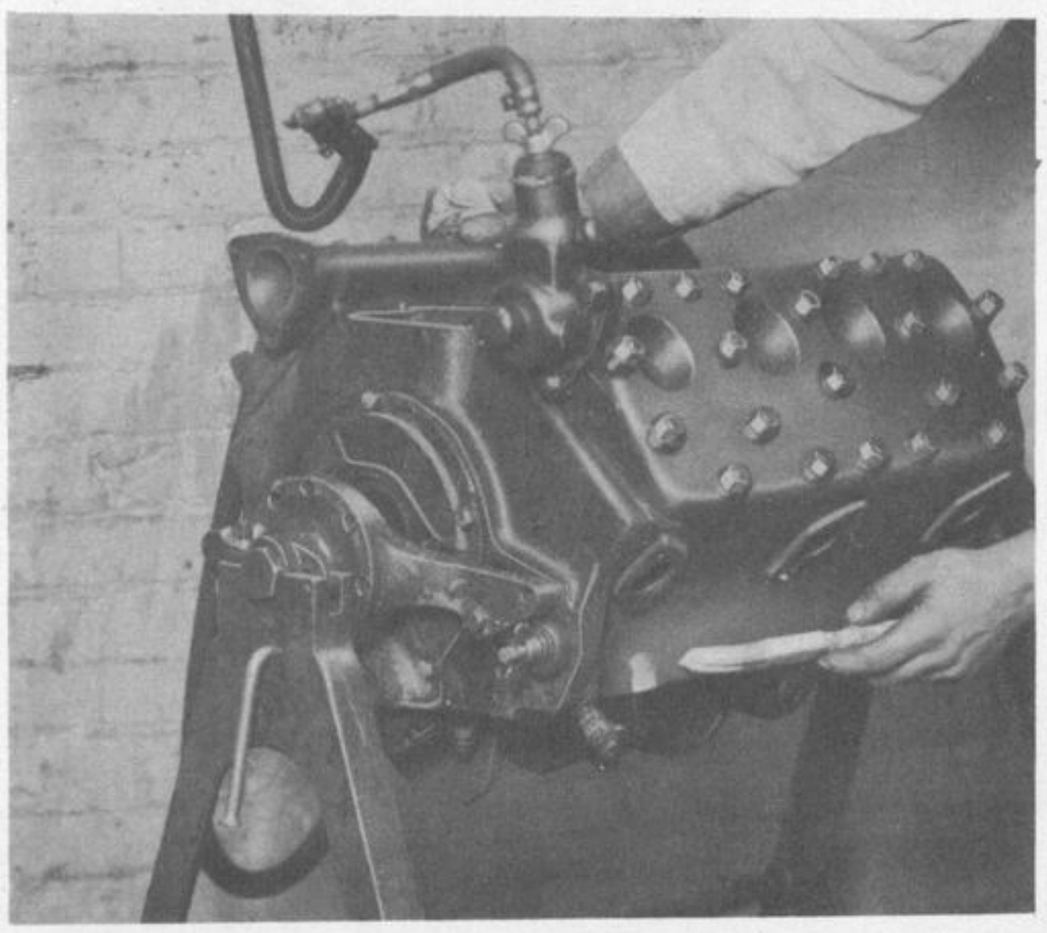


Figure 28—Cylinder Block Testing

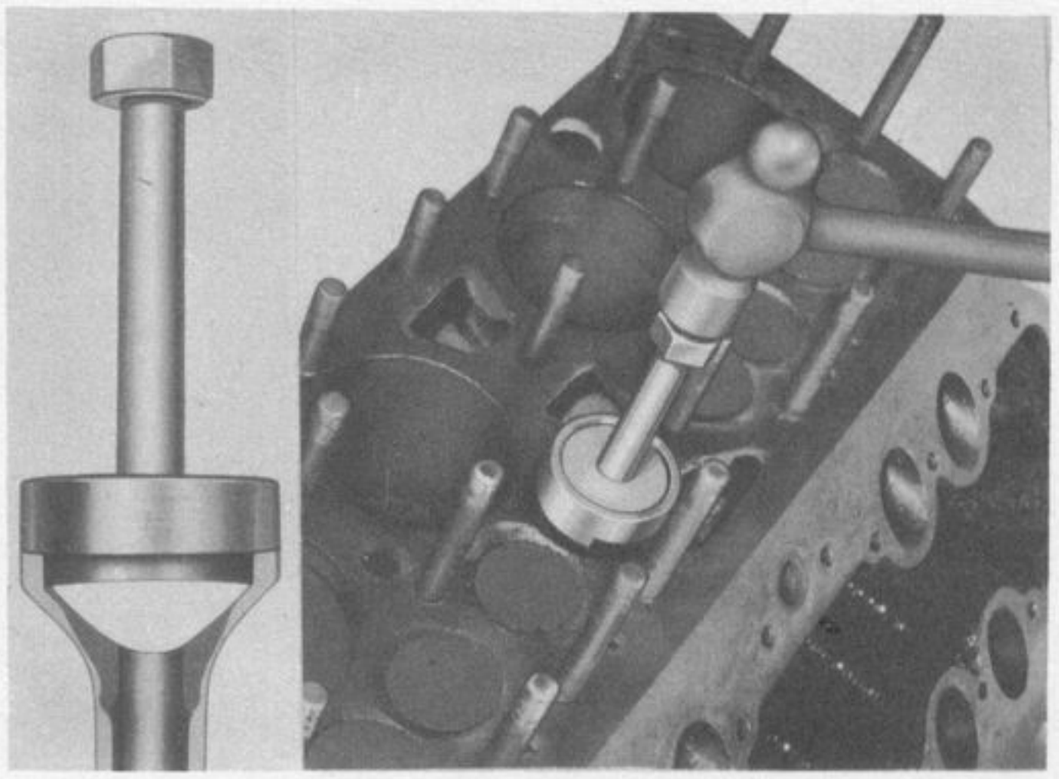


Figure 29—Valve Guide Driver

ever, if the spindle bearings are in good condition this should not result in too much error in the bore.

11. BABBITT MAIN BEARING BORING BAR.

The babbitt line boring bar shown in figure 6 is driven by a power arrangement which allows the operator time for performing other operations during the cutting time.

12. DISTRIBUTOR, FUEL PUMP, AND CARBURETOR TOOLS.

Distributor reconditioning tools (Fig. 22) are available from K. R. Wilson under group number 12,000. Fuel pump and carburetor tools (Fig. 21) are available from the same source under group number 9350 A and D.

13. SPECIAL EQUIPMENT DEVELOPED BY RECONDITIONERS.

The equipment shown in figures 23 through 39 has been developed by reconditioners and found to be practical and instrumental in saving labor and material.

14. PARTS, RACKS AND TRAYS.

Figures 23 through 27 show several special parts racks and trays in use and include dimensional drawings. The use of these racks

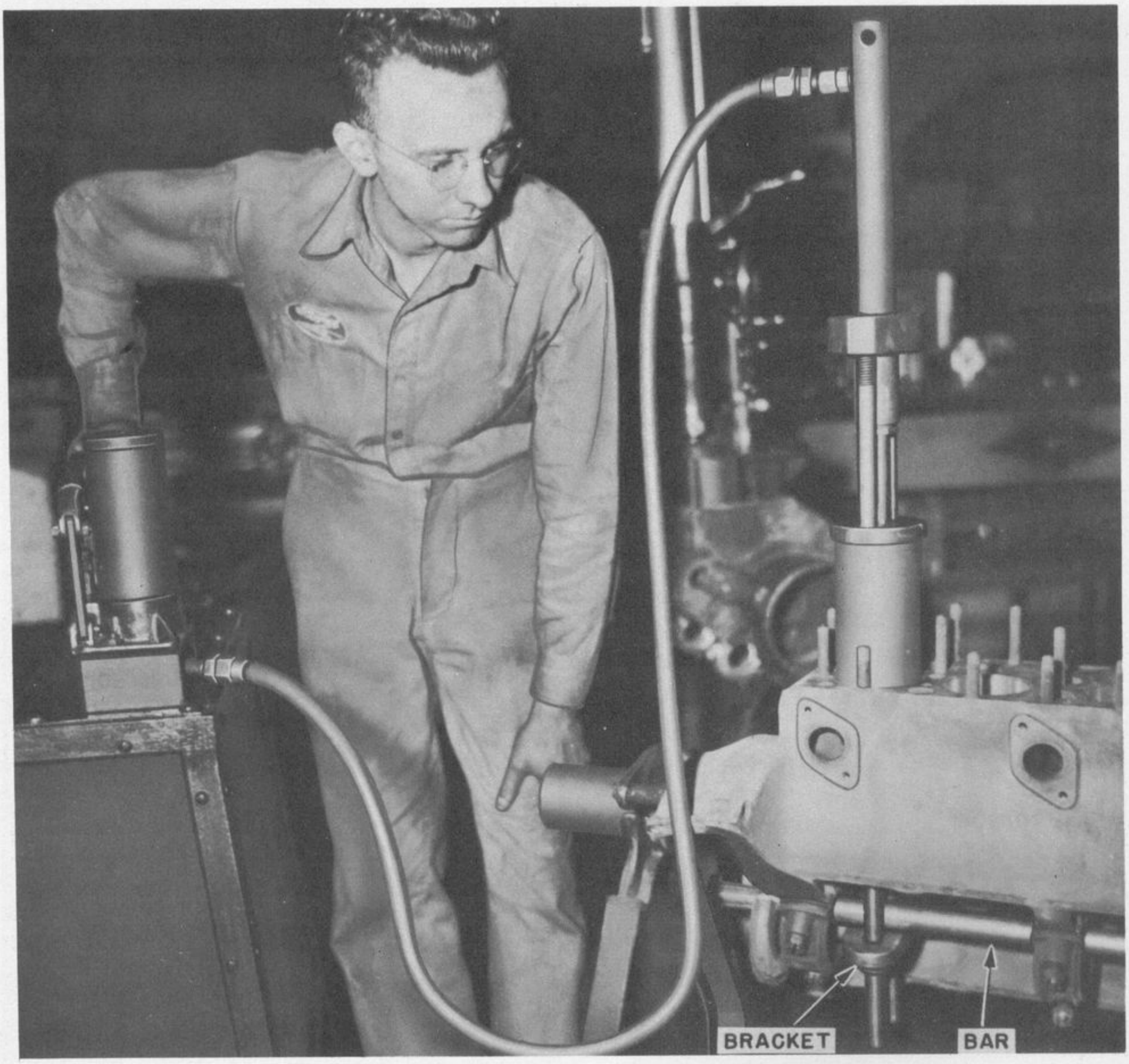


Figure 30—Hydraulic Type Cylinder Sleeve Replacer

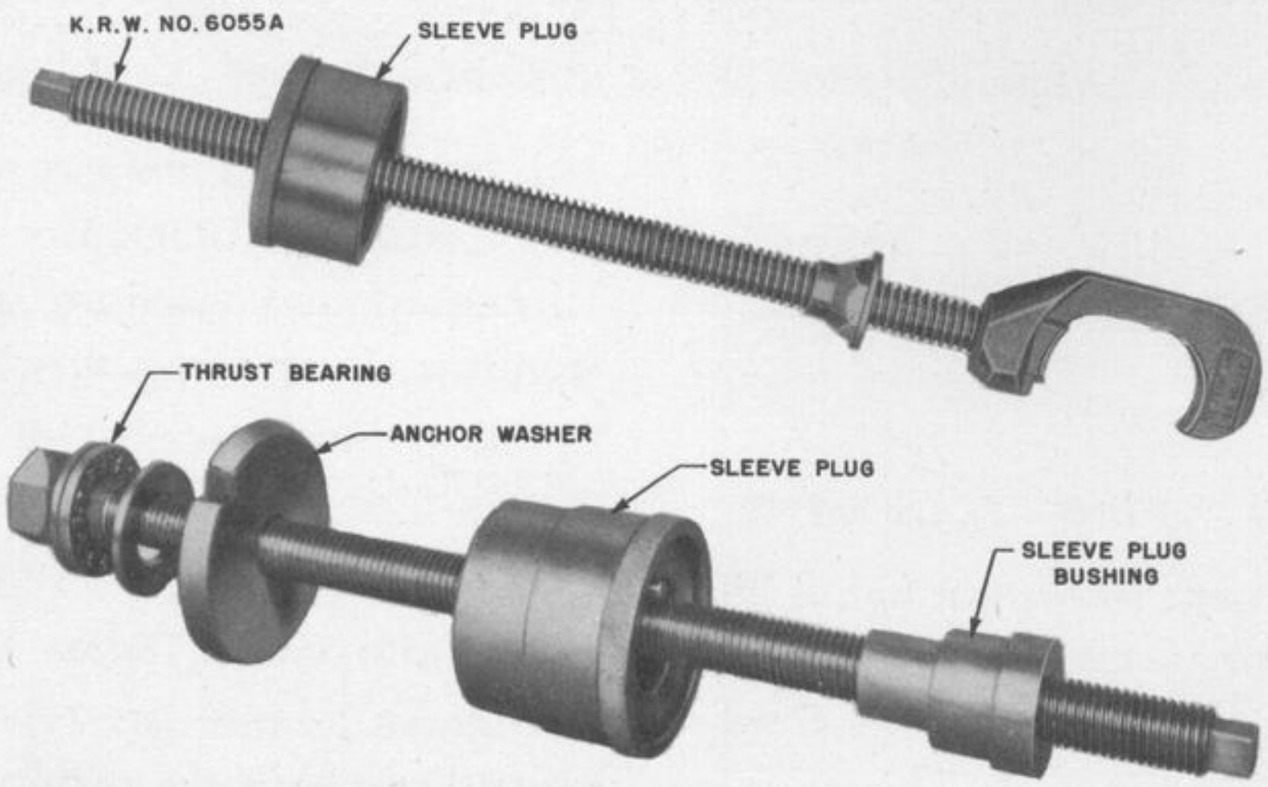


Figure 31—Screw Type Cylinder Sleeve Replacers

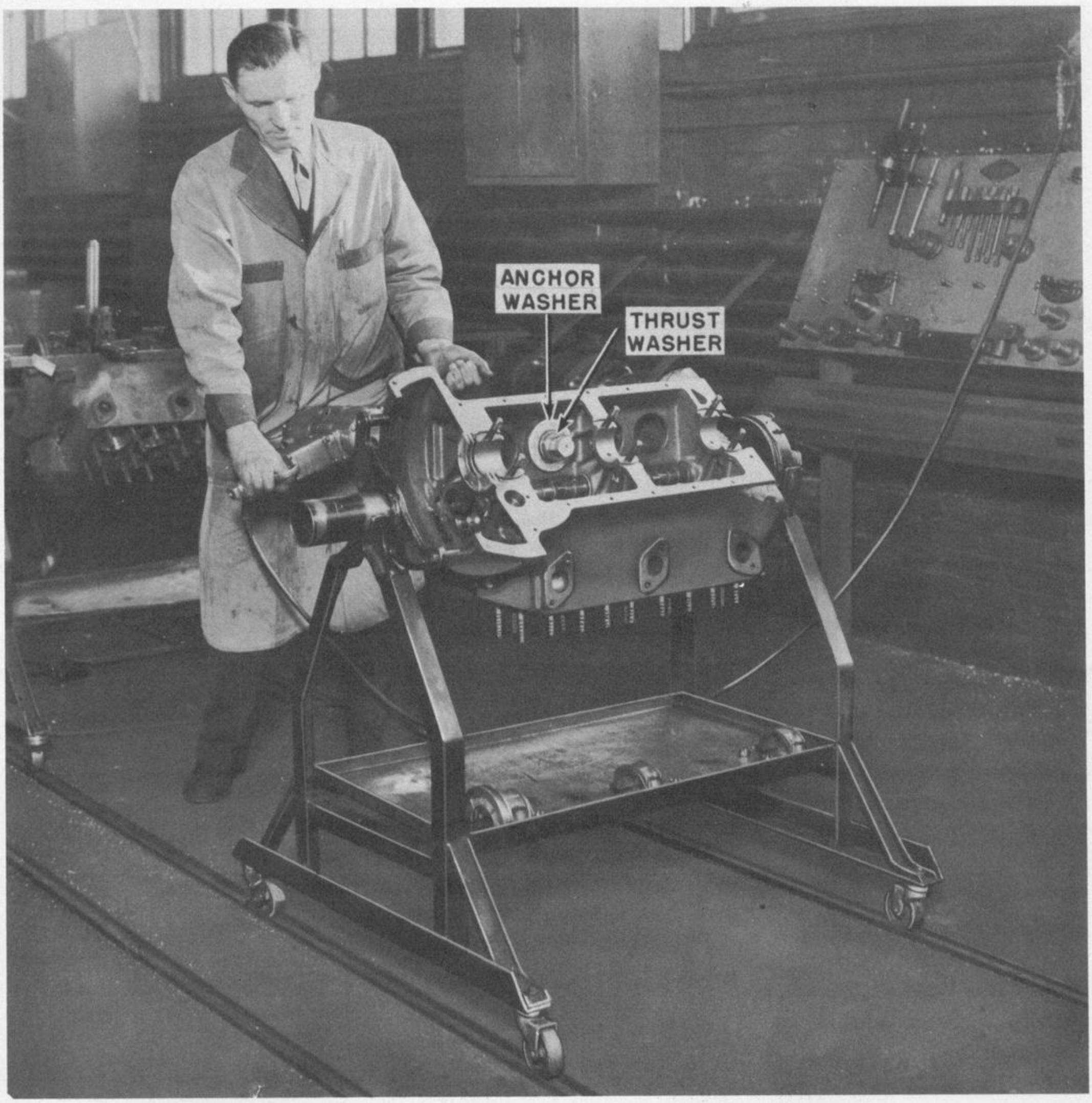


Figure 32—Sleeve Installation with Screw Type Replacer

and trays not only facilitate the assembly of engines, but keep the parts in an orderly manner.

15. CYLINDER BLOCK TESTING EQUIPMENT.

The testing equipment, shown in figure 28, is used to locate water jacket cracks in cylinder blocks that are not readily visible. Compressed air is used for the test. The equipment consists of a pressure gage, hose and quick attaching plugs. Reconditioners who use this equipment eliminate much of the expense involved in the loss of cylinder blocks, customer disputes and "come backs".

16. VALVE GUIDE DRIVER.

The purpose of the valve guide driver (Fig. 29) is to release the retainer from the machined recess in the cylinder block permitting the retainer to be removed without damage,

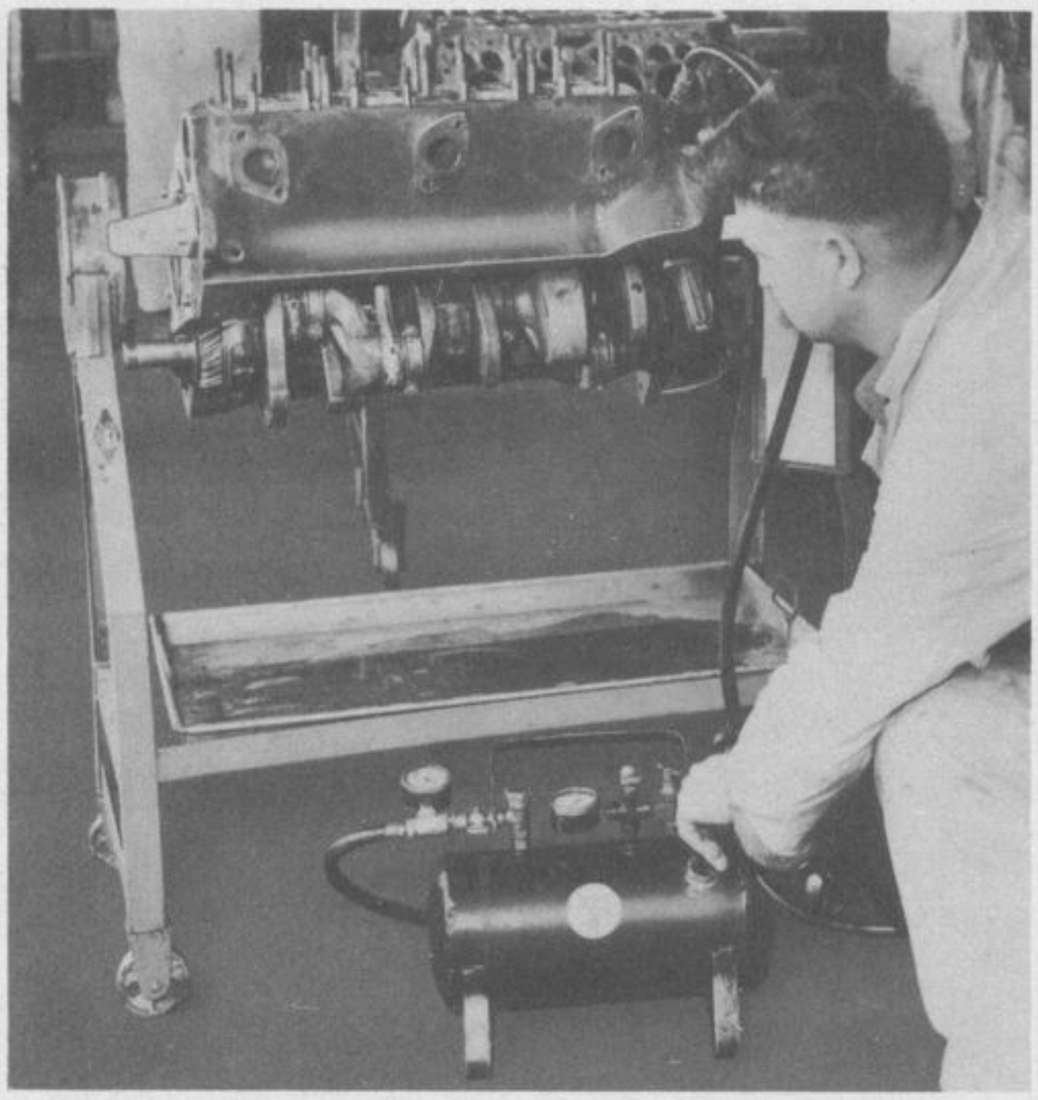


Figure 33—Oil Leak Tester

thus saving this part for further use. To use this driver, the valve is raised and the driver is inserted along the valve stem until it contacts the top of the valve guide. By striking the top of the driver, the valve guide is driven down, freeing the retainer. This also frees the valve guide, making it easier to remove.

17. CYLINDER SLEEVE TOOLS.

The cylinder sleeve fixture shown in figure 30 is the hydraulic press type. Two solid rods extend through the cylinder bore and are held in place by a bracket beneath a bar which extends through the main bearing caps.

The screw type fixtures shown in figure 31 are the K. R. Wilson tool No. 6055A and another type similar to the K. R. Wilson tool with the following exceptions: In place of the hook, an anchor washer (Fig. 32) is placed over the cylinder bore. Between the larger washer and the head of the screw is a thrust bearing. This permits the screw to rotate freely against the anchor washer.

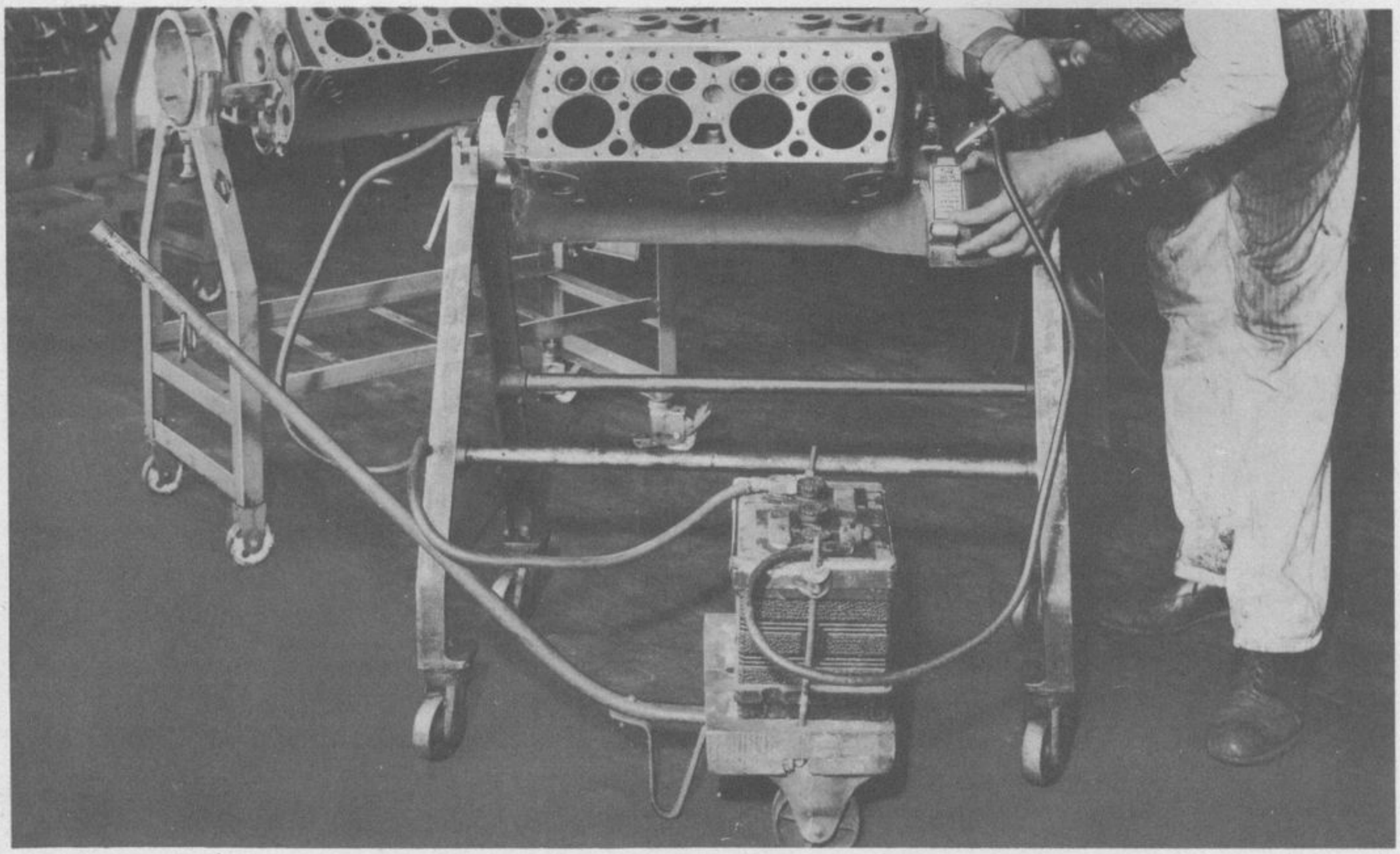


Figure 34—Installing Authorized Plate

A threaded bronze bushing (Fig. 31) fits into the sleeve plug which permits the screw to be operated by an electrical nut runner (Fig. 32).

The screw (Fig. 31) is 16 inches long and ⅞ inch in diameter with a 1½ inch hexagon head. The threaded part is 13¼ inches long with nine threads to the inch.

For the V8-85 and 100 H.P. block, the washer is 3½ inches in diameter with a 15/16 inch center hole. For the 60 H.P. block, a 3¼ inch diameter washer is used.

The use of either the hydraulic or screw type tool decreases the installation time for a set of sleeves to the time previously required for one sleeve.

18. OIL LEAK TESTER. (Fig. 33).

The oil leak test equipment detects excessive oil leaks at rod, main and camshaft bearings, and oil lines, that otherwise would not be discovered until after the engine has been installed in the chassis.

19. WELDER FOR AUTHORIZED ENGINE PLATE. (Fig. 34).

This simple device consists of a 6-8 volt battery, one 4-foot negative cable with a good clamp attached on one end and one 4-foot positive cable with a one pound soldering iron attached to one end. The cables are attached to the battery and the negative cable is clamped to the cylinder block.

Figure 35—Cylinder Head Grinder

While holding the authorized plate in place the soldering iron is placed against the tag, which causes a short circuit. The heat generated welds the plate to the cylinder block.

20. GRINDING CYLINDER HEADS. (Fig. 35).

It is important that the cylinder heads have a true surface for gasket contact. Many cylinder heads will be warped slightly after long use. Such heads should be resurfaced. The machine shown in figure 35 is designed for this purpose. Cylinder heads will usually clean up by grinding .010 to .015 off the surface. Heads that do not clean up after grinding .020 off the surface should be discarded.

21. MULTIPLE MAIN BEARING HEATING FIXTURE. (Fig. 36).

This fixture can be built to fit the volume required. The fixture consists of an angle iron frame under which is extended a ¾ inch pipe, with ⅛ inch holes drilled ½ inch apart. The pipe is capped on one end and a mixer valve installed at the other.

Air and natural gas are injected through the mixer valve and ignited at the holes in the pipe. (Notice the jigs directly in front of the heater. The use of the jigs and heater will greatly reduce the rebabbitting time of the main bearing caps.)

Figure 36—Multiple Main Bearing Heating Fixture

22. MULTIPLE CARBURETOR FLOAT TESTER. (Fig. 37).

The multiple tester consists of a large pan and main feed line, to which are attached individual feed lines. The main feed line is attached to a K. R. Wilson carburetor and fuel pump tester. This permits the operator to set a number of carburetors without changing attachments and fuel.

23. MULTIPLE FUEL PUMP ASSEMBLY FIXTURE. (Fig. 38).

The fixture consists of a slotted five inch angle iron, weight levers and clamps. Locating pins are provided on the side of each slot in the angle iron to accommodate the holes in the fuel pump base.

When the weight lever is raised, a spring moves the clamp forward, providing space to insert the fuel pump. When the weight lever is lowered the cam action against the angle iron holds the clamp tight against the fuel pump mounting flange.

The fixture can be made whatever length is desired to accommodate as many fuel pumps as desired. Details for constructing this fixture are shown in figure 39.

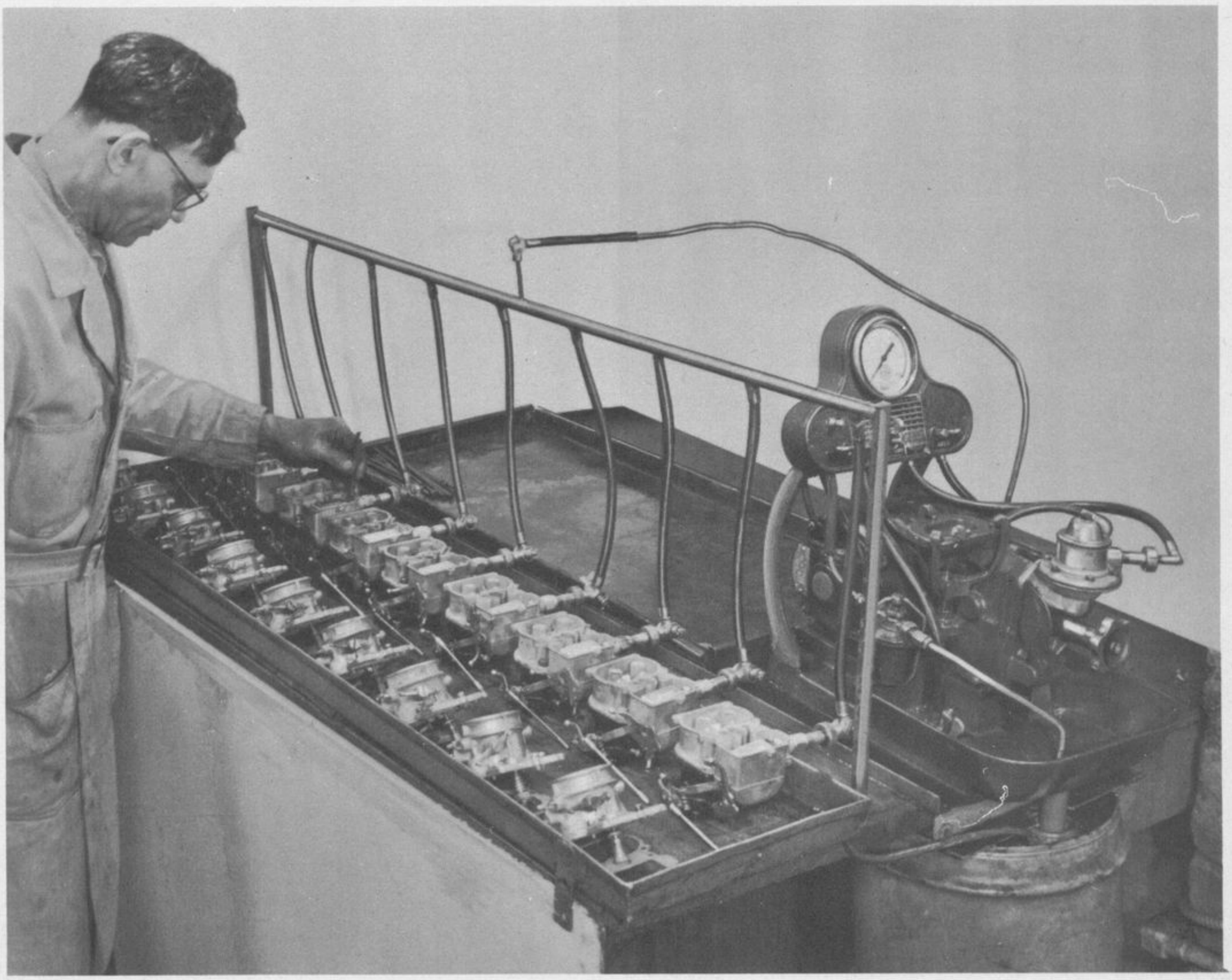


Figure 37—Multiple Carburetor Float Tester

Figure 38—Multiple Fuel Pump Assembly Fixture

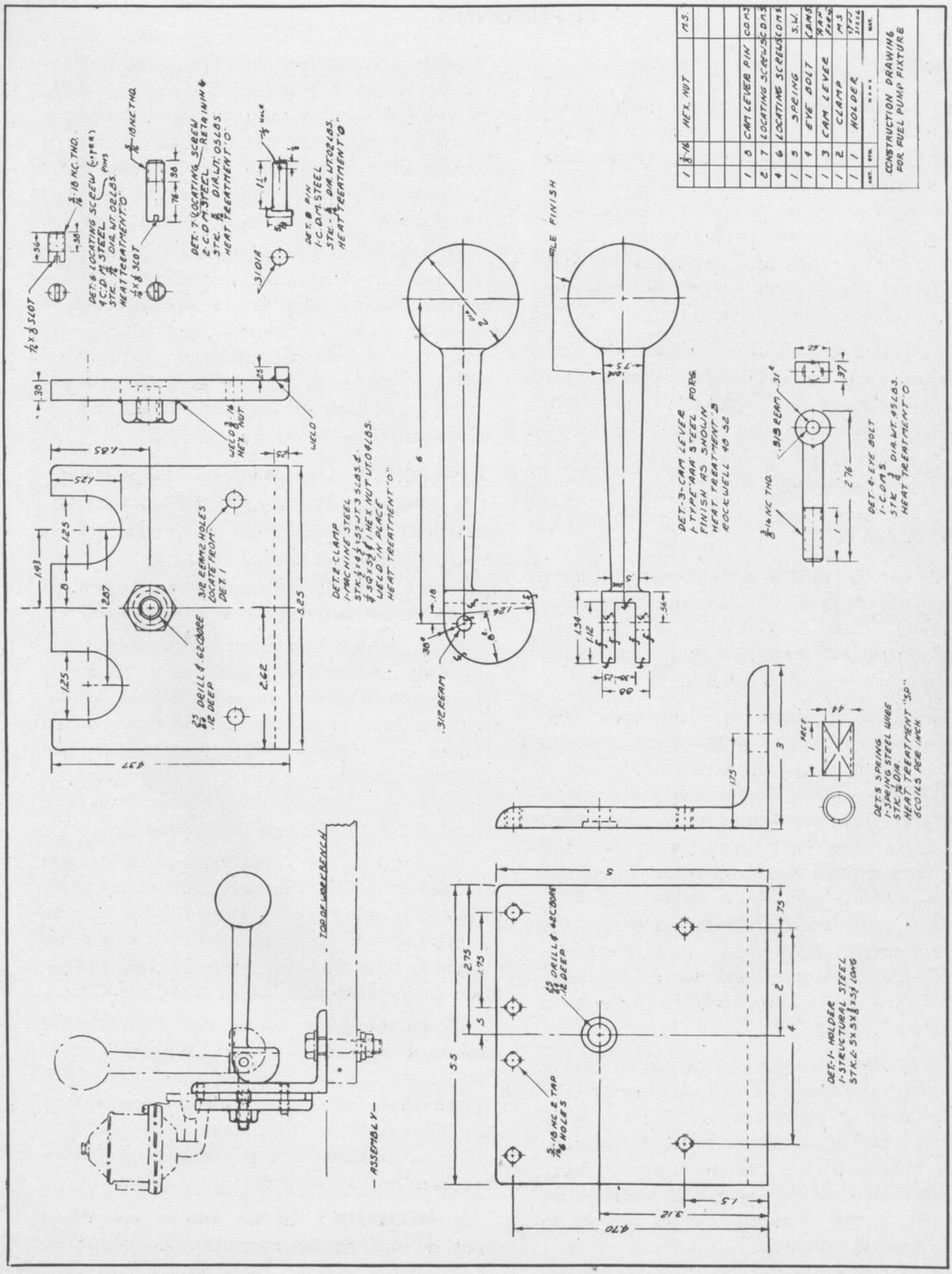


Figure 39—Construction Drawing for Fuel Pump Fixture

C—PERSONNEL

1. GENERAL.

All persons employing help must adjust their thinking to existing labor conditions. These conditions vary in different communities and the problems of securing adequate competent help must be met if the operation of the reconditioning department is to be successful. The problem divides itself into how to get the men or women needed, how to train them and how to hold them.

No hard and fast rules suitable to each community can be outlined, however, the following paragraphs do present some of the problems and contain suggestions for the selection, training and holding of reconditioning department personnel.

2. SUPERVISOR.

The success of the entire reconditioning operation will, to a large measure, depend on the qualifications and abilities of the supervisor and extreme care should be used in the selection of the man to fill this key position.

The ideal, of course, is a mechanic who understands all phases of the work, who can exercise good judgment in deciding which parts can be re-used and which parts should be scrapped. He should be able to get production without too much conflict with the other help. He should understand office procedures and have some production experience. This represents the ideal man to supervise the reconditioning department and, generally speaking, such a man will not be available and usually some compromise from the ideal must be accepted.

The qualifications of the person in charge will determine the degree of skill required in the balance of the personnel. With a good mechanic and production man in charge, generally speaking, it is not necessary to have first-class mechanics doing the work, since each person can be readily taught how to do one or several jobs well.

Such a supervisor will not work for mechanics wages. Pay whatever is required within reason to get the man you need. A portion of his pay can be in the form of a bonus. If such a plan is adopted, don't be too quick to change the rules if he makes more profits for you than you originally thought possible.

In operations involving less than six employees, a working supervisor should be made responsible for the entire operation. The working supervisor's base mechanical pay should be supplemented either by a bonus based on profits or by a flat increase in wages as compensation for his extra duties and responsibilities.

3. SELECTING AND TRAINING PERSONNEL.

a. SPECIALIZATION AS COMPARED TO ALL-AROUND MECHANICS. In an operation large enough to permit specialization by each employee, all-around mechanics are not required if competent supervision is in operation.

Even though they may not have had any previous mechanical experience, at least one person out of three inherently has enough latent mechanical ability so that they can be taught some phase of even the most complicated reconditioning operation, often in one hour or less. Those without this aptitude can be used for "tear-down" and cleaning.

Apprentices are of real value right from the start and by frequently changing them from one operation to another they can be developed into all-around reconditioning mechanics, thus fulfilling your implied obligation to them to train them to be mechanics.

Under this plan, women also may be used for most operations. In small operations in which less than six men and women are used, the working supervisor and at least one of the men must be first class all-around mechanics. In these operations non-mechanics are used for disassembly, cleaning, etc.

b. MECHANICS. In the smaller operations that do not permit complete specialization,

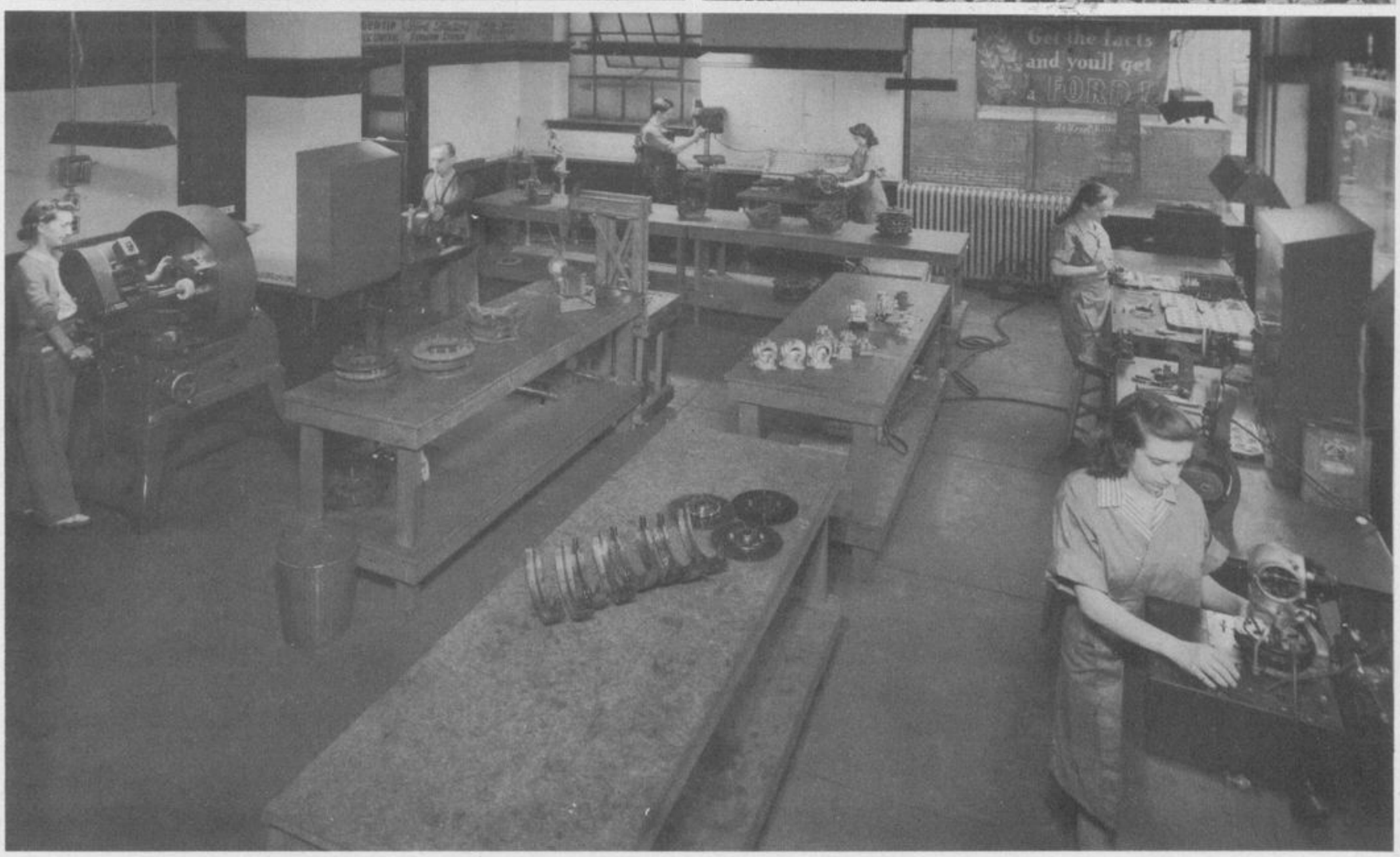


Figure 40—Women at Work

ENGINE PARTS RECONDITIONING

Figure 41—Apprentices at Work

such jobs as the establishment of valve clearances, line reaming, reboring, and the fitting and assembling of the reciprocating parts must be performed by competent all-around mechanics.

War industries and the armed services have absorbed any surplus of these men that may have previously existed. However, some of the former mechanics who have gone into the war industries can be employed part time if the wages offered are sufficiently attractive to them. Some independent garage men are going out of business and are available.

The number of skilled men available is limited and competition for their service is very keen in most communities. Lower your requirements for skilled men by a system of specialization and where skilled mechanics are absolutely necessary, pay high enough wages and raise the standard of the working conditions to attract and hold the men you need.

c. EMPLOYMENT OF WOMEN. (Fig. 40). With the exception of those operations that require heavy lifting, etc., a majority of the operations in a reconditioning department can be performed satisfactorily by women. This is particularly true of small parts' reconditioning and light machining and assembling operations.

In every community, many women are available for either full or part time work. Suitable washroom and locker facilities must be provided and a higher standard of cleanliness throughout the department must be maintained.

d. APPRENTICES. The employment of apprentices places the obligation on the employer to teach them a trade. Usually the prospect of learning a trade that will be of value to them is the chief reason that these boys will be willing to work as apprentices at less pay than they possibly could receive elsewhere.

Boys just out of school who are, as yet, undecided as to their future plans, can be sold on the idea of learning the mechanics trade.

By specialization in single operations at a time and by frequent changing from one operation to another, these boys can be developed into first class mechanics and yet be of real value throughout their training period. Figure 41 shows boys at work reconditioning various parts.

As the value of these boys to you increases, increase their pay in recognition of their efforts. This will reduce the possibility of their being attracted to some other place of employment and someone else gaining the benefit of the training you have given them.

4. WORKING CONDITIONS.

Reconditioners generally not only have the problem of originally obtaining adequate help, but also have the problem of labor turnover. The amount of money your employees can earn is, of course, their chief consideration, however, other factors also account for dissatisfaction and shifting from one job to another.

The ideal working space is where each person has sufficient room to permit freedom of action in a well lighted, clean, well ventilated space without drafts, that is, kept at approximately 65°F in cold weather.

Each employee should be provided with a locker where he can keep his street clothes. Adequate wash room facilities must be provided.

Many reconditioners have found it profitable to supply clean work clothes. In most cases the fact that work clothes are provided assumes a greater importance in the employees' mind than the same amount of money would if used as an increase in pay.

D—RECORDS AND ACCOUNTING

Due to the many details involved in engine reconditioning, a number of reconditioners find it advantageous and profitable to maintain a separate record and accounting system for their engine reconditioning department.

1. DAILY OPERATING CONTROL RECORD.

A "daily operating control record" is reproduced in figure 42. This form of record provides you with the following information daily: engines sold (by models), to whom sold, total dollar sales, overhead expenses, production cost, net profit, daily production, cost of parts, cost of labor and total cost of parts and labor.

The following instructions will aid you in setting up this daily operating control record.

In columns one to ten inclusive, under each model, list the number of engines sold.

In column 11, list total number of engines sold, all models.

In columns 12 to 15 inclusive, list the num-

Date Jan. 1944

DAILY OPERATING CONTROL RECORD

Work Day	MODELS 1 A	2 B	3 52	4 022	5 51	6 91	7 99	8 21	9 29	10 QA	11 Total Engines Sold	SALES 12 Dlr.	13 Whsl.	14 Dist.	15 Rtl.	16 Total Sales $	17 Overhead Exp.	18 Prod. Cost	19 Net Profit	20 Daily Prod.	21 Parts Cost	22 Labor Cost	23 Total Parts and Labor
1																							
2																							
3	1		2		2	1	4		1		11	3	2	4	2	644.27	111.76	378.95	153.56	10	207.30	137.20	344.50
4					4	4	5				13	5	3	4	1	761.41	132.08	447.85	181.48	9	186.57	123.48	310.05
5			1		4	2	3				10	2	3	3	2	585.70	101.60	344.50	139.60	8	165.74	109.76	275.60
6				3	5	3	4				16	4	5	5	2	917.12	1056	551.40	204.36	11	228.43	150.92	378.95
7	1				3	4	4				12	3	4	4	1	702.84	121.92	403.40	177.52	12	248.76	164.64	413.40
8		2	2			3	5				12	5	1	3	3	702.84	121.92	403.40	177.52	10	207.30	137.20	344.50
9																							
10				2	2	2			3		9	3	3	2	1	527.13	91.44	310.05	125.74	10	207.30	137.20	344.50
11			2		1	3	2			1	9	2	3	4		527.13	91.44	310.05	125.74	10	207.30	137.20	344.50
12					4	3	6	1			14	4	3	5	2	819.98	142.24	482.30	195.44	8	165.74	109.76	275.60
13					2		8		2		12	2	3	4	3	702.84	121.92	403.40	177.52	12	248.76	164.64	413.40
14					4	2	3				9	3	2	3	1	527.13	91.44	310.05	125.74	10	207.30	137.20	344.50
15					5	1	5				11	4	3	4		644.27	111.76	378.95	153.56	10	207.30	137.20	344.50
16																							
17					2	1	4				7	1	2	3	1	409.99	71.12	241.15	97.72	10	207.30	137.20	344.50
18					4	2	6				12	4	3	2	3	702.84	121.92	403.40	177.52	10	207.30	137.20	344.50
19					3	1	5				9	2	1	4	2	527.13	91.44	31205	125.74	9	18657	123.48	310.05
20					2	2	3	1			8	3	1	4		468.56	81.28	275.60	111.68	9	18657	123.48	310.05
21					2	3	2		1		8	2	2	3	1	468.56	81.28	275.60	111.68	12	248.76	164.64	413.40
22		1			1	2	4			1	9	2	1	4	2	527.13	91.44	310.05	125.74	11	228.03	150.92	378.95
23																							
24					2	1	4	2			9	3	2	3	1	527.13	91.44	310.05	125.74	10	207.30	137.20	344.50
25					3	1	5				9	4	1	3	1	527.13	91.44	310.05	125.74	10	207.30	137.20	344.50
26			2		1	2	4		2		11	4	3	4		644.27	111.76	378.95	153.56	10	207.30	137.20	344.50
27					2	1	5				8	2	2	4		468.56	81.28	275.60	111.68	10	207.30	137.20	344.50
28	1				3	1	3		1		9	2	2	3	2	527.13	91.44	310.65	125.74	8	165.74	109.76	275.60
29			1		2	2	2	1			8	3	1	3	1	468.56	81.28	275.60	111.68	12	248.76	164.64	413.40
30																							
31					3	3	4				10	3	3	4		585.70	101.60	344.50	139.60	12	248.76	164.64	413.40
Total	3	3	10	5	66	50	100	6	10	2	255	75	59	89	32	14733.35	2570.80	8734.75	3559.80	257	5327.61	3526.04	8853.65
Average					2⅓	2	4				10	3	2⅓	3⅓	1½	585.7	102.83	349.39	142.39	10.28	213.11	141.04	354.15

Figure 42—Daily Operating Control Record

MONTHLY PRODUCTION SCHEDULE

Date Nov. 1943

Work Days	MODELS										Daily Total
	A	B	52	022	51	91	99	21	29	GA	
1					6		4				10
2						5	5				10
3					6		4				10
4								2	8		10
5					6		4				10
6						5	5				10
7											
8	3	3						4			10
9			3	2			5				10
10					6		4				10
11						5	5				10
12			3	2			5				10
13					6		4				10
14											
15						5	5				10
16					6		4				10
17			3	2			5				10
18						5	5				10
19					6		4				10
20						5	5				10
21											
22					6		4				10
23					6		4				10
24					6		4				10
25						5	5				10
26					3	7					10
27							10				10
28											
29						8				2	10
30											
31											
TOTAL	3	3	9	6	63	50	100	6	8	2	250

Figure 43—Monthly Production Schedule

ber of engines sold to: dealer, wholesale trade, parts distributor and at retail.

In column 16, total the dollar sales.

In column 17, list overhead expenses, based on the average per engine for the month.

In column 18, list production cost, based on the average per engine for the month.

The net profit listed in column 19 is obtained by subtracting the sum of column 17 and 18 from column 16.

List in column 20 the number of engines produced, in column 21 the parts cost, in column 22 the labor cost, in column 23 total parts and labor cost.

Lines one to 31 inclusive represent the days of the month and are for daily listings. The last two lines denote the total and average of each column for the month.

This form of record is fairly simple and is complete and it places you in a position to make corrections of unfavorable conditions as soon as they become apparent and will aid in the setting up production schedules and ordering of parts.

2. PRODUCTION SCHEDULES.

In order to insure an uninterrupted schedule of engine production, plan and schedule production of the various models to meet the sales requirements. To accomplish this purpose, it is necessary to maintain a monthly and daily production schedule.

3. MONTHLY PRODUCTION SCHEDULE. (Fig. 43).

Estimate your production requirements for the following month the first of each month (i.e. on January first, estimate February requirements), this will provide time to order parts and plan for actual production.

In order to determine the number of engines to be produced each month, it is necessary to know the monthly sales of the various models. This information can be obtained by referring to the figures listed under models

DAILY PRODUCTION SCHEDULE

DATE.....

	CYLINDER BLOCK					ROD BEARINGS			CRANKSHAFT				MAIN BEARINGS					
	STD.	.015	.030	.045	.060	STD.	.003	.005	.010	.015	.020	.030	STD.	.005	.010	.015	.020	.030
51			2						16						12			
51				2							16					12		
51					2							16					12	
99A	2								8					4				
99A		1									8				6			
99A			1							8						12		

RINGS						VALVES	SPRINGS	CAM GEARS	GUIDES	RETAINER
81A6149			2	2	2	8	8	2	4	10
99A6149	2		1	2						

Figure 44—Daily Production Schedule

RECEIVING REPORT
FORD DEALER INC.

270 TALBOT AVE.

AUTHORIZED MOTOR REBUILDER

1

TAL 807 6100

OFFICE COPY

CUSTOMER'S ORDER NO. _____ DATE _____ 194

REC'D FROM _____

ADDRESS _____

_____ UNRECONDITIONED MOTORS _____ MOTOR BOXES No. 0015

TYPE	BLOCK	HEADS	OIL PUMP	CR. SHAFT	RODS	MISC.	BOXES	CHARGES	
		L							
		R							
		L							
		R							
		L							
		R							
		L							
		R							
		L							
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		R							
		L							
		R							
		L							
		R							
		L							
		R							
							TOTAL		

INSPECTED BY _____ DELIVERED BY _____

Figure 45—Receiving Report

of the daily operating control record (Fig. 42).

The figures obtained from the daily operating control record, less the finished flot (if any) and plus the orders on hand (if any) will determine the estimated number of each model to be produced the following month. Divide the total of all types by the number of work days in the particular month, this will determine the number of engines to be produced daily.

List on lines one through 31 in columns under models the estimated number of each model to be produced daily, leaving Sundays and other non-work days blank. A fairly accurate figure can be arrived at by consulting the daily operating control record (Fig. 42) and noting the number of each of the different models sold daily, bearing in mind to hold your schedule to not more than two different models in any one day. This will avoid confusion as to sizes, parts, etc.

When the monthly schedule is completed, it is turned over to the parts manager who will order the parts and make up the daily production schedules.

4. DAILY PRODUCTION SCHEDULE. (Fig. 44).

Daily production should be scheduled at least two days ahead of actual production. This will provide time for the production and parts managers to accumulate material to maintain uninterrupted production.

Consult estimated monthly production schedule and determine the models to be produced, modifying the daily schedule in order to meet current conditions, if necessary.

In the columns under model (Fig. 44),

list number of each unit to be produced. Check in the columns provided for cylinder block size, rod and main bearing sizes.

List the number of valve springs, guides, valves, retainers and camshaft gears required to replace those that had to be scrapped.

The daily production schedule now is given to the parts manager who will list the piston ring sizes and make up the parts kits for the assembly line. The schedules are then filed for reference when ordering parts.

5. RECORDS.

Figures 45 through 53 inclusive show various record cards that will assist in keeping the department running smoothly.

Figure 45 shows a receiving report. Figure 46 shows an identification tag, front view. Figure 47 shows the identification tag, rear view. Figure 48 shows owner's notification card. Figure 49 shows "hold for inspection of

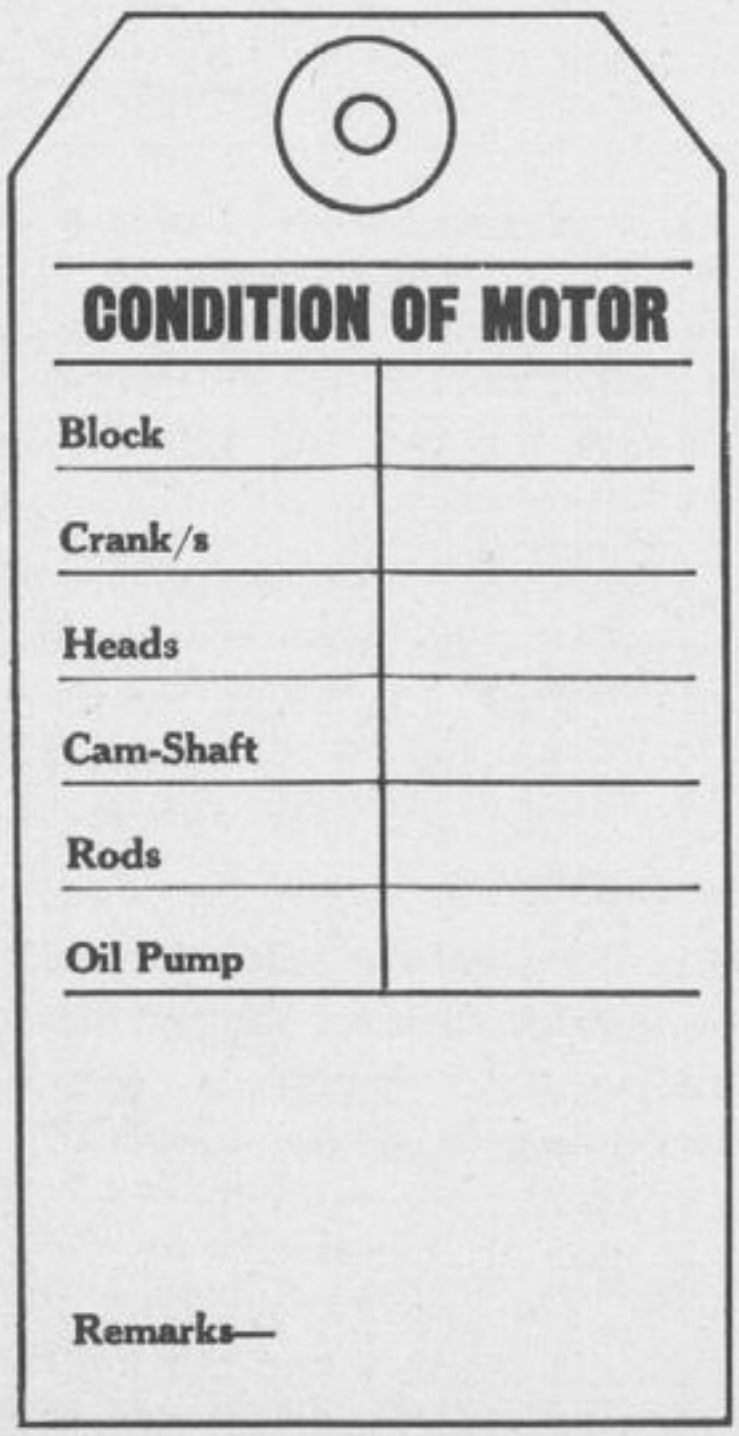

Figure 46—Identification Card, Front View

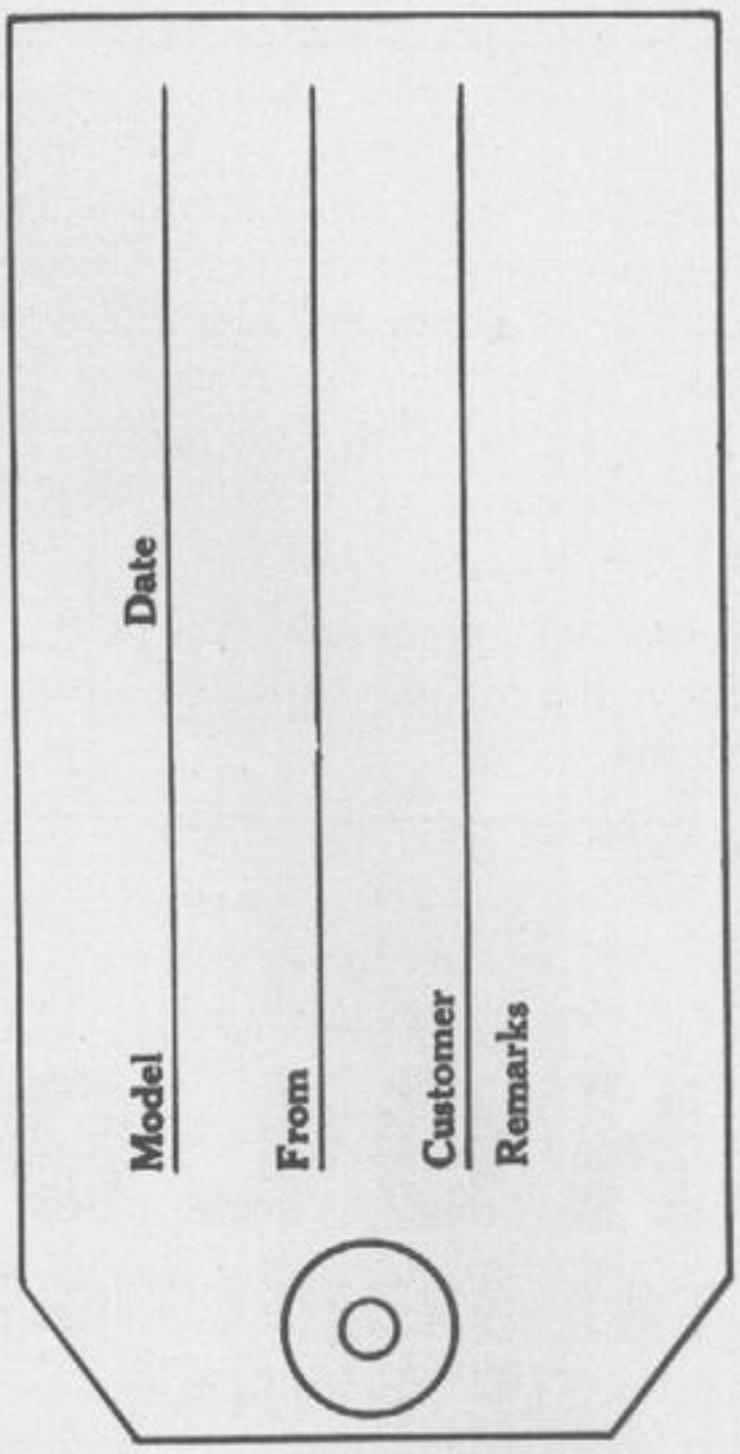

Figure 47—Identification Card, Rear View

owner" tag. Figure 50 shows the production work order (front view of hard copy). Figure 51 shows the production work order (rear view of hard copy). Figure 52 shows the "inventory control record" card.

The production manager knows from his daily production schedule of the different model engines and sizes that are to be reconditioned. A work order (Figs. 50 and 51)

Gentlemen:--The used motor_____ returned to us on_____has been inspected by us and the following defects and additional charges are listed below:-

Type of Motor _____

	Defects	Charges
Block	_____	_____
Heads	_____	_____
Crank Shaft	_____	_____
Misc.	_____	_____
	Total	_____

Figure 48—Owner's Notification Card

is made out for each engine right on the job (Fig. 53). This work order is complete in every detail and when properly filled out, provides an efficient and accurate record of each engine reconditioned. The work order is made out in triplicate, two soft copies and one hard copy. The front side of the hard copy is the same as the soft copies. The back of the hard copy has spaces for machining and service data (Fig. 51).

The production manager fills in the Reconditioner's engine number and the job number and model.

FORD DEALER INC

Motor Department

Motor No._____ Model_____

Job No._____

To _____ Date_____, 194__

Block_____ Oil Pump_____

Crank Shaft | Cam Shaft | Cyl. Heads

Quantity	PART No.	Nomenclature		
	6110	Piston		
	6149	Ring		
	6135	Pin		
	6211	Bearing		
	6331	Bearing		
	6333	Bearing		
	6505	Valve		
	6513	Spring		
	6512	Retainer		
	6140	Retainer		
	6654	Spring		
	6663	Plunger		
	6200	Con Rod		
	6623	Screen		
	35102517	Head Nut		
	6256	Gear		
	OIA6261C	Bushings		
	OIA6262C	Bushings		
	52-6608	Gear		
Set	Gaskets			
		Total Parts		
		Labor		
Mechanics		Total		

Figure 50—Production Work Order (Front of Hard Copy)

The parts manager fills in the required parts and retains the two soft copies.

The hard copy is attached to the job and as each operation is completed, the mechanics and inspectors numbers are noted in space provided (Fig. 51). When the job has been completed, the hard copy is attached to the two soft copies and filed numerically under engine number.

When the engine is sold, the work order is removed from the file, the purchaser's name is filled in, the number one copy is sent to the accounting department and filed numerically under the job number. The number two copy is filed alphabetically by the parts department. The hard copy is filed numerically under motor number and the file kept available for service data and for reference.

HOLD

FOR INSPECTION OF OWNER

Date Received_____

From:_____

On Exchange Motor No._____

Defect:_____

Amount Penalized $_____

HOLD [ ] **UNTIL**

Figure 49—Hold for Inspection of Owner Tag

NO.	OPERATION	DONE BY	INSPECTOR
1	BLOCK INSPECTION & TEST		
2	BLOCK REPAIR		
3	REBORED - SLEEVES		
4	REBABBITTED		
5	LINE REAMED		
6	CRANK SHAFT GROUND		
7	CRANK SHAFT FITTED		
8	CAM SHAFT		
9	PISTONS - RINGS- RODS		
10	OIL PRESSURE TEST		
11	VALVES		
12	CYL. HEADS - PAINT		

CYLINDER BLOCK: NEW USED BORE	PISTONS: KIND SIZE
CRANKSHAFT: MAINS ROD	PISTON PINS: KIND SIZE
CONNECTING RODS: KIND SIZE	PISTON RINGS: KIND SIZE
MAIN BEARINGS: KIND SIZE	CYLINDER HEADS: IRON-ALUM. TYPE
ROD BEARINGS: KIND INSIDE OUTSIDE	REMARKS:

Figure 51—Production Work Order (Back of Hard Copy)

INVENTORY CONTROL RECORD

DATE	STOCK ON HAND	STOCK ORDERED	REMARKS
FORM 950-B			

Figure 52—Inventory Control Record Card

6. ACCOUNTING.

In the accounting procedures for the reconditioning department, the standard Ford accounting system can readily be adapted to keep the engine reconditioning accounts separate from the main dealership accounts. Some reconditioners who have large production, however, keep a separate set of ledgers for their engine reconditioning department.

If your small reconditioned parts volume warrants, it is equally advisable to maintain a separate account of this operation.

The engine reconditioning department should be charged for all material and labor pertaining to the reconditioning of engines. Credit should be given to the reconditioning department for all sales of reconditioned en-

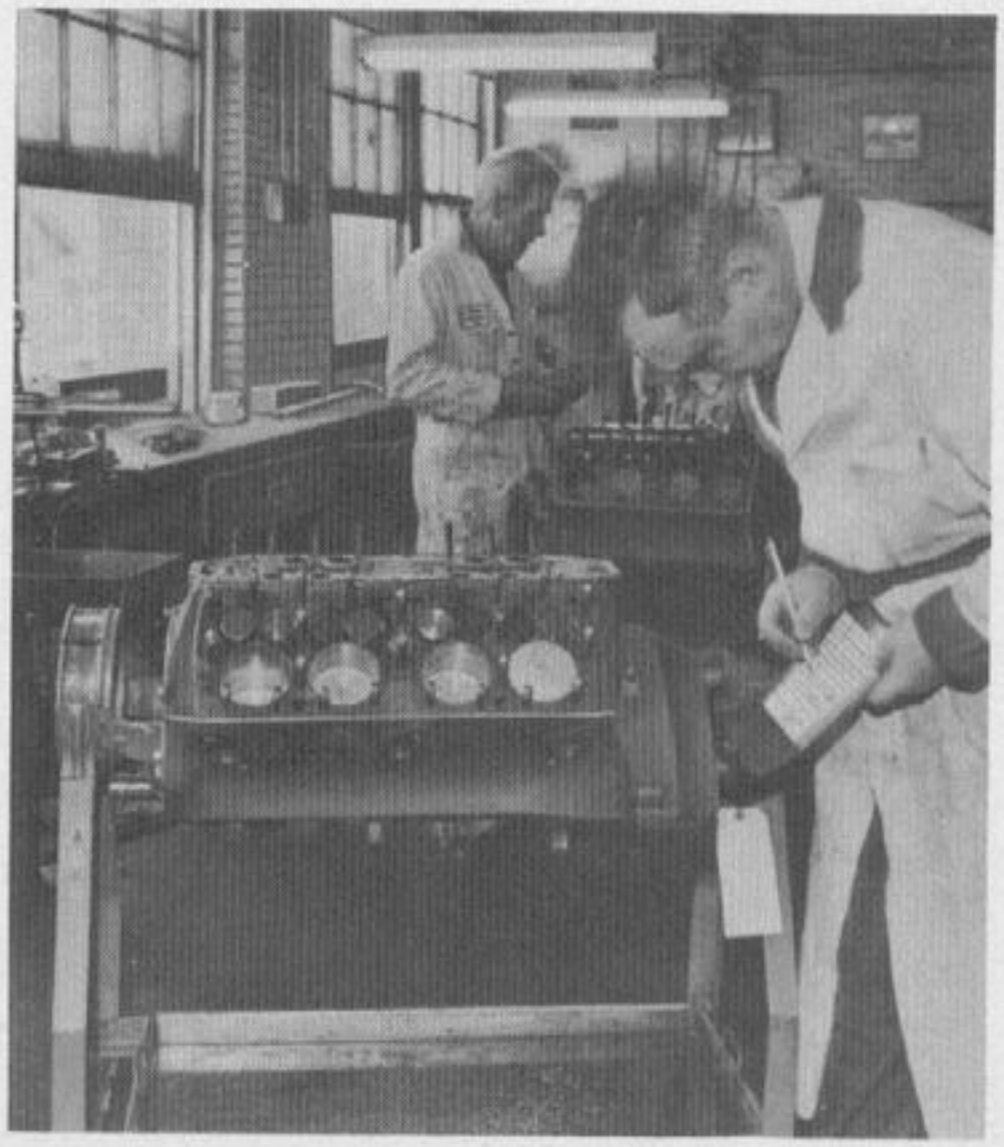

Figure 53—Entering Mechanic's and Inspector's Number on Work Order

gines. Income from the sales of salvage and scrap and profit made on the repairing of cylinder blocks and regrinding of crankshafts for the outside trade should be classed as miscellaneous earnings, out of which a reserve fund should be set up for warranty labor and material.

Reconditioning Parts Taxes. It is important also to keep a separate account of all taxes pertaining to reconditioning of parts.

Engine Reconditioners' Comparison Report. The following is an engine reconditioners' operating comparison report which is submitted for your information. The figures used were taken from reconditioners' actual statements on a cross section survey of six states.

	Average Per Unit	Average Per Engine
Sales Price		$58.57
Parts Cost		20.73
Labor Cost		13.72
Total Cost		34.45
Gross Profit		24.12
Expense		10.16
Net Profit		13.96

DETAIL OF EXPENSES

Rent and Lease Expense	$ .90
Advertising	.08
Depreciation, Equipment	.45
Freight and Express	.14
Gasoline and Oil	.12
Heat, Light and Power	.25
Insurance	.80
Interest	.05
Miscellaneous	.09
Supplies "Records"	.11
Repairs, Equipment	.25
Management Salary	.66
Guarantee	.31
Salary and Wage Supervision	1.20
Manufacturing Tax	2.28
Other Taxes	.47
Telephone and Telegraph	.13
Tools and Supplies	1.70
Traveling Expenses	.15
TOTAL EXPENSES	$10.14

7. ENGINE PRODUCTION TIME STUDY.

The following time study was made by the Office of Price Administration for one reconditioner and it is submitted here merely for your information.

OPERATION	Hrs.	Min.
1. Remove cylinder heads		20
2. Remove camshaft front cover		5
3. Remove oil baffles and plugs		2
4. Install cylinder heads for cleaning with one-quarter inch wooden wedge between head and block, each held in place with one nut		5
5. Attach lifting hook and hoist engine into tank		3
6. Remove engine from tank and flush off with pressure hose		30
7. Attach fixtures to engine and place engine on stand		5
8. Disassemble engine and remove carbon from block and heads	1	
9. Clean crankshaft, camshaft, valves, guides and springs		50
10. Inspect cylinder blocks and parts		30
11. Rebore cylinder blocks	1	
12. Rebabbitt main bearings*	2	
13. Regrind valve seats		45
14. Repair cylinder blocks†	1	
15. Replace camshaft bearings		30
16. Clean cylinder blocks after babbitting and boring		15
17. Reface valves and set valve stem clearance	1	
18. Install camshaft gear		15
19. Reface push rods‡		45
20. Regrind connecting rods and rebush and fit pins‡	1	30
21. Regrind crankshaft‡	1	
22. Recondition oil pump		30
23. Install camshaft		5
24. Install push rods		10
25. Assemble valve parts. Install: valves to cylinder block, pistons on rods, rings on pistons, crankshaft in cylinder block, pistons and rods in cylinder block, oil baffles and plugs in valve chambers, front and rear camshaft cover, cylinder heads and paint engine assembly	2	
26. Crate engine assembly for delivery	1	
27. Average time for engine reconditioning§	15	

*25% of total engines reconditioned have babbitt type blocks. This percentage will vary according to number of units of this type in reconditioner's area.

†5% of engines require miscellaneous cylinder block repairs, such as broken cylinder head studs, cracked bell-housing, dowel pin holes, etc.

‡Deduct time required for these operations from average time per motor, when the operations are performed through an outside source.

§Based on experience that only 5% of engines require miscellaneous repairs to block and 25% of total engines reconditioned have babbitt type blocks.

E—PARTS PROCUREMENT

In order to obtain parts with the minimum loss of time, it is necessary that the production and parts manager work in close touch with each other. This is best accomplished if the parts for reconditioning are stocked in the room or building in which the reconditioning is performed.

Parts are ordered from the inventory control record cards (Fig. 52) to maintain the stock up to the required inventory. The inventory control record cards are filled out by consulting the daily operating control and the monthly and daily production schedules as these records reflect the quantity and prevailing sizes.

1. RECONDITIONER'S PARTS ORDER.

The reconditioner's parts order form number 1937 is to be used only in ordering parts of the reconditioning department. Only parts for brake, engine, clutch, fuel pump, carburetor and distributor reconditioning are listed on this form.

Parts ordered on this form and received at the branch on assigned due date will be shipped freight prepaid. The use of form 1937 should eliminate emergency orders, insure prompt service and simplify reconditioner's inventory control and parts follow-up system.

2. RECLAMATION OF PARTS.

Due to the critical shortage of materials, it is essential that every effort should be made to reclaim as many parts as possible. In many cases, the availability of new parts, rather than cost, determines the wisdom of parts reclamation. However, in the majority of cases the cost of reclaiming is less than a new part. In reclaiming operations, it is not sufficient that parts be merely patched up. Parts should be restored to a condition where their expected additional usefulness approaches the normal usefulness of a new part. If the part cannot be restored to this high requirement, it should be scrapped.

F—HANDLING OF ENGINES

1. RECEIVAL AND IDENTIFICATION.

Upon receiving unreconditioned engines, each one should be identified by number, owner's name and a receiving report (Fig. 45) made out. This report is made out in triplicate. Number one is the office copy, number two is an invoice and is retained until the final inspection is made, number three is the customer's receipt.

If final inspection is made while customer waits, charges for cracked cylinder block and other damaged parts are made at that time and the transaction is completed.

If, at the time of receival, the unreconditioned engines are not in boxes, the identification number should be stamped on the cylinder block, the crankshaft, and the camshaft. The identification tag with the customer's name should be tagged to the engine (Figs. 46 and 47).

If engines are in boxes, tack the tag to the box and record identification number in the space for remarks.

The identification number is the same as that on the receival form (Fig. 45). The unreconditioned engine carries this identification number until it is completely reconditioned, at which time the reconditioner's authorized numbered metal tag is attached.

If time does not permit inspection while the customer waits, or if there are several engines involved and inspection is to be made later and if there are any charges, the number two copy of the receiving report is sent to the accounting department and customer is then notified by post card (Fig. 48) of item and the amount charged.

A "hold for inspection of owner" tag (Fig. 49) is attached to a cracked cylinder block

or other damaged parts and held for a certain designated length of time.

Some reconditioners have worked out a satisfactory arrangement to have the Ford dealer, Ford distributor, fleet owner and wholesale trade clean most of the dirt from cylinder assemblies, remove all the cylinder head nuts and cylinder heads, inspect for visible cracks and install heads with two nuts per head.

This arrangement is recommended as it saves cleaning time, man power, inspection time and avoids disputes about cracked cylinder heads, cracked blocks or badly scored cylinders.

It is especially important, under present conditions, that reconditioners devote a great deal of attention to the care and upkeep of their precision equipment. The life of any tool can be prolonged by following the instructions furnished by the manufacturer of the equipment. To supplement the manufacturer's instructions, the following instructions that can be applied generally are given, but are not intended to supersede any instructions by the equipment manufacturer.

G—CARE OF PRECISION EQUIPMENT

1. CRANKSHAFT GRINDERS.

a. LATHE ATTACHMENT TYPE. With a lathe attachment type grinder, be sure that the lathe is in good condition, and on a solid level foundation, as any loose movements in the spindle bearings, the tail stock spindle, the centers, the carriage or the cross slides will reflect in the accuracy of the work. If back gears clatter, it will cause chatter marks in work and rapid wheel wear. It is best to use a small motor (¼ hp.) with a worm gear reducer so the lathe can be turned slowly in direct drive, as low as 16 R.P.M. It is good practice to always grind the most worn journal of the crankshaft first. This will determine the size to which the crankshaft will have to be ground. Follow the equipment manufacturer's recommendations for the lubrication and maintenance of the equipment.

b. CONVENTIONAL CRANKSHAFT GRINDER. Follow the manufacturer's recommendations for setting up the machine. Generally these recommendations are that the machine be kept absolutely level. Usually it should be mounted on a good, solid foundation of at least six inches of concrete to avoid any twisting of the bed which tends to throw the entire machine out of alinement.

Follow the manufacturer's recommendations for the operation, maintenance and lubrication of the machine.

Wipe "ways" off each day and oil with waterproof grease.

Keep the coolant tank clean and do not use too heavy a solution.

Don't forget to remove index pins before starting the machine.

Be sure to place tailstock lock in "out" position when grinding throws.

Always lock chucks securely on crankshaft.

Keep the grinding wheel sharp.

Cover the "ways" while dressing the wheel and wipe them off when finished.

Use plenty of water while grinding.

Tighten drive belts just enough to provide a positive drive.

Always shut motor off before shifting gears.

Exercise care so grinding wheel is not damaged in removing or installing the crankshaft in the machine.

Make certain that the grinding wheel is properly mounted on spindle and in balance.

Clean both the adapter and the spindle before mounting.

Make certain that flange screws and lock ring are tight.

Never run wheel unless wheel guard is on the machine.

First and last—keep the machine clean. Take pride in it and it will repay you well in the long run.

2. CONNECTING ROD INTERNAL GRINDER.

a. LUBRICATION AND CARE. Follow the manufacturer's recommendations for maintenance and lubrication.

b. OPERATING SUGGESTIONS. Before mixing grinding compound, the water must be softened with trisodium, sal soda, or some other suitable softener. This is important, particularly where the water is highly alkaline. After the oil and water are mixed, it should have the consistency of soapy water. The solution should be milky but not too heavy. Too much oil in the solution will cause the grinding wheels to load quickly.

During hot weather, change solution regularly as it is apt to get rancid. When grinding connecting rods, the compound should flow on the grinding wheel.

Clean grindings from pan regularly. This is important as an accumulation of grits and grindings in the pan will overflow the riser into the reservoir, after which they will circulate through the cooling system, causing scratches on the ground surfaces.

Clean coolant compound reservoir thoroughly, should any grits or grindings accumulate therein.

Wipe the table and the cross slide ways of the grinder clean and coat them with a good grade of lubricant. Oil daily. If this is neglected, the grindings quickly destroy the accuracy of the machine. Clean out holes and slots in face plate occasionally. Wipe the face plate, cam holding plates and all attachments clean before assembling a mounting. A little grit can cause gross inaccuracies.

The belt should be adjusted so when opposite sides are fully squeezed toward each other they will be one inch apart. If the belt is too tight, unnecessary wear will occur to the spindle bearings.

3. BORING BARS OPERATING SUGGESTIONS.

Exercise care when moving the boring bar so the base face is not nicked or injured. The base face is a ground and scraped surface. The alignment accuracy is dependent on the smoothness of the face surface.

When moving bar from cylinder block, do not set the bar on a concrete floor. It should be placed on a block of clean wood or heavy cardboard. Suspending the bar by counterweights is a good method to keep base face free from rough surface contact.

Keep the quill clean and lubricated. Follow the boring bar manufacturer's instructions on maintenance and lubrication.

Keep the cutting tools well protected. More of these tools are spoiled due to fractures and mishandling than from actual wear. Keep the tools sharp, otherwise they will overheat and fracture.

Keep the tool holder slot clean and free from dirt and chips. See that tool holder slides freely in the slot as a slight burr on the holder will cause it to stick.

Keep belts properly adjusted. Loose belts cause rough boring and reduce the cutting capacity of the machine. When the belts slip, the cutting stops but the downward feed does not, this damages the cutting tool.

Keep lap disk clean and well lubricated with lapping compound recommended by the manufacturer of the boring bar. Under no circumstances permit anyone to use this disk for anything other than sharpening tool bits. Do not use pressure in sharpening.

Keep centering jaws clean and dry. Keep cutter head clean at all times. Keep micrometer clean and dry. Oil spindle every six months with light spindle oil.

Do not, under any circumstances, adjust cutter to cut more than recommended by the manufacturer, as overloading the boring bar results in poor workmanship and unnecessary wear to the boring bar.

Boring bars equipped with adjustable main

bar bearings should be periodically checked. There should be a noticeable drag on the main bar when feeding it up or down by hand. If, in feeding the bar down with hand lever, you notice it slip down from its own weight faster than you are feeding it, then the main bearing is too loose. If drag of main bar is allowed to become slack, the bar will drop slightly when the cutter passes over a deep pocket or score without cutting. This may fracture the cutter tip. Follow the manufacturer's instructions closely in making this adjustment.

In boring bars equipped with hand raising wheels, it is important to be sure that the wheel is turned in the right direction, especially if the bar is to be raised out of the cylinder before the boring is finished, otherwise the cutting tool will be broken.

4. MAIN BEARING LINE BORING MACHINE OPERATING INSTRUCTIONS.

Keep bridges and parallel bars clean and covered with a light film of oil. Keep tools mounted on a panel board as some are small and easily lost.

The cutting edges of the boring and flanging tools will require honing from time to time, as they must be sharp and smooth in order to produce a good finish. The hone will last longer if used with oil. If the hone becomes smooth and gummy, it may be cleaned with gasoline.

When honing, care should be taken to keep the tool face flat against the hone. If the edge is allowed to dig into the hone, not only the cutting edge will be destroyed, but also the hone. Try to retain the original shape of the tool. On flanging tools only the faces should be honed. Attempting to hone the edges will destroy their shape.

5. VALVE FACING MACHINE OPERATING INSTRUCTIONS.

Keep the machine clean and well lubricated. In the majority of cases, all the bearings and moving parts, except the motor, should be lubricated daily. The motor bearings should be oiled every six months.

It is always necessary to true up the grinding wheel before using it. Take the same precaution if the wheel has been loosened or removed from the shaft. Be sure the diamond dressing tool is locked securely in place. Move grinding wheel across the diamond point very slowly and with a uniform motion. Each time you use the diamond tool, turn it slightly in its bearing. In this way you will prevent wearing a flat spot on the diamond. Take very light cuts. Heavy cuts may grind away the mounting and loosen the diamond. Be careful not to jam wheel into the diamond.

Belts should always be kept at the proper tension. The machine must not be used for grinding anything but valves and cutters. Be sure that the dust pan is kept in place under the grinding wheel at all times and filled to a depth of ¼ inch with engine oil. Push accumulated grindings back under the grinding wheel. Never allow grindings to accumulate above the top of the oil. Clean the pan out with gasoline as it becomes necessary and refill with clean oil.

6. VALVE SEAT GRINDER OPERATING INSTRUCTIONS.

Do not place grinder over the pilot while the motor is running. Do not start motor until grinding wheel almost touches the valve seat. Wipe pilot with an oiled cloth before and after using. True the grinding wheel with diamond, in the same manner as explained for valve facing grinder.

If there is doubt as to the strength of the grinding wheel, it should be run on a guarded wheel dressing arbor to make sure it will not fly apart while in operation. Never grip the grinding unit or grinding wheel in a vise as the grinding body will be distorted and grinding wheel broken.

The motor bearings are permanently lubricated. However, if the unit, for any reason, is dismantled, the bearings should be relubricated.

7. USE OF ELECTRIC DRILLS.

In using heavy drills be sure of good footing, as the drill bit may jam and personal injury result from the sudden twist of the powerful drill motor. Do not make a practice of overloading the drill; use a drill of sufficient capacity for the job.

If the drill stalls, it is being seriously overloaded. Do not try to force it. Turn the switch off as quickly as possible. Do not snap the switch off and on, in an effort to start a stalled drill. This damages the switch, overheats the motor and may break the bit. Remove the drill from the work. Determine the cause of stalling. In many cases, stalling is caused by too much feed pressure as the drill bit breaks through the finished hole.

When drill is not in use, hang it up with cable coiled loosely to avoid sharp bends or kinks. Do not drag drill over the floor by the cable. Keep drill ventilators clean by blowing air through the openings.

Most modern drill motor bearings are permanently lubricated. However, a semi-annual check-up prevents many failures. Wash out old grease in gear case with a good solvent before refilling with fresh lubricant. Never fill gear case more than half full. Too much grease is not desirable as the grease will expand and be forced into the motor, damaging the windings.

8. CARE OF ELECTRIC EQUIPMENT CABLES.

Do not run over cables with floor trucks. Do not drag cables over rough floors. Do not jerk cable plugs out of wall connection as this, in many cases, will break the plug or tear the wires loose. Do not drop sharp objects on the cable.

Where possible, suspend the cable out of the way of accidental damage. Examine cable connections weekly to minimize need of connection repairs while equipment is in operation.

H—WARRANTY

The Ford Motor Company has tried to use every precaution to see that those persons who have been selected as Authorized Parts Reconditioners are responsible business men of good standing in their communities, and the fact that they have authorized reconditioned engine plates (Fig. 54) infers to the public that Ford standards of workmanship and tolerances are adhered to. However, it is recognized that some practices as outlined are emergency methods and so considered by Parts Reconditioners due to the critical shortage of parts.

The warranty on the parts or assemblies that you recondition is your responsibility and not the Ford Motor Company. In view of this fact, it is suggested that you obtain legal assistance in the wording of any warranty you make. It is suggested that the warranty be for 30 days or 4000 miles and your liability limited to correction within your own shop. Actually, there will be any number of cases where you will want to do more than the warranty calls for and it is good business for you to do so. Nevertheless, it is suggested that your written or implied warranty be limited as outlined above.

Parts manufactured by the Ford Motor Company are sold to you under the Ford warranty and it is suggested that where, due

Figure 54—The Authorized Reconditioned Engine Plate

to shortages, you find it necessary to use other than genuine Ford parts, you insist on a similar warranty from the Parts Manufacturer.

With a suitable parts warranty from all parts sources, your chief responsibility then will be for the workmanship and those parts that fail as the result of poor workmanship, rather than a defect of the part itself. Make sure that your reconditioning department supervisor and key mechanics understand your responsibility so they will not gamble too much on the suitability of parts of doubtful value. Where incentive bonuses are used, impose penalties for "come backs".

When it is necessary to make an adjustment, whether outside or within the letter of your warranty, you will no doubt want to do so.

☆ ☆ ☆

CHAPTER II

ENGINES

A—PRELIMINARY CLEANING AND INSPECTION

To prepare the cylinder blocks for cleaning, the cylinder heads are separated from the cylinder block by a one-quarter inch thick block of wood. The space provided permits the cleaning liquid to enter the combustion chamber and soak the carbon loose.

Place the engine assemblies in the cleaning tank at close of day and permit them to soak over night. After engine assemblies have passed through the soaking period, remove one or two at a time and place on the drain board located at the end of the tank nearest the pressure washer. This permits excess cleaning liquid to drain back into cleaning tank. While the engine assemblies are draining, dirty engine assemblies are prepared for the cleaning tank.

Next, remove the engine assembly to an open tank and wash off exterior dirt by hot water under high pressure, after which preliminary inspection is made for external cylinder block cracks and other damage.

B—DISASSEMBLY

1. CYLINDER HEADS.

Remove cylinder heads and place them on cleaning bench next to the engine stand for cleaning and inspection.

2. CONNECTING RODS.

Remove connecting rods and reinstall the rod caps so that the cylinder number of the cap and rod are on the same side (Fig. 55).

Remove the old pistons and attach the rods together in sets as they come out of the engine. This can be done in a simple and efficient manner by the use of a holder (Fig. 56). This pin provides an ideal attachment for hanging the rods in the final cleaning tank.

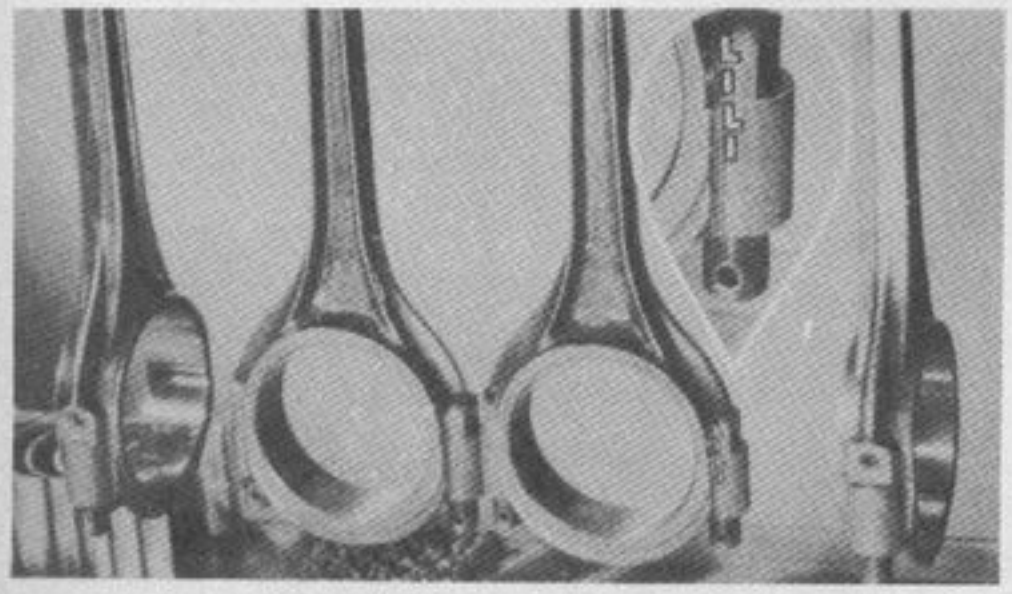

Figure 55—Marking on Connecting Rods

3. CRANKSHAFT.

Remove the crankshaft and place it on the inspection stand (Fig. 60).

4. MAIN BEARING CAPS.

Reinstall the main bearing caps which will keep them with the block to which they belong and prevents damage to cap studs and bearing seats.

5. VALVE ASSEMBLIES.

Remove valve assemblies, disassemble each

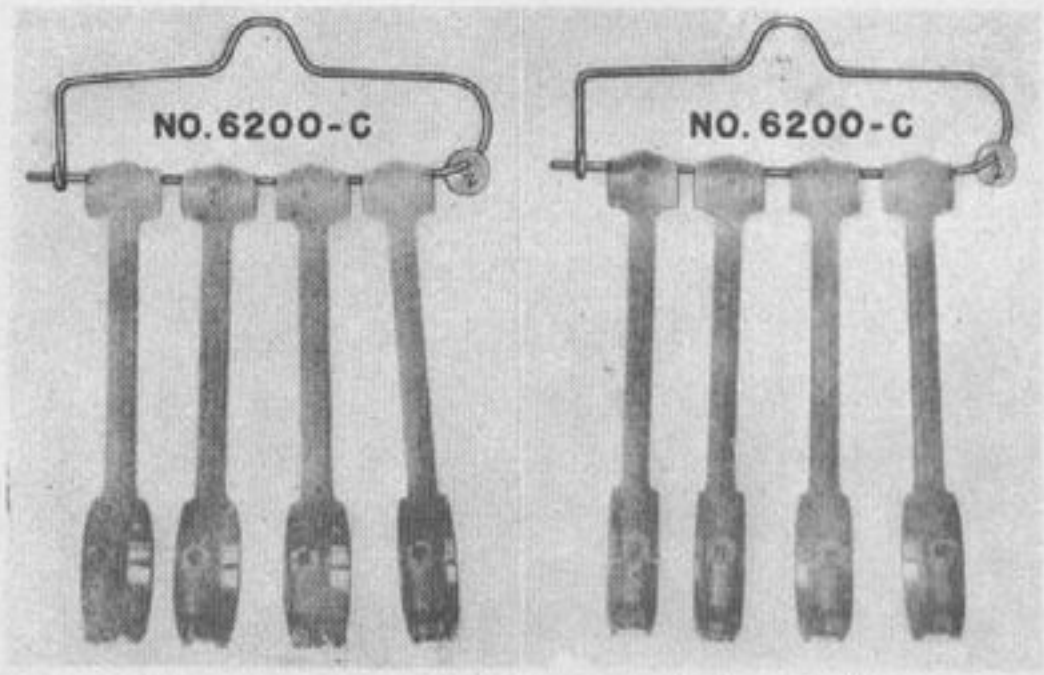

Figure 56—Holder for Connecting Rods

assembly and place the valves, springs, and retainers in the open mesh tray for the final cleaning tank. Place valve guides in special tray (Fig. 25) so as to keep the valve guides in pairs. *This is important* as the guides were originally machined in pairs and after being in service the normal wear of each guide is different, therefore, to mix the guides would cause improper fit, improper oil seal around the valve guides and noisy valves due to the valve stems not properly fitted in the guides.

The valves are put in the tray (Fig. 25) for cleaning. After the valve parts have been in the final cleaning tank a sufficient length of time to remove sludge, they are removed and polished on a buffing wheel, the guide trays are hooked on a rack close by assembly line, and retainers are placed in a sectioned bin on end of rack. The valve springs are passed to the test bench.

6. CAMSHAFT AND OIL PUMP.

Remove camshaft. Remove camshaft gear from shaft. Remove oil pump.

C—CLEANING AND INSPECTION

1. CYLINDER BLOCK AND CYLINDER HEADS.

a. CLEAN CYLINDER BLOCK. The cylinder block is thoroughly cleaned with the use of an electrically driven rotary wire brush. Where the power brush cannot be operated to remove carbon and dirt, a hand operated brush and scraper are used. While the block is being cleaned, a visual inspection is made for cracks.

b. INSPECT AND TEST BLOCK FOR CRACKS. In many cases, cracks are found when the block is cleaned. However, a final inspection and test should be made with water pressure (Fig. 28) by a competent employee who knows where to look for cracks and leaks that are difficult to locate. A good bright light should be used.

c. GRADING CYLINDER BLOCKS.

(1) SCRAP BLOCKS. Do not permit scrap blocks to accumulate as they take up valuable space. Hold only those blocks tagged for owner's inspection.

(2) CRACKED BLOCKS. Cracked blocks that can be repaired should be marked plainly and separated from the good blocks.

(3) SIZE. Grade each cylinder block as to nearest oversize to be rebored. Stamp the oversize on a tin tag (when engine is reconditioned tag is removed to use again), and fasten to the cylinder block. This is more satisfactory than marking with chalk, as the chalk marks wipe off in handling.

The cylinder block is then placed with a group of corresponding oversize unless it is to be immediately reconditioned, in which case it is moved to the rebore position. Grouping cylinder blocks and crankshafts by types and oversizes facilitates planning the daily production schedule, as the production manager can easily ascertain the types and oversizes available for production.

d. MEASURING CYLINDER WALLS. The most accurate method of measuring cylinder bore diameter is by the use of a telescope gage and micrometers. This method shows the exact sizes in thousandths of an inch, yet requires no particular skill other than the ability to read micrometers. To check cylinder bore sizes, using gage and micrometers, proceed as follows:

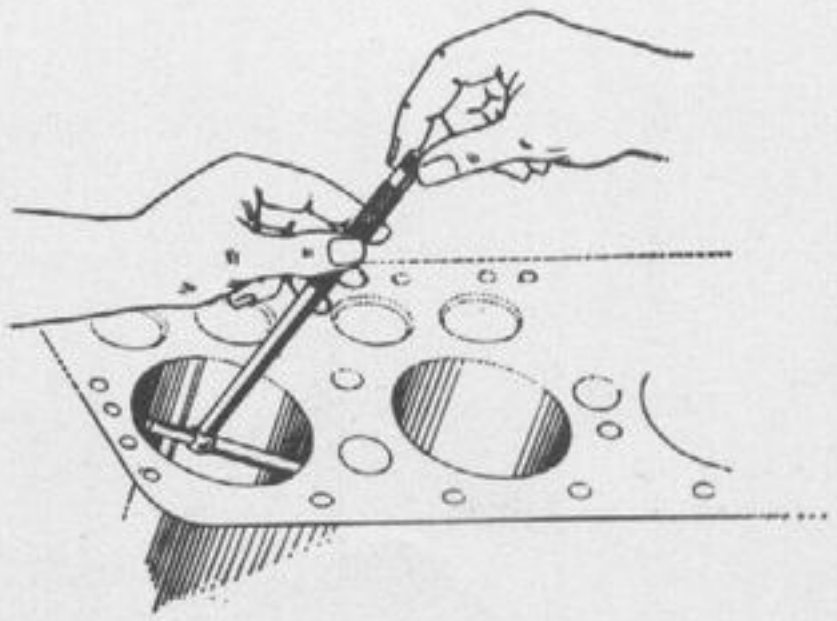

Figure 57—Placing Gage in Bore

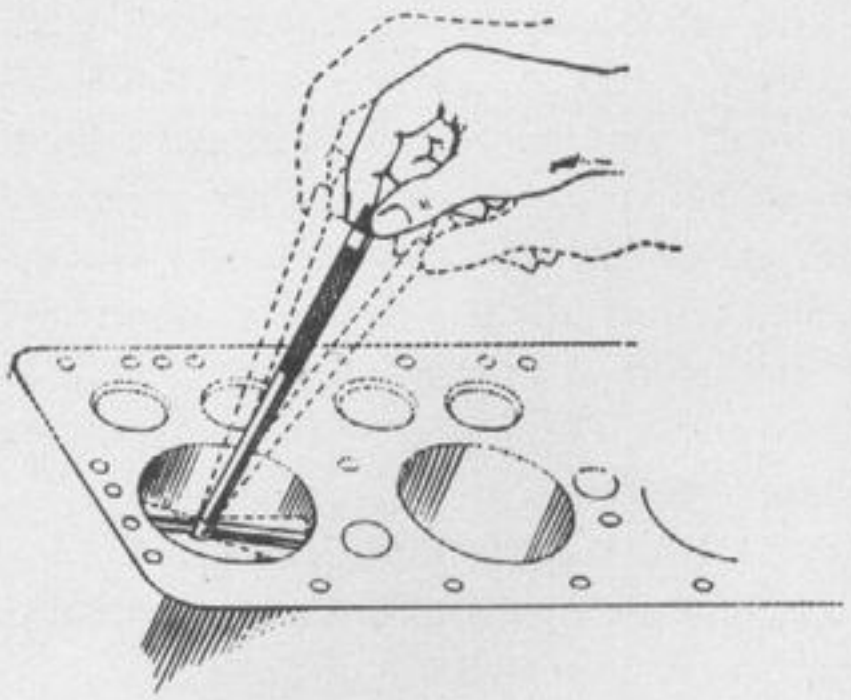

Figure 58—Measuring Bore

(1) Loosen the friction screw on the end of the telescope gage handle.

(2) Close the points to a size smaller than the bore to be checked, holding them while you retighten the friction screw.

(3) Place the gage in the bore on a slight angle as shown in figure 57.

(4) Loosen the friction screw (Fig. 58). Spring tension will now cause the points to expand until stopped by the walls of the bore.

(5) Retighten the screw. Owing to the angle on which the tool was held, the distance between the points will be greater than the bore.

(6) To close the points to the actual size of the bore, move the gage as shown by the dotted line (Fig. 58). This movement will cause the gage to find center and will close the points. The friction screw will hold the setting.

(7) Check this setting with micrometers as shown in figure 59.

To determine the original size of the cylinder bore, measure at a point two inches above the bottom of the bore.

e. **INSPECT CYLINDER HEADS.** Clean cylinder heads in cleaning tank and with wire brush. Inspect for indication of cracks and corroded water outlets. Run a tap through spark plug holes to clean out threads. If this is not done before heads are installed, the dirt will enter the cylinders, causing damage to the newly machined surface.

Thoroughly clean inside of water jacket to provide free water circulation. Gasket surface of head should be smooth and free from nicks that would tend to cause the gasket to leak.

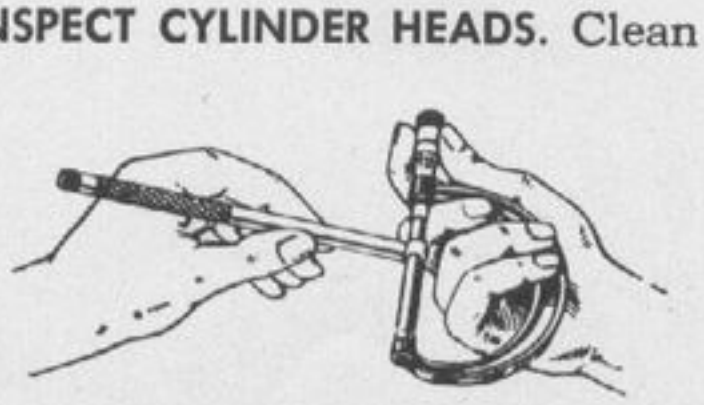

Figure 59—Checking Setting of Telescope Gage

2. CRANKSHAFT.

Place crankshaft to be tested for run-out on stand (Fig. 60). Place a dial gage against the center main bearing surface and turn the crankshaft by hand. The run-out should be less than 0.005 inch. If it is more, the crankshaft should be scrapped.

If the crankshaft has passed run-out inspection, the crankshaft bearing surfaces are then measured to determine regrinding size. The size should be stamped on a small tin tag and wired to each crankshaft bearing surface. The shaft is now placed on a rack (Fig. 26) with other shafts of corresponding bearing sizes.

3. CAMSHAFT.

Inspect the camshaft bearing and cam surfaces. If either are pitted, worn or rough the shaft should be scrapped. If the timing gear is worn excessively, it should be replaced.

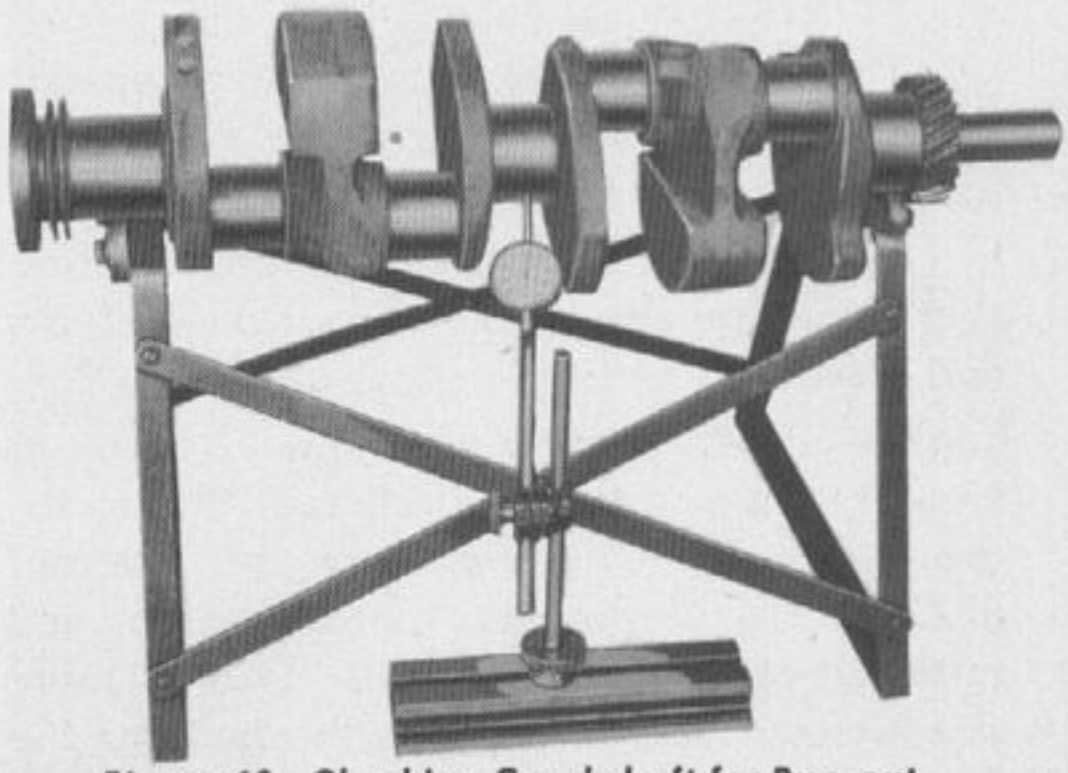

Figure 60—Checking Crankshaft for Run-out

ENGINE PARTS RECONDITIONING

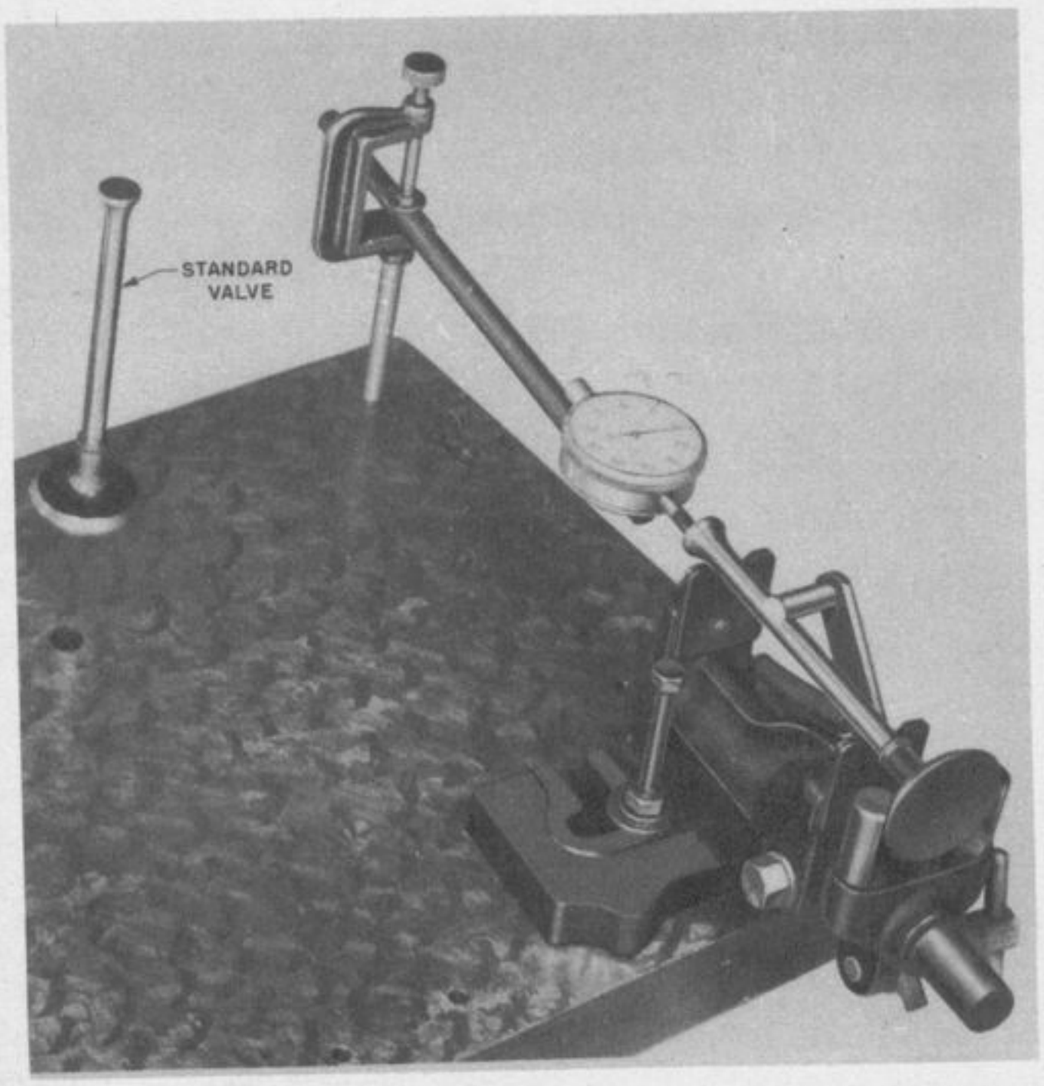

Figure 61—Measuring Valve Stem Length

4. VALVES, SPRINGS AND GUIDES.

a. VALVES. Valves with warped or badly burnt heads that will not clean up should be scrapped when refacing. Check valve stem length (Fig. 61). Check for bent valve stems (Fig. 62). Replace valves that have stems bent in excess of 0.001 inch.

b. VALVE SPRINGS. Avoid cleaning valve springs in caustic solution as this will destroy the rustproof coating on the spring. Check the tension of each valve spring (Fig. 63). Replace all valve springs that check five or more pounds under the following specifications when compressed to the length indicated:

Part Number	Lbs.	Length
52-6513—HP	60	1¾ in.
78-6513—All models	80	1¼ in.
86H-6513—Lincoln Zephyr	51	2⅛ in.

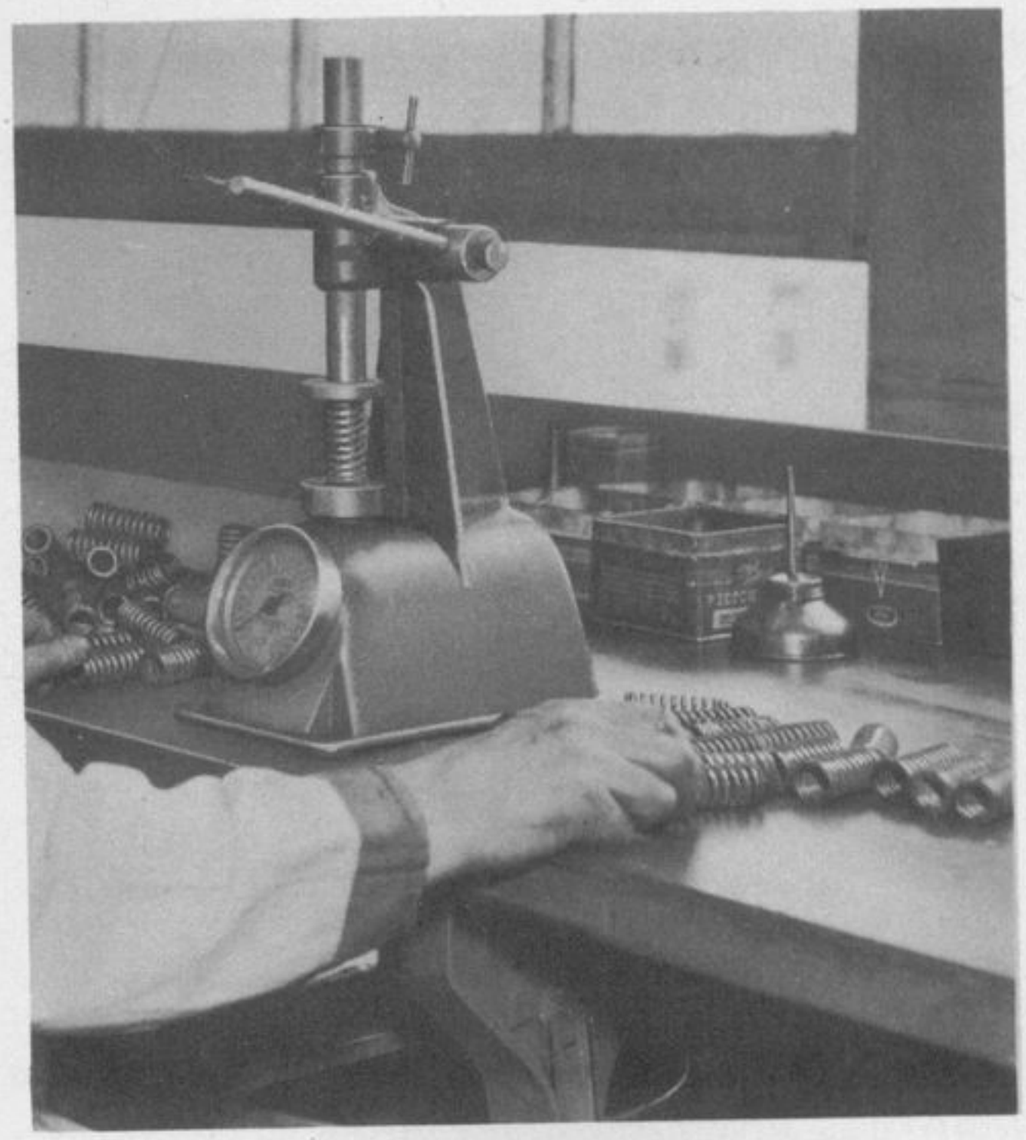

Figure 63—Checking Valve Spring Tension

5. PUSH RODS.

Inspect push rods for cracks and excessive

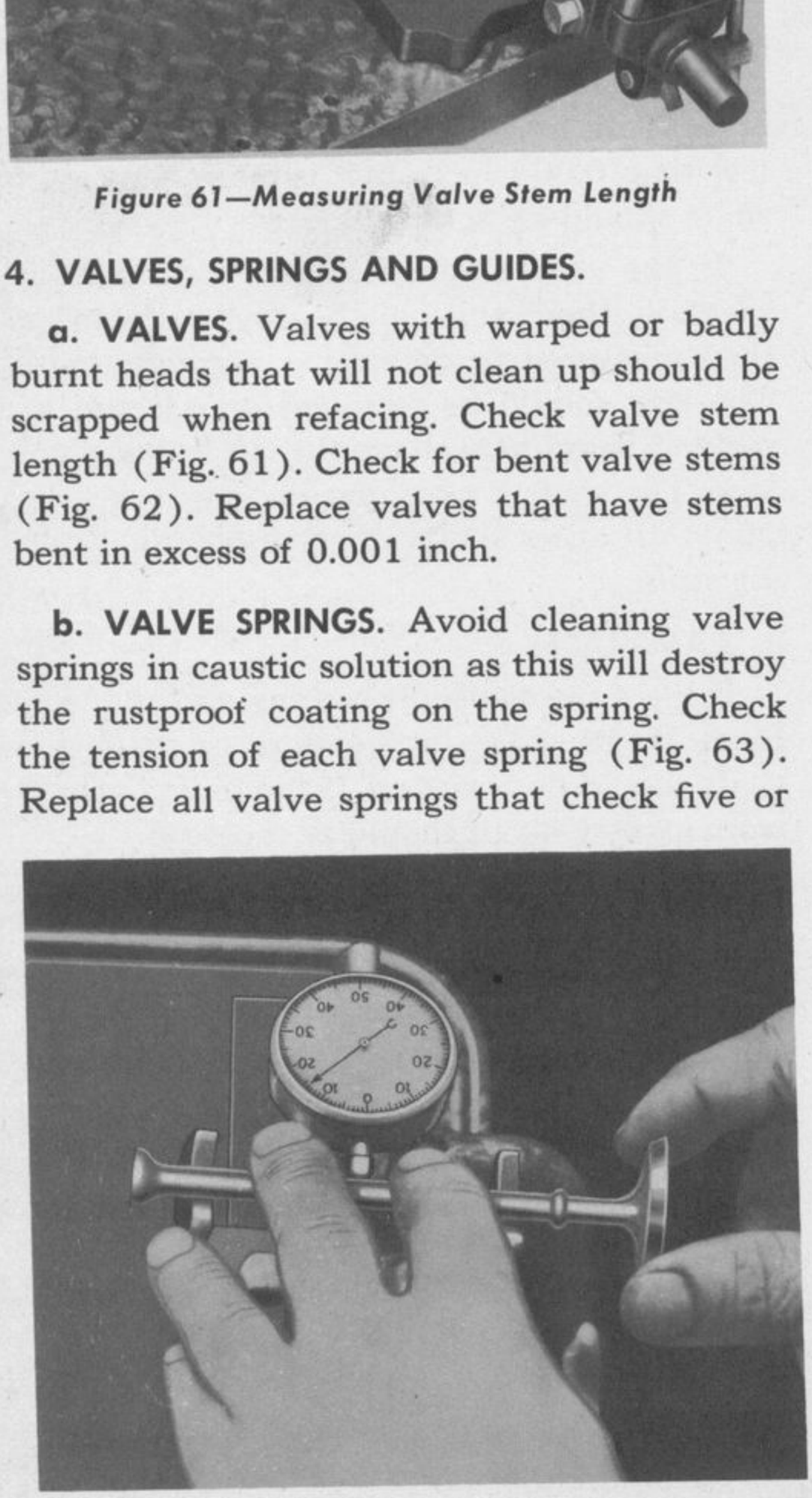

Figure 62—Checking for Bent Valve Stem

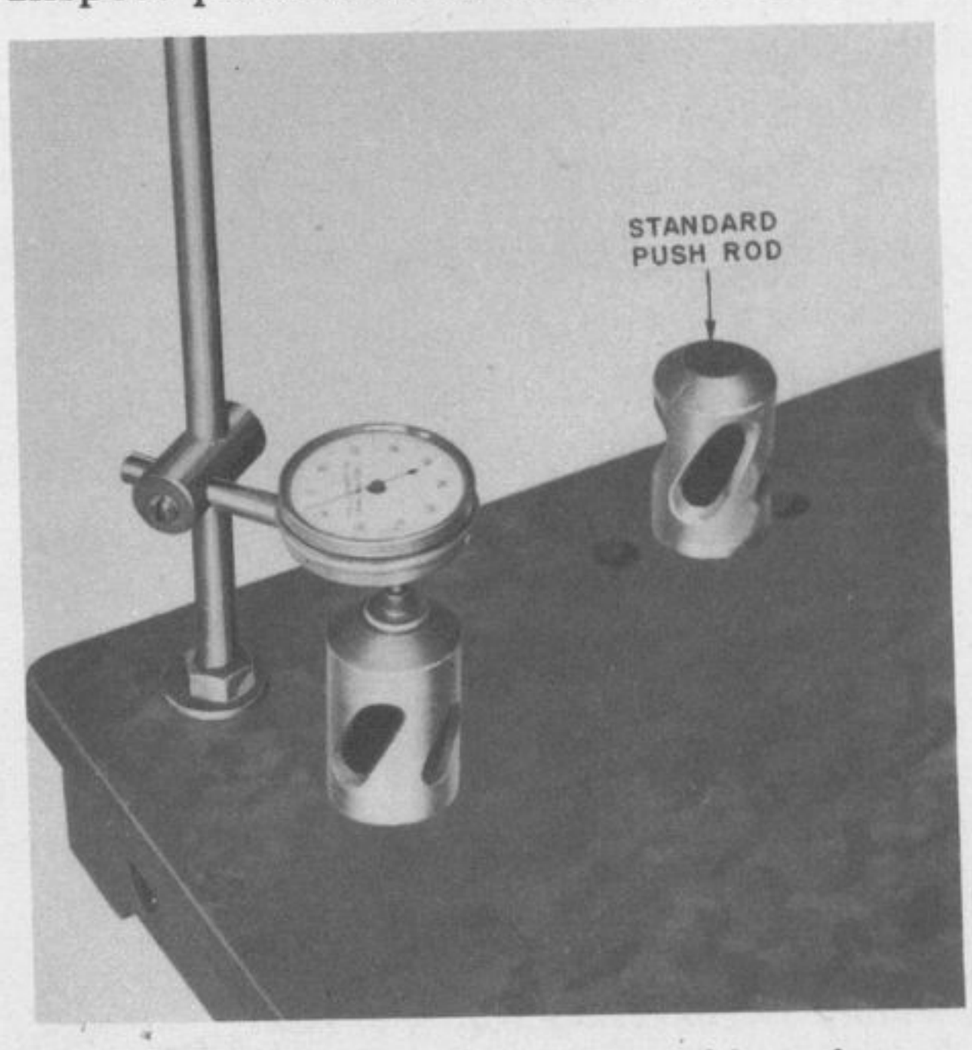

Figure 64—Measuring Push Rod Length

wear. Check length of each push rod (Fig. 64). The standard length for the 18 and 91-6500 push rod is 1.720 inches to 1.725 inches. Any push rod 0.020 inch or more under the standard length, should be scrapped.

6. OIL PUMP.

Disassemble oil pump and clean all parts thoroughly. Replace oil pump body if badly worn. Scrap the pins which hold gear to oil pump shaft if they are loose. It is seldom necessary to replace the oil pump shaft as most of the wear takes place in the body. Scrap the driven gear if worn excessively.

7. CONNECTING RODS.

Check length of rods, center to center. The standard rod lengths are:

Model	Length
Ford & Mercury V8	6.998 in. to 7.002 in.
60 HP V8	6.123 in. to 6.127 in.
1 GA—6 Cyl.	6.998 in. to 7.002 in.
9 N—4 Cyl.	6.998 in. to 7.002 in.
Lincoln Zephyr	7.398 in. to 7.402 in.

The rod should be scrapped if the center to center length is 0.015 inch under the standard length, otherwise, when a connecting rod bearing partially or completely fails on a short rod, the crankshaft counterweight may strike the piston, causing irreparable damage to the engine.

Scrap all connecting rods if the bores are so worn that further machining will expose the connecting rod studs to the bearings or face.

Check rods for mismatched caps—not only as to numbers, but as to types, i.e., 91A rods with 48 type caps or shanks with caps that are misfitted and offset at the parting line.

Rods with visibly worn or battered threads should be scrapped.

Rod caps that have been filed, milled, or ground excessively cannot be used. The original lengths of the cap bosses are:

Type	Length
52 or 92A-6200	$19/32$ in.
18 or 48-6200	$11/16$ in.
91A or 21A-6200	$3/4$ in.
99A or 29A-6200	$25/32$ in.

D—REPAIR

1. CYLINDER BLOCK.

a. BORING CYLINDERS. The cylinder bore sizes listed in figure 65 have a tolerance of plus 0.001 inch, never undersize. The piston sizes have a tolerance of minus 0.001 inch from the size given. Automatically, then, new standard size pistons will fit a standard size bore. Oversize pistons are the specified amount larger than the standard piston and not that amount larger than the standard bore.

Remember in reboring cylinders that if you desire to fit oversize pistons, first determine at what diameter the cylinder will clean up. Then determine what oversize pistons are available and bore the cylinder oversize in the amount the piston is oversize, leaving from 0.0015 inch for honing (where sleeves are to be installed, don't leave stock for honing).

When cylinders have reached their boring limit (0.060 inch oversize) the V-8 Ford block can be sleeved and restored to the standard bore. The V-8 Mercury block can be sleeved with the 11A6055 sleeve after which it becomes a standard V-8 Ford block. V-8 blocks with 11A6055 sleeves when worn can be bored to 0.030 oversize.

b. REPLACE CYLINDER SLEEVES.

(1) TYPES OF SLEEVES. Two types of sleeves have been used in Ford engines, the difference being the thickness of the sleeve walls. Engines containing sleeves with a wall thickness of 0.060 inch or 0.090 inch require the use of a sleeve puller to remove the sleeves from the cylinder. Engines containing sleeves with a wall thickness of 0.040 inch can be removed as outlined in the following paragraphs. The type of sleeves an engine contains can be determined by a visual inspection.

(2) REMOVAL OF THIN TYPE SLEEVES. Drive a thin cap chisel lightly between the cylinder wall and the sleeve. This bends the sleeve inward. Insert a thin drift into the opening made by the cape chisel. Drive the drift the full length of the sleeve. This causes the sleeve to collapse, after which it can easily be removed without the use of special tools.

(3) INSTALL CYLINDER SLEEVES.

(a) PRELIMINARY STEPS. Clean the cylinder walls. Remove all rough edges, raised metal at the bottom of the cylinders and carbon accumulations in the chamber at the top of the cylinder bore. Clean the cylinder sleeves thoroughly and remove all nicks and burrs.

(b) PRESS SLEEVES IN CYLINDERS. Aline sleeve in cylinder by hand. Attach the sleeve replacer as shown in figure 30 or 31. Press the sleeve into the cylinder slowly to be sure it does not tilt to one side, causing it to buckle.

(c) CHECK SLEEVES AFTER INSTALLATION. Check cylinder sleeves with a plug gage after installation to make sure the sleeves have not buckled during the pressing operation. Sleeves found to be buckled must be removed and a new sleeve installed.

(4) REBABBITT AND LINE REAM MAIN BEARINGS.

(a) GENERAL. A survey recently made indicated that on the average, 25 percent of the total engines reconditioned have poured babbitt main bearings. The rebabbitting procedure is as follows:

(b) POUR BABBITT. Remove old babbitt from the block and caps. Thoroughly

CYLINDER BORING SIZES

Model	Std.	.015	*.020	*.030	*.040	.045	*.060
A-B	3.875 3.876	3.890 3.891	3.895 3.896	3.905 3.906	3.915 3.916	3.920 3.921	3.935 3.936
60	2.600 2.601	2.615 2.616	2.620 2.621	2.630 2.631	2.640 2.641	2.645 2.646	2.660 2.661
85-90	3.062 3.063	3.0775 3.0785	3.0825 3.0835	3.0925 3.0935	3.1025 3.1035	3.1075 3.1085	3.1225 3.1235
95-100	3.1875 3.1885	3.2025 3.2035	3.2075 3.2085	3.2175 3.2185	3.2275 3.2285	3.2325 3.2335	3.2475 3.2485
6 Cyl.	3.300 3.301	3.315 3.316	3.320 3.321	3.330 3.331	3.340 3.341	3.345 3.346	3.360 3.361
4 Cyl.	3.1875 3.1885	3.2025 3.2035	3.2075 3.2085	3.2175 3.2185	3.2275 3.2285	3.2325 3.2335	3.2475 3.2485
L. Z. 86H	2.750 2.751	2.765 2.766	2.770 2.771	2.780 2.781	2.790 2.791	2.795 2.796	2.810 2.811
L. Z. 06H	2.8750 2.8755	2.8900 2.8905	2.8950 2.8955	2.9050 2.9055	2.9150 2.9155	2.9200 2.9205	2.9350 2.9355
L. Z. 26H	2.9375 2.9380	2.9525 2.9530	2.9575 2.9580	2.9675 2.9680	2.9775 2.9780	2.9825 2.9830	2.9975 2.9980

*These oversizes conform with Government Order L 158.

SLEEVE BORING SIZES

Model	Cylinder Block Bore	Sleeve Diameter	Sleeve Flange Dia.	Counterbore Diameter	Counterbore Depth
91A	3.1434 3.1437	3.1434 3.1443	3.248 3.2520	3.258 3.2620	.042 .044
99A .040 Sleeve	3.2684 3.2687	3.2684 3.2693	3.3725 3.3775	3.3825 3.3875	.042 .044
99A .060 Sleeve	3.3084 3.3087	3.3084 3.3093	3.3725 3.3775	3.3825 3.3875	.064 .066
52A	2.6809 2.6812	2.6809 2.6818	2.785 2.790	3.795 3.800	.044 .046

Figure 65—Cylinder and Cylinder Sleeve Boring Sizes

clean all caps. Coating the surface with soldering fluid creates a bond between babbitt and cap.

See that the babbitt is thoroughly melted and will pour freely (800° F. to 850° F.). Skim the dirt from the top of the babbitt as any dirt or impurities in the babbitt will produce a poor bearing.

Set up the babbitting jigs. Heat the block and mandrel. If the babbitt is poured in a cold block, it will splatter and not adhere to the block. Pour babbitt slowly at first so all space will be filled, otherwise blow holes will be formed. Use the same procedure for the main bearing caps.

When babbitt is thoroughly cooled, remove jigs. Thoroughly peen the babbitt in block and caps. Trim off excess babbitt and clean surface of block and caps.

(c) LINE REAMING. Bolt the caps in place and install the line boring fixture. Set the cutting bit to proper diameter. Bore and face bearings. Remove the caps, open the oil lines, blow babbitt cuttings from the block and replace the caps.

(5) REFACE VALVE SEAT. Make sure that the valve seats are in good condition. Keep the refacing stone properly dressed. The valve grinder pilot must fit snugly. If the width of the valve seat face is more than 0.090 inch for the intake or 0.0100 inch for the exhaust after refacing, the seats should be narrowed by means of a valve port angle cutter. Check an occasional valve seat with a valve seat dial gage as shown in figure 69 to be sure the grinder is doing its work properly.

(6) CLEAN BLOCK. After all of the machine work has been performed on the cylinder block, it is most important that dust and metal shavings be cleaned from the cylinder block, oil lines and water jackets. Remove oil line plugs. Flush out main bearing oil lines. Flush out main oil line through engine. Remove freeze plugs. With long thin scraper and flexible wire, work loose all rust and cooling liquid sediment that can be reached through the various block openings. Flush the loosened matter out through the freeze plug openings. Reinstall oil line and freeze plugs.

2. REGRIND CRANKSHAFTS.

Clean any grit from the crankshaft journals. Crankshaft centers must be in good condition; if not, the crankshaft must be recentered. Have the grinding wheel dressed, sharp and true. Mount the crankshaft in the grinder.

It is good practice to grind the most worn journal of the crankshaft first. This will determine the size to which the crankshaft will have to be ground. Detail instructions for the grinding operation have been omitted as it is assumed an experienced operator will perform the operation. (The chart in figure 70 shows crankshaft grinding sizes.)

After the grinding has been completed, the crankshaft oil passages must be carefully swabbed and washed out with kerosene or flushing oil.

3. CONNECTING RODS AND PISTON PIN BUSHINGS.

a. REGRIND. Connecting rods are reground to 0.004, 0.005, 0.008, and 0.010 inch oversize (Fig. 17). Identify each oversize with a designated color of paint. As the rods are finished, they are matched according to sizes in sets of eight and held together with a holder (Fig. 56). After the grinding operation has been completed (Fig. 17), check the diameter, out-of-round and taper. The maximum allowable out-of-round for all types of rods is 0.0003 inch. The maximum allowable taper is 0.0002 inch.

The standard diameter of the various rods is:

	Diameter		Out of	
Type	Min.	Max.	Round	Taper
52	1.7995″	1.8000″	0.0003″	0.0002″
92	1.8995″	1.9000″	0.0003″	0.0002″
18-48-91A	2.2195″	2.2200″	0.0003″	0.0002″
99A-29A	2.3595″	2.3600″	0.0003″	0.0002″

b. REPLACE PISTON PIN BUSHING AND FIT PISTON PIN. Remove old bushing and remove burred edge of rod bore with a 45 degree tapered reamer, (otherwise the metal will be scraped off the new bushing, causing it to be a loose fit in the rod). Press a new

bushing in rod and ream and burnish or hone to the following sizes:

Type	Diameter
52-92	0.6877" to 0.6880"
18-48-91A	0.7503" to 0.7506"
99A-29A	0.7503" to 0.7506"

Check the piston pin fit in the rod. Make sure piston pin and rod bushing are clean and dry. Hold the rod in one hand (Fig. 66) and start the pin in the hole. When released, the pin should drop slowly through the piston pin bushing of its own weight. With the pin in position in the bushing, check the rod for alinement (Fig. 67).

Figure 66—Checking Fit of Piston Pin in Connecting Rod Bushing

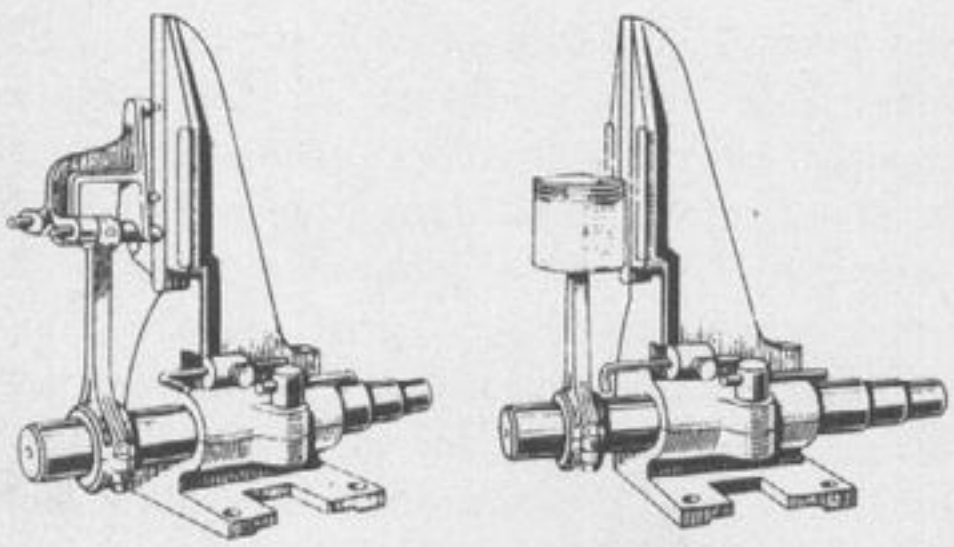

Figure 67—Alining Fixtures

4. OIL PUMP.

Assemble the oil pump with new gaskets. Replace the screen if it is badly bent or has a broken reinforcement. Test oil pump by placing it in a vessel containing fuel oil or kerosene. Twirl oil pump driving gear by hand. Liquid should spurt from oil line opening.

5. PISTON PINS.

When fitting new piston pins to piston, make sure piston pin and piston are clean and dry.

a. STEEL PISTONS. The tolerance between the piston pin and steel piston is from 0.0005

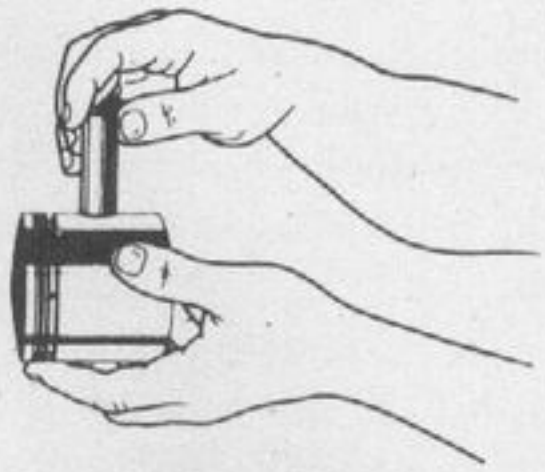

Figure 68—Checking Fit of Piston Pin in Piston

inch to 0.0007 inch loose. Check the fit by holding the piston in one hand (Fig. 68) and start the piston pin in the hole, the pin should drop through the piston of its own weight with a slight drag.

b. ALUMINUM PISTONS. The tolerance between the piston pin and aluminum piston, is from 0.0001 inch to 0.0003 inch loose. This tolerance produces a thumb-press fit. (Pin can be pressed in by means of thumb-pressure.) Pins that do not require the pressure of the thumb fit too loose. When making the above checks, both the piston and pin must be of approximately the same temperature (approximately 70° F.).

6. PUSH RODS.

Do not grind more than 0.020 inch from standard length of push rods or the base will be weakened. Most push rods will clean up by grinding from 0.005 to 0.020 inch under standard length.

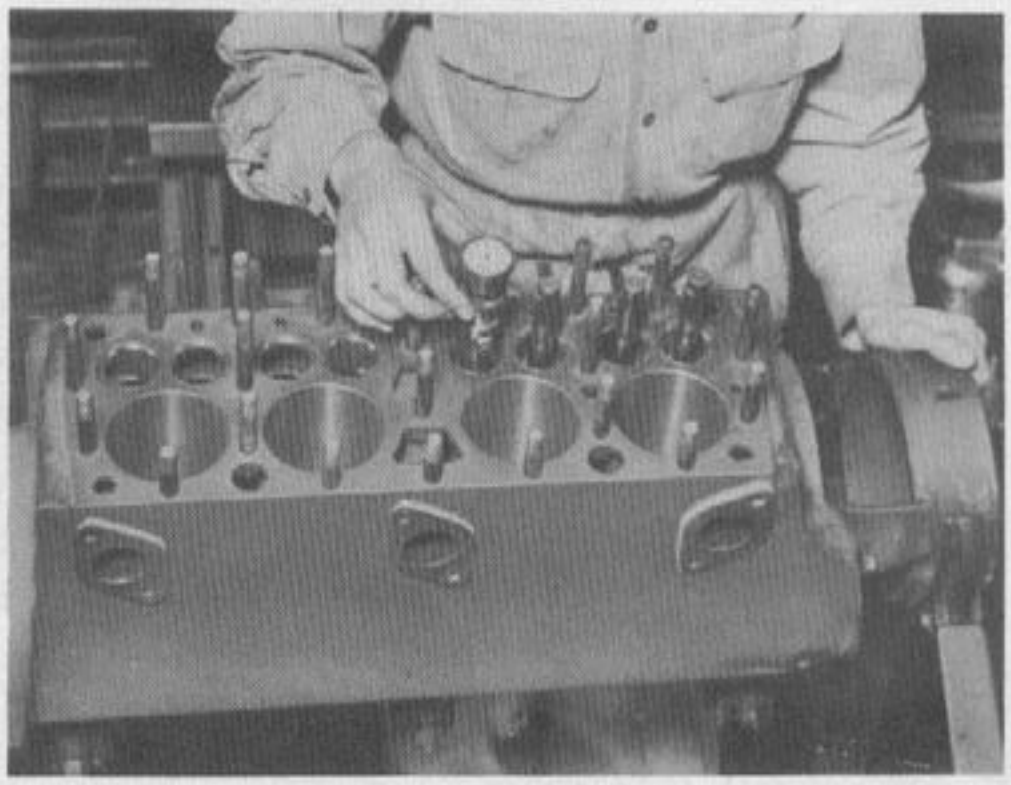

Figure 69—Checking Valve Seat

CONNECTING ROD JOURNAL UNDERSIZES

Model	Std.	*.002	.003	*.005	*.010	.015	*.020	*.030
A	1.497 1.499	1.495 1.497	1.494 1.496	1.492 1.494	1.487 1.489	1.482 1.484	1.477 1.479	1.467 1.469
B	1.873 1.874	1.871 1.872	1.870 1.871	1.868 1.869	1.863 1.864	1.858 1.859	1.853 1.854	1.843 1.844
52	1.598 1.599	1.596 1.597	1.595 1.596	1.593 1.594	1.588 1.589	1.583 1.584	1.578 1.579	1.568 1.569
022A	1.698 1.699	1.696 1.697	1.695 1.696	1.693 1.694	1.688 1.689	1.683 1.684	1.678 1.679	1.668 1.669
18-68-91	1.998 1.999	1.996 1.997	1.995 1.996	1.993 1.994	1.988 1.889	1.983 1.984	1.978 1.979	1.968 1.969
99A	2.138 2.139	2.136 2.137	2.135 2.136	2.133 2.134	2.128 2.129	2.123 2.124	2.118 2.119	2.108 2.109
9N	2.0935 2.0945	2.0915 2.0925	2.0905 2.0915	2.0885 2.0895	2.0835 2.0845	2.0785 2.0795	2.0735 2.0745	2.0635 2.0645
1GA	2.2343 2.2351	2.2323 2.2331	2.2313 2.2321	2.2293 2.2301	2.2243 2.2251	2.2193 2.2201	2.2143 2.2151	2.2043 2.2051
L. Z. H.	2.1255 2.1260						2.1055 2.1060	
L. Z. 26H	2.2495 2.2500		SEE	NOTE			2.2295 2.2300	

MAIN BEARING JOURNAL UNDERSIZES

A	1.622 1.624	1.620 1.622	1.619 1.621	1.617 1.619	1.612 1.614	1.607 1.609	1.602 1.604	1.592 1.594
B	1.998 1.999	1.996 1.997	1.995 1.996	1.993 1.994	1.988 1.989	1.983 1.984	1.978 1.979	1.968 1.969
52	1.998 1.999	1.996 1.997	1.995 1.996	1.993 1.994	1.988 1.989	1.983 1.984	1.978 1.979	1.968 1.969
022A	2.098 2.099	2.096 2.097	2.095 2.096	2.093 2.094	2.088 2.089	2.083 2.084	2.078 2.079	2.068 2.069
18	1.998 1.999	1.996 1.997	1.995 1.996	1.993 1.994	1.988 1.989	1.983 1.984	1.978 1.979	1.968 1.969
68	2.398 2.399	2.396 2.397	2.395 2.396	2.393 2.394	2.388 2.389	2.383 2.384	2.378 2.379	2.368 2.369
91A-99A	2.498 2.499	2.496 2.497	2.495 2.496	2.493 2.494	2.488 2.489	2.483 2.484	2.478 2.479	2.468 2.469
9N	2.248 2.249	2.246 2.247	2.245 2.246	2.243 2.244	2.238 2.239	2.233 2.234	2.228 2.229	2.218 2.219
1GA	2.4986 2.4994	2.4966 2.4974	2.4956 2.4964	2.4936 2.4944	2.4886 2.4894	2.4836 2.4844	2.4786 2.4794	2.4686 2.4694
L.Z.	2.4005 2.4010						2.3805 2.3810	

*These undersizes conform with Govt. Order L-158.

NOTE: Lincoln Zephyr have only two grinding sizes for mains and rods. (.020) and .040) undersize.

Figure 70—Crankshaft Grinding Sizes

E—ASSEMBLY

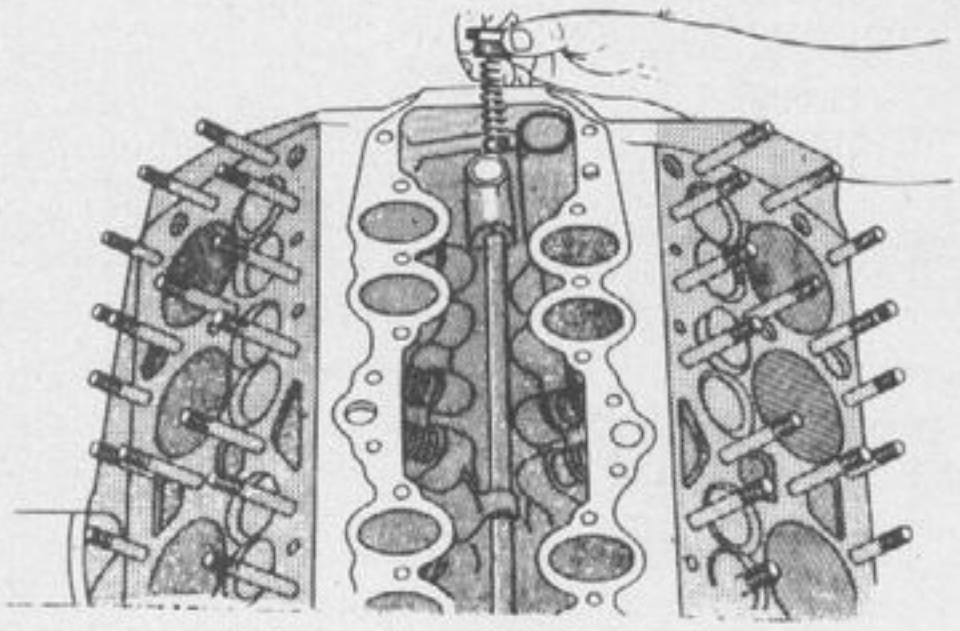

Figure 71—Oil Relief Valve

1. CYLINDER BLOCK.

Install oil line plugs. Install oil relief valve (Fig. 71). Install valve chamber oil baffles (Fig. 72). Install front and rear oil seal.

2. INSTALL CRANKSHAFT IN CYLINDER BLOCK (Babbitt Type Bearing).

Remove main bearing caps, wipe the block half of bearings clean and see that oil passages are free. Cover bearings with a thin film of oil. Examine crankshaft to be installed for identification marking on the front end. Some 21A-6303 and 29A-6303 crankshafts have a figure 8 stamped on the shaft. A shaft so marked is to be used with 21A and 29A pistons because of the extra piston weight on the shaft.

Carefully lay, *do not drop,* crankshaft into the bearings in the block. Use care to see that sharp edges of shaft do not damage bearing edges.

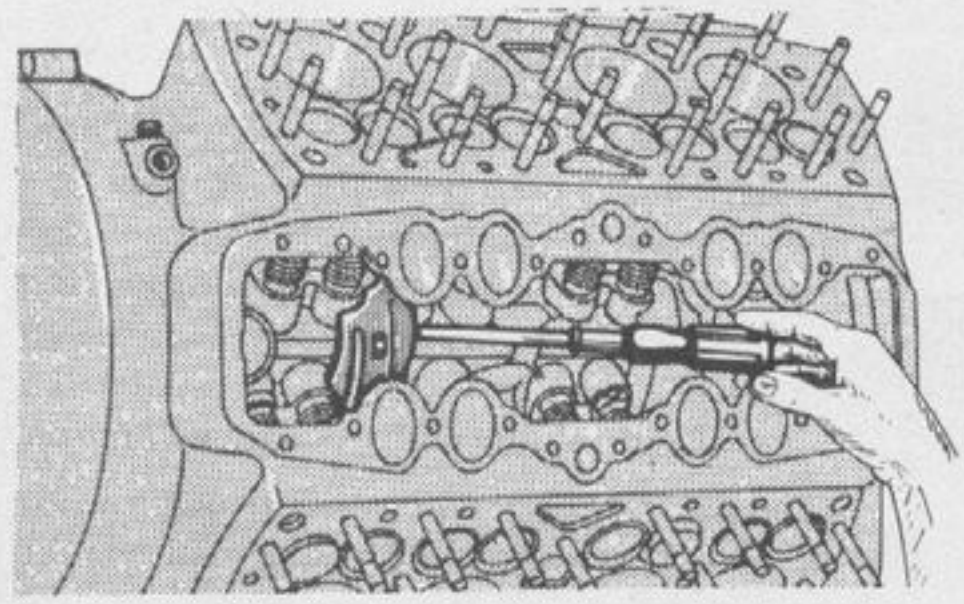

Figure 72—Valve Chamber Oil Baffle

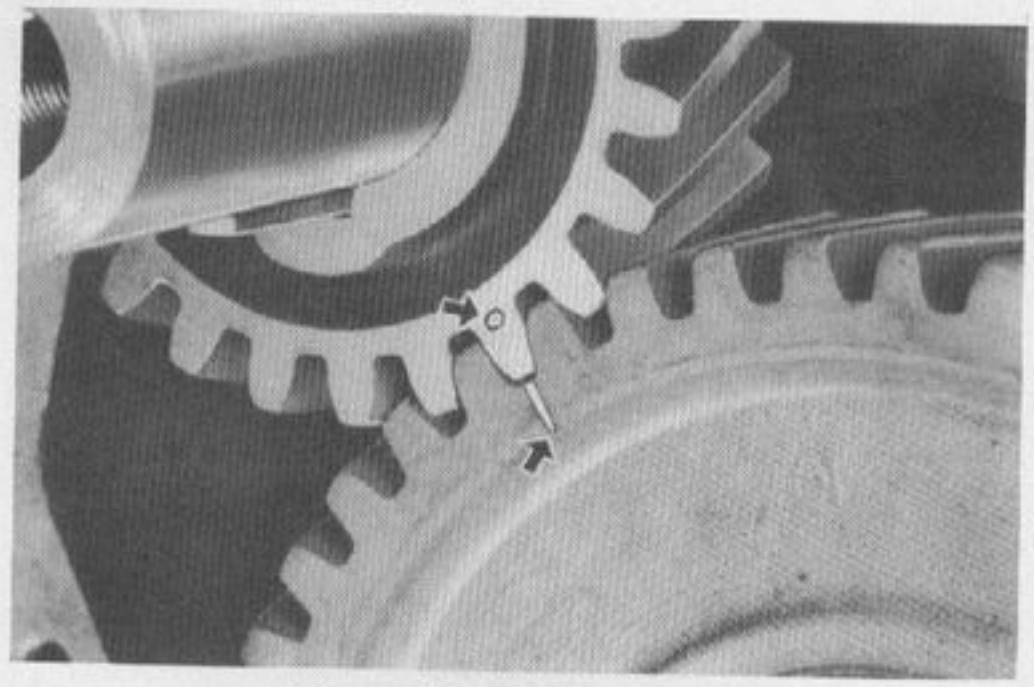

Figure 73—Timing Marks

Spin the crankshaft by hand. It should move freely and have end play of from 0.002 to 0.006 inch measured between rear bearing flange and crankshaft.

Wipe main bearing caps clean, cover with a thin film of oil and install. Tighten the cap nuts with a tension wrench from 75 to 85 ft. lbs. Turn the crank several revolutions, the drag should be equal at all points. Lock bearing cap nuts with wire.

3. INSTALL CRANKSHAFT IN CYLINDER BLOCKS (Liner Type Bearings).

Examine cylinder block for "E.R.P." stamped on front end, right side. All blocks so marked are machined for 0.015 inch oversize outside diameter main bearing liners and

Figure 74—Push Rod on Heel of Cam

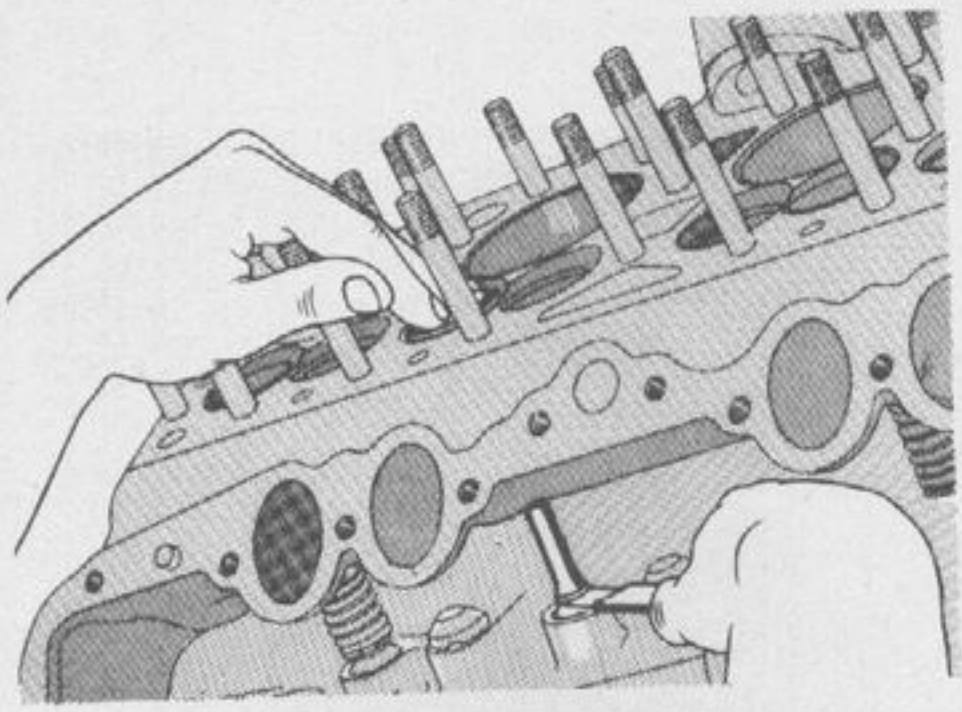

Figure 75—Checking Valve Clearance

0.010 inch oversize between flanges. If there is any doubt, measure main bearing bores with micrometers.

See that the oil holes in the bearings are alined with the holes in the block.

4. INSTALL CAMSHAFT.

Lower the camshaft into its bearings, using care that the sharp corners of the cams do not cut into the babbitt bearing. Set the timing marks on crankshaft gear and camshaft gear together (Fig. 73).

5. INSTALL VALVE ASSEMBLIES.

Clean and oil the push rods and install them in the block. Set the valves in place in the block without the valve guides. Be sure the valves marked with the letter "R" are only installed in the intake ports.

Establish the clearance between each push

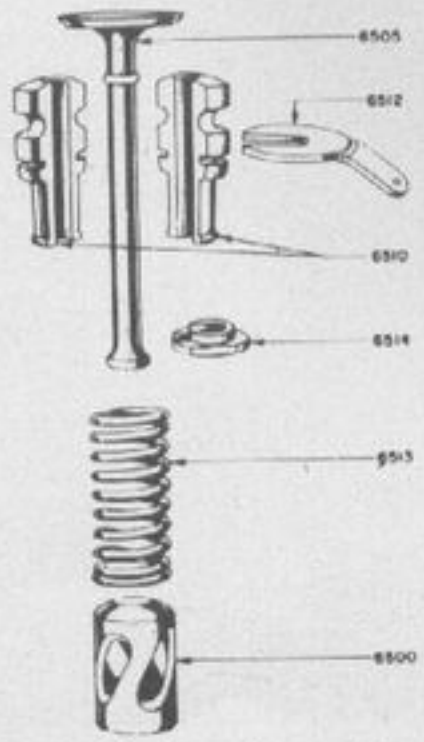

Figure 76—Valve Assembly Parts

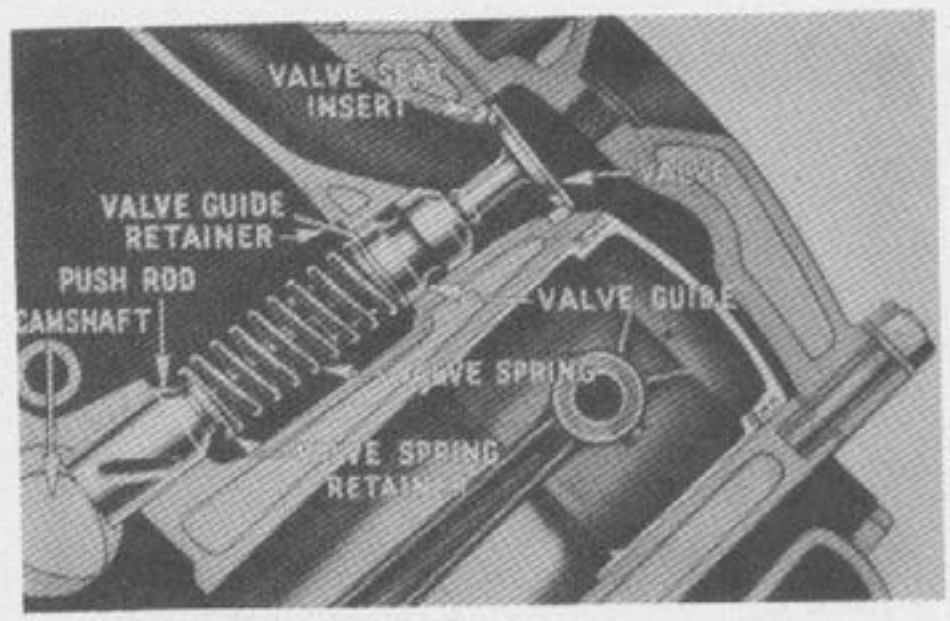

Figure 77—Valve Assembly in Place

rod and valve when the push rod is on the heel of the cam (Fig. 74) at from 0.010 to 0.012 inch for the intake valves and from 0.015 to 0.017 inch for the exhaust valves. Figure 75 shows checking clearance with feeler gage.

Leave each valve in the port in which the clearance was established.

Be sure the valve guide bushings are in pairs. Assemble the valve springs and valve guide bushings to valves. Figure 76 shows the parts of the valve assembly. Install each valve assembly in the port to which the clearance was set, making sure that the split center line of the valve guide bushing faces the valve chamber. This permits the prongs of the retainer to fully surround both halves of the valve guide bushing. Figure 77 shows the valve assembly in place.

Figure 78—Fitting Piston to Cylinder Bore

 Sleeved

Engine	Material	Skirt	Thickness Feeler Blade		Pounds Pull
			Sleeved	Plain Bore	
60 H.P.	Steel	Solid	.0025	.002	7 to 12
85-95 H.P.	Steel	Solid	.003	.0025	6 to 10
85-95 H.P.	Aluminum	"T" Slot	.0025	.002	6 to 10
95-100 H.P.	Aluminum	"T" Slot		.0025	6 to 10
95-100 H.P.	Steel	Solid		.003	6 to 10
6 Cyl., 90 H.P.	Steel	Solid		.0025	6 to 10
6 Cyl., 90 H.P.	Aluminum	"T" Slot		.003	6 to 12
8 Cyl., 40 H.P.	Steel	Solid	.003	.0025	7 to 12
L. Z.	Steel	Solid		.002	4 to 8

Figure 79—Fit of Piston in Cylinder Bore

Six Cylinder Valve Guides. The intake six cylinder valve guides have an oil relief slot and drain hole to prevent oil from being drawn into the combustion chamber. These guides should always be assembled in the intake ports.

6. ASSEMBLE PISTONS AND RODS.

Wipe piston pins and connecting rods clean. Assemble the pistons to the rods, leaving the piston pin retainers out until the pistons have been fitted to each cylinder.

Check the clearance of the pistons in the cylinder bore, using a ½ inch wide feeler blade with a pull scale (Fig. 78). Install the piston and feeler blade into the cylinder bore together. Hold the piston in place and pull on the scale, observing the pounds pull required to move the feeler blade. It may be necessary to try several pistons in a particular cylinder before the correct fit is obtained. Figure 79 shows the thickness of feeler blade and pounds pull for various pistons. After each piston has been fitted, install the piston pin retainer (Fig. 80). Check alinement of piston and rod assembly (Fig. 67).

7. FIT AND INSTALL PISTON RINGS.

a. GENERAL. Each piston (except heavy duty) has three rings, the top and middle rings are compression rings. The bottom ring is an oil control ring with an expander. The heavy duty type piston has two compression rings at the top and two oil control rings, one below the piston pin.

b. ESTABLISH RING GAP. Check each ring for correct gap of 0.010 to 0.015, as follows: Place one ring at a time in the cylinder bore to which it is to be fitted. Place a piston against the ring and gently push downward to square the ring in the cylinder bore.

Check the gap with a feeler gage, if under 0.010 inch, remove the ring and file the ends in a filing block (Fig. 81) until the gap is within the limits. If ring has a gap over 0.015 inch, select the next oversize ring.

Leave each ring in cylinder bore after fitting so that they will be ready to be installed on the piston fitted to that particular cylinder.

c. FIT RINGS TO PISTONS.

Remove rings from one cylinder at a time and install the piston fitted to that particular cylinder.

Make sure each ring is free in the groove by rolling the back side of the ring around the

Figure 80—Installing Piston Pin Retainer

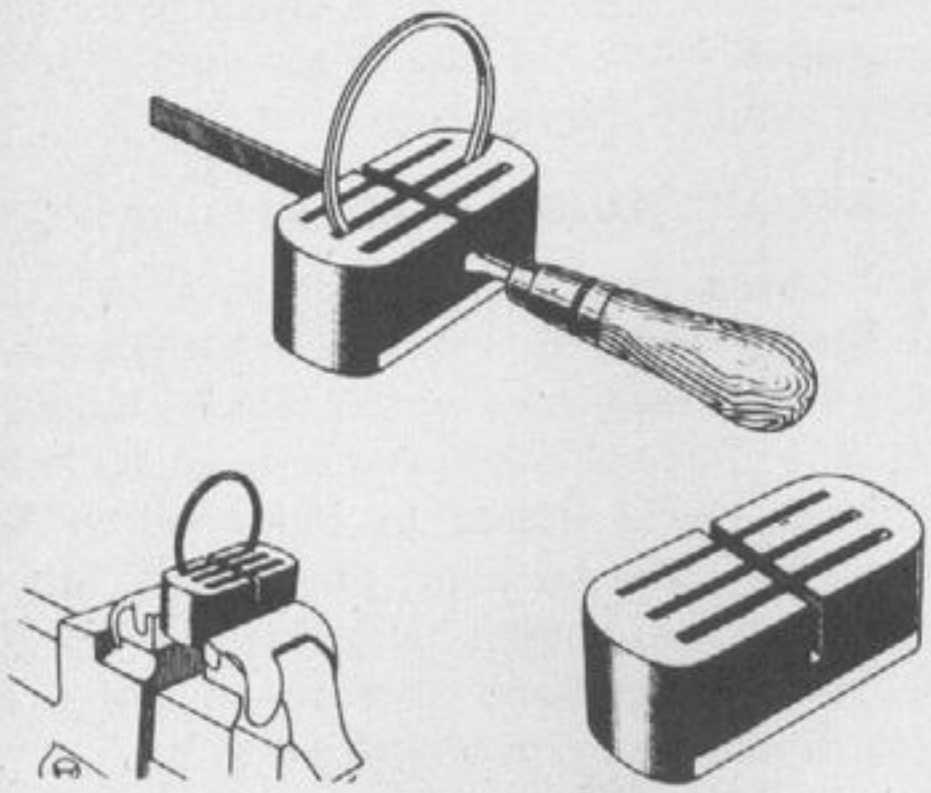

Figure 81—Piston Ring Filing Block

groove in the piston. The correct clearance of the ring in the piston groove is from 0.0025 to 0.003 inch.

Install the rings on the piston, installing the bottom ring first, the middle ring next and the top ring last, making sure the middle and top ring are installed with the side marked "top" toward the top of the piston.

Care should be used when installing rings not to over expand or twist them as this will result in distortion or breakage. Hold the piston in a horizontal position and rotate it slowly, the compression rings should drop to the bottom of the grooves and continue to do so as the piston is rotated. It will be necessary to use a feeler gage to check the fit of the oil rings.

In case a ring is too tight in the groove, re-

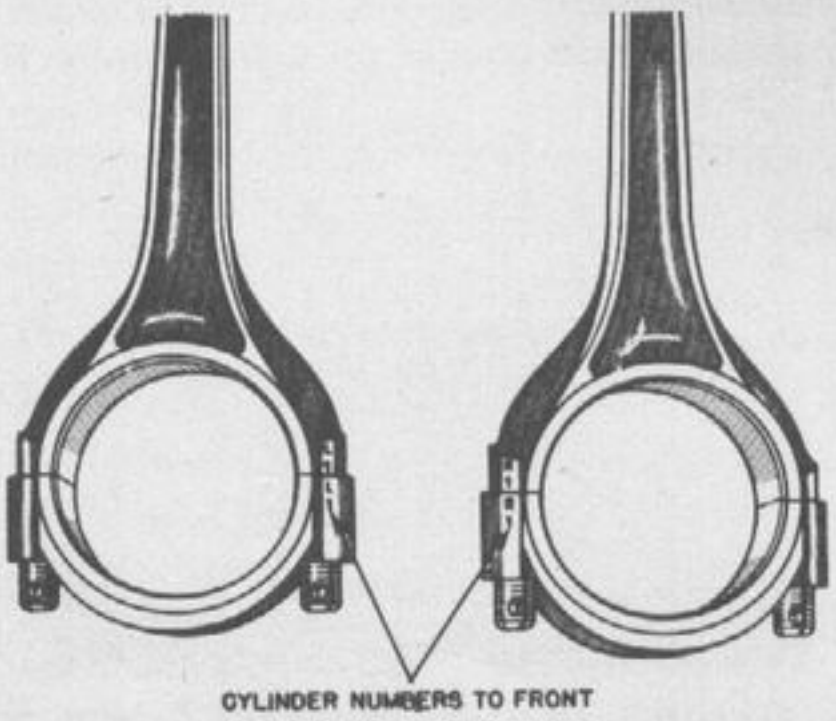

Figure 82—Connecting Rod Marks

Figure 83—Installing Pistons

move the ring and examine groove for burred edges. Use a thin file to remove any burrs from the groove. Also measure the ring width, if found slightly oversize, place the ring flat on a piece of crocus cloth and move evenly back and forth several times.

8. INSTALL PISTON AND ROD ASSEMBLIES.

Oil the piston pin and the rod bushing and cover the cylinder wall with a light film of oil. Remove the connecting rod caps, noting the marking on rod and cap. Place the piston and rod assemblies on the engine stand with the cylinder block to which they have been fitted.

Start the pistons in cylinder bores with marks on connecting rods (Fig. 82) toward the front of the engine. Push the pistons in until the bottom rings just clear the top of the cylinder bores (Fig. 83). Clamp piston ring squeezer (Fig. 84) around the rings and push each piston down until all the rings have entered the cylinder bore.

9. ASSEMBLE CONNECTING RODS TO CRANKSHAFT.

Turn the engine over to the crankshaft side. Starting at the front of the engine, assemble the rods to the crankshaft, one at a time, in the following order: Number 1-L, 1-R, 2-L, 2-R, etc. Oil each connecting rod liner and

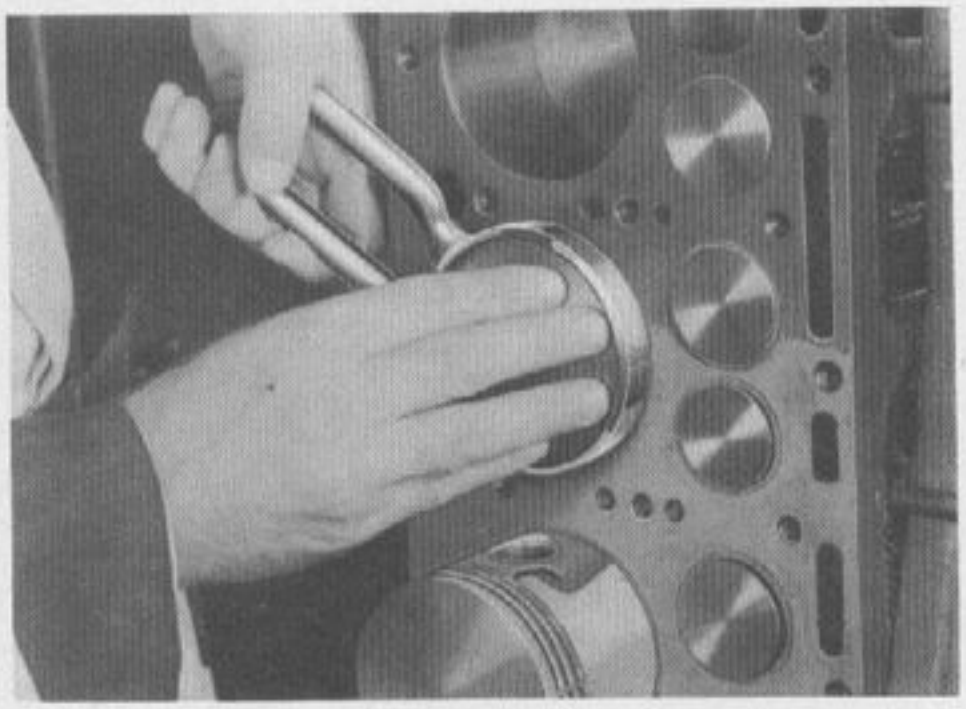

Figure 84—Piston Ring Squeezer

place on crankshaft throw. (The bearing should rotate freely by hand.)

Carefully pull each pair of rods against the liner with the numbered side of the rod toward the front of the engine. Be careful that the threads of the rod studs or the sharp edges of the rod do not scrape the polished surface of the rod liner.

Oil the rod cap and start it over the rod studs, making sure that the number on the cap corresponds with the number on the rod.

Hold the rod firmly against the liner and gently tap the rod caps in place. Install the rod stud nuts and tighten evenly with a tension wrench from 35 to 40 ft. lbs.

The Marsden self-locking nut used on the six cylinder engine connecting rods should be tightened to 50 ft. lbs.

Install cotter pins in connecting rod nuts. Spread the cotter pin so that one-half is over the stud and the other against the flat side of the nut. If a star washer is used, bend one prong against the flat side of the nut and two prongs against the rod cap.

10. INSTALL CYLINDER HEADS AND GASKETS.

Oil top of pistons and cylinder walls. Install head gaskets and cylinder heads. Tighten the cylinder head nuts with a tension wrench (Fig. 85). The cylinder head nuts on 60 H.P. aluminum heads should be tightened to 30 ft. lbs. The cylinder head nuts on all other aluminum heads should be tightened to 40 ft. lbs. The cylinder head nuts on all cast iron heads should be tightened to 50 ft. lbs.

Each reconditioned engine should have a tag attached explaining the importance of tightening the cylinder head nuts again to the above specifications after the engine is warmed up. Valve seat distortion, failure of gaskets and loss of compression may be caused by neglecting to correctly tighten cylinder head nuts after engine has been run.

11. FINISHED ENGINES.

Paint cylinder assemblies with standard Ford color. Store engine assemblies in boxes. Stencil each box, indicating type of engine.

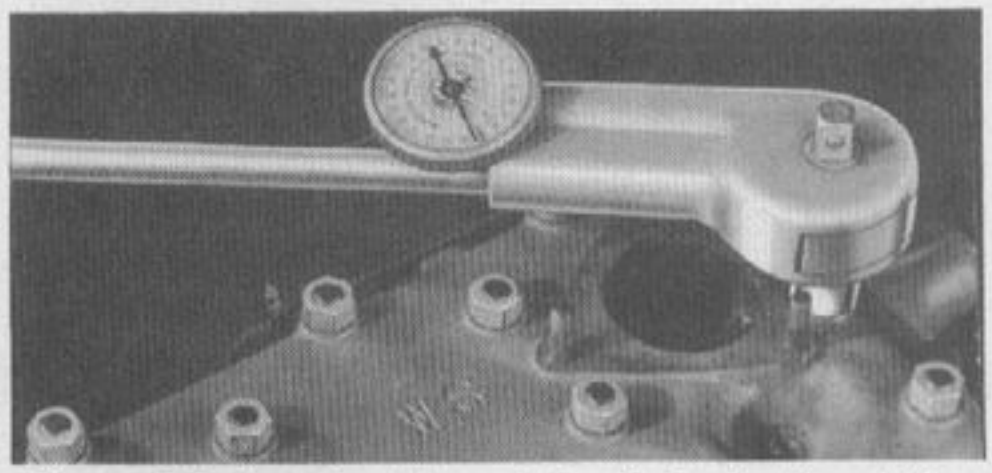

Figure 85—Tension Wrench for Cylinder Head Nuts

CHAPTER III

CARBURETORS

A—GENERAL

A sufficient quantity of assemblies must be handled at one time to make the work a production job so time required per unit will be minimized.

Each lot of assemblies that are worked on must all be of like size and type to avoid mixing parts.

Convenient storage spaces must be provided for all of the detail parts so, as the parts are inspected and reconditioned, they can be put right where they will be within reach for the reassembly operations.

The shop work space should be conveniently arranged to eliminate all avoidable steps or motions. For example, the hand tools should be kept in a cabinet or on a rack within reach of the mechanic so each tool may be picked up by merely reaching for it as needed and may be put right back in its place as soon as the operation for which it is used is finished.

After disassembly, the parts must be thoroughly cleaned prior to inspection, to determine which can be used again and which must be discarded.

Repeated performances of all operations in an efficient sequence will permit reducing the time required to a minimum and will be of material assistance in producing a finished product of uniform high quality.

Absolute cleanliness must be maintained at all times. After disassembly of any carburetors, it is particularly important to clean the work bench and tools, as well as to thoroughly clean the hands before starting the inspection and reconditioning of the cleaned parts. Care must be used in blowing out parts with compressed air to be sure chips and dirt are not blown into parts that have already been cleaned.

A suggested sequence of operations for the reconditioning of carburetors is outlined in this chapter. In describing the operations, the part numbers are shown for the 91A-9510-A Ford carburetor and the 67-9510-A Stromberg carburetor. For other models of carburetors, the proper part numbers for the respective parts can be obtained from the Ford and Mercury or Lincoln Chassis Parts and Price Lists.

After carburetors have been reconditioned, care must be used in handling, as a jolt may affect the float level or other parts. Carburetors should be placed in cartons to protect from dirt. Paper plugs should be placed in the fuel inlet opening.

B—CLEANING ZINC ALLOY CASTINGS

The materials used are: A cold degreasing solvent, mineral spirits, caustic soda and chromic acid.

Caustic tank should have a large sign over it marked "DANGER CAUSTIC."

Acid crock should have a large sign over it marked "DANGER ACID."

Boric acid should be available in one gallon bottle in plain sight near these materials so that it can be quickly poured over anyone who spills these acids on his body. A suitable sign for this would be marked "IF CAUSTIC SODA OR ACID IS IN EYE, POUR IN BORIC ACID."

Employes should wear rubber gloves, rubber acid-proof goggles and a rubber apron when handling these materials.

Special care must be used when filling containers for use.

When disposing of these solutions after

use, they should be heavily diluted with water.

Special care should be taken to see that the public cannot in any way come in contact with this layout. This especially applies to children.

Very Important—When mixing or diluting any of these solutions, add the caustic or acid to the water, adding slowly and stirring constantly. *Never add water to the acid or caustic.*

The most important safety factor is cleanliness.

Keep the floors clean.

Avoid overflowing the containers.

Avoid spilling when transferring from containers.

Guard against any leaks.

Keep warning signs, goggles and aprons in perfect condition at all times.

Place the parts in a suitable cold degreasing solvent. Various makes of degreasing solvents are available on the market. Usually about 15 minutes of soaking with some agitation of the solution is desired.

Rinse the parts in mineral spirits and brush away any loosened dirt or paint.

Place the parts in a caustic soda solution for not over 15 minutes. This solution should contain 1½ pounds of caustic soda (flake or granular caustic soda) per gallon of water. For the caustic to act on the parts, all oil and grease film must have been removed as outlined in operations numbers 1 and 2. This solution removes corrosion from sediment chamber of fuel pump and from float bowl of carburetor. It also brightens the parts.

Remove the parts from the caustic solution and rinse thoroughly in running water. Several minutes of rinsing is usually needed to remove all traces of caustic.

Dip the parts for not over 15 seconds in a chromic acid solution. This solution should contain the following materials per gallon of solution.

2 pounds of chromic acid, commercial grade

5 fluid ounces of commercial grade nitric acid

2½ fluid ounces of commercial grade sulphuric acid

Balance water.

After removing the parts from the chromic acid solution, rinse thoroughly in running water. Be sure the running water rinse is free of all traces of caustic before rinsing the parts removed from the chromic acid solution. A final rinse in hot water will make the parts dry faster.

It may be necessary to clean very badly corroded parts a second time, but for the average run of parts once will give them a new appearance.

Some fuel pump castings are made of an alloy containing a small amount of copper. These castings will not have the same brightness as parts not having copper in the alloy. By matching parts of like brightness at time of assembly, the reconditioned pumps will make the best possible appearance.

When removing the parts from the various solutions, permit them to drain well and turn any parts that have a cupped side up. This will conserve the solutions so they will last for many cleanings before having to be renewed.

The caustic solution must be kept in an iron container with welded seams. Soldered seams or galvanizing will be attacked by the caustic.

The chromic acid solution must be kept in crockery as it will attack any metal, even lead.

When using the solutions, acid and oil proof rubber gloves should be worn. Any of the sollution coming in contact with the sin should be washed off with water immediately. Goggles should be worn to protect the eyes against splashing.

C—FORD V8 CARBURETOR (91A-9510A)

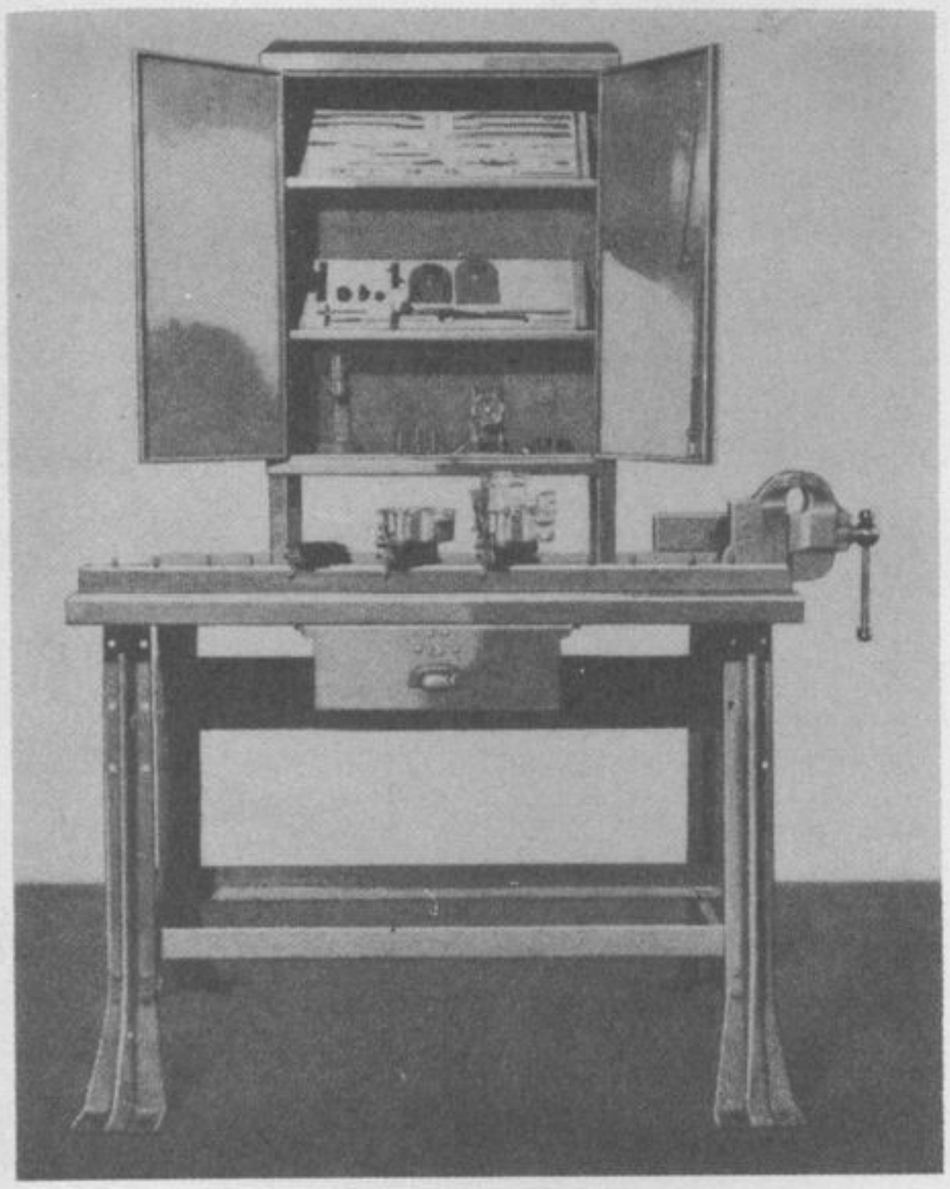

Figure 86—Carburetor Rack

1. PRELIMINARY INSPECTION.

Inspect carburetor for cracks in flange and for missing or damaged parts.

2. DISASSEMBLY.

NOTE: The carburetors cannot be placed on a flat surface due to throttle arm extending below the lower surface of carburetor mounting flange. Therefore, a channel iron should be arranged as shown in figure 86. This can usually be made locally from three-inch channel iron with pins arranged as indicated to hold the carburetors.

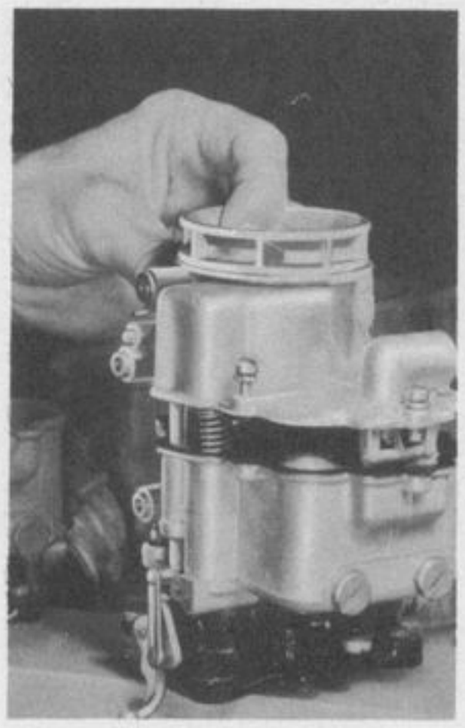

Figure 89—Lifting Off Air Horn

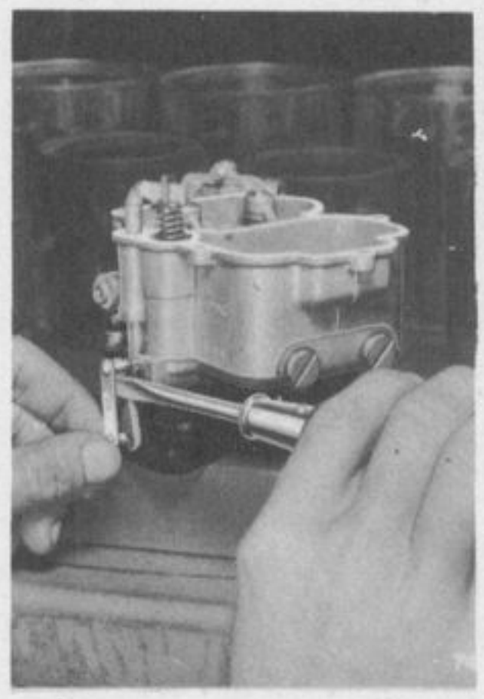

Figure 90—Removing Accelerating Pump Link

All parts are disassembled except the choke plate and shaft which are not removed from the air horn; also throttle plates and shaft are not removed from the throttle body. These parts should not be disassembled, as a used choke plate will usually not fit properly in an air horn assembly from another carburetor. The same applies to the throttle plates and used throttle body assemblies. A sequence of disassembly operations that has been found desirable is as follows:

Remove the choke lever screw (Fig. 87).

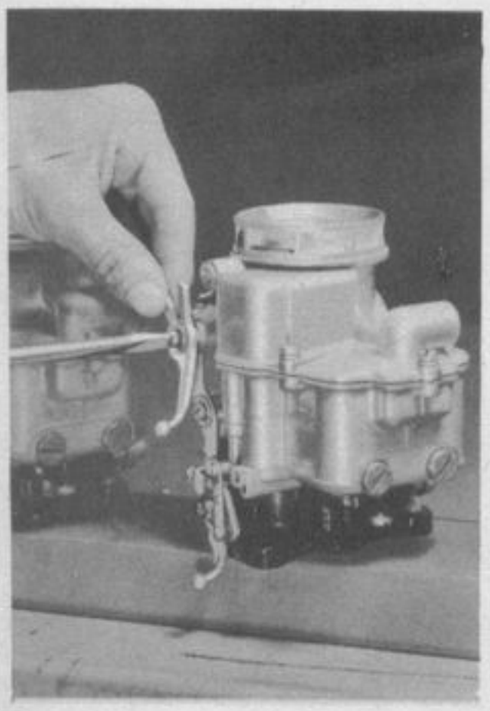

Figure 87—Removing Choke Lever Screw

Figure 88—Removing Kicker Screw

Figure 91—Removing Accelerating Pump

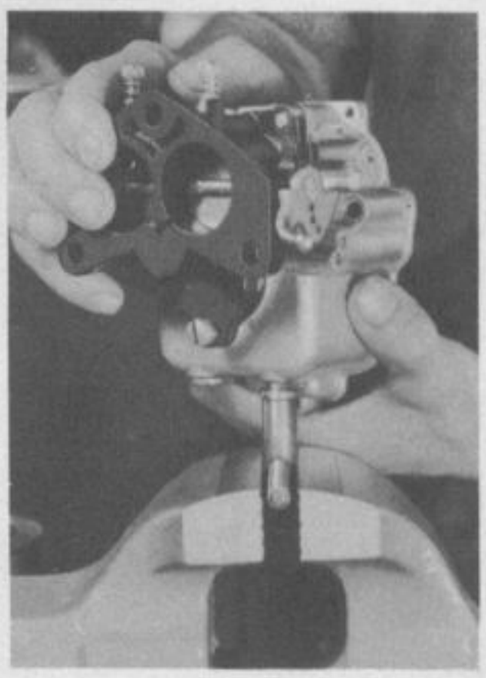

Figure 92—Removing Drain Plugs

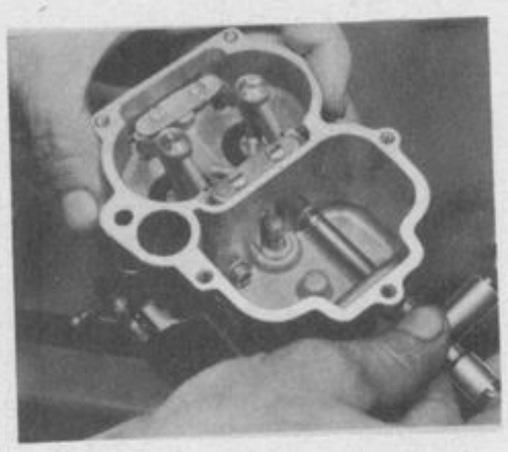

Figure 93—Removing Main Jets

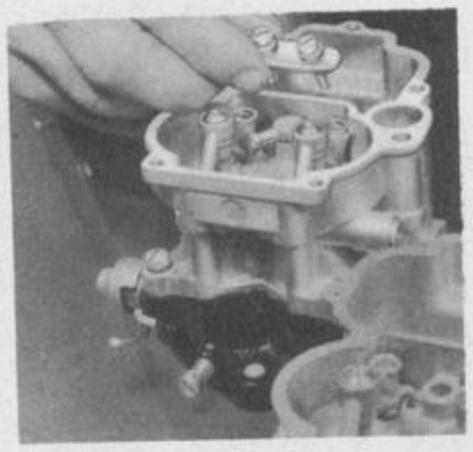

Figure 94—Removing Front Nozzle Screws and Clamp

This results in removal of the 31588-S7 screw, 34703-S7 washer, 78-9548 carburetor choke lever, 78-9537 choke lever pawl and the 78-9587 choke lever pawl spring.

Remove the throttle kicker screw (Fig. 88). This results in removal of the 31588-S7 screw, 34703-S7 washer, 78-9597 throttle kicker and the 78-9599 throttle kicker spring.

Unscrew the five air horn screws (31620-S7) and lift air horn off (Fig. 89). Place air horn on bench in inverted position to avoid bending float. Remove accelerating pump link (91A-9526). Use care so link will not be bent by prying on upper end of link only (Fig. 90). Remove accelerator pump (78-9630) (Fig. 91). Remove drain plugs (78-9562) and drain plug gaskets (78-9563). Use wrench No. 9510-A (Fig. 92).

Remove main jets (78-9533). Use wrench 9510-A (Fig. 93). Remove front nozzle bar screws (31109-S7) and clamp (78-9928) (Fig. 94). With the rear clamp still intact, remove the idle tubes from the nozzle bar

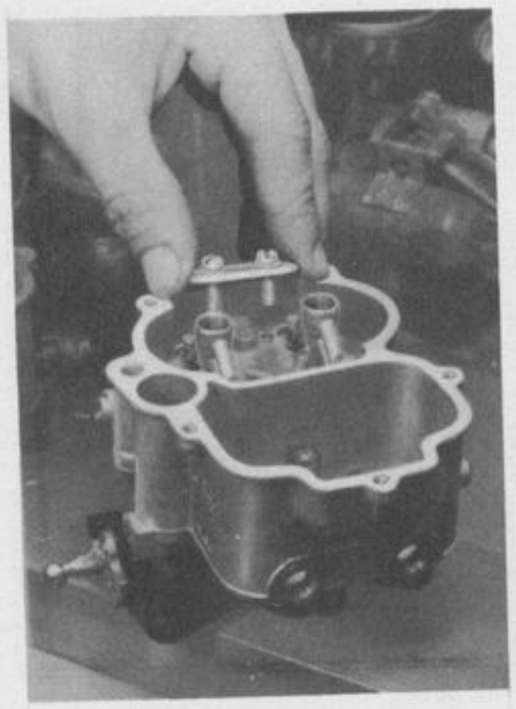

Figure 97—Removing Nozzle Bar Rear Clamp

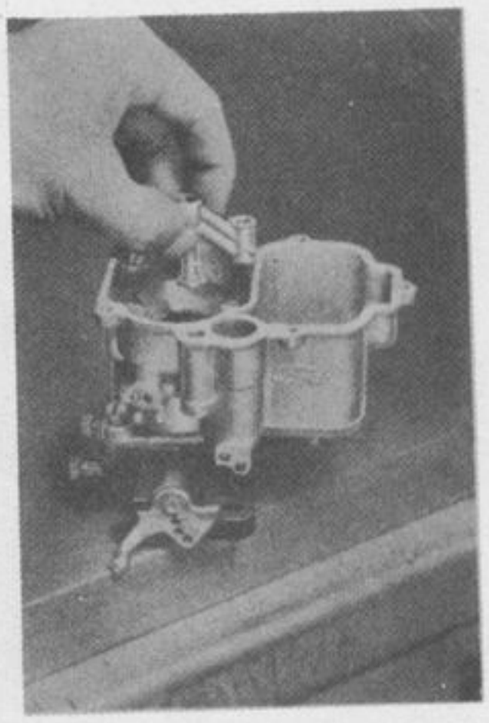

Figure 98—Removing Nozzle Bars

(78-9542) (Fig. 95) and the brass air bleeds (78-9924) (Fig. 96).

Remove the nozzle bar rear clamp (78-9928) and screws (31077-S2 (Fig. 97). Remove 78-9922 nozzle bar, R.H.; 78-9923 nozzle bar, L.H.; 78-9577 accelerating pump discharge nozzle; 78-9580 pump discharge nozzle gasket and the four 78-9926 nozzle bar gaskets (Fig. 98).

Remove the check valve retainer (78-9575) (Fig. 99). (A tool for this operation can be made by grinding the end of a small diameter rod down to a point and hooking the end.) Remove the two 31079-S7 main body to throttle body screws and the two 34804-S2 main body to throttle body lock washers (Fig. 100).

Remove carburetor from the rack and turn it over (Fig. 101), catching the brass needle

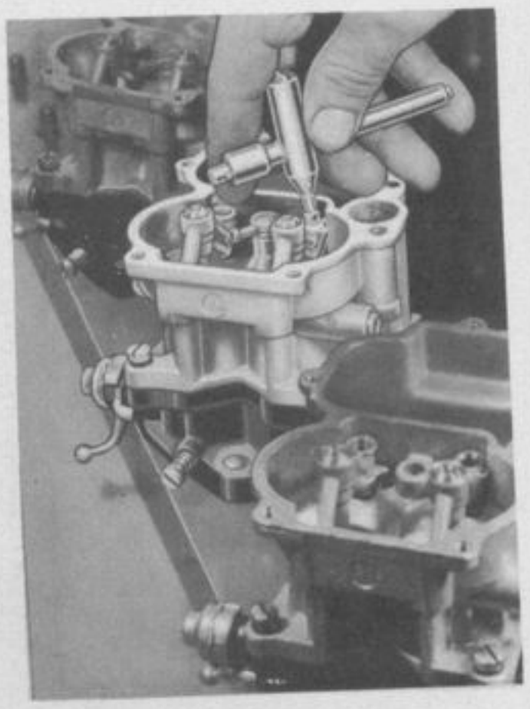

Figure 95—Removing Idle Tubes

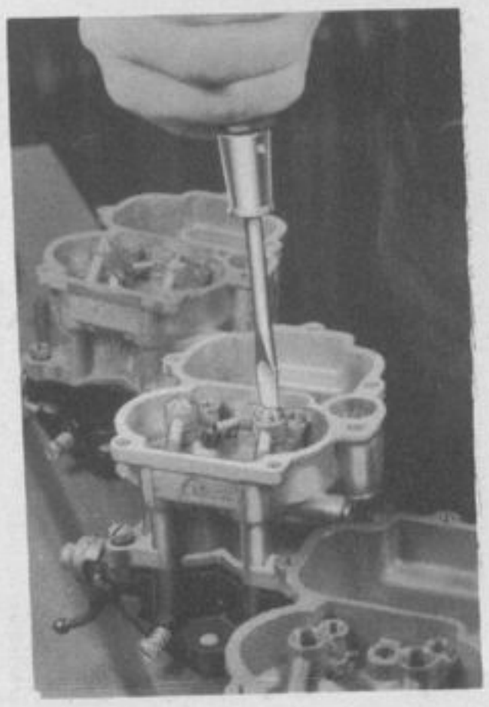

Figure 96—Removing Air Bleeders

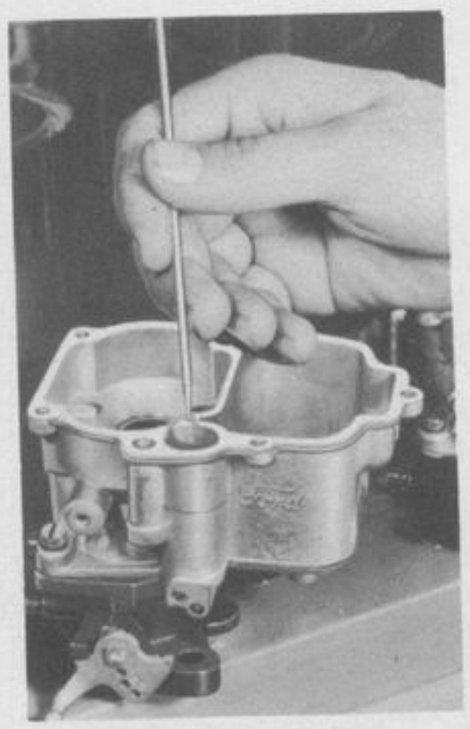

Figure 99—Removing Check Valve Retainer

Figure 100—Removing Main Body Screws

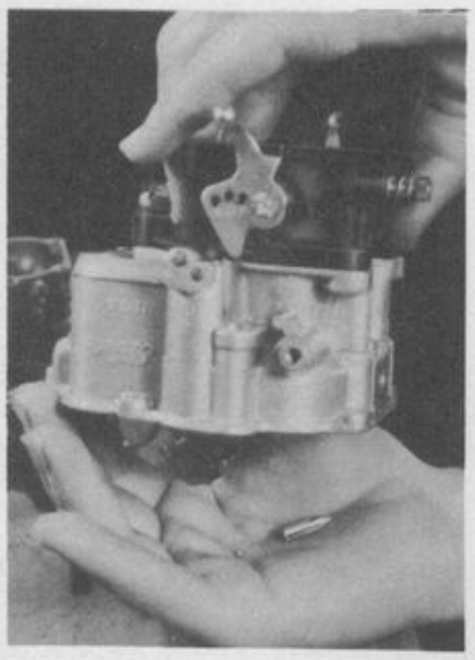

Figure 101—Removing Needle and Check Valve

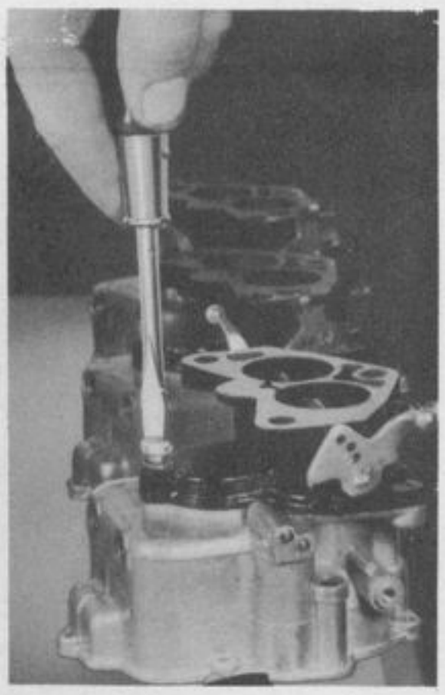

Figure 102—Removing Screws from Throttle Body

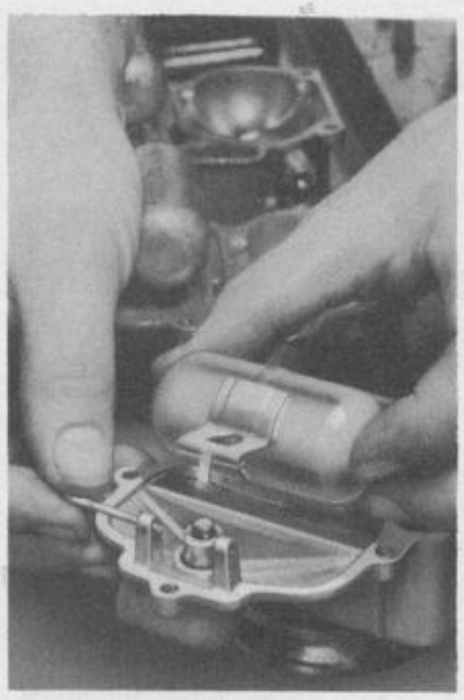

Figure 105—Removing Float

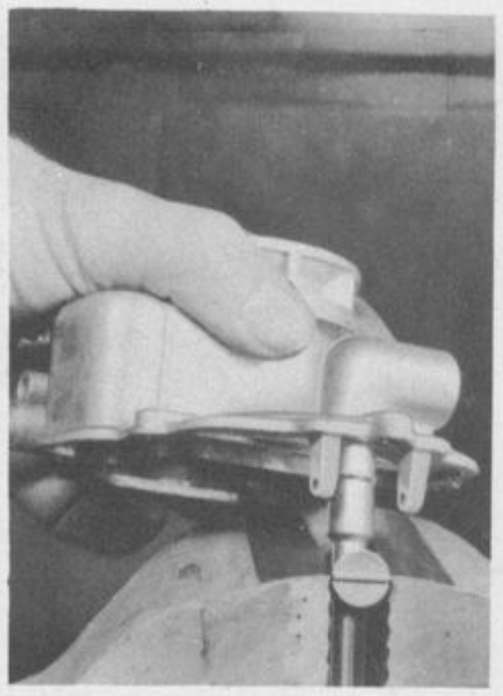

Figure 106—Removing Needle Valve and Seat

(78-9594) and the steel ball check valve (78-9576).

Place carburetor on rack (Fig. 102) and remove the 31646-S7 throttle body to main body screw and the 34805-S2 throttle body to main body lock washer.

Remove the 78-9904 power by-pass valve (economizer valve) (Fig. 103), using wrench No. 9904-A.

Disassemble 78-9614 loose lever collar, 78-9615 loose lever, 78-9624 loose lever spring, two 78-9541 idle adjusting needles and two 78-9578 idle adjusting needle springs from throttle body assembly 78-9514 (Fig. 104).

Remove 78-9558 float hinge pin, 78-9550 float assembly, 78-9564 fuel inlet needle and seat, and 78-9569 gasket from the air horn assembly (78-9520) (Fig. 105).

Use wrench (9510-A) to remove the fuel needle valve and seat (78-9564) (Fig. 106).

Figure 103—Removing Economizer Valve

Figure 104—Parts Removed from Throttle Body

Fuel inlet needle and seat (78-9564) must be kept together as one needle will not always work properly in another seat. Rinse off parts in cleaning solution and wipe with a clean cloth. Inspect needle and discard the needle and seat assembly if there is any indication of wear on the seat of the needle. If suitable for further use, polish end of needle that contacts float, using No. 320 "wet-or-dry" paper.

Clean all parts, being particularly sure that all corrosion is removed from the float bowl of carburetor. Thorough cleaning of parts is a first essential of producing a good reconditioned carburetor, both from the standpoint of appearance of the finished job as well as to insure good performance.

3. INSPECTION AND REPAIR OF PARTS.

Make a visual inspection of tightness of fit of choke plate when closed, by holding toward a light and observing amount of light that can be seen around the edge of the choke plate. Very little light should show through.

Check poppet valve stem in choke plate. If loose or if poppet valve spring is weak or

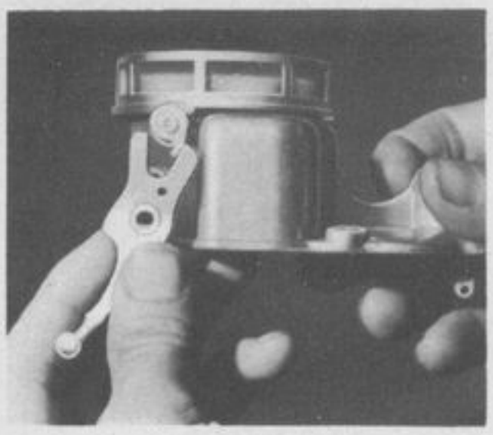

Figure 107—Checking the Choke Lever Boss

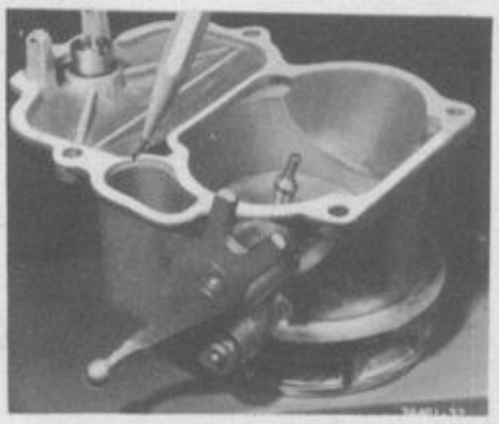

Figure 108—Vent Slot

broken so that poppet valve will not stay in position firmly, replace choke plate assembly (78-7549).

Check the choke lever boss on air horn (78-9521), using a new choke lever (78-9548) (Fig. 107). Discard air horn if worn too much at this boss.

Make visual inspection of choke lever (78-9548) for wear on ball end and also for wear in the "V" opening which operates the lever on choke plate shaft.

If there is no vent in the air horn between the float chamber and the accelerating pump rod head clearance chamber (Fig. 108), a vent slot must be cut with a small file or hack saw blade.

Clean out the hole for the choke lever pawl (78-9537), using reamer (9537-A).

Inspect float (78-9550) to be sure that the solder holding the lever to the float is in good condition. Inspect the float for leaks by holding float under the surface of water that has been heated to just below the boiling point. Bubbles will appear if float leaks. A badly leaking float can frequently be detected by shaking vigorously to see if it is loaded with liquid. Discard float if it leaks.

Polish fuel needle contact surface of float arm indicated in figure 109, using No. 320 "wet-or-dry" paper.

Make visual inspection of tightness of fit of throttle plates when closed, by holding

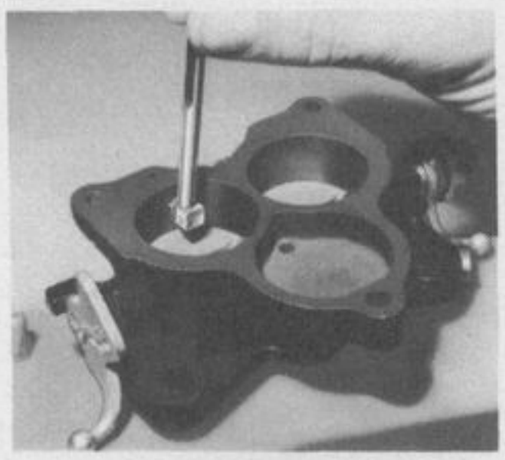

Figure 111—Checking Throttle Plates

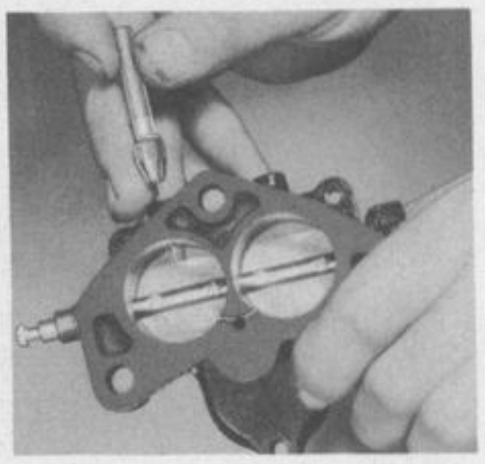

Figure 112—Cleaning Idle Adjusting Holes in Throat

toward a light and observing amount of light that can be seen around edges of throttle plates. A very snug fit at the throttle plates is necessary for proper idling and low speed operation. The complete assembly should be discarded if wear and looseness is encountered around the edges of throttle plates or if throttle shaft is worn loose so air will leak into throat or if the throttle lever is loose on shaft, or if link (91A-9526) is loose in holes in throttle lever.

Clean out idle feed holes in the throat above the throttle plates (Fig. 110). Use hand chuck No. 9518-E with No. 9518-H drill (0.037") for lower hole (hole closest to throttle plate). Use hand chuck No. 9518-E with No. 9518-G drill (0.0395") for upper hole (hole farthest from throttle plate).

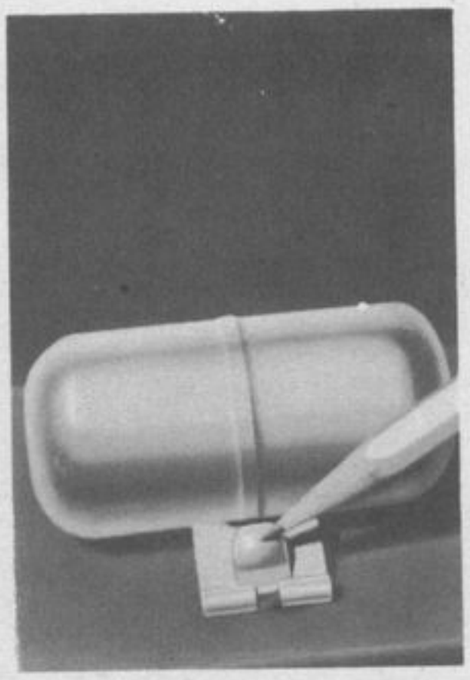

Figure 109—Contact Surface of Float Arm

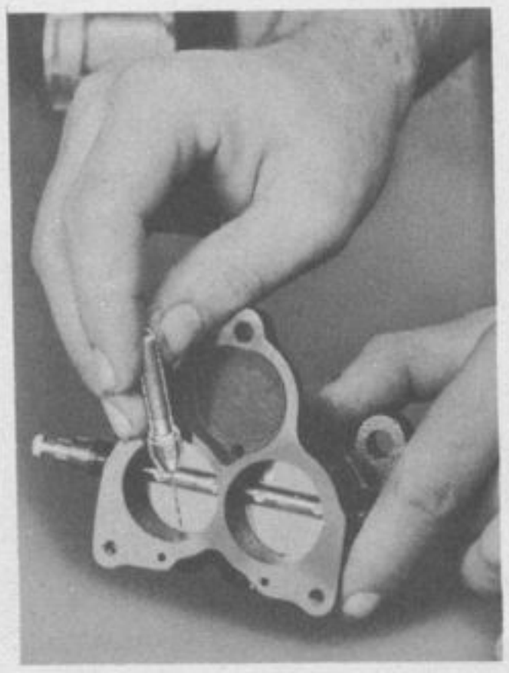

Figure 110—Cleaning Idle Feed Holes

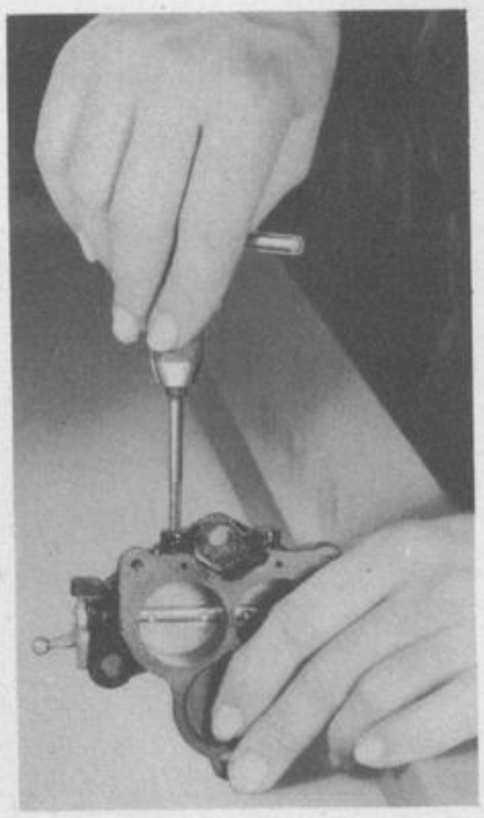

Figure 113—Cleaning Idle Adjusting Threads

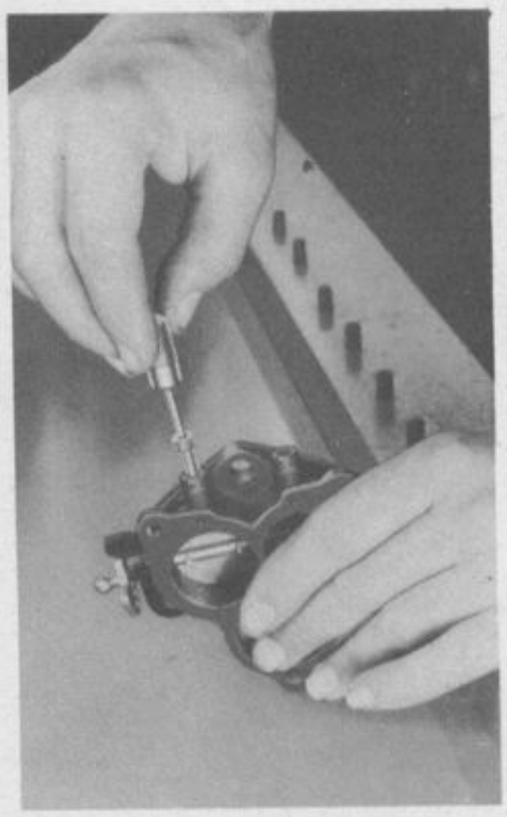

Figure 114—Refacing Idle Adjusting Needle Seat

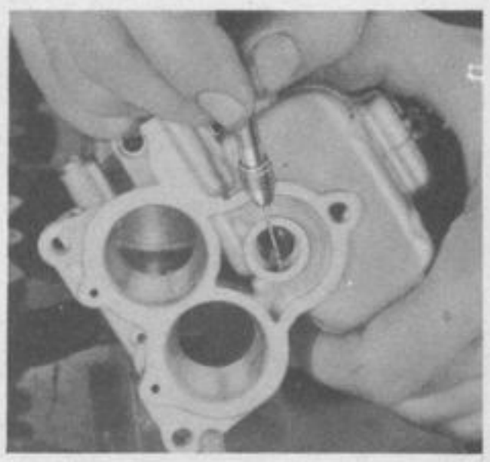

Figure 115—Cleaning Hole from By-pass Valve

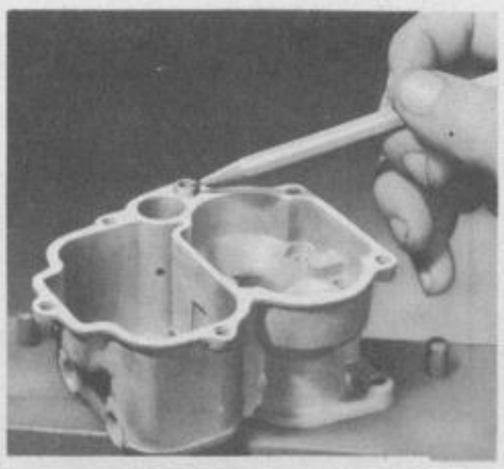

Figure 116—Shoulder Around Hole for Accelerating Pump Rod

Hold the throttle closed and check distance from throttle plates to the idle feed holes nearest the plate. Use No. 9518-A gage as shown in figure 111. Discard the throttle body and plate assembly if distance is not within gage limits, otherwise poor idling and low speed operation will likely be encountered.

Install dummy idle adjustment screws (78-9541) and paint the throttle body with black lacquer, being careful not to get paint inside throat, in idle fuel passages or on gasket surfaces. After paint dries, remove the screws (78-9541).

Clean out the idle adjustment screw holes into throat using hand chuck No. 9518-E and No. 9518-F drill (0.046″) (Fig. 112).

Clean out idle adjustment screw threads in throttle body, using tap No. 9541-A (Fig. 113). Care must be used not to remove any metal as the screws (78-9541) must fit tightly enough to prevent an air leak which would prevent obtaining the proper idling mixture adjustment.

Reface the idle adjusting needle seat, using No. 9541-C refacer and No. 9541-D guide bushing (Fig. 114).

The brass retainer (351336-S8) and felt (78-9535) at bottom of opening for accelerating pump rod (78-9531-A) must be removed when main body assembly is cleaned, due to the action of the cleaning solutions on the felt.

Make a visual inspection for signs of rough handling or mutilation and discard parts if damaged.

The two holes leading from power by-pass valve into each throat of carburetor should be cleaned, using hand chuck No. 9518-E and No. 9513-A drill (0.039″) as shown in figure 115. Use a smaller drill for the 922A-9520-A carburetor which has a 0.033″ hole at this point. Some "91A" carburetors for high altitude have a 0.038″ hole so the 0.037″ drill No. 9518-H should be used. Be sure that the seat for power by-pass valve is not nicked.

If main body has a raised shoulder around hole for accelerating pump rod, as shown in figure 116, remove the shoulder with a file. This shoulder, if not removed, will shorten effective stroke of the accelerating pump.

Clean out groove for brass retainer (351336-S8) and hole for accelerating pump operating shaft, using No. 9513-B reamer (Fig. 117).

Inspect idle mixture jet tube (78-9542) and discard if plugged, bent or damaged in any way or if screwdriver slot is mutilated. Wire should not be used to clean out any jets or passages.

Make visual inspection of pump link (91A-

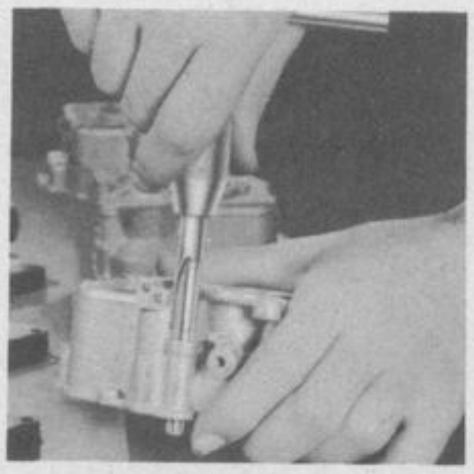

Figure 117—Cleaning Hole for Accelerating Pump Shaft

Figure 118—Staking Throttle Plate Screws

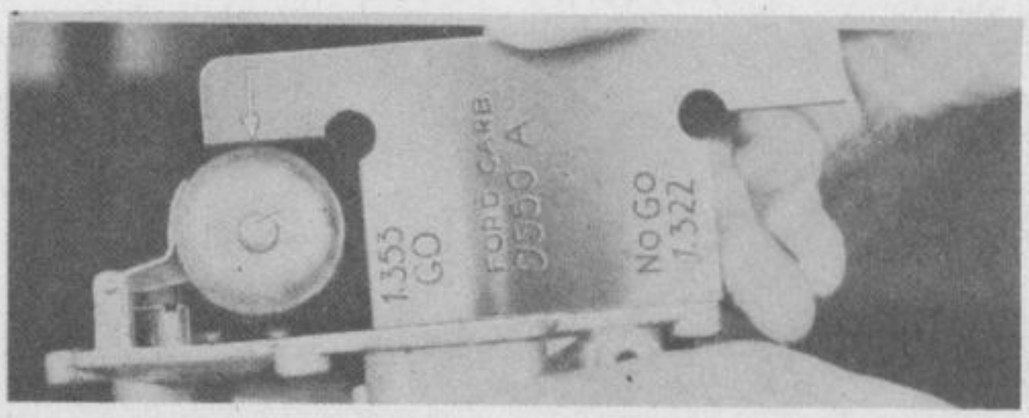

Figure 119—Checking Float Position ("Go" Side of Gage)

9526) and scrap if ends are loose or if link is bent.

Check hole in lower end of pump rod (78-9531-A) using new link (91-A-9526) as a gage to be sure retainer ball and spring are OK.

Straighten nozzle bar clamps (78-9928).

4. ASSEMBLY.

Replace the 78-9535 accelerator pump rod felt, 351336-S8 accelerator pump rod brass retainer, 78-9575 check valve retainer, 78-9631 accelerating pump piston, 78-9904 power by-pass valve (economizer valve) and all gaskets with new parts.

Assemble two 78-9541 idle adjustment needles, two 78-9578 idle adjustment needle springs, and the 78-9614 loose throttle lever collar, 78-9615 loose throttle lever, and 78-9624 loose throttle lever spring to the throttle body.

The idle adjustment screws should be run in just barely snug, then backed out 5/8 to 3/4 turn. Be sure that throttle plate screws are well staked. (Use No. 9518-C anvil and No. 9518-D punch, Fig. 118). Assemble 78-9564 fuel inlet needle and seat, 78-9550 float assembly, 78-9558 float hinge pin to the air horn, being careful that the fuel inlet needle and seat are kept together. Also be sure that the stop on the float will permit it to drop to bottom of float chamber.

Be sure the choke plate screws are well staked. Use No. 9518-C anvil and No. 9518-D punch. Check float position, using No. 9550-A Go-No-Go gage. "Go" end of gage must clear boat at arrow (Fig. 119). The

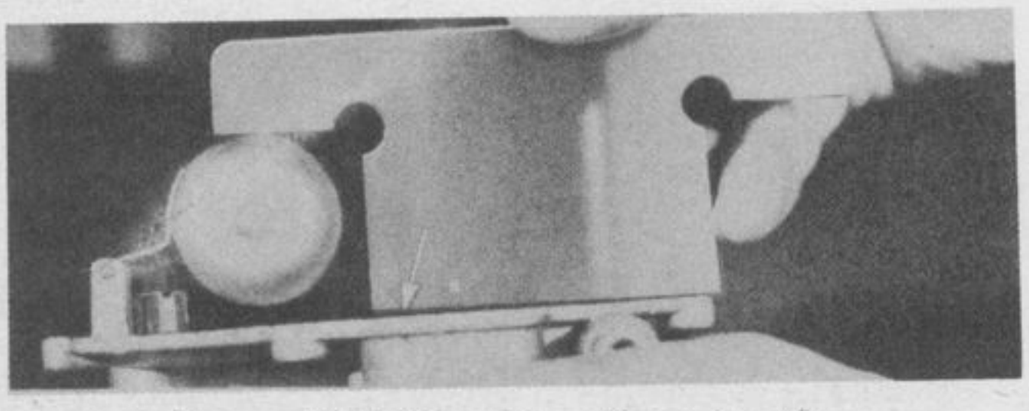

Figure 120—Checking Float Position ("No-Go" Side of Gage)

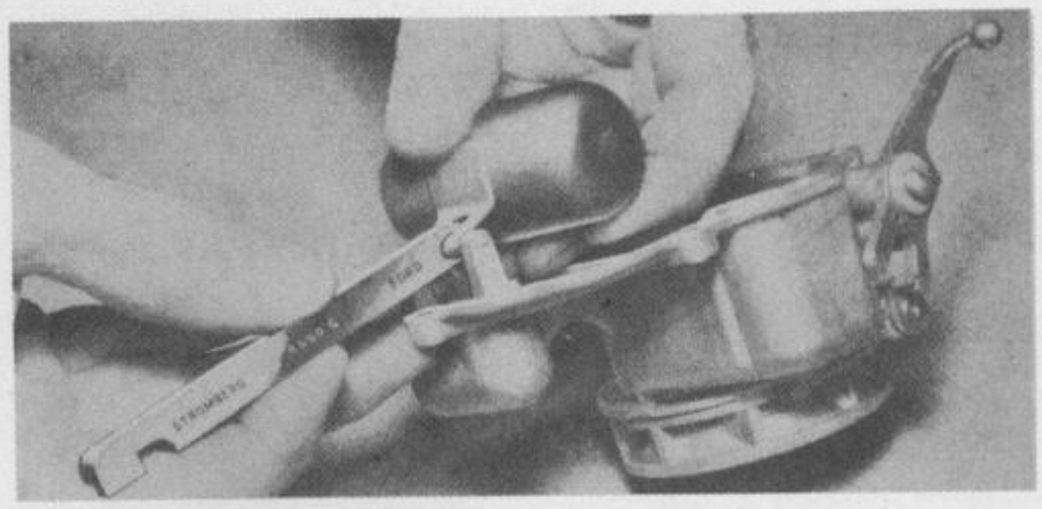

Figure 121—Float Arm Bending Tool

"No-Go" end of gage must rest on float and clear air horn at arrow as shown in figure 120. Be sure to make both checks at each end of the float.

For Lincoln-Zephyr's, 1936 to 1940 and all 1941 Lincolns, use a 1/16-inch thick feeler between float and the "Go" and "No-Go" ends of the No. 9550-A gage.

If float position is not correct, it may be corrected by using float arm bending tool No. 9550-C (Fig. 121). If the "No-Go" end of gage does not touch the float as shown in figure 120, bend float arm up (Fig. 122). If the "Go" end of float position gage does not clear the float (Fig. 119), bend float down (Fig. 122).

Assemble the 78-9535 felt washer and the 351336-S retainer (brass) to the main body (Fig. 123), using No. 9513-C driver. Install the 78-9904 power by-pass valve and the 78-9909 gasket, using wrench No. 9904-A (Fig. 103 shows the use of this tool). This part must be screwed tightly into place. A torque of 15 foot pounds is recommended. Assemble main body to throttle body. Parts used are 78-9513 main body, 78-9514

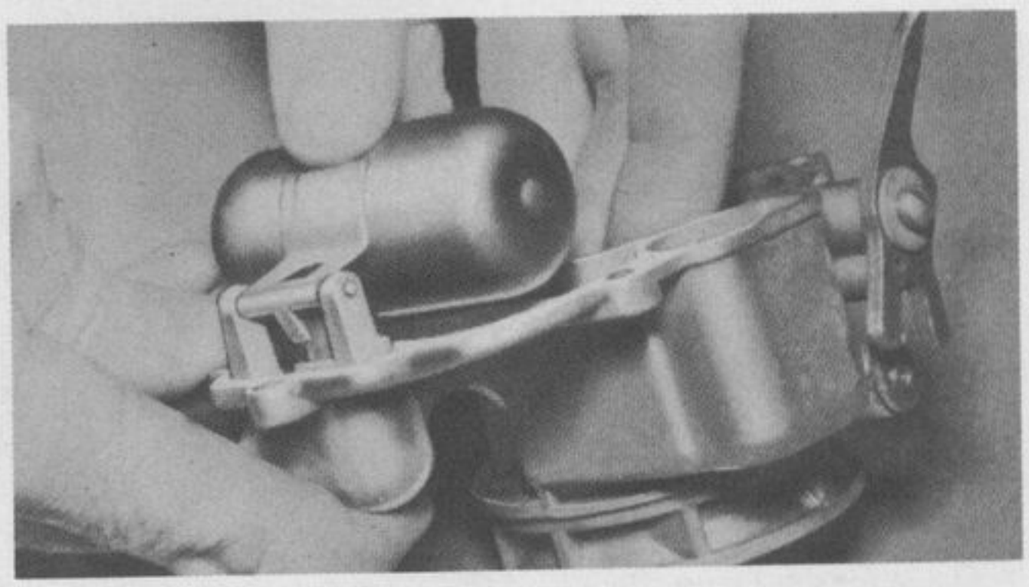

Figure 122—Bending Float Down

Figure 123—Assembling Retainer

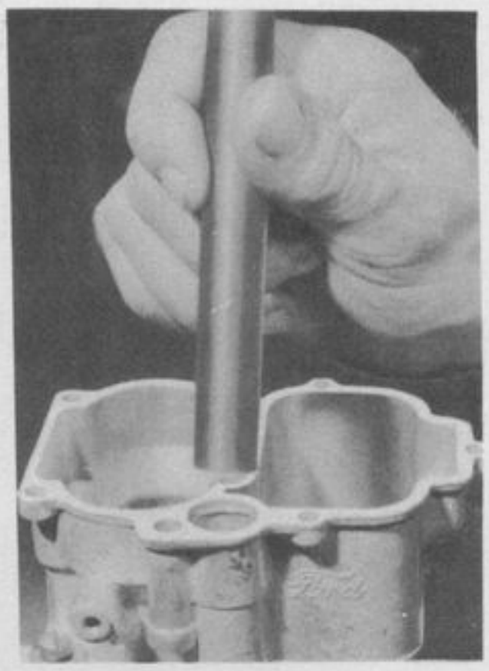

Figure 124—Assembling Pump Check

throttle body assembly, 78-9516 throttle body gasket, 31646-S7 screw, two 31079-S7 screws, 34805-S2 lock washer and two 34804-S2 lock washers.

Assemble 78-9576 pump check (steel ball) and the 78-9575 pump check retainer, using a piece of ⅝" diameter wood or fiber dowel stock to push retainer down into place (Fig. 124). Before installing the retainer, the steel ball should be tapped lightly with a brass drift rod to be sure that it seats tightly.

Install main jets 78-9533. Install the left hand drain plug (78-9562) and gasket (78-9563). Use wrench No. 9510-A.

Drop the brass discharge needle (78-9594) into place (Fig. 125) and tap it lightly with a brass drift rod to be sure it seats tightly.

Assemble four 78-9926 nozzle bar gaskets (Fig. 126), 78-9580 discharge nozzle gasket, 78-9577 discharge nozzle, 78-9922 nozzle bar R.H., and 78-9923 nozzle bar L.H. Secure the nozzle bars by tightening clamp screws, be sure nozzle bars do not tilt. Install 91A-9928 nozzle bar clamp and two 31077-S2 screws and 34902-S2 lock washers.

Install two 78-9542 idle tubes, 78-9924 air bleeds, and 78-9925 air bleed gaskets. Install 91A-9928 front clamp and two 31109-S7 screws and 34902-S2 lock washers.

Inspect and remove any burrs or foreign matter from carburetors. Blow out with air hose.

Assemble the accelerator pump assembly (78-9630) which includes the 78-9531A pump rod assembly, 78-9631 piston assembly, 78-9632 retainer and the 78-9636 spring.

Install the accelerator pump assembly (78-9630), using link (91A-9526). Be sure this has a "C" stamped on it for the 91-A carburetor. (Use link 78-9526-A, with a "6" stamped on it, for the 922-A carburetor and for 1936 Lincoln and Lincoln-Zephyr carburetors). Links without these marks are not the correct length and must not be used. Put the lower end of link in correct hole for season of year.

Install the 78-9520 air horn assembly, 78-9519 gasket and five 31628-S7 screws and 34803-S2 lock washers.

Grease the 78-9537 choke lever pawl and install the 78-9537 pawl, 78-9587 spring, 78-9548 choke lever, 34703-S7 washer, and

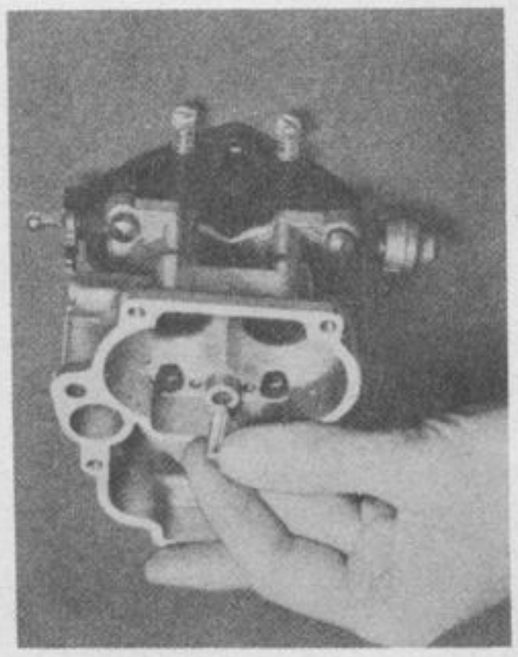

Figure 125—Assembling Brass Discharge Needle

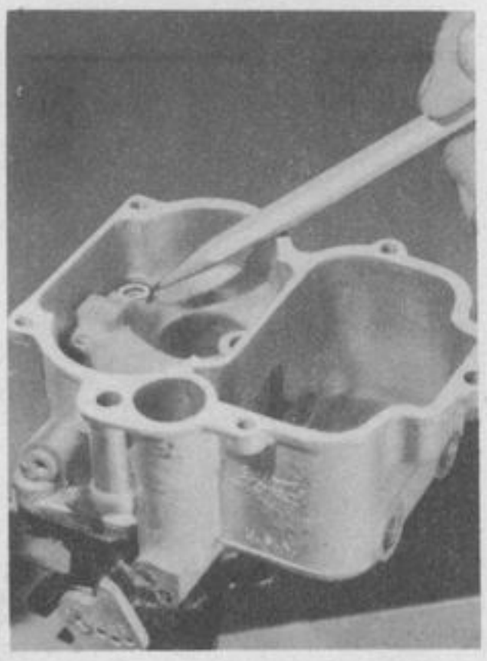

Figure 126—Nozzle Bar Gasket

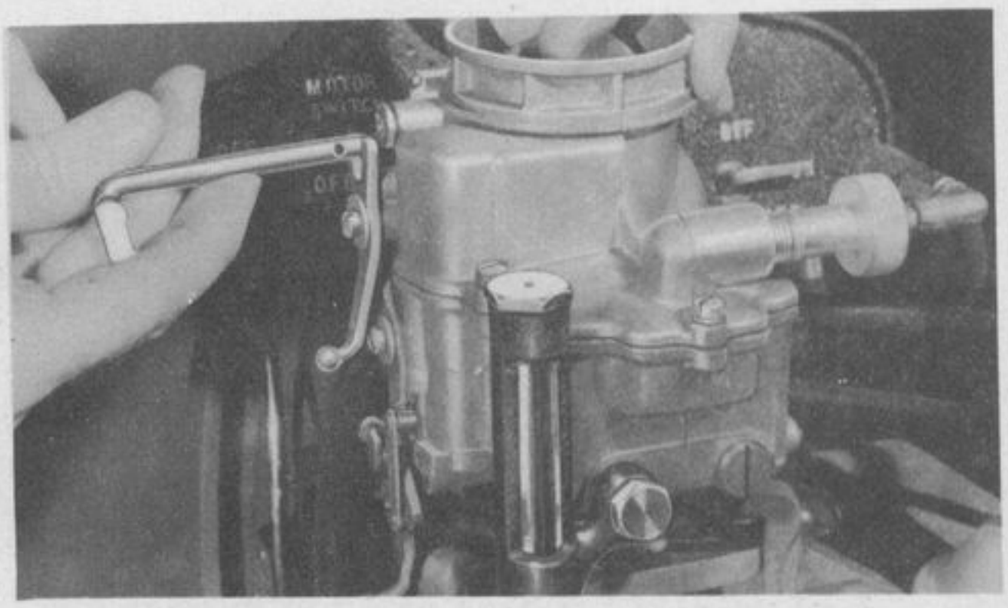

Figure 127—Float Level Gage

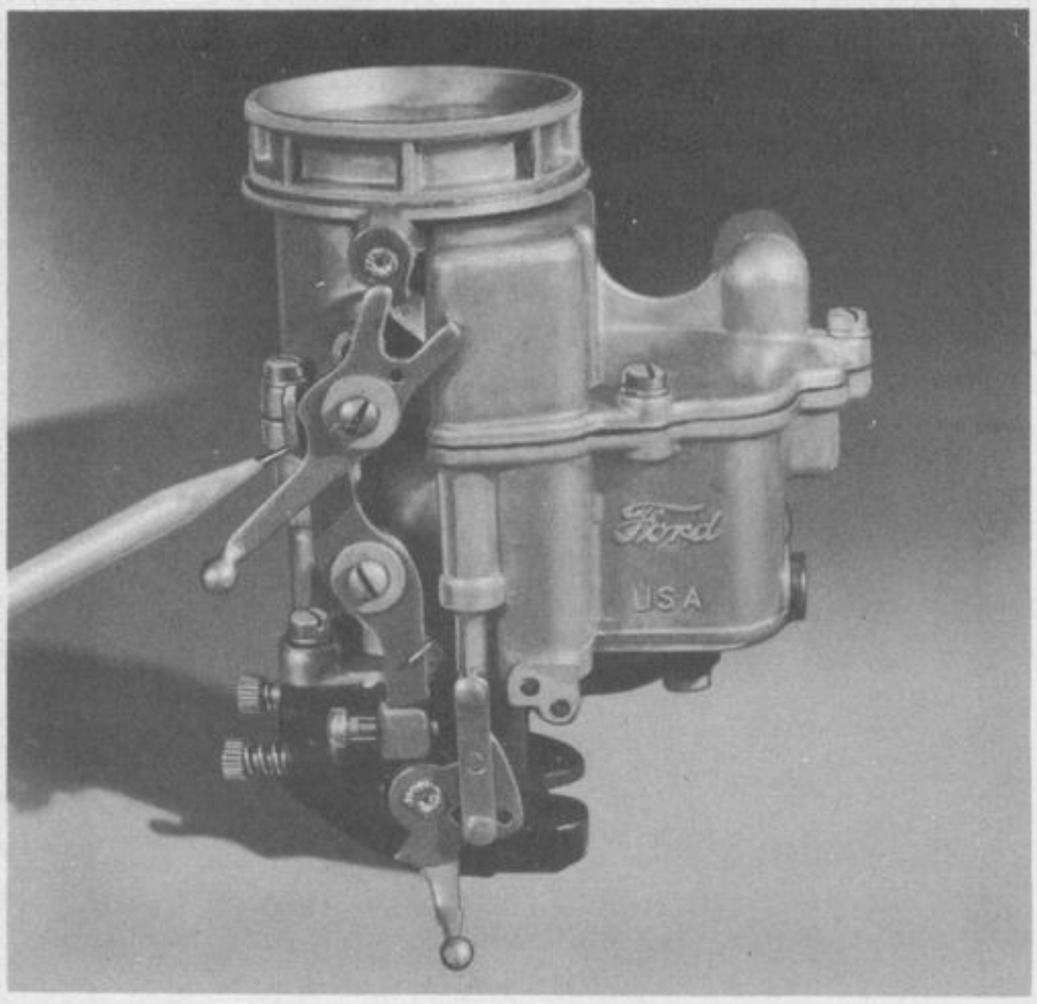

Figure 128—Choke Lever Position

35188-S2 screw. Install the 78-9599 spring, 78-9597 throttle kicker assembly, 34703-S7 washer and 35188-S2 screw. Make sure the throttle idle speed adjusting screw is round nosed. If it is flat nosed, it should be replaced. Before using throttle and choke arms, etc., compare them with new parts to be sure they have not been bent.

5. FINAL INSPECTION.

Check float level, using glass tube gage No. 9510-D with carburetor on fixture No. 9350-A (Fig. 127). Fuel level should be 11/16-inch from the upper face of main carburetor body, to the surface of the liquid in the glass tube.

Check operation of the accelerating pump by making several strokes of the throttle, observing the discharge through air horn to be sure a good stream comes from each.

Remove float level gage No. 9510-D and install the 78-9562 drain plug and 78-9563 gasket.

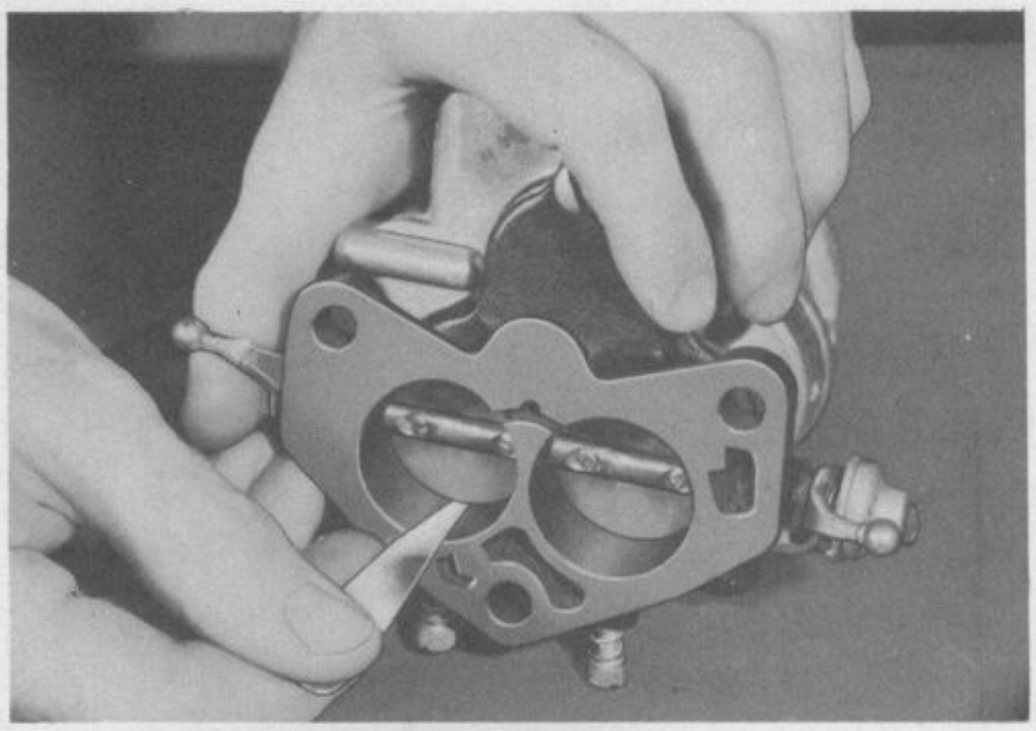

Figure 129—Throttle Plate Clearance

Make sure the pawl (78-9537) and pawl spring (78-9587) hold the choke plate so that it will not rattle. The arm on choke shaft must sometimes be bent to prevent possibility of choke plate rattling. This can be done as shown in figure 127, by using an accelerating pump rod (78-9531) from which spring and ball retainer have been removed.

With full choke, make sure that the cam on the choke lever (78-9548) touches the upper end of kicker (78-9598) when the choke is fully closed. If the portion of choke lever below the cam, as indicated in figure 128, touches the kicker, file the lower edge of flange at the upper end of the kicker so that it clears the choke lever.

Set the idle speed approximately correct for five miles per hour speed in high gear by using a 0.006″ feeler blade (Fig. 129). Adjust the idle speed adjusting screw so that the feeler blade will slip between the edge of the throttle plate and throat of the carburetor. The feeler blade must not be over ⅛-inch wide.

D—FORD SIX CYLINDER CARBURETOR (1GA-9510-A)

1. PRELIMINARY INSPECTION.

Inspect carburetor for cracks in flange and missing or damaged outside parts.

2. DISASSEMBLY AND PARTS INSPECTION.

Disassemble all parts except the choke plate and shaft and the throttle plates and shaft. Used choke plates and throttle plates usually will not fit properly in air horn assemblies and throttle body assemblies from another carburetor. As basic part numbers are

mentioned in the following disassembly procedure, they can be identified by referring to figure 130, Six Cylinder Carburetor, Exploded View.

Remove pin (9682). Unhook the fast idle rod 9598 from the choke shaft lever (lever is part of assembly (9546).

Remove the air horn assembly by taking out the five air horn attaching screws. Four of these screws are taken out from the top. One of these screws holds the choke tube bracket (9791). The fifth air horn screw is inverted and is located under the choke lever (9548). Set the air horn on the bench upside down so as to prevent bending the float.

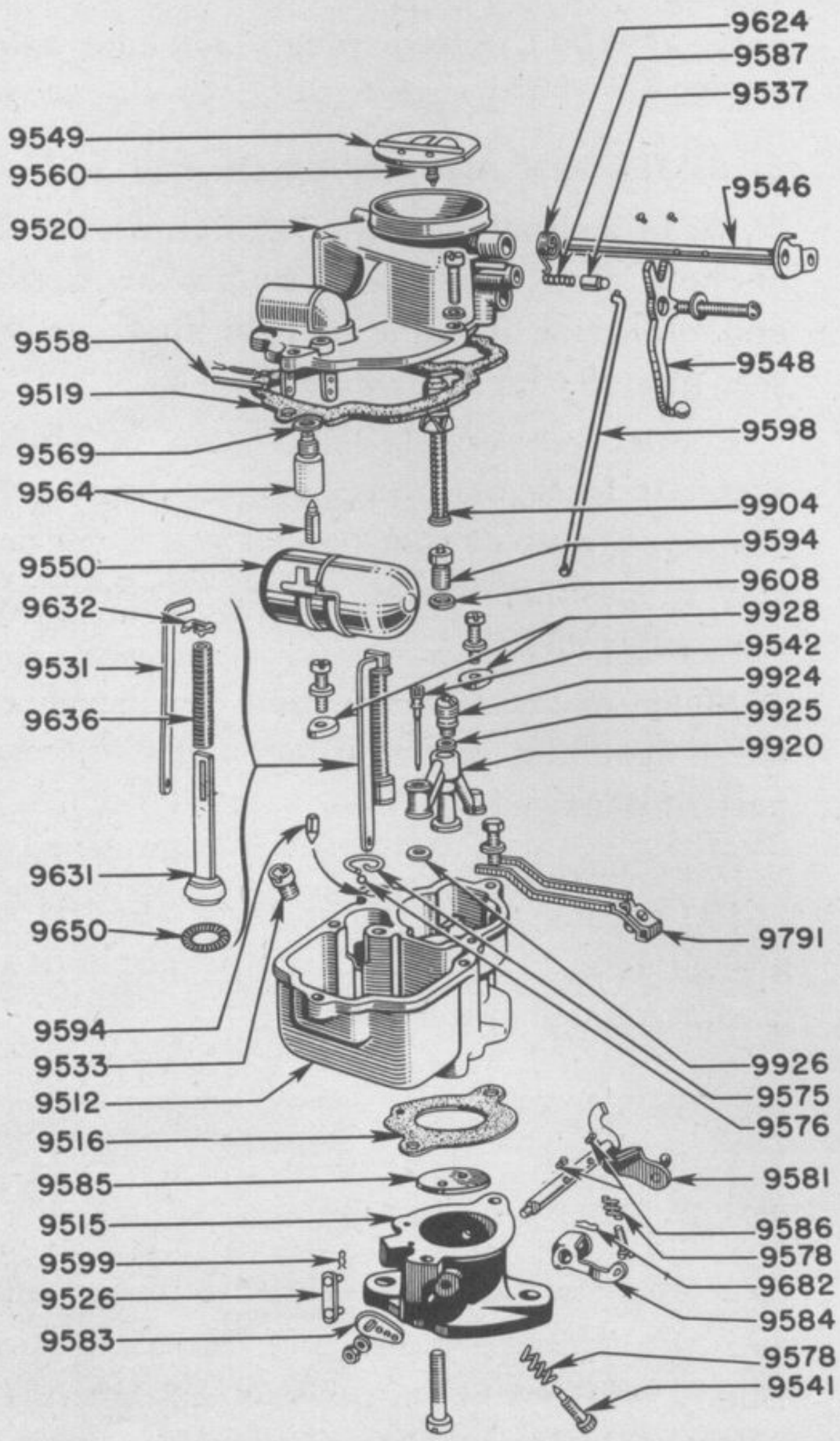

Figure 130—Six Cylinder Carburetor, Exploded View

Remove the float hinge pin (9558) and the float assembly (9550) and fuel valve needle (9564).

Remove the choke lever screw and washer to inspect choke lever pawl (9537) and spring (9587). The choke shaft assembly (9546) and choke valve assembly (9549) should not be removed unless there is excessive wear in the shaft and bearings. If the choke valve is removed, slide it down and take it out from the bottom.

The power jet piston assembly (9904) is held in by an expansion washer. The assembly can be removed by pulling firmly on the pin. The power jet piston should move freely in the air horn and return to position by the action of the spring. Any dirt or grit should be washed out with gasoline.

The fuel inlet valve needle and seat (9564) should be inspected for dirt or grime and cleaned thoroughly. The needles and seats should be kept as a set because one needle will not always work in another seat.

The end of the needle which contacts the float arm and the contacting surface of the float arm should be smooth and shown no sign of wear. If suitable for further use, these two surfaces should be polished with No. 320 "wet-or-dry" abrasive paper.

If either float arm or needle valve and seat show wear or do not hold the proper level, they should be replaced. If they are replaced or float setting changed, they should be checked by using Ford carburetor gage No. 9550-A and bending tool 9550-C (Figs. 133, 134 and 135). If the air horn gasket (9519) shows any signs of deterioration, it should be replaced.

The accelerating pump assembly can be taken out by removing pin (9599) and pump link (9526). The accelerating pump assembly consists of the following parts:

9631 Pump Piston Assembly
9650 Pump Expander Spring
9636 Pump Follow-up Spring
9531 Pump Operating Rod
9632 Pump Follow-up Lock Washer

The leather piston on (9631) assembly should be soft and pliable and expander spring (9650) should be in good condition, otherwise they should be replaced. Accelerating pump inlet check ball retainer (9575) should be removed and check ball (9576) taken out. The check ball retainer can be removed by a wire with a hook formed on the end. Remove the pump outlet check (9594) by turning the carburetor body upside down.

Care should be taken in cleaning out the pump channels and the pump inlet check seat. The pump inlet check seat must be clean and free from dirt or the accelerating pump will not function properly. The pump outlet check needle (9594) must also be replaced if worn.

Remove the nozzle bar assembly by taking out nozzle bar clamp screws and nozzle bar clamps (9928). When the nozzle bar is removed, care must be taken not to lose the two nozzle bar gaskets (9926). Make sure these two gaskets are in place when reassembling the nozzle bar.

The idle tube (9542) should next be removed and inspected. If any obstruction is present, it should be blown out with compressed air. The bleed plug (9924) and gasket (9925) are then removed and cleaned. The nozzle bar (9920) can now be blown out and cleaned.

Remove the power jet valve (9594) and check for dirt and freedom of valve operation. When this valve is installed, gasket (9608) must be in good condition.

The metering jet (9532) should be removed and cleaned by blowing with compressed air. (Never use wires, drills, etc.)

The main body (9512) can be taken off the throttle body by removing the main body connecting screws. The main body can now be cleaned thoroughly and all channels blown out with compressed air. The throttle body gasket should be replaced if there are any signs of tearing or deterioration.

The throttle body can be cleaned and inspected by removing the idle needle valve (9541) and needle valve spring (9578). All channels should be blown out or a wire passed through each hole to make sure all passages are clean. The throttle shaft and lever (9581) should not be taken out unless there is excessive wear. If the shaft is removed, the throttle plate (9585) should be marked with a scriber to insure replacing it in the correct position. The pump operating lever (9583) can be removed by taking off the nut and lock washer.

If special carburetor service tools are not available, it is absolutely essential that good screwdrivers are used. The screwdrivers must exactly fit the slots in the fuel valve seat (9564), metering jet (9533), power jet valve (9594), bleed plug, and idle tube (9542).

3. INSPECTION AND REPAIR OF PARTS.

Make a visual inspection of tightness of fit of choke plate when closed by holding a light and observing amount of light that can be seen around edge of choke plate.

Check the poppet valve stem in choke plate. If loose or if poppet valve spring is weak or broken so that poppet valve will not stay in position firmly, replace choke plate assembly (9549).

Make a visual inspection for signs of rough handling and mutilation and discard parts if damaged.

Gage choke lever boss on the air horn (9521) using a new choke lever (9548) as a gage (Fig. 131). Discard the air horn if worn too much at this boss.

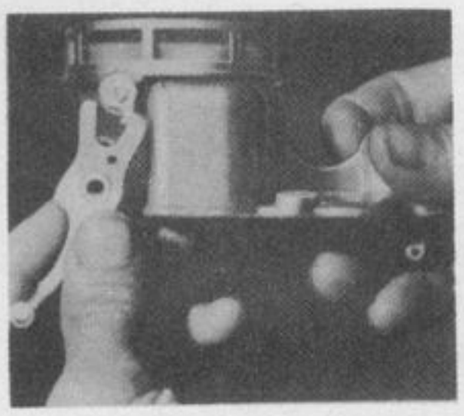

Figure 131—Gaging Choke Lever Boss

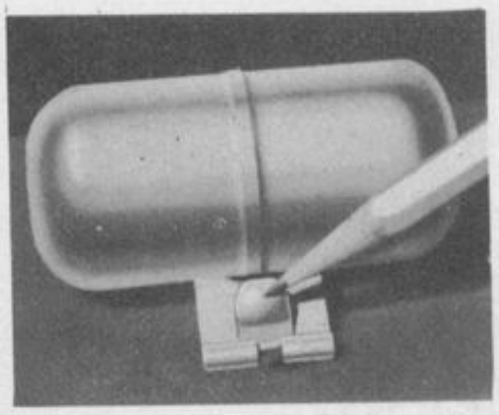

Figure 132—Contact Surface of Float Arm

Make a visual inspection of choke lever (9548) for wear on ball end and also for wear in the "V" opening which operates the lever on choke plate shaft.

Clean out the hole for the choke lever pawl (9537), using reamer No. 9537-A.

Inspect float (9550) to be sure the solder holding the lever to the float is in good condition. Inspect float for leaks by holding float under the surface of water that has been heated to just below the boiling point. Bubbles will appear if float leaks. A badly leaking float can frequently be detected by shaking vigorously to see if it is loaded with liquid. Discard the float if it leaks.

Polish fuel needle contact surface of the float arm (Fig. 132), using No. 320 "wet-or-dry" paper.

Make visual inspection of tightness of fit of throttle plate when closed, by holding it toward a light and observing the amount of light that can be seen around the edges of the throttle plate. A very snug fit is necessary for proper idling and low speed operation. The complete assembly should be discarded if wear and looseness are encountered around edges of throttle plate, if throttle shaft is worn loose so air will leak into throat, if throttle lever is loose on the shaft, or if link (9526) is loose in throttle lever.

Clean out idle feed holes in throat above throttle plates.

Clean out the idle adjustment screw hole into the throat, using drill (0.052").

Clean out idle adjustment screw threads in throttle body. Care must be used not to remove any metal as the screws (9541) must fit tightly enough to prevent an air leak.

Make a visual inspection of main body for signs of rough handling or mutilation and discard parts if damaged.

Be sure the seat for the power by-pass valve is not nicked so the by-pass valve will seat solidly.

Inspect the idle mixture jet tube (9542) and discard if plugged, bent or damaged in any way or if screwdriver slot is mutilated. Wire should not be used to clean out any jets or passages.

Make visual inspection of pump link (9526) and scrap if its ends are loose or if the link is bent.

Check hole in the lower end of the pump rod (9531-A), using new link (9526) as a gage to be sure retainer ball and spring are OK. Straighten the nozzle bar clamp (9928).

4. ASSEMBLY.

All new gaskets must be used when reassembling. Carefully examine 9575 check valve retainer, 9631 accelerating pump piston and the 9904 power by-pass valve (economizer valve) and replace them if there is any indication of wear or damage.

Assemble the 9541 idle adjustment needle and the 9578 idle adjustment needle spring to throttle body.

Idle adjustment screw should be run in just barely snug, then backed out 5/8 to 3/4 turn.

Be sure throttle plate screws are well staked.

Assemble 9564 fuel inlet needle and seat, 9550 float assembly, and 9558 float hinge pin to the air horn, being careful that the fuel inlet needle and seat are kept in sets. Also be sure the stop on the float will permit it to drop to the bottom of the float chamber.

Be sure that the choke plate screws are well staked.

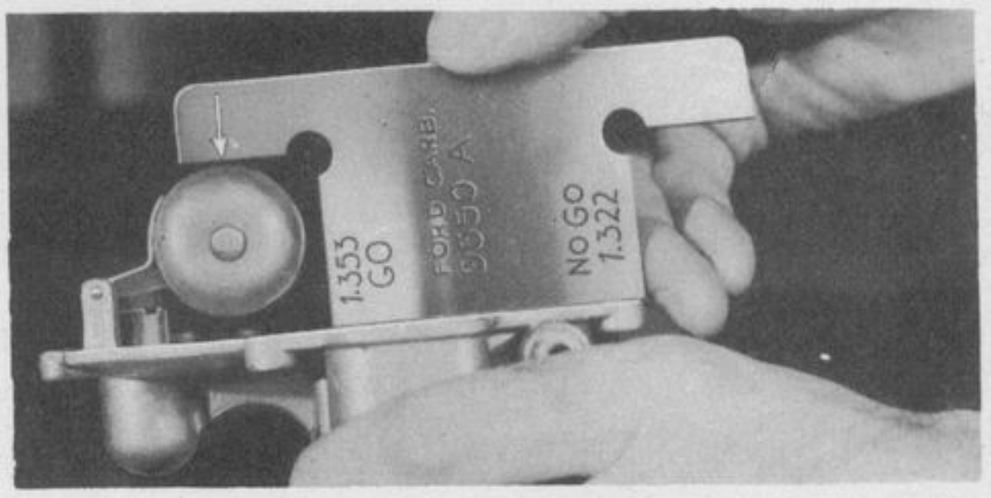

Figure 133—Checking Float Position ("Go" End of Gage)

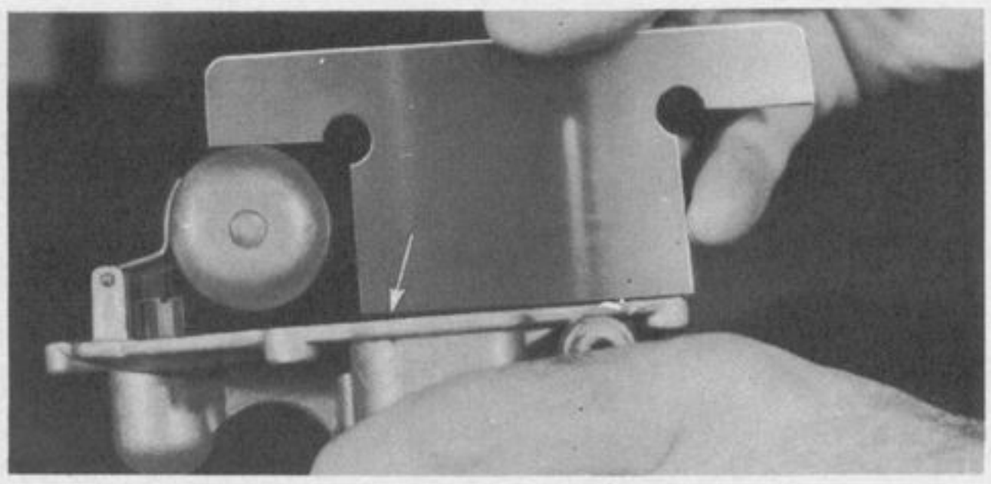

Figure 134—Checking Float Position ("No-Go" End of Gage)

Check the float position, using No. 9550-A "Go-No-Go" gage. The "Go" end of the gage must just clear float at the point indicated by the arrow in figure 133. The "No-Go" end of the gage must rest on float and clear air horn at the point indicated by the arrow in figure 134. Be sure to make both checks at each end of the float.

If the float position is not correct, use float arm bending tool No. 9550-C. If the "No-Go" end of the gage does not touch float (Fig. 134), bend float arm up (Fig. 135). If the "Go" end of the gage does not clear float (Fig. 132), bend float down (Fig. 136).

Install the Power Valve assembly (9904), by inserting the brass piston in the hole and then pressing down on the expansion washer until it seats against the flange in the hole. Assemble main body to throttle body. Parts used are 9512 main body, 9518 throttle body assembly and 9516 throttle body gasket.

Assemble the pump check (9576) and the pump check retainer (9575), using a piece of $\frac{5}{8}$-inch diameter wood or fiber dowel stock to push retainer down into place. Before installing the retainer, the steel ball should be tapped lightly with a brass drift to be sure that it seats tightly.

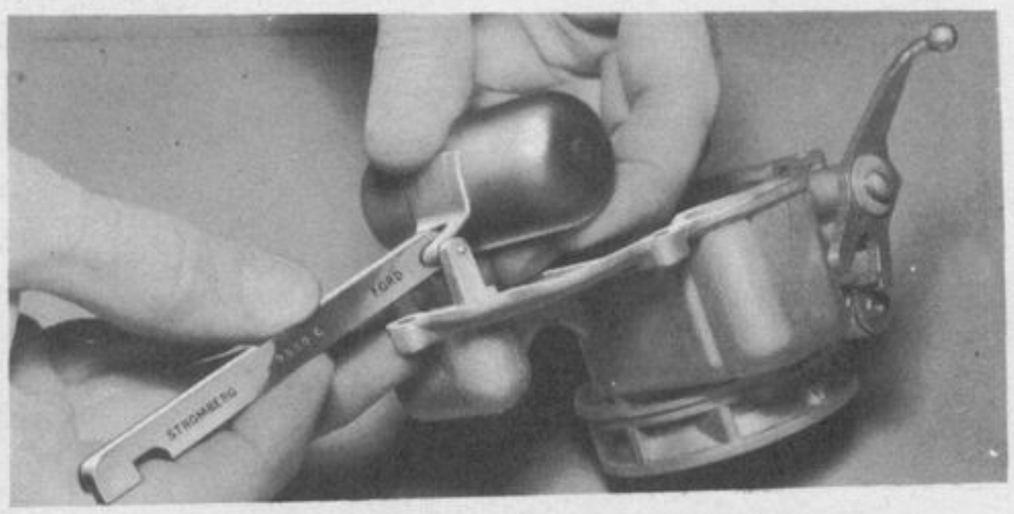

Figure 135—Bending Float Arm Up

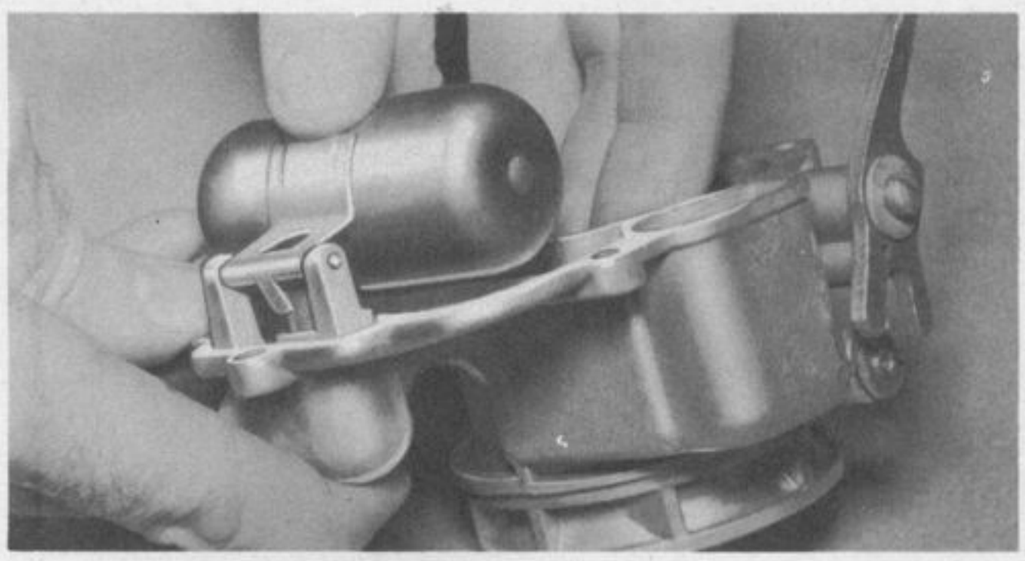

Figure 136—Bending Float Arm Down

Install main jet (9533) of correct size for the carburetor and for the altitude. For altitudes below 5000 feet, use size .064″ and from 5000 feet to 10,000 feet, use size .062″.

Install the power jet valve (9594) in the float bowl after checking it carefully for dirt and freedom of operation. Make sure the gasket (9608) is in good condition and properly placed in the hole.

Assemble the nozzle bar (9228) by tightening the clamp screws; be sure nozzle bar does not tilt. Be sure clamps (9928) are straight before using them and that the gaskets (9926) are in place. Install 9542 idle tube, 9924 air bleed and 9925 gasket (air bleed).

Inspect accelerator pump assembly and remove any burrs or foreign matter that may have been caused by previous operations. Blow out with compressed air. Assemble accelerator pump assembly in the following order:

9531-A	Pump rod assembly
9631	Accelerator pump piston assembly
9632	Pump rod spring retainer
9636	Pump piston spring
9650	Piston expander spring

Install accelerator pump assembly, using the link (9526) to connect the pump rod (9531) to the pump operating lever (9583). The long pin on the link should be inserted in the hole in the pump rod and the short pin should be inserted in the operating lever in the left hole for summer, the center hole for

winter and the right-hand hole for extremely cold weather. Secure the link in place by installing the retainer (9599) in the groove in the upper pin of the link.

Drop the pump discharge needle (9594) into the pump outlet hole after making sure there is no foreign substance in the opening and that the needle is not worn.

Install the 9520 air horn assembly, 9519 air horn gasket and the 31628-S7 screws and 34803-S2 lock washers.

When placing the air horn in position on the float bowl, make sure the gasket is properly located so it will not obstruct the passages for the accelerator pump outlet or power valve vacuum line. Install the three screws in the top of the float bowl first. The fourth screw and lock washer should then be installed in the hole directly underneath the choke lever (9548) inverted. Do not install the choke tube bracket screw at this point.

Grease the 9537 choke lever pawl and install it and the 9587 choke lever pawl spring, 9548 choke lever, 34703-S7 washer and 35188-S2 screw.

Install the fast idle rod (9598) in the hole in the choke lever (9548) and then attach the idle lever (9584) to the other end of the fast idle rod. The idle lever (9584) should then be installed on the throttle body and secured with a cotter pin.

Install the choke tube bracket (9791) together with the screw and lock washer which holds it in place. The bracket should be installed so it points to the choke lever side.

5. FINAL INSPECTION.

Check the operation of the accelerating pump by making several strokes of the throttle (with fuel in float bowl) and observing the discharge jets through air horn, making sure a good stream comes from the jets.

Make sure the pawl (9537) and pawl spring (9587) hold the choke plate from rattling. Sometimes the arm on the choke shaft must be bent slightly to prevent possibility of the choke plate rattling.

Set idle speed approximately correct for speed of five miles per hour in high gear by using a 0.006″ feeler blade. Adjust the idle speed adjusting screw so that the .006″ feeler will just slip between the edge of the throttle plate and throat of the carburetor. The feeler blade must not be over ⅛ inch wide.

E—FORD "STROMBERG" TYPE CARBURETOR (67-9510-A)

1. PRELIMINARY INSPECTION.

Inspect carburetor for cracks in flange and missing or damaged parts.

2. DISASSEMBLY.

NOTE: To hold the "Stromberg" type carburetor during disassembly and reassembly, the same carburetor rack may be used, as shown in figure 86.

Remove the choke lever screw as shown in figure 137. This results in removal of the 40-9592 choke lever fulcrum screw, 40-9539 choke lever spring, 67-9537 choke lever pawl and the 67-9587 choke lever pawl spring.

Remove the 40-9641 accelerator pump lever fulcrum screw as shown in figure 138 and remove the 72000-S7 cotter, 40-9531 accelerator pump lever, 40-9571 accelerator

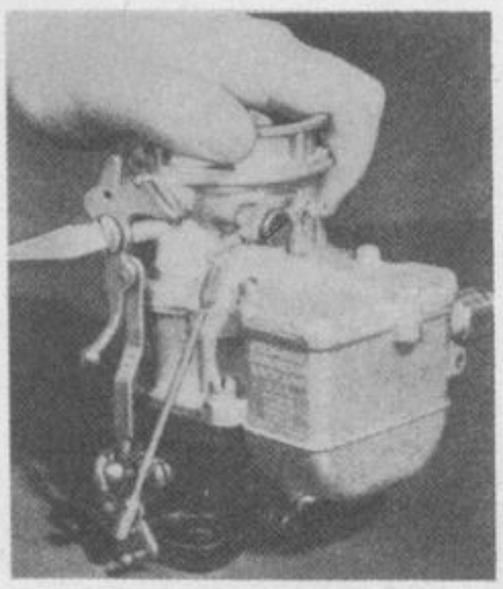

Figure 137—Removing Choke Lever Screw

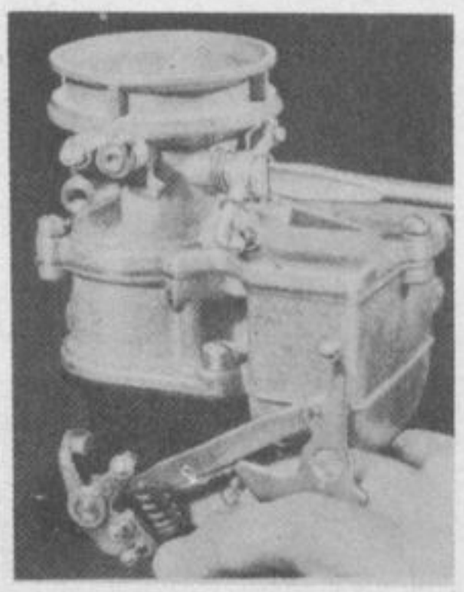

Figure 138—Removing Pump Lever Screw

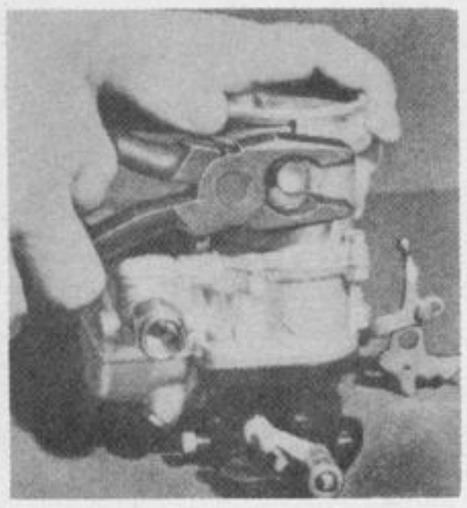

Figure 139—Removing Choke Shaft End Cap

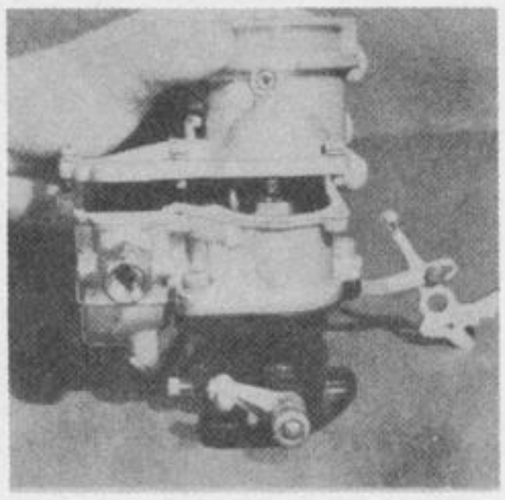

Figure 140—Removing Air Horn

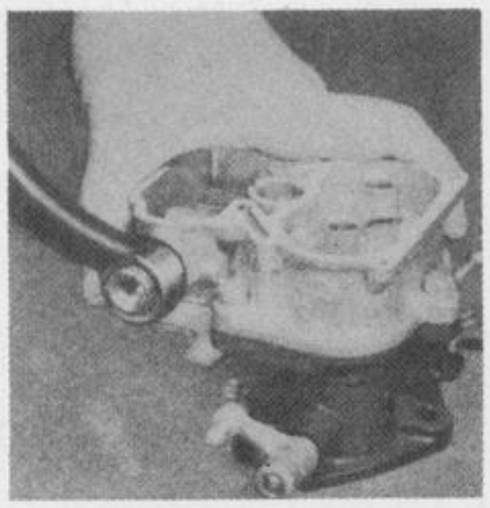

Figure 143—Removing Fuel Needle Valve and Seat

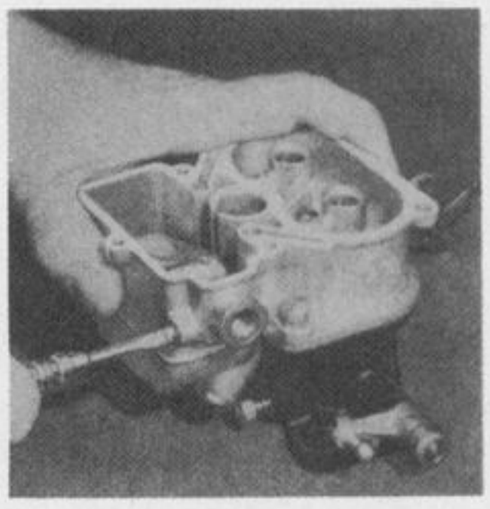

Figure 144—Removing Float Assembly

pump spring and the 67-9526 accelerator pump rod.

Remove the choke shaft end cap (40-9645), using wire cutting pliers as shown in figure 139 to pull the cap out of the end of the shaft.

Unscrew the five air horn screws. Lift off air horn as shown in figure 140. Remove five 31062-S7 screws, five 34803-S7 lock washers, the 40-9631 accelerator pump, 67-9632 accelerator retainer, pump, and plunger, the 40-9634 accelerator pump felt gasket, 40-9636 accelerator pump return spring, 67-9637 accelerator pump return seat, 40-9639 accelerator pump plunger washer and the 40-9640 accelerator pump plunger upper spring.

Remove the two 40-9542 idling jets (Fig. 141). Remove 67-9594 economizer valve (power by-pass valve) (Fig. 142), using special screw driver (9594-B).

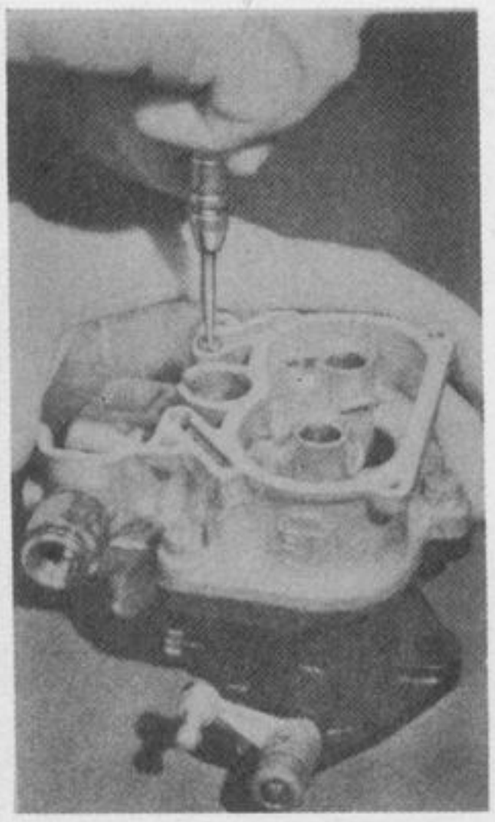

Figure 141—Removing Idling Jets

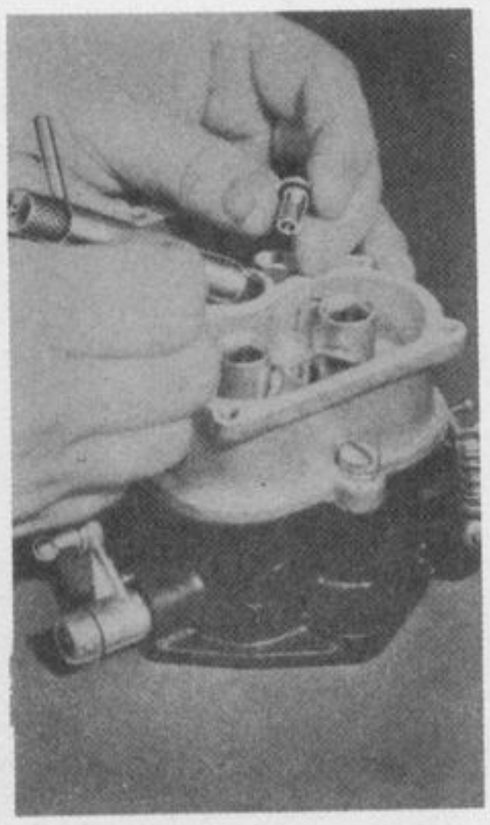

Figure 142—Removing Economizer Valve

Remove 40-9564 fuel needle valve seat (Fig. 143). The fuel needle valve and seat must be kept together as removed from the carburetor as one needle valve will not always work properly in another seat. Rinse off parts (in sets) in cleaning solution and wipe with a clean cloth. Discard both needle and seat if needle shows any signs of wear on seating end. Polish the end of needle that contacts float.

Remove 40-9558 float hinge pin and the 40-9550 float assembly (Fig. 144). Remove the float bowl to throttle body screws and washer (Fig. 145).

Remove the 72195-S7 or S8 pin for the throttle shaft loose lever stop. Using 9359-D guiding fixture, 9614-A driver and 9514-B anvil (Fig. 146), remove the 40-9614-B throttle shaft loose lever stop, 40-9624-B throttle shaft loose lever spring, 40-9615-C throttle shaft loose lever, two 40-9541 idle adjusting needle and two 40-9578 idle adjusting needle spring.

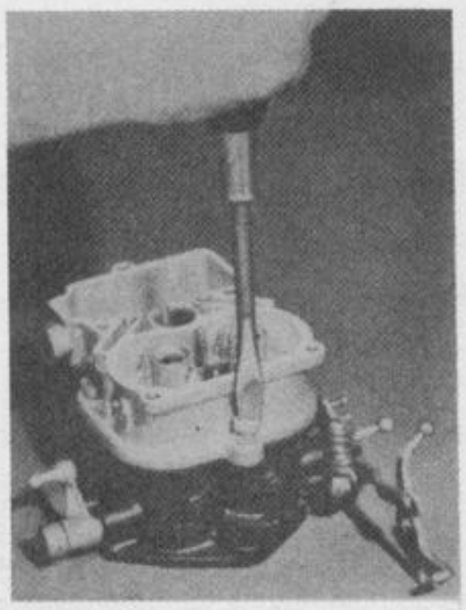

Figure 145—Removing Throttle Body

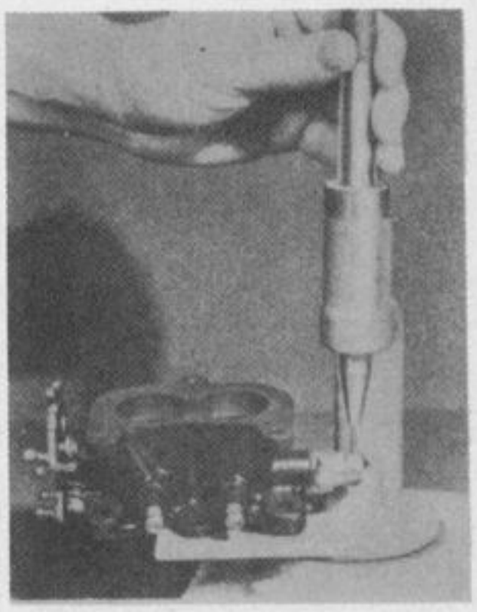

Figure 146—Removing Throttle Shaft Loose Lever

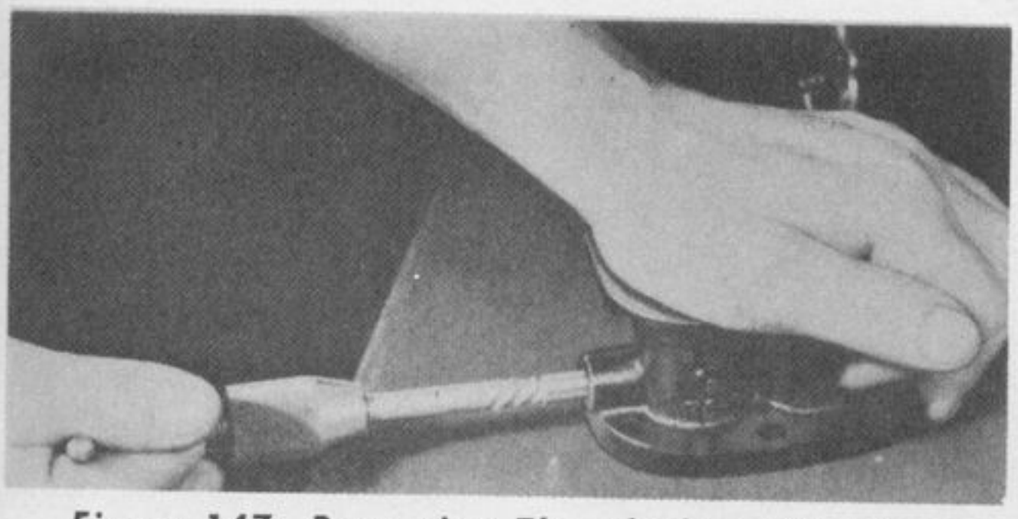

Figure 147—Removing Throttle Stem Bushing

Remove four 40-9586 throttle plate screw, two 40-9585 throttle plates and the 67-9581 throttle and lever shaft.

Remove the throttle shaft bushings as shown in figures 147 and 148, using 9644-B Ezy-Out tap. This results in removal of the 40-9657 throttle stem bushing, 40-9644 throttle body kicker bushing and the choke lever and throttle kicker assembly.

Disassemble choke lever and throttle kicker, using 9539-D guiding fixture, 9614-A driver and 9579-C anvil (Fig. 149). Parts disassembled are the 67-9548 air shutter lever, 40-9579 throttle link rivet, 40-9595 kicker spring washer, 40-9597 carburetor throttle kicker and the 40-9643 kicker washer.

Remove from float bowl, as shown in figures 150, 151, 152 and 153, the two 40-9522 metering jet plugs, 40-9562 drain plug, 40-9573 accelerator pump check valve, 67-9533 main metering jet (Use No. 9510-B jet wrench, Fig. 151) and 40-9534 main jet discharge tube (Use 9534-A remover, Fig. 153). Do not drive on this remover or the discharge tubes will be ruined.

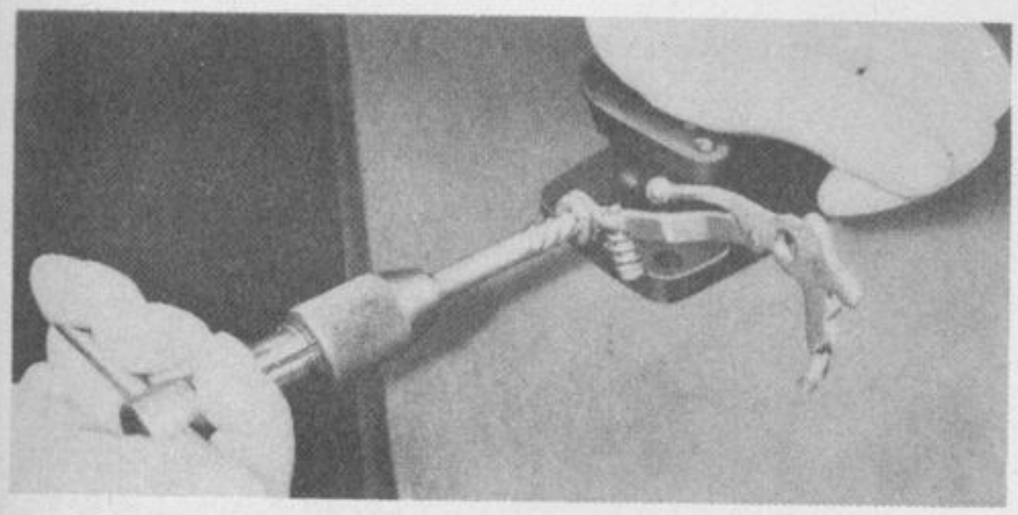

Figure 148—Removing Throttle Kicker Bushing

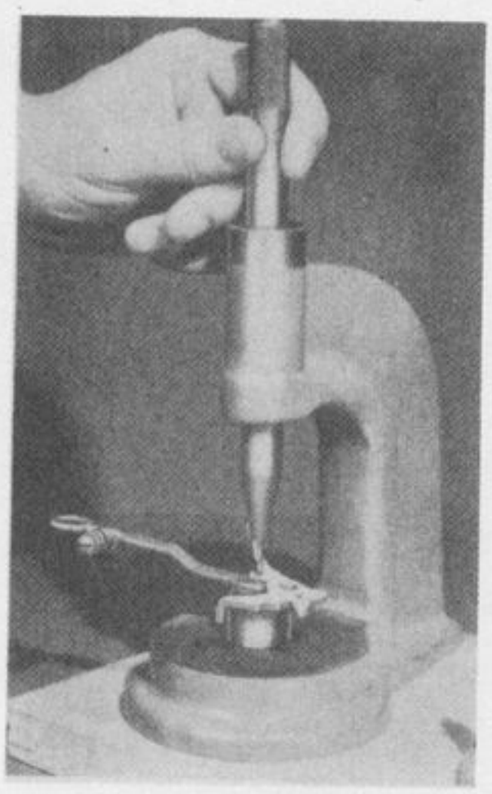

Figure 149—Disassembling Choke Lever

Figure 150—Removing Drain Plug

Remove two 40-9586 choke plate screws, 40-9549 choke plate assembly and the 40-9546 choke shaft assembly (Fig. 154).

Clean all parts, being particularly sure that all corrosion is removed from the float bowl of carburetor. Thorough cleaning of all parts is a first essential of producing a good reconditioned carburetor.

3. INSPECTION AND REPAIR OF PARTS.

Make a visual inspection for signs of rough handling and mutilation and discard damaged parts.

Clean out the hole for the choke lever pawl using reamer (9537-A) (Fig. 155).

Check fit of poppet valve stem in choke plate. If lose or if poppet valve spring is weak or broken so valve will not stay in position firmly, discard choke plate assembly (40-9549).

Figure 151—Removing Accelerator Pump Check Valve

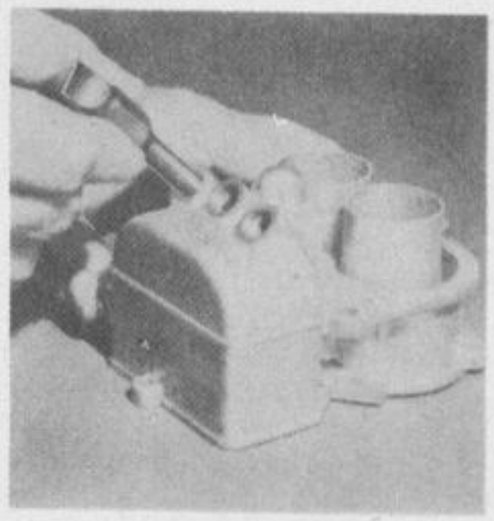

Figure 152—Removing Main Metering Jet

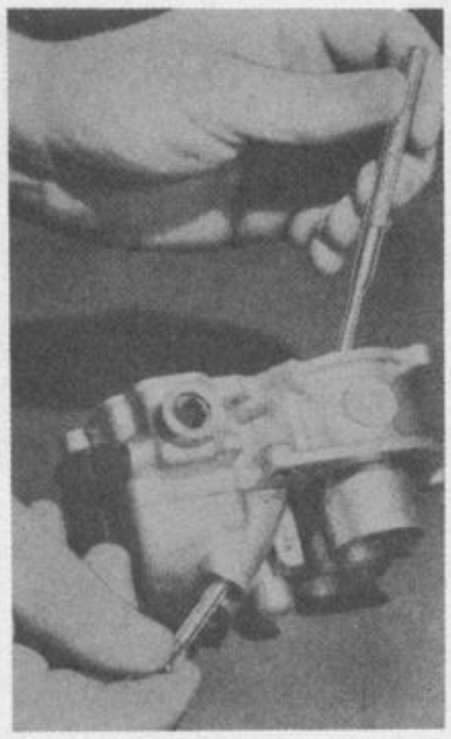

Figure 153—Removing Main Jet Discharge Tube

Figure 154—Removing Choke Plate and Shaft

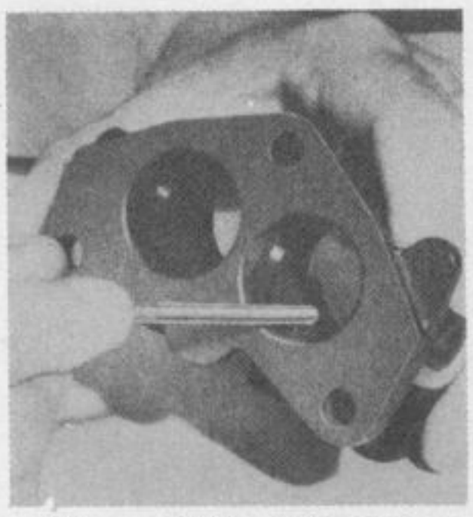

Figure 156—Cleaning Upper Idle Discharge Hole

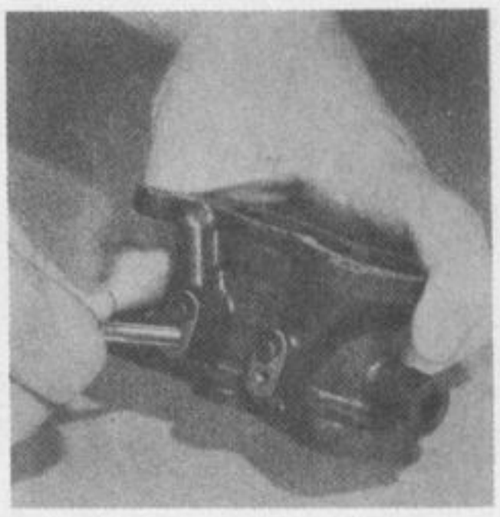

Figure 157—Cleaning Idle Adjustment Screw Threads

Place dummy idle adjustment screws (40-9541) in throttle body and repaint outside of throttle body with black lacquer, being careful not to get paint inside throat, in idle fuel passages or on gasket surfaces.

Clean out the idle adjustment screw discharge holes into throat, using hand chuck (9518-E) and 9518-F drill, size (0.046″) as shown in figure 112.

Clean out the upper idle discharge hole into throat, using the 9515-A cleanout tool with 0.037″ diameter wire (Fig. 156).

Clean out the idle adjustment screw threads in throttle body, using tap (9514-A) as shown in figure 157. Care must be used not to remove any metal as the screws (40-9541) must fit tightly enough to prevent an air leak.

Make a visual inspection for signs of rough handling or mutilation and discard parts if damaged. Clean out threads for main jets (Fig. 158), using tap (9533-A).

Inspect all passages and clean out any obstructions. Inspect ball end of choke lever (67-9548) and discard part if ball shows appreciable wear. Inspect float (40-9550) to be sure solder holding lever to float is in good condition. Inspect float for leaks by holding it under surface of water that has been heated to just below the boiling point. Bubbles will appear if float leaks. Float should be discarded if it leaks. Polish fuel needle contact surface of float arm.

All new gaskets, cotters, rivets and pins must be used when reassembling. The following parts also should be replaced: 40-9631 accelerator pump, 40-9644 throttle body kicker bushing, and 40-9657 throttle stem bushing.

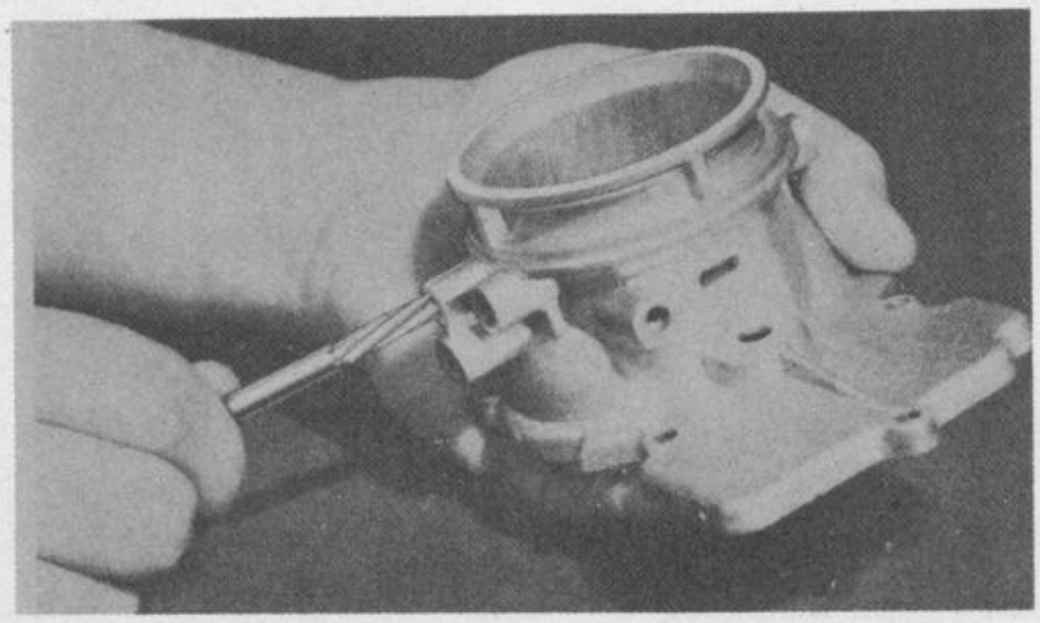

Figure 155—Cleaning Hole for Choke Lever Pawl

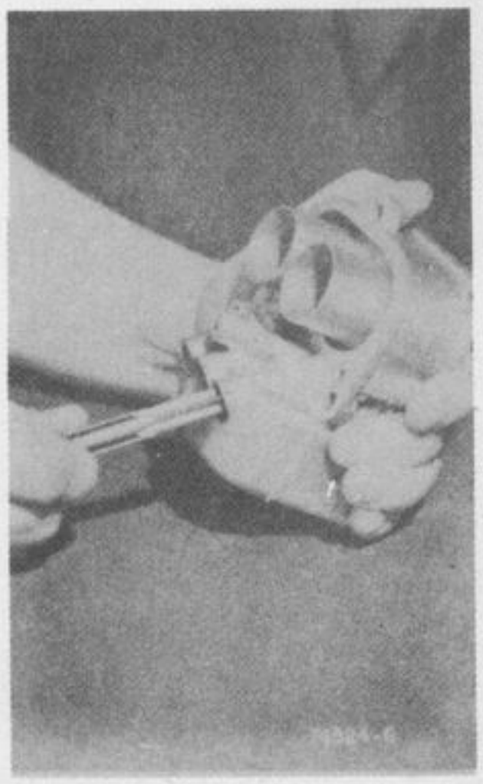

Figure 158—Cleaning Threads for Main Jets

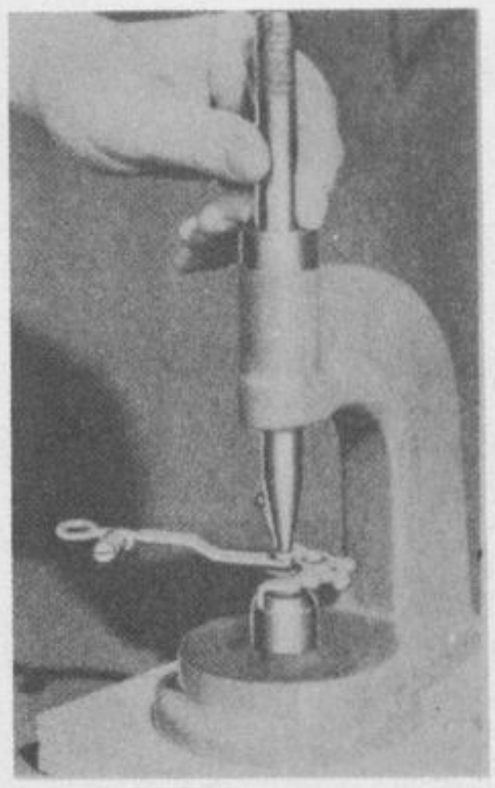

Figure 159—Assembling Carburetor Throttle Lever

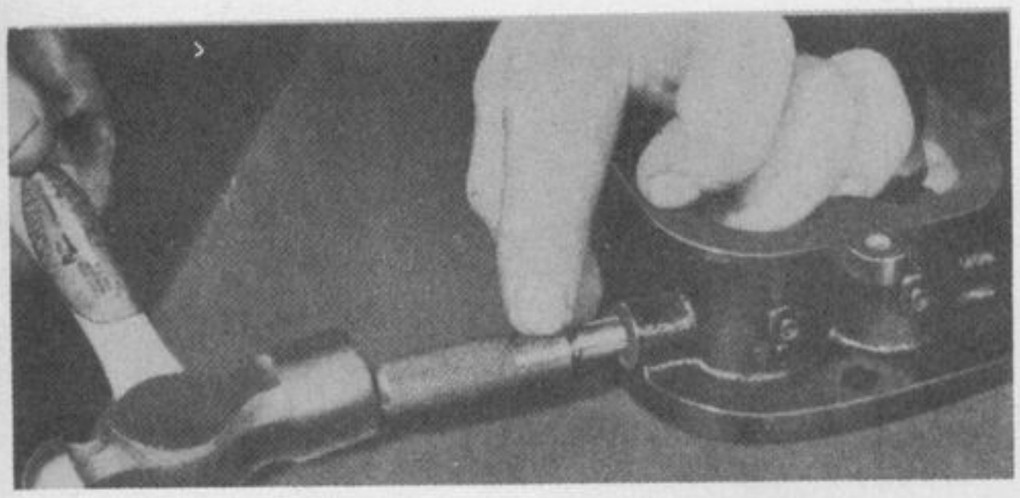

Figure 160—Installing Throttle Shaft Bushing

Using 9359-D guiding fixture, 9579-B riveter, 9579-C and 9579-D anvil (Fig. 159) assemble the 67-9548 air shutter lever, 40-9579 throttle link rivet, 40-9595 kicker spring washer, 40-9597 carburetor throttle kicker and the 40-9643 kicker washer. Be sure the rivet is installed so parts work together freely.

Install new throttle shaft bushings in throttle body, as shown in figures 160 and 161, using piloted driver (9644-C). Line ream throttle shaft bushings with 9944-A reamer as shown in figure 162. Install the 40-9644 throttle body kicker bushing, 40-9657 throttle stem bushing and the choke lever and throttle kicker assembly.

Do not use old throttle shaft assembly (67-9581) if it is worn enough to permit an air leak past the bushings in throttle body. Also be sure the lever is tight on the shaft and that the ball end studs for the accelerating pump link are tight.

Install the 40-9585 throttle plates in the 67-9581 shaft. Edges of the throttle plates are beveled to fit tightly into throttle throat

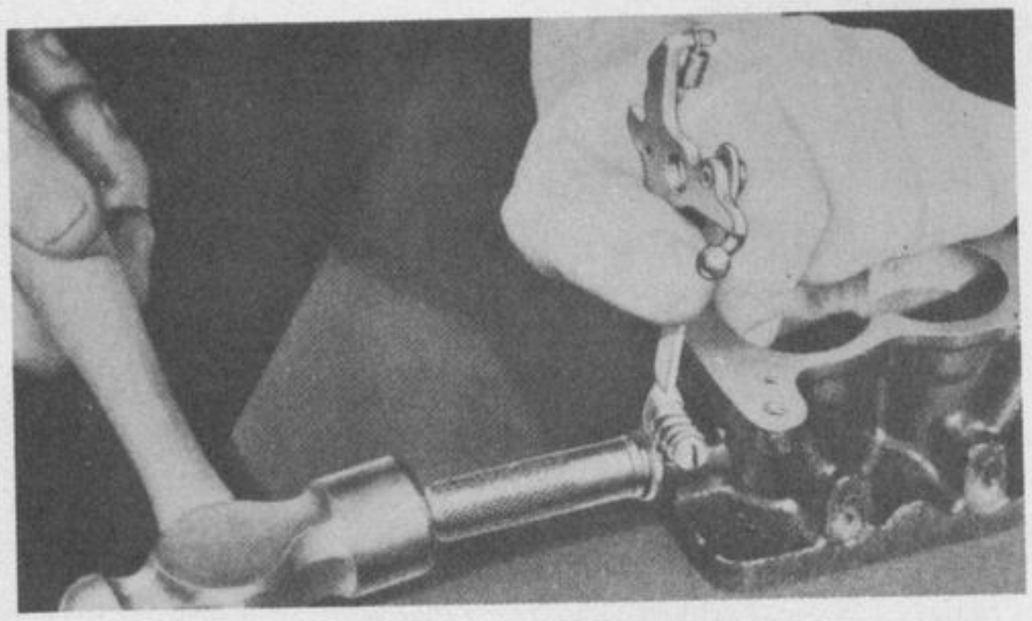

Figure 161—Installing Throttle Shaft Bushing (Lever Side)

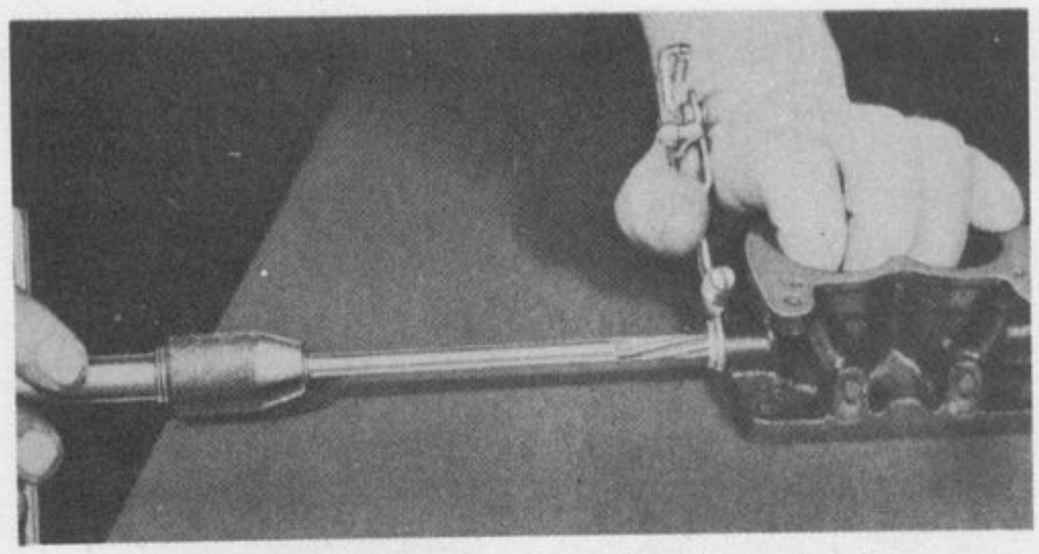

Figure 162—Reaming Throttle Shaft Bushings

so care must be used not to install them upside down. Before tightening throttle plate screws (40-9586), close throttle tightly. This will center the throttle plates properly, at which time throttle plate screws should be tightened.

Make visual inspection of tightness of fit of the throttle plates when closed, by holding toward a light and observing amount of light that can be seen around edges of throttle plates. A very snug fit is necessary for proper idling and low speed operation. If throttle plates or throttle body are worn so a tight fit cannot be obtained, install new parts as needed.

Hold throttle closed and gage distance from throttle plates to the idle discharge holes just above plates (Fig. 163). Use "Go-No-Go" gage 9518-B. If distance is not with-

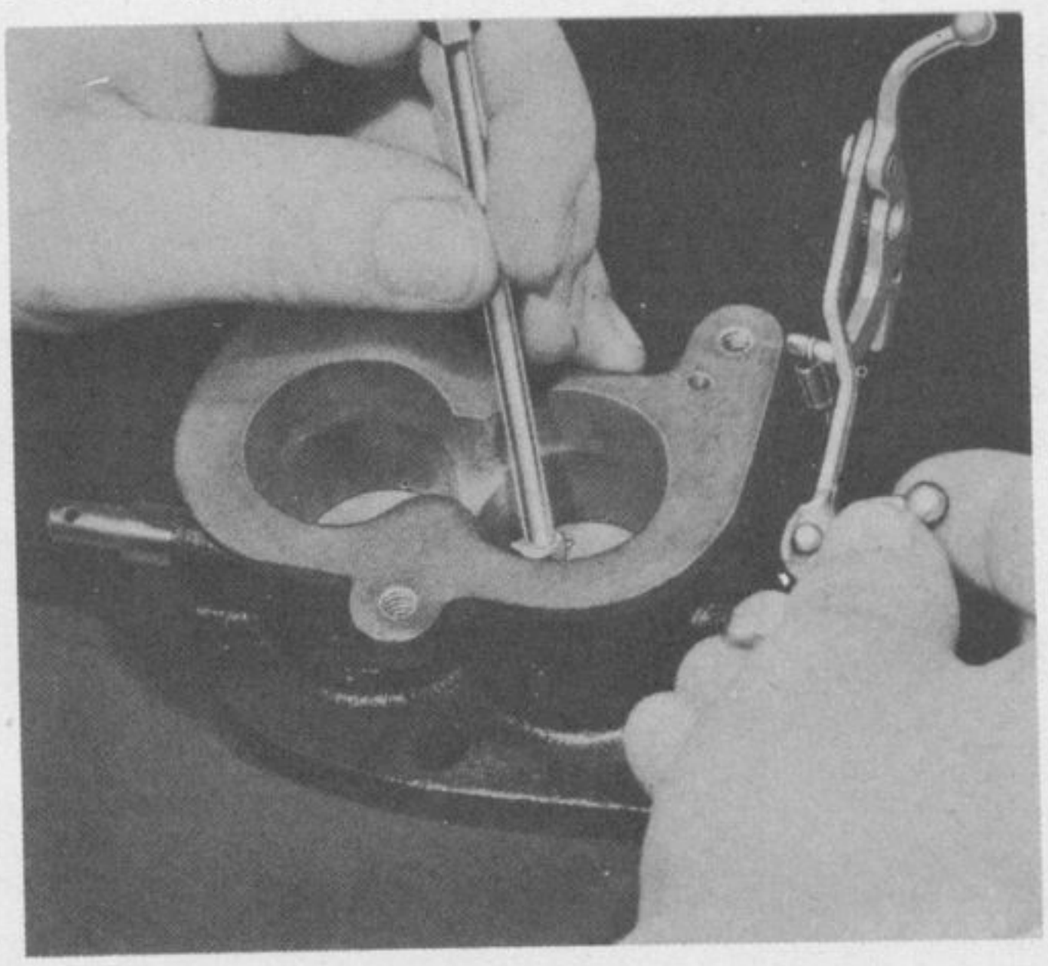

Figure 163—Gaging Throttle Plates

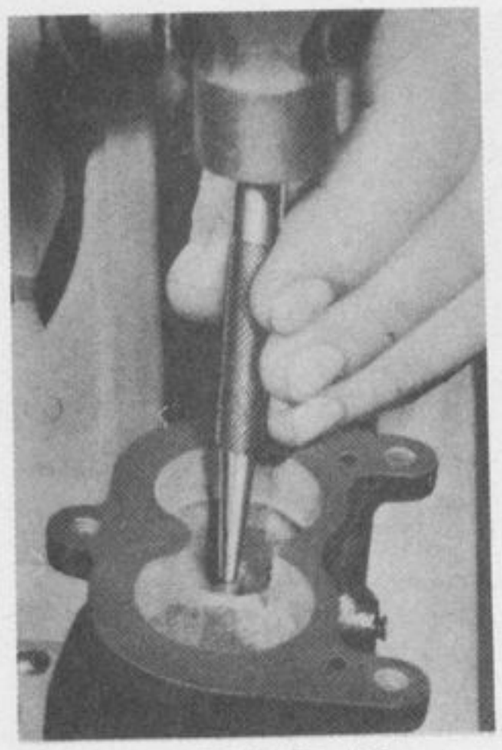

Figure 164—Staking Throttle Plate Screws

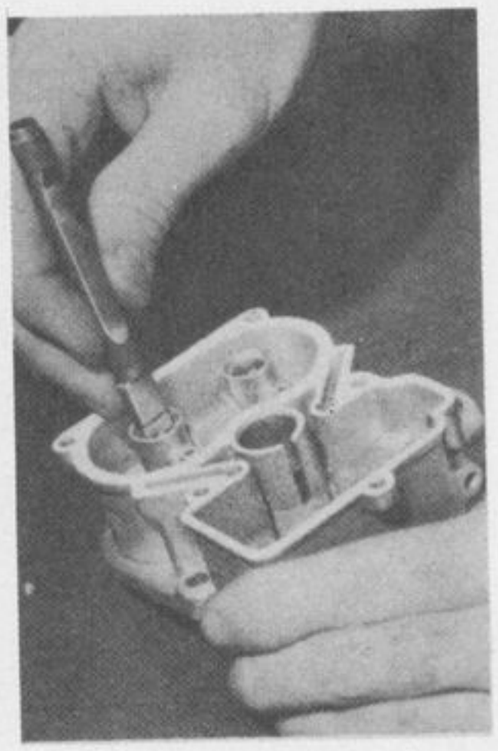

Figure 165—Gaging Main Jet Tubes

in gage limits, install new throttle plates on throttle body or both if needed. Poor idling and low speed operation will likely be encountered if this dimension is not within specified limits.

Stake end of brass throttle plate screws with center punch (9518-D) and anvil (9518-C) as shown in figure 164, so they will not become loose. Be sure to place throttle body assembly on the anvil with the proper side on highest side of anvil. If it is placed on anvil improperly, throttle plates will be wedged tightly into throttle body throat and the parts ruined.

Assemble to the throttle body assembly two 40-9541 idle adjusting needle, two 40-9578 idle adjusting needle spring, 40-9615-C throttle shaft (loose) lever, 40-9624-B throttle shaft (loose) lever spring, 40-9614-B throttle shaft (loose) lever stop and 72195-S7 throttle shaft loose lever stop pin. Run in the idle adjustment screws just barely snug, then back them out 5/8 to 3/4 turn.

Assemble the 40-9546 choke shaft assembly, 40-9549 choke plate assembly and the two 40-9586 screws to the air horn. Before tightening the screws, close the choke tightly. This will center the choke plate properly while the screws are being tightened. Stake the ends of screws with center punch (9518-D) and anvil (9518-C).

Assemble to the float bowl two 40-9534 main jet discharge tubes, two 67-9533 main metering jets, two 40-9522 metering jets plugs, two 40-9563 plug gaskets. Jet size is marked on main body lower flange toward the back side of the carburetor. Size marking should be removed if a different jet is installed than the size marked.

Gage the distance from the outlet end of main jet tubes to side of venturi, using "Go-No-Go" gage 9534-B, as shown in figure 165. Discard tubes or float bowl or both if necessary to obtain limits within "Go-No-Go" surfaces of gage.

Assemble the float bowl to throttle body, using three 31088-S7 screws, three 34805-S7 washers, 40-9516 throttle body gasket.

Install 40-9558 float hinge pin, 40-9550 float assembly, 40-9564 float needle and seat valve, 67-9594 power jet (power by-pass valve), and two 40-9542 idling jets.

Place the assembly on the 9350-A carburetor and fuel pump tester, install 9550-E carburetor bowl drain cock as shown in figure 166. Install a fuel pump on the No. 9350-A tester, make connections and start the motor so fuel will be supplied to the carburetor under specified pressure. Check level of fuel bowl, using "Go-No-Go" gage (9550-B)

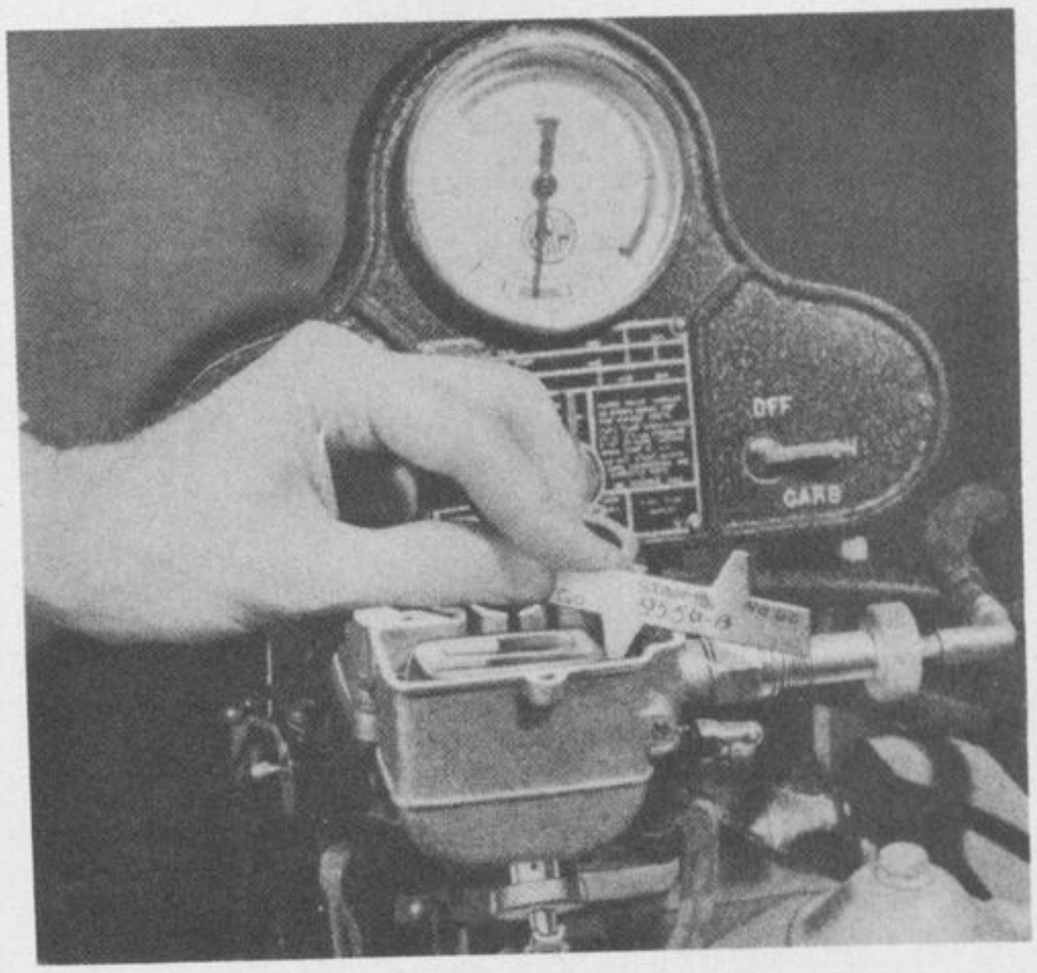

Figure 166—Checking Fuel Level

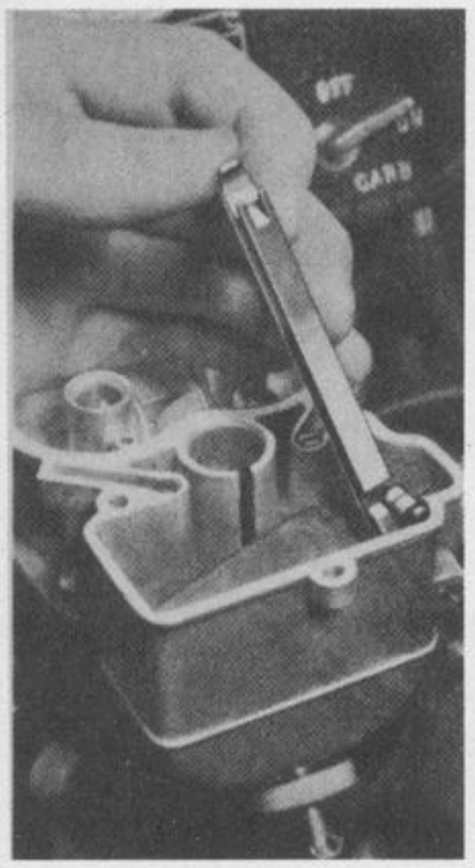

Figure 167—Raising Float Level

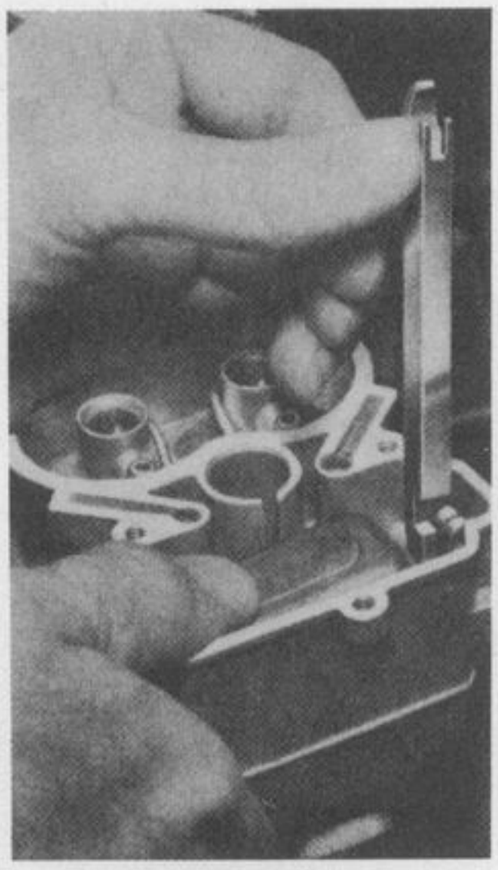

Figure 168—Lowering Float Level

(Fig. 165). "Go" end of the gage should just barely dip into the fuel. The "No-Go" end should not touch the fuel.

Be sure gage is dry as any moisture or fuel adhering to the end of gage will prevent obtaining a correct reading. Be sure end of gage is well over in center of bowl away from the edge where the fuel adheres to side of bowl. The 9350-A tester must be setting level. If fuel level is too low, it can be raised as shown in figure 167, using 9550-C float arm bending tool. If level is too high, it can be lowered as shown in figure 168. Before rechecking fuel level, it is necessary to drain float bowl.

Install the air horn, using the following parts:

48-9519 Upper body gasket
Five 31062-S7 Screws
Five 34803-S7 Lock washers
40-9631 Accelerator pump
67-9632 Accelerator pump plunger retainer
40-9634 Accelerator pump felt gasket
40-9636 Accelerator pump return spring
67-9637 Accelerator pump return seat
40-9639 Accelerator pump plunger washer
40-9640 Accelerator pump plunger upper spring
40-9645 Choke shaft cap
40-9641 Accelerator pump lever fulcrum screw
72000-S7 Cotter
40-9531 Accelerator pump lever
40-9571 Accelerator pump lever spring
67-9526 Accelerator pump rod
40-9592 Choke lever fulcrum screw
40-9539 Choke lever spring
67-9537 Choke lever pawl
67-9587 Choke lever pawl spring

Put accelerator pump link in the "S" position, since this is the correct position for making the test of power by-pass valve opening. Grease choke lever pawl (67-9537) and choke lever fulcrum screw (40-9592) at time of assembly. Before using throttle and choke arms, etc., compare them with new parts to be sure they have not been bent.

4. FINAL INSPECTION.

The power by-pass valve (67-9594) must open correctly with respect to the throttle plate position as shown in figures 169 and 170. If it opens too soon, fuel economy will be reduced as much as 10 to 15 percent. If it opens too late, there will be a loss of power at wide open throttle due to too lean a mixture.

To check throttle position at which power

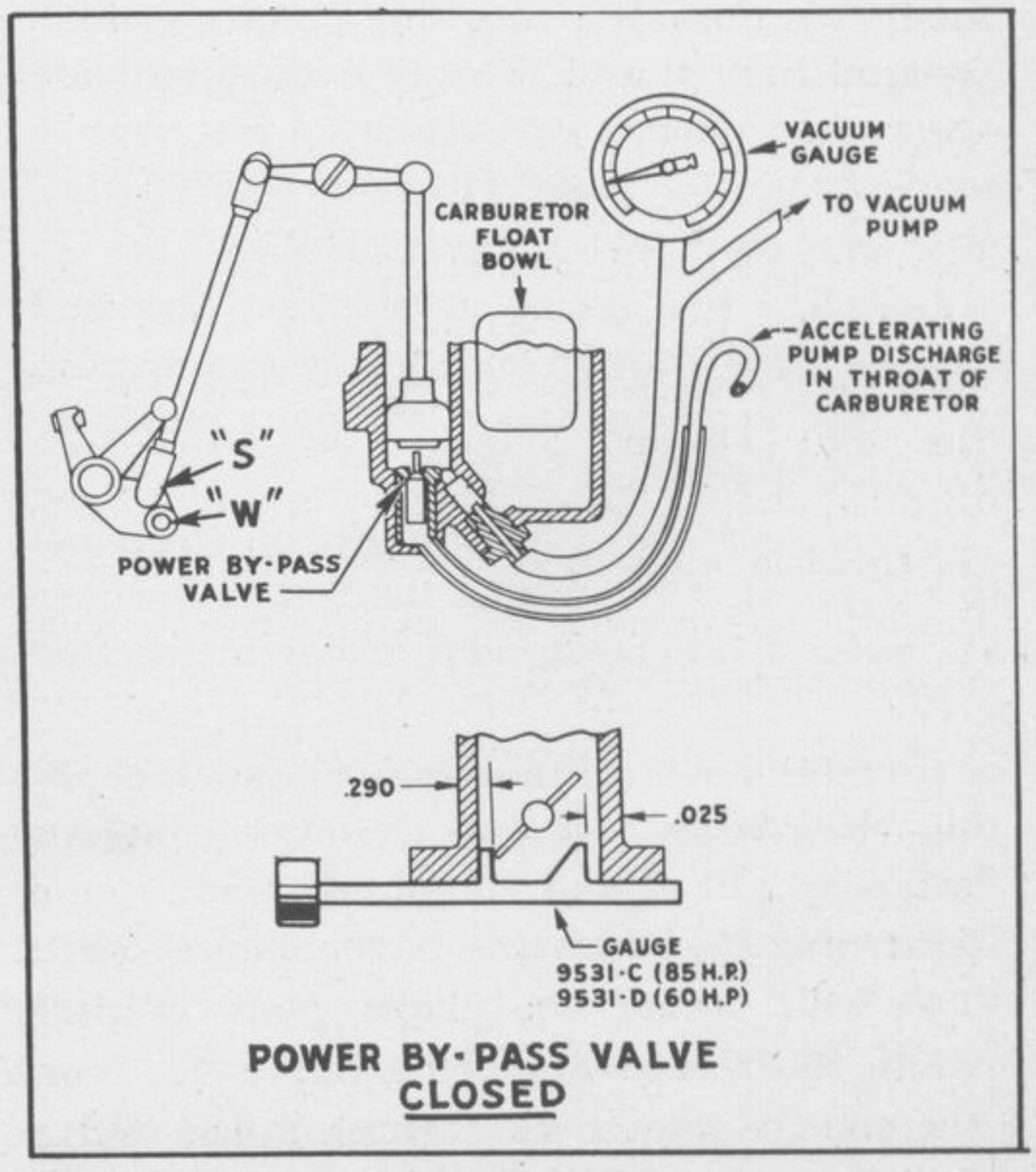

Figure 169

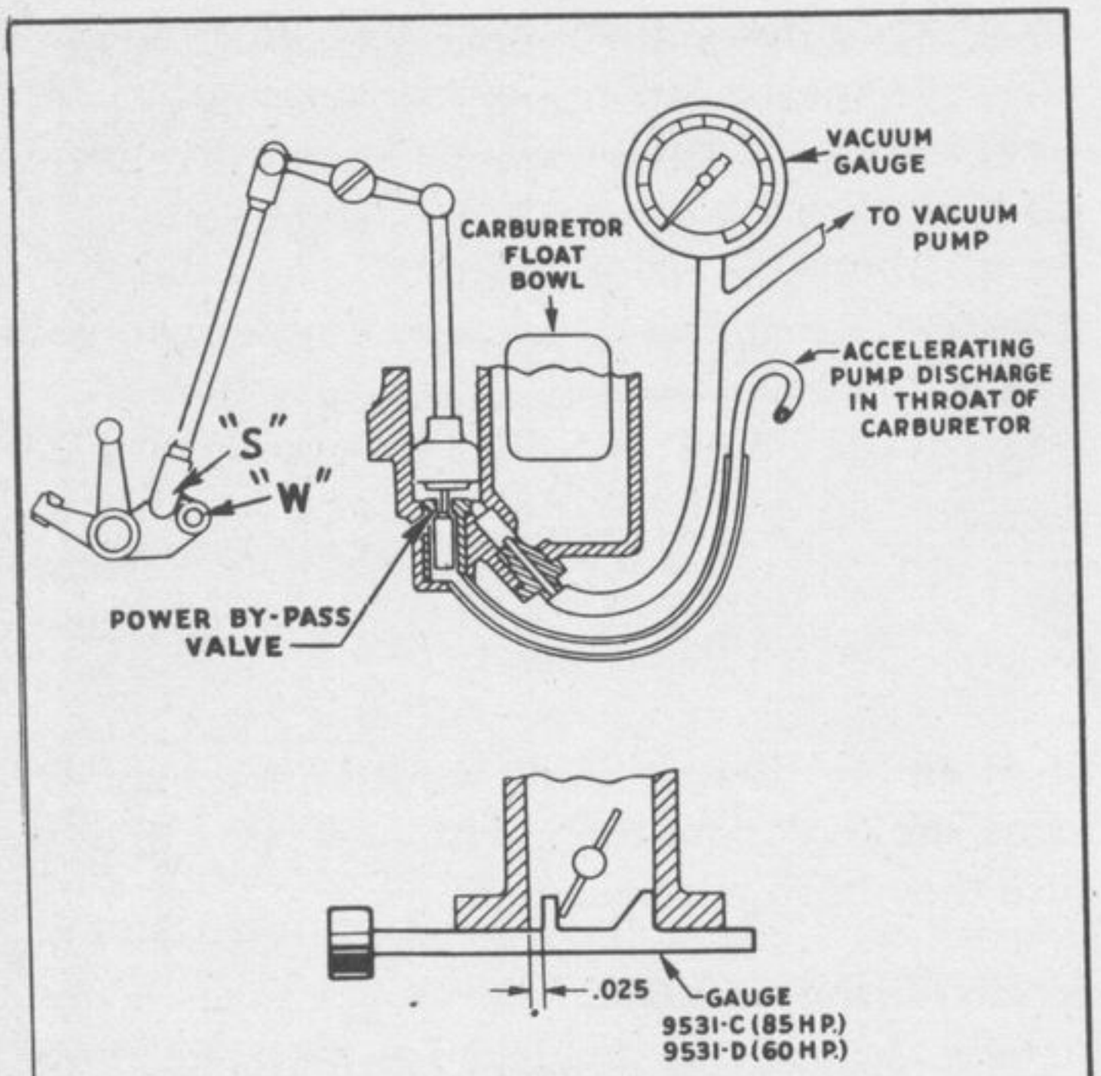

Figure 170

by-pass valve opens, place the carburetor on the 9350-A tester as shown in figure 171. The throttle plate position gage (9531-C for 85 H.P., 9531-D for 60 H.P.) must be in position in the slot in test unit flange on which carburetor is placed. Throttle must be wide open when placing carburetor on test unit so edge of throttle plate will enter the 9531-C or D gage as shown in figures 169 and 170.

Install a fuel pump on the test unit and connect hose to inlet and outlet connections of pump as marked on instrument panel instruction plate.

Turn the three valves on instrument panel to the position for testing fuel pump vacuum as marked on instrument panel instruction plate.

Connect hose (with valve at connector fitting) into bottom of float chamber as shown in figure 171. Drain plug (40-9562) and check valve (40-9573) have not yet been installed in carburetor, in order to permit this test to be made.

Start the motor of test unit and move throttle until position is found at which the vacuum reading drops to zero. The relationship between this position and the throttle plate position shown in figures 169 and 170 will indicate how much the end of accelerating pump lever (40-9531) must be bent down to obtain proper adjustment of opening of power by-pass valve.

In case the vacuum reading remains at zero, with throttle closed (as far as the 9531-C or D gage will permit), the power by-pass valve is opening too soon. The end of the accelerating pump lever (40-9531) must be bent *up* to correct this condition.

To bend the accelerating pump lever (40-9531), use tools (9531-A and 9531-B) as shown in figure 172.

When the accelerating pump lever (40-9531) has been set correctly, the power by-pass valve will open when the edge of the throttle plate is held tight against the 9531-C or D gage. In this position, there will be a vacuum reading as shown in figure 169.

When the throttle position gage (9531-C or D) is pushed to opposite side of carburetor throat as shown in figure 170, the vacuum reading should drop to zero.

The test outlined above can be made very easily by pushing on the throttle lever with one finger and simultaneously pushing on the 9531-C or D gage with another finger of the same hand as shown in figure 171.

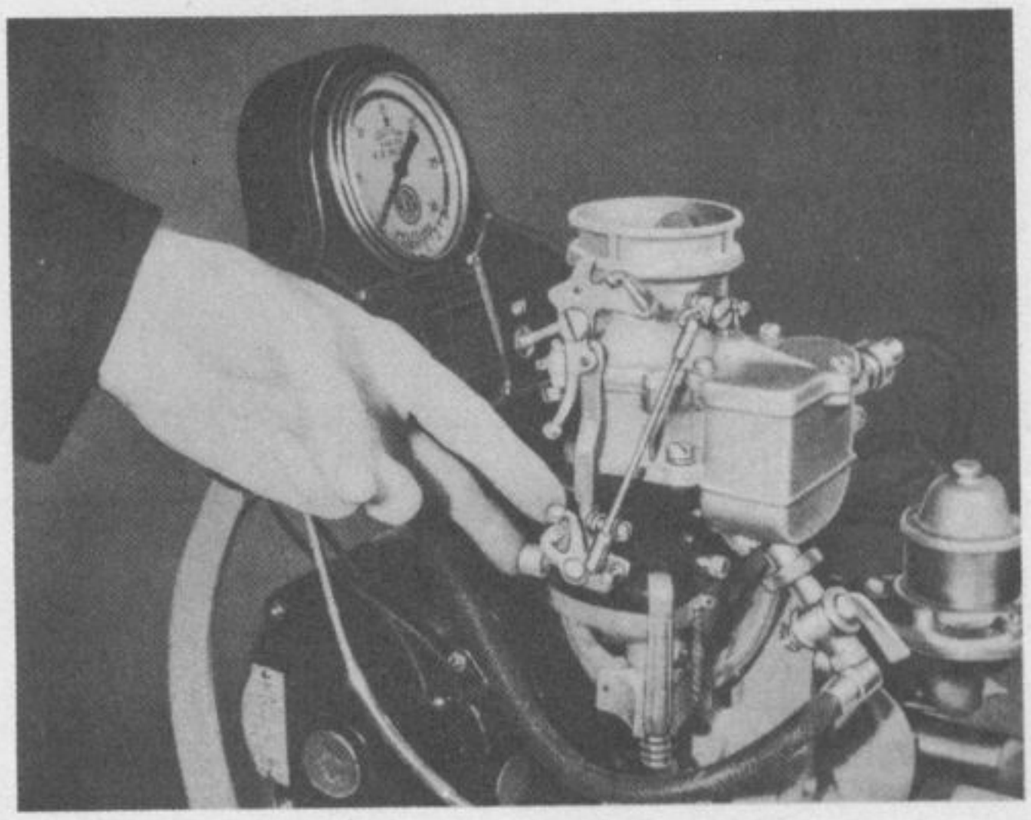

Figure 171—Checking Power Valve Opening

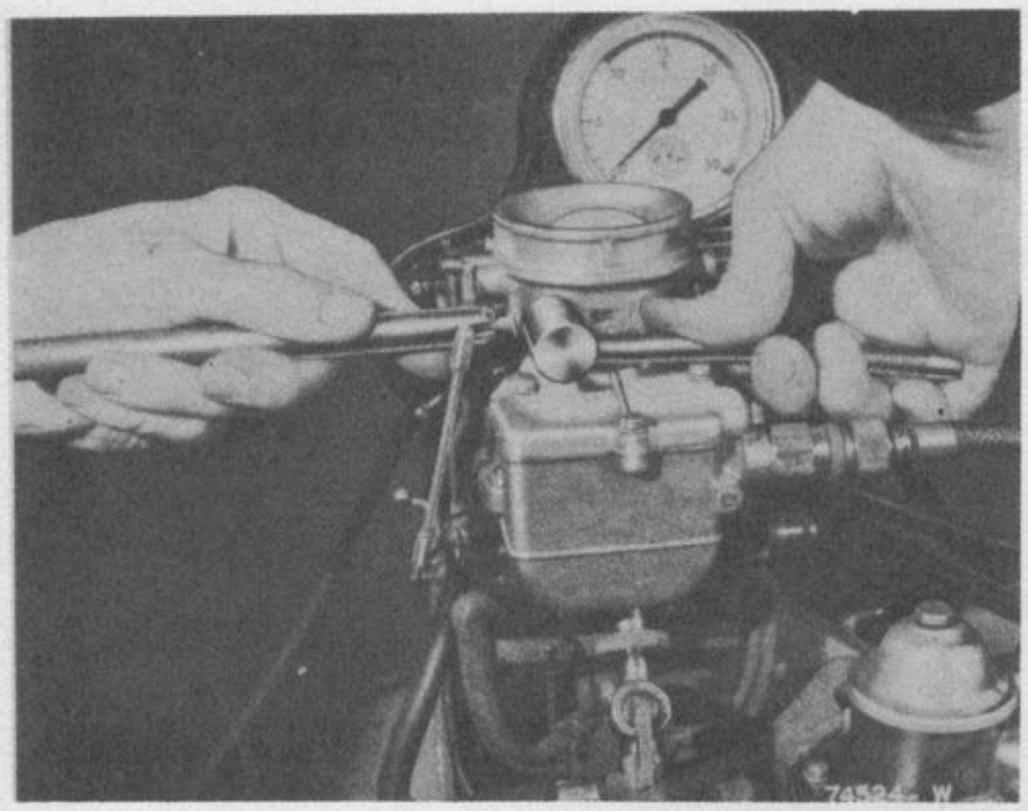

Figure 172—Bending Accelerating Pump Lever

Put accelerator pump link in the correct position for the season of the year ("S" for summer, "W" for winter).

Remove hose connection from carburetor float bowl drain plug opening, turn valve in hose to off position and install the 40-9573 accelerating pump check valve and the 40-9562 float bowl drain plug.

Turn the three valves on the test unit instrument panel to the position to fill carburetor float bowl, then start test unit motor. Remove throttle plate position gages 9531-C or D so throttle can be moved from fully open to fully closed position. Now, to be sure accelerating pump is opening properly and that all passages leading to the accelerating discharge jets are open, quickly move throttle lever from fully closed to fully open position. Do this several times while observing through the air horn to be sure a good stream comes from the accelerating jet in each throat of the carburetor.

Remove the drain plug (40-9652) long enough to drain float bowl, then replace it, using a new gasket (40-9563). With the choke plate open, be sure pawl (67-9537), pawl spring (67-9587) and choke lever spring (40-9539) hold choke so it will not rattle.

Set the idle speed approximately correct for five miles per hour speed in high gear by using a 0.006″ feeler blade (Fig. 129). Adjust the idle speed adjusting screw so that the feeler blade will slip between the edge of throttle plat and throat of the carburetor. The feeler blade must not be over ⅛″ wide.

CHAPTER IV

FUEL PUMPS

A—GENERAL

In setting up and operating a fuel pump reconditioning department, the same principles should be observed as are outlined for carburetor reconditioning in Chapter 3. The sequence of operations for the reconditioning of fuel pumps outlined below cover the eight-cylinder fuel pump. These operations may be followed in general for the six-cylinder fuel pump. These instructions are based on the use of fixtures and tools especially designed for reconditioning Ford fuel pumps by K. R. Wilson, Buffalo, New York. The basic numbers of the parts are included to assist in identifying each part.

B—DISASSEMBLY

Mount the fuel pump in the fixture (9350-C) as shown in figure 173. Disassemble the following parts in the order listed:

20009-S2 Fuel pump cover screw
40-9357 Fuel pump cover screw washer
68-9355 Fuel pump cover
68-9364 Fuel pump cover gasket
68-9365 Fuel pump screen
B-9185-B Fuel pump drain screw
B-9182 Drain screw spring
31628-S7 Upper body to lower body screw (six)
34803-S7 Washers (six)

Remove the lower body assembly from the 9350-C fixture and install another pump in the fixture for this same disassembly operation. After all pumps in the lot being worked on have been disassembled to this extent, proceed with the following operations, completing each operation on all parts of the lot before proceeding to the next operation.

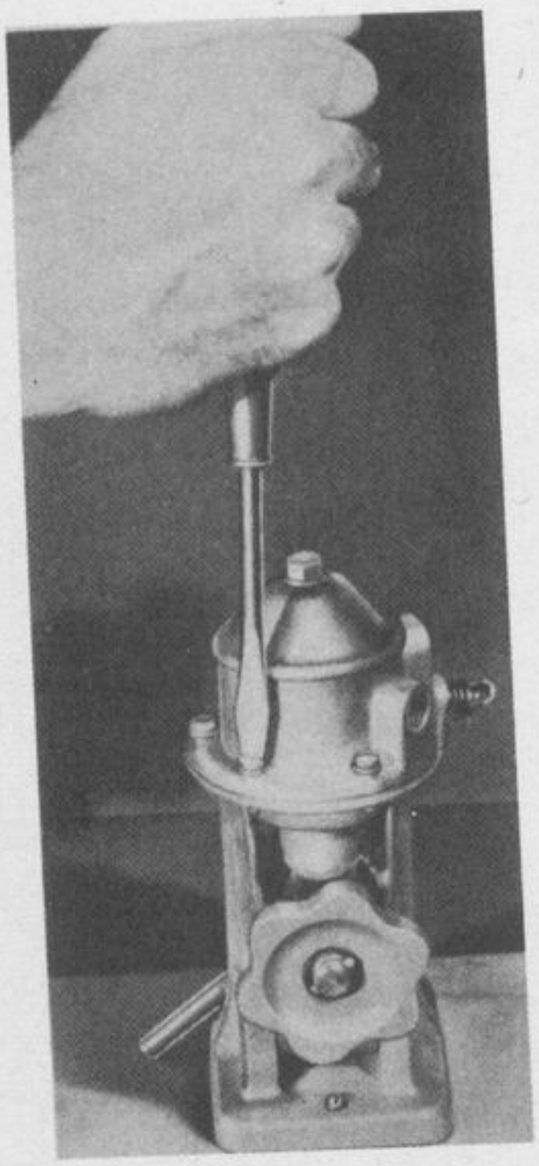

Figure 173—Fuel Pump Fixture

Figure 174—Fixture for Removing Rocker Arm Pin

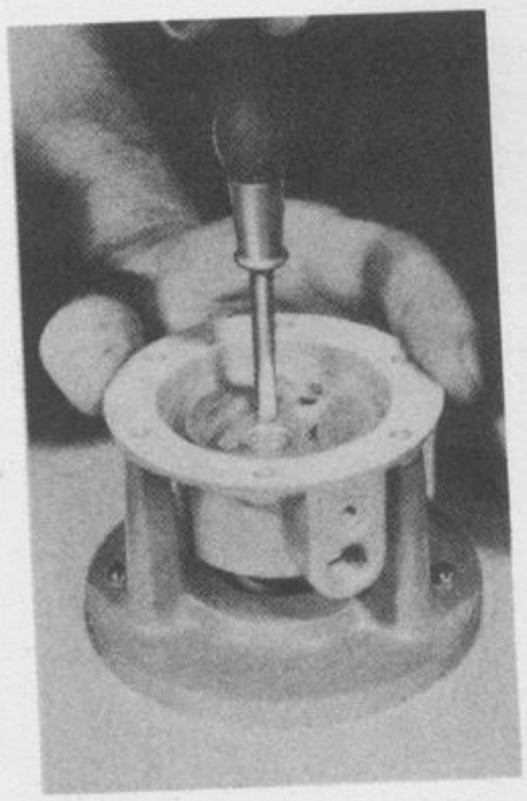

Figure 175—Fixture for Removing Valve Plate

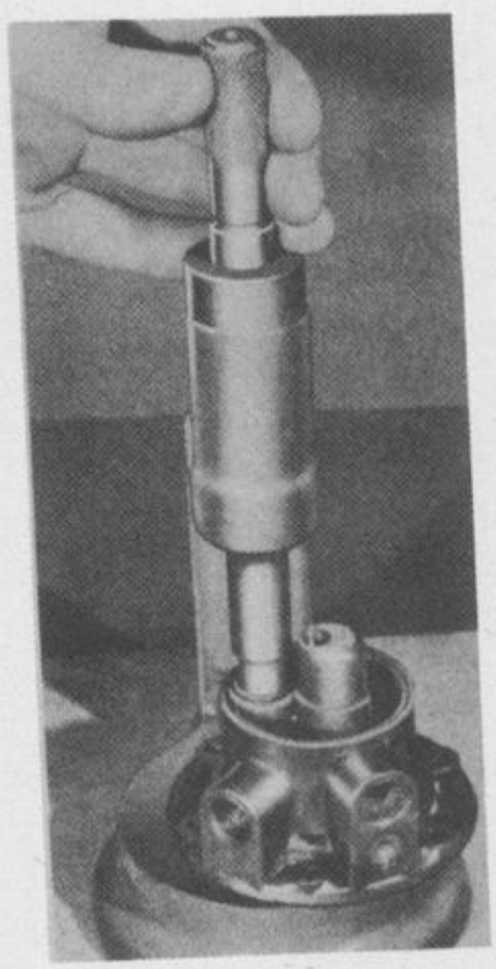

Figure 176—Fixture for Removing Valve Seat Bushing

Remove 40-9380 fuel pump rocker arm return spring, 68-9398 diaphragm and pull rod assembly and 40-9396 fuel pump diaphragm spring from the lower body assembly. The diaphragm and pull rod assembly (68-9398) can be removed easily by holding the fuel pump link (40-9381-A2) as shown in figure 181 while slipping pull rod off of end of link.

Drive out the fuel pump rocker arm pin (40-9378) as shown in figure 174. Tools used are the 9358 driver, the 9350-D driver guiding fixture and the 9378-A anvil. This results in disassembly of 40-9378 fuel pump rocker arm pin, 40-9389 rocker arm bushing, 40-9381-A2 link and 40-9376 rocker arm.

Remove valve plate (40-9361), using fixture (9353-B) as shown in figure 175. This results in disassembling the following parts:

40-9373 Screws (three)
40-9361 Valve plate
40-9363 Valve plate gasket
40-9358 Valve discs (two)
B-9360 Valve disc springs (two)
40-9362 Outlet valve spring retainer

Remove inlet valve seat bushing (40-9359) using driver (9359-A) and guiding fixture (9359-A) and guiding fixture (9359-D) as shown in figure 176.

C—CLEANING

Clean all parts, being particularly sure that all corrosion is removed from the sediment chamber (see "Cleaning Zinc Alloy Castings" Chapter 3. B.).

Some of the castings are made of an alloy containing a small amount of copper and these castings will not have the same brightness as parts not having copper in the alloy. By matching parts of like brightness at time of assembly, the reconditioned fuel pumps will look their best.

D—INSPECTION AND REPAIR OF PARTS

Make a visual inspection for signs of rough handling or abuse and discard parts that are damaged or rusty.

Check wear in upper body casting around inlet valve seat. Wear at this point may be enough to interfere with the proper seating of valve discs (40-9358). If this condition exists the upper body should be discarded. If the wear is not excessive, the upper body may be used again by using an oversize inlet valve seat bushing (40-9359-B) and a round valve disc (40-9358-B).

Clean out broken threads and dirt from pump inlet and outlet, using tap (9354-A) (Fig. 177).

Inspect drain screw (B-9185-B) and scrap if any ring wear is apparent on the seating end of the screw.

Inspect contacting surfaces at each end of link (40-9381-A2) and also hole for bushing and discard if there is any indication of wear when compared with a new part.

Inspect contacting surfaces at each end of rocker arm (40-9376) and also hole for bushing and discard if there is any indication of wear when compared with a new part.

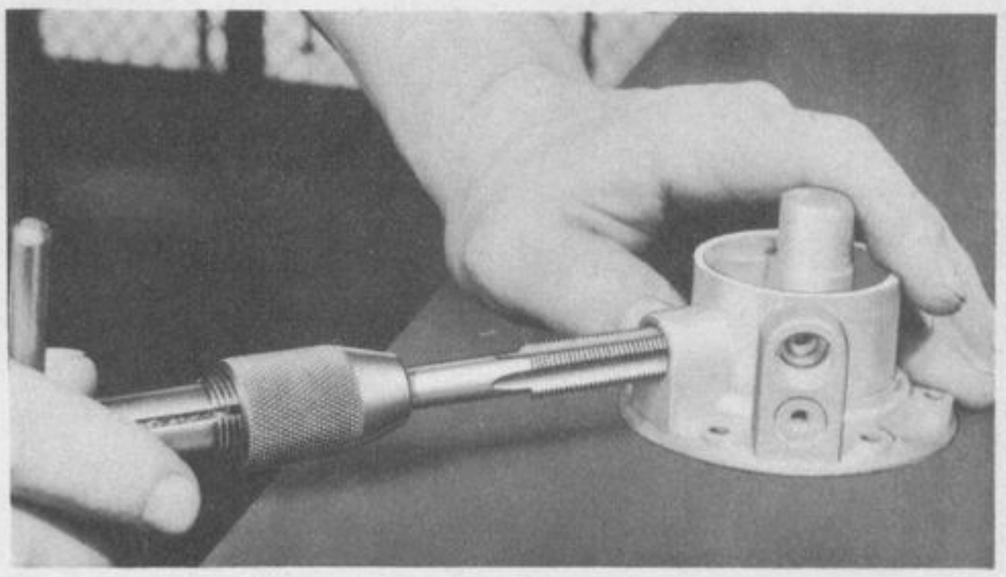

Figure 177—Cleaning Threads in Pump Inlet and Outlet

E—ASSEMBLY

All new gaskets must be used when reassembling. When volume of pumps handled is not large, the fuel pump kit (68-18373) will be most economical to use. For large volume reconditioning, purchase of individual parts in quantity lots is advisable.

Install a new valve seat bushing (40-9359-A or B), using driver 9359-A, ⅜ inch steel ball (9359-B), anvil (9359-C) and guiding fixture (9359-D) (Fig. 178). New valve seat bushings do not have to be refaced after installation as they are made with a true seating surface.

Assemble following parts, using fixture 9353-B (Fig. 175).

68-9351 Upper body and inlet valve seat
40-9362 Outlet valve spring retainer
B-9360 Valve disc springs (two)
40-9358-A or B Valve discs (two)
40-9363 Valve plate gasket
40-9361 Valve plate
40-9373 Screws (three)

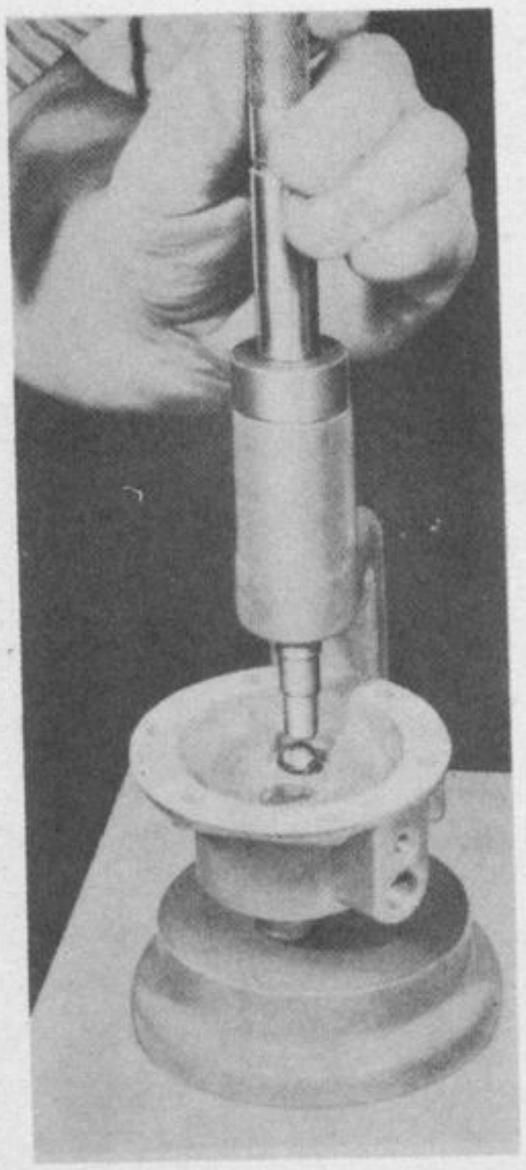

Figure 178—Fixture for Installing Valve Seat Bushing

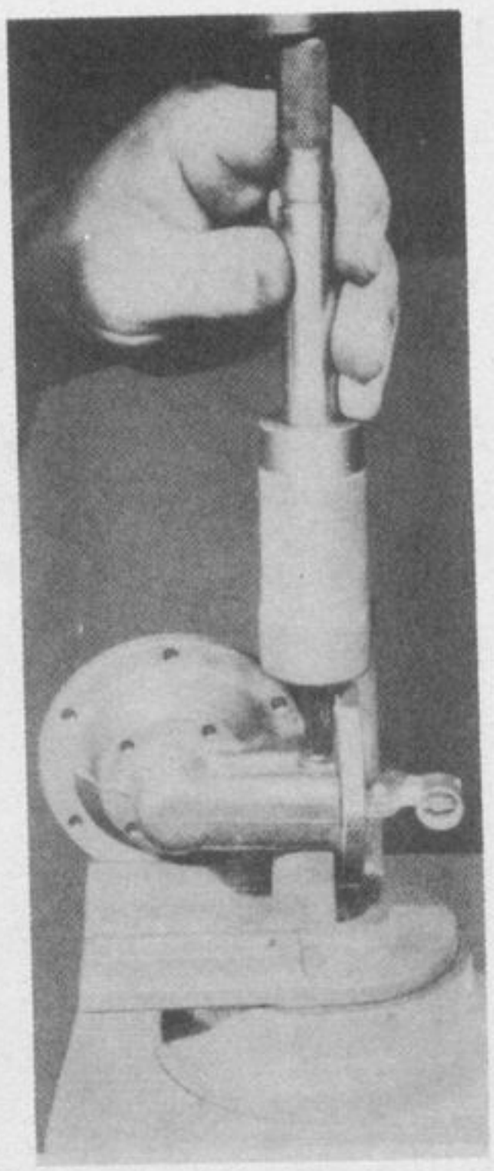

Figure 179—Fixture for Installing Rocker Arm Bushing

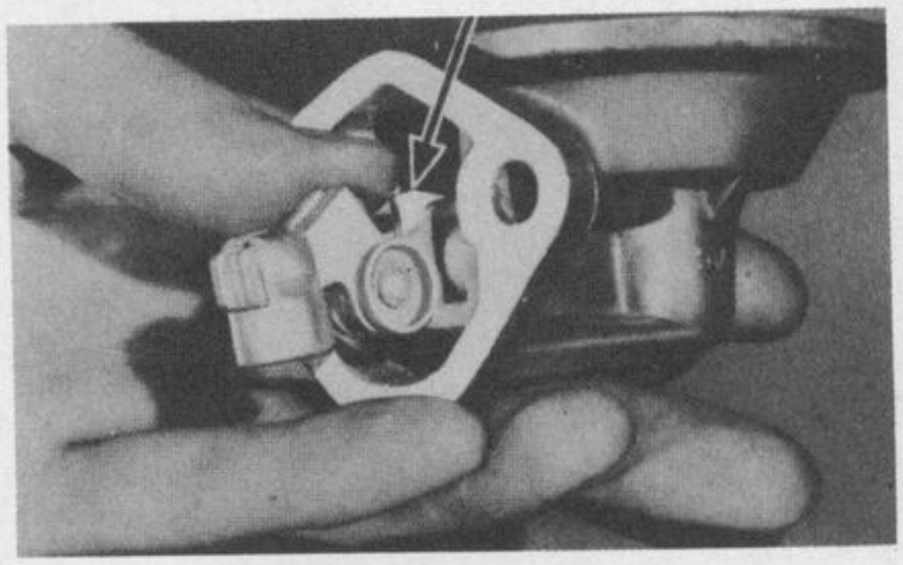

Figure 180—Link in Position for Assembling Diaphragm

Apply graphite grease to the rocker arm bushing and assemble 40-9376 rocker arm, 40-9381-A2 link, 40-9389 rocker arm bushing and 40-9378 fuel pump rocker arm pin. Use guiding fixture (9359-D), driver (9378-C) and anvil (9378-A) as shown in figure 190. The four points on the end of the driver (9378-C) will peen the metal at the end of the rocker pin hole retaining the pin. To produce a neat job, care should be used to set the four points of the 9378-C driver directly into the old peen marks. Peen the pin in place from both ends.

Assemble 40-9396 fuel pump diaphragm spring and 68-9398 diaphragm and pull rod assembly (Figs. 180 and 181), holding the end of the link (40-9381-A2) down as shown in figure 180, while slipping slotted

Figure 181—Assembling Diaphragm

Figure 182—Upper Body Assembly

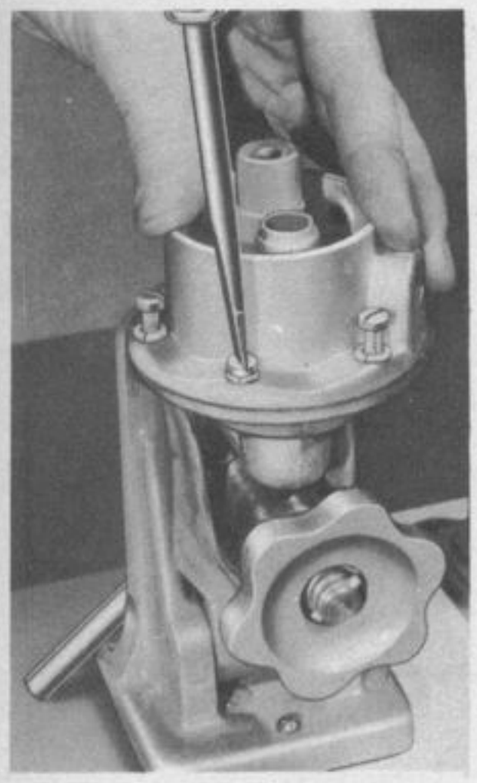

Figure 183—Assembling Fuel Pump Body

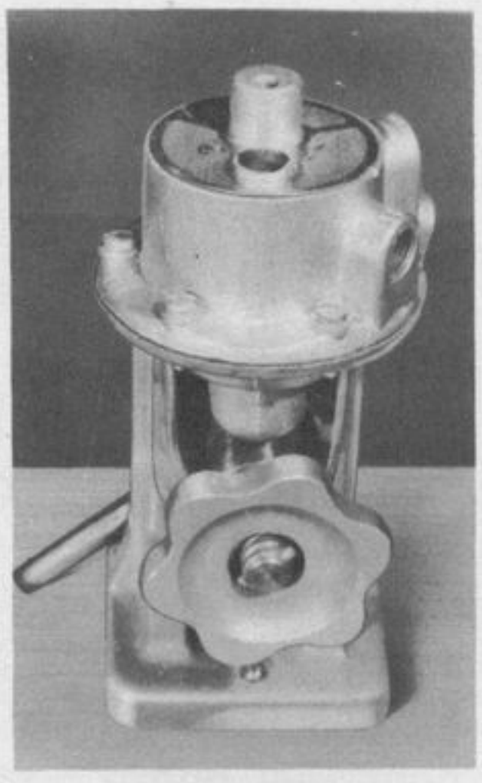

Figure 184—Assembling Fuel Pump Parts

end of diaphragm pull rod over the end of the link as shown in figure 181. Dip lower end of diaphragm pull rod in graphite grease before assembling.

Apply graphite grease to the contact surfaces between the rocker arm and the link, then install the 40-9380 fuel pump rocker arm return spring.

Place the lower body assembly on upper body assembly as shown in figure 182, using fixture (9350-C). The lever must be "up" as shown, so diaphragm will be straightened out. Just start two of the screws, but do not tighten them.

Now, put lever "down" (Fig. 183), being sure the rocker arm drops to its lower position. This permits the large diaphragm spring (40-9396) to push the diaphragm to its extreme upper position. The six screws should now be tightened. If this operation is not performed properly, the diaphragm will be stretched too tight and its life will be shortened.

Install the following parts (Be sure side of screen with the reinforcement is "up," Fig. 184):

B-9182 Fuel pump drain screw spring
B-9185-B Fuel pump drain screw
68-9365 Fuel pump screen
68-9364 Fuel pump cover gasket
68-9355 Fuel pump cover
40-9357 Fuel pump cover screw washer
20009-S2 Fuel pump cover screw

F—TEST

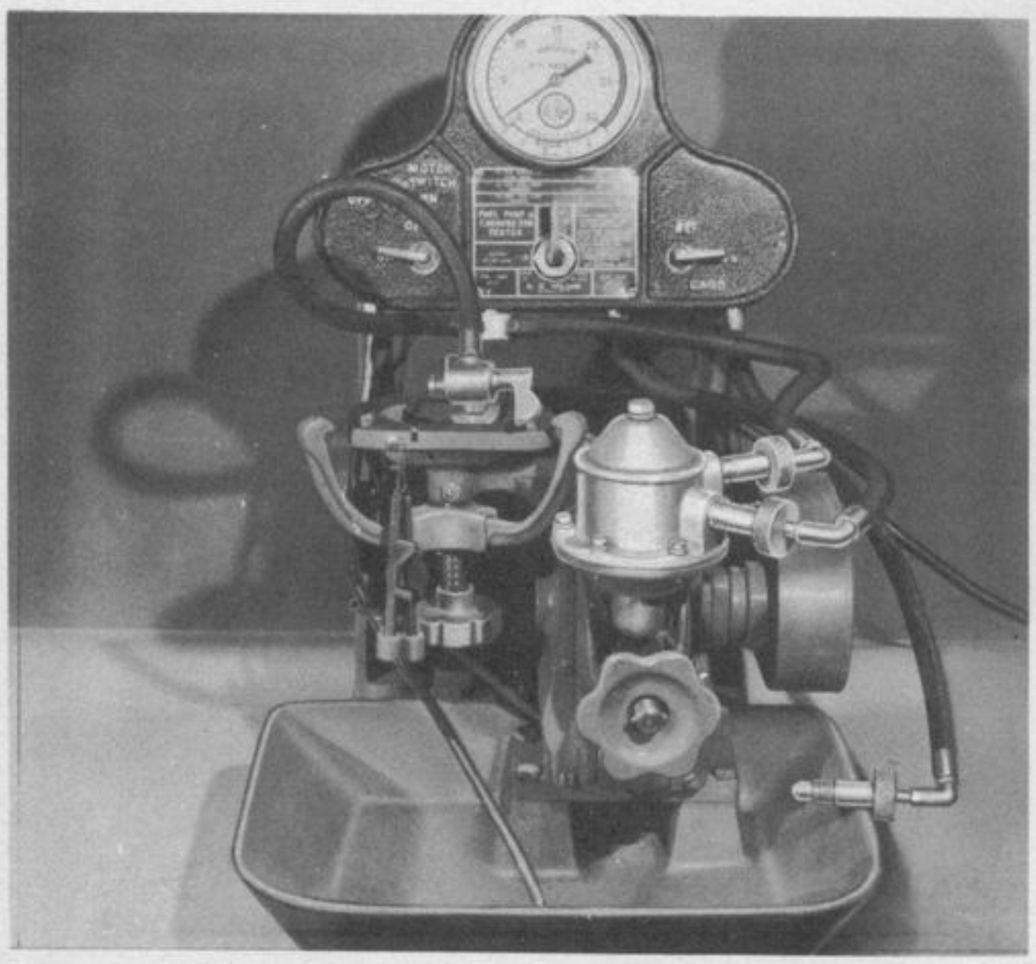

Figure 185—Testing Unit

Place the pump in test unit (9350-A) and make connections (Fig. 185).

Test priming time by setting the three valves on instrument panel to the positions shown in figure 185. Valve at the end of the left hand hose must be closed. Start the motor and with finger on pump rocker, count the number of strokes pump makes before it primes. Pump is primed when fluid is discharged from the right hand hose. The pump should prime within 18 seconds (equal to 36 strokes on pump rocker).

If connections are loose, pump will not prime within the specified time. Drain plug must also be tight. Also be sure cover gasket (68-9364) and cover screw gasket (40-9357) are new and that the cover screw is tight.

Check the free travel of the rocker arm with gage (9350-L) as shown in figure 186.

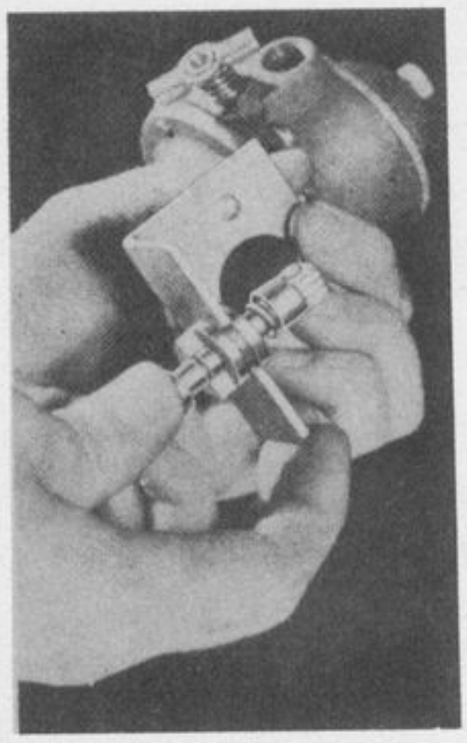

Figure 186—Checking Free Travel of Rocker Arm

Excessive free travel may be caused by too much wear in the pump linkage or by diaphragm being stretched too tight due to insufficient care having been used in assembly.

Test fuel pump pressure by placing the three instrument panel valves in the position as shown on plate on instrument panel. Pump should develop 1½ to 2¾ pounds pressure. Too high a pressure may be caused by a diaphragm that is stretched too tight or by too much tension on diaphragm spring (40-9396). Too low a pressure may be due to insufficient tension on the diaphragm spring (40-9396) or leakage of valves.

Test fuel pump vacuum by placing the three instrument panel valves in the position as shown on plate on panel. The pump will build up a vacuum which should advance until it reads at least 10. Stop the motor and observe the vacuum gage. The hand should fall back slowly. A fast rate of fall indicates a poor fuel pump outlet valve condition, loose drain plug, loose cover, loose connections or a leaky diaphragm.

Place a temporary plug in the pump outlet hole to keep out any foreign particles. Pump should be placed in a carton to keep it clean and in presentable condition for resale.

A "seal" oil must be put in pump through inlet valve opening, to protect the diaphragm from drying out and cracking, if pump is to be in storage for over six months.

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CHAPTER V

DISTRIBUTORS

A—GENERAL INSTRUCTIONS

The operations outlined in this chapter cover the eight cylinder distributor, however, these operations may be followed in general for the six cylinder distributor also. These instructions are based on the use of fixtures and tools especially designed for reconditioning Ford distributors by K. R. Wilson, Buffalo, N.Y. The basic numbers of the parts are included in the text and exploded views (Figs. 187 and 188) to assist identifying each part.

B—DISASSEMBLY

Remove the screw, lock washer and breaker adjustment plate (12174). Remove the vacuum brake adjustment assembly (12227). Lift out the vacuum brake spring (12225-B) and plunger (12220). Pull the rotor (12220) off the shaft.

Remove the distributor base spring (12146) from the distributor housing (12130). This permits disassembly of the breaker plate assembly, shaft, and cam and

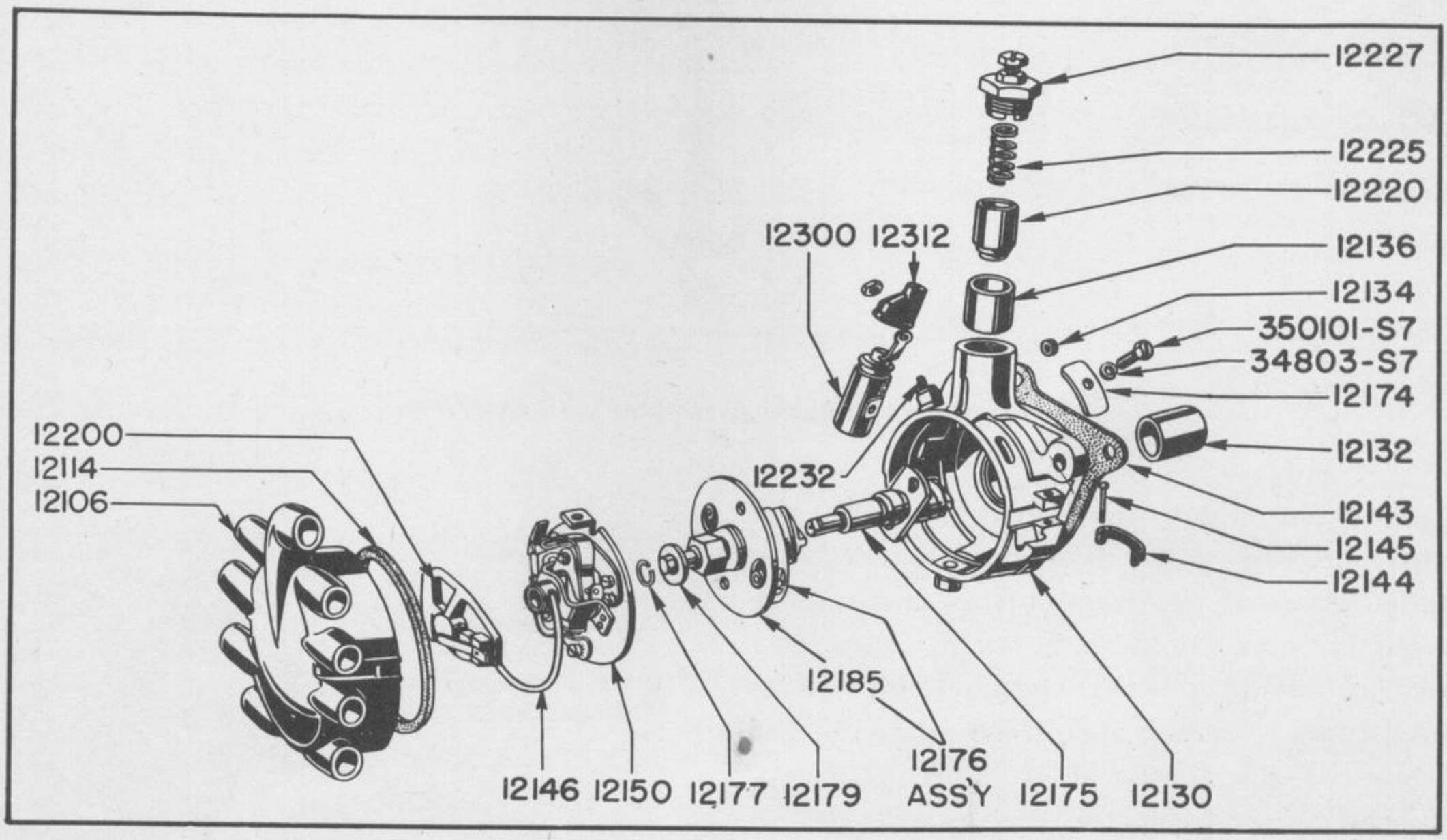

Figure 187—Distributor Assembly, Exploded View

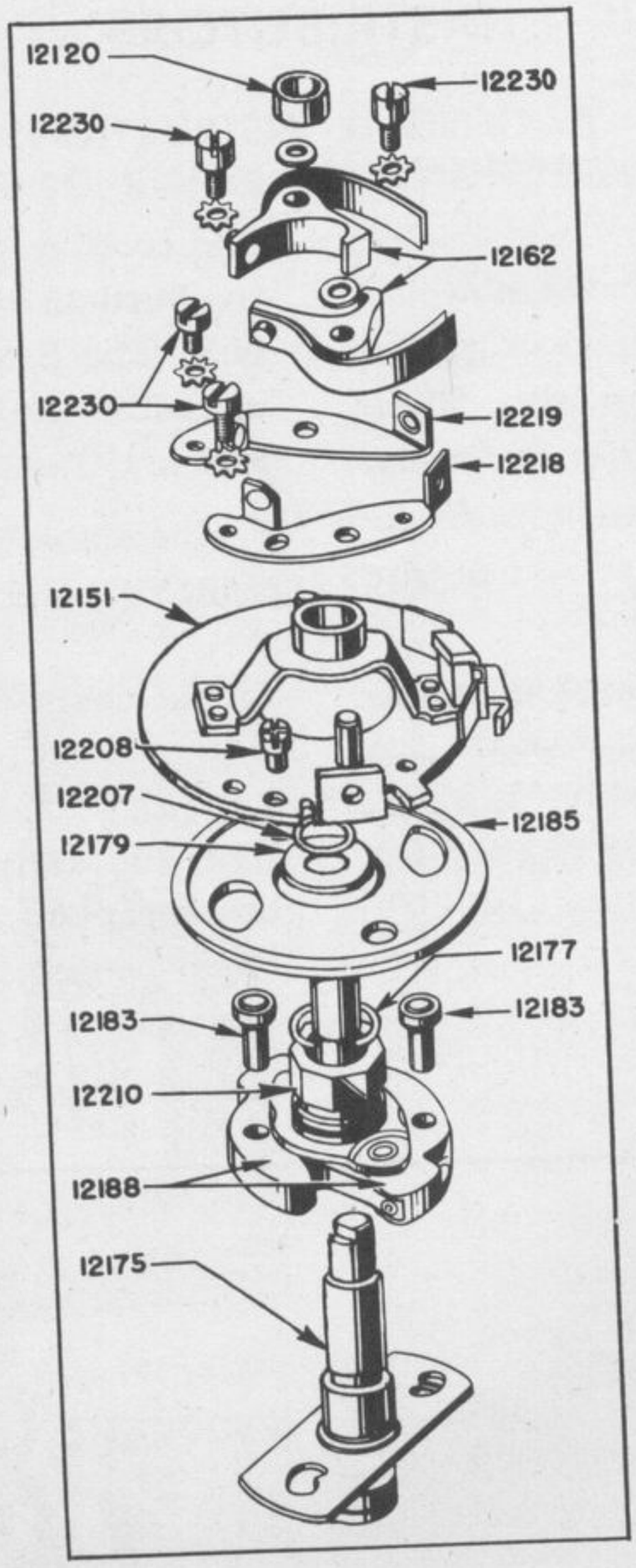

Figure 188—Breaker Assembly, Exploded View

weight assemblies from the housing. If the distributor has been disassembled merely to replace breaker points, no further disassembly work is necessary. If it is to be completely reconditioned, however, the governor weight and cam assembly should be disassembled from the distributor shaft. This is accomplished by removing the snap ring (12177), which holds the retard disc, cam and governor weight assembly on the distributor shaft.

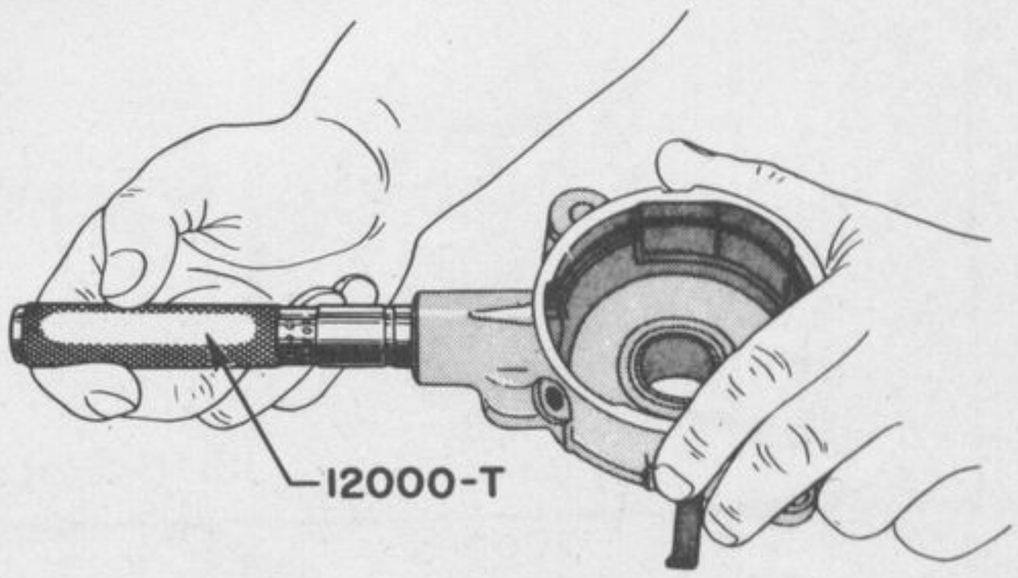

Figure 189—Checking Vacuum Brake Cylinder Bore

To disassemble the retard disc from the cam and governor weight assembly, remove the retainer (12207). This will complete disassembly of all internal parts of the distributor, with the exception of the bushings in the advance housing and breaker plate assembly.

C—INSPECTION AND REPAIR OF PARTS

Check the bore in the base assembly (12130) for fit of vacuum brake piston (12220), using a plug gage (Fig. 189). Clean out the bore if gage does not enter freely. Examine the threads of the vacuum brake adjustment (12227) to insure correct fit into base assembly (12130).

Check the 12130 base assembly for burrs in the opening for the terminal plate and also on the flange which contacts the cylinder block front cover, using a new terminal plate and new cylinder block front cover as gages to test for improper fit.

Check the bushing (12120) in the base assembly (12130), using plug gage "S" as illustrated in figure 190. If the bushing shows excessive wear, place the base assembly on fixture "A" supported by the anvil "C" and drive the bushing out with the driver "H" (Fig. 191).

Install a new bushing in the housing by means of fixture "A" anvil "C", driver "H" and collar "CA" (Fig. 192). After installing the bushing in the housing, check it with the plug gage "S" and if necessary, ream the bushing with reamer "J" while holding the base in fixture "A" (Fig. 193).

Check the bushing in the breaker assembly (12150) and if there is any indication of

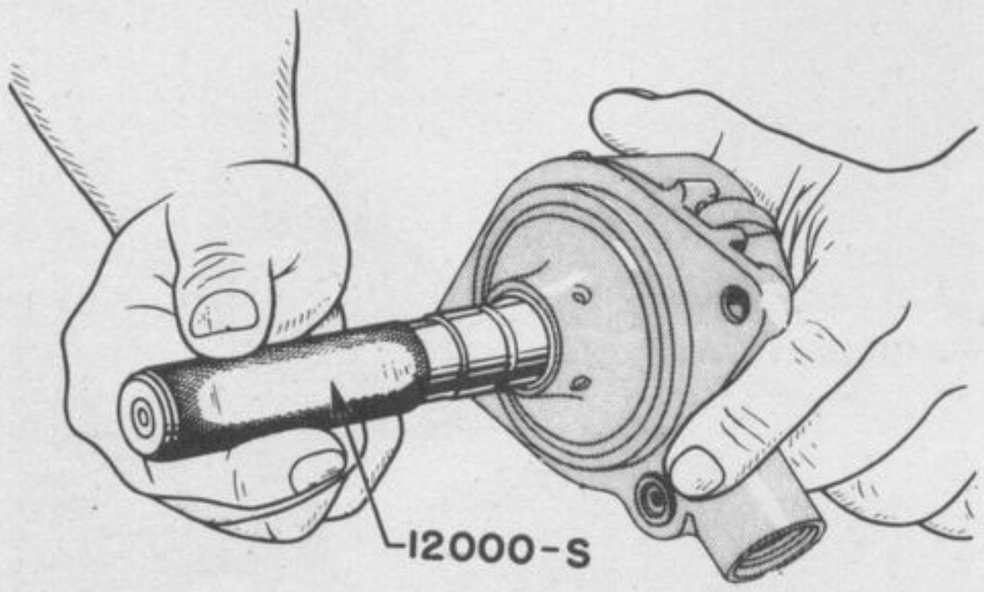

Figure 190—Gaging Distributor Base Bushing

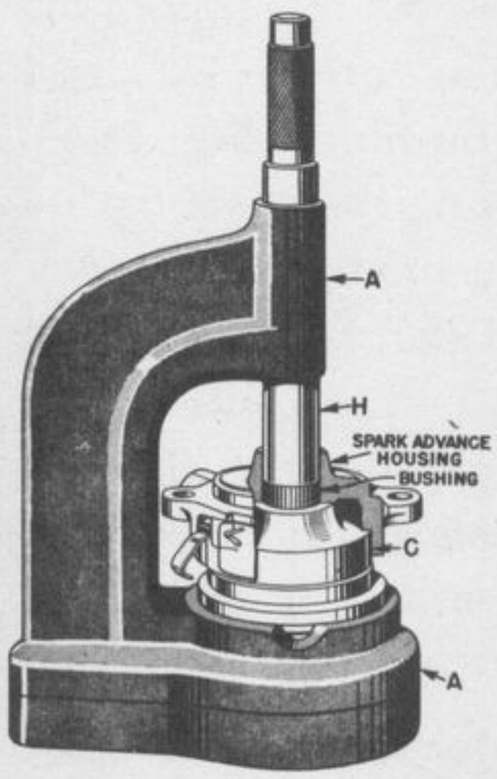

Figure 191—Removing Distributor Base Bushing

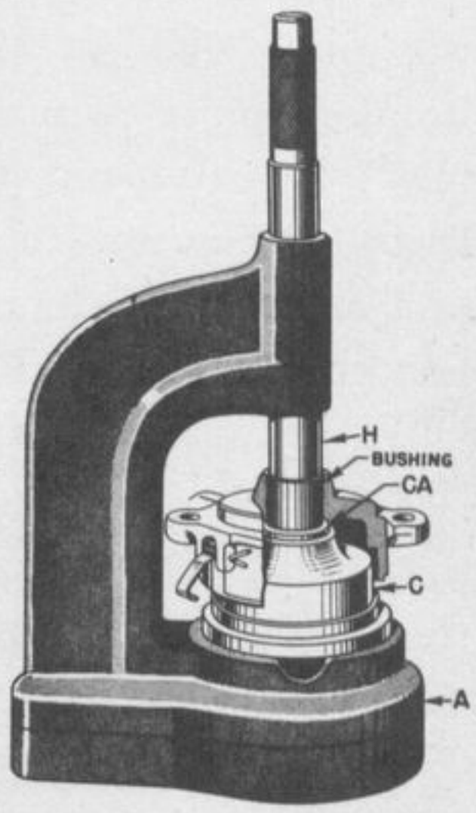

Figure 192—Installing Distributor Base Bushing

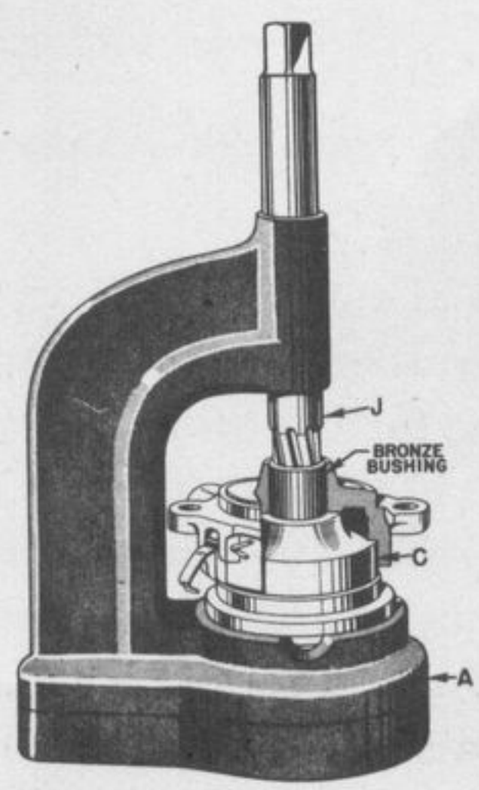

Figure 193—Reaming Distributor Base Bushing

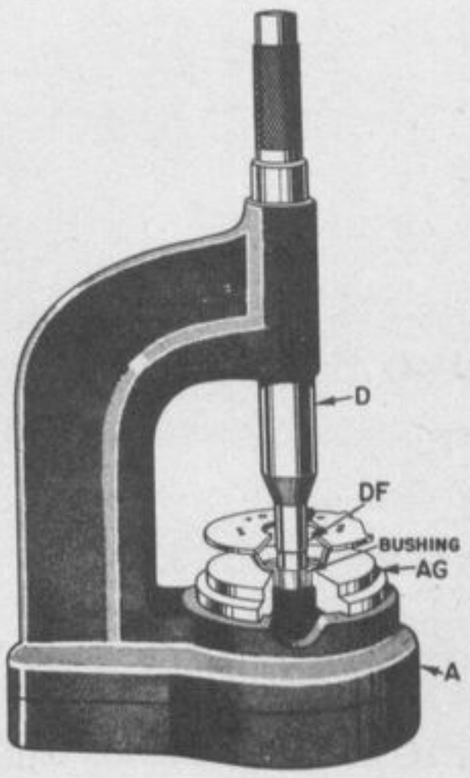

Figure 194—Removing Breaker Plate Bushing

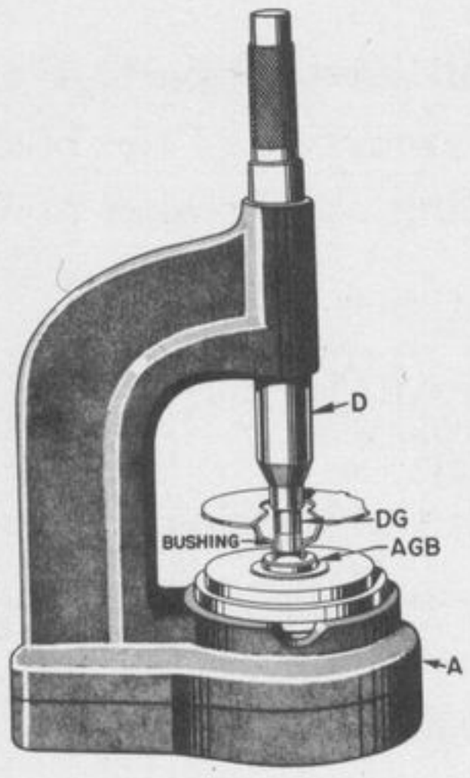

Figure 195—Installing Breaker Plate Bushing

wear, the bushing should be replaced. Install the anvil "AG" in fixture "A" to support the breaker plate while using driver "D" and "DF" to drive out the bushing (Fig. 194). Install a new bushing, using the same fixture and anvil into which the small anvil "AGB" has been inserted (Fig. 195). Driver "D" and "DF" are used for driving in the bushing.

Check fit of the cross plate on the distributor shaft (12175). If this plate is loose on the shaft, the complete assembly should be discarded (Fig. 196).

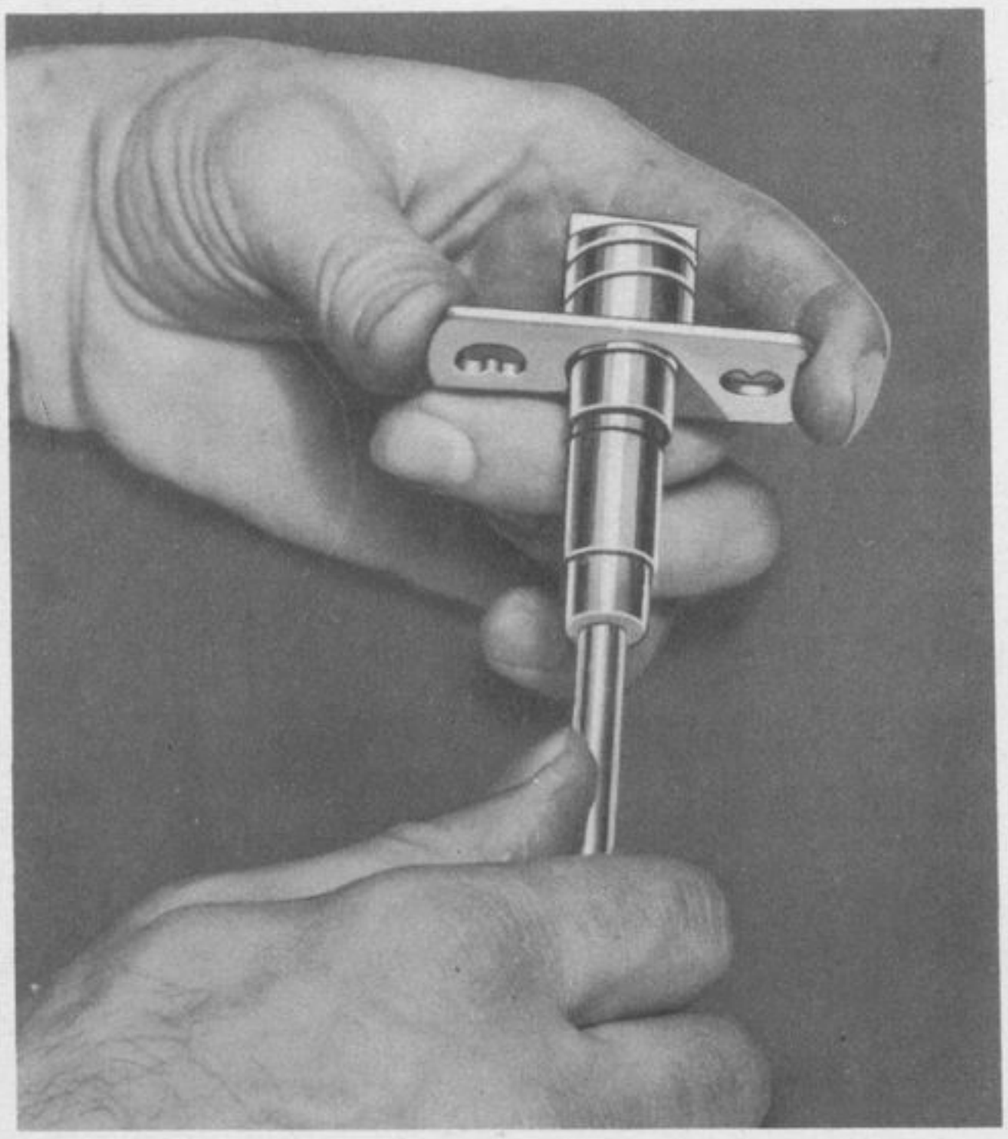

Figure 196—Checking Cross Plate

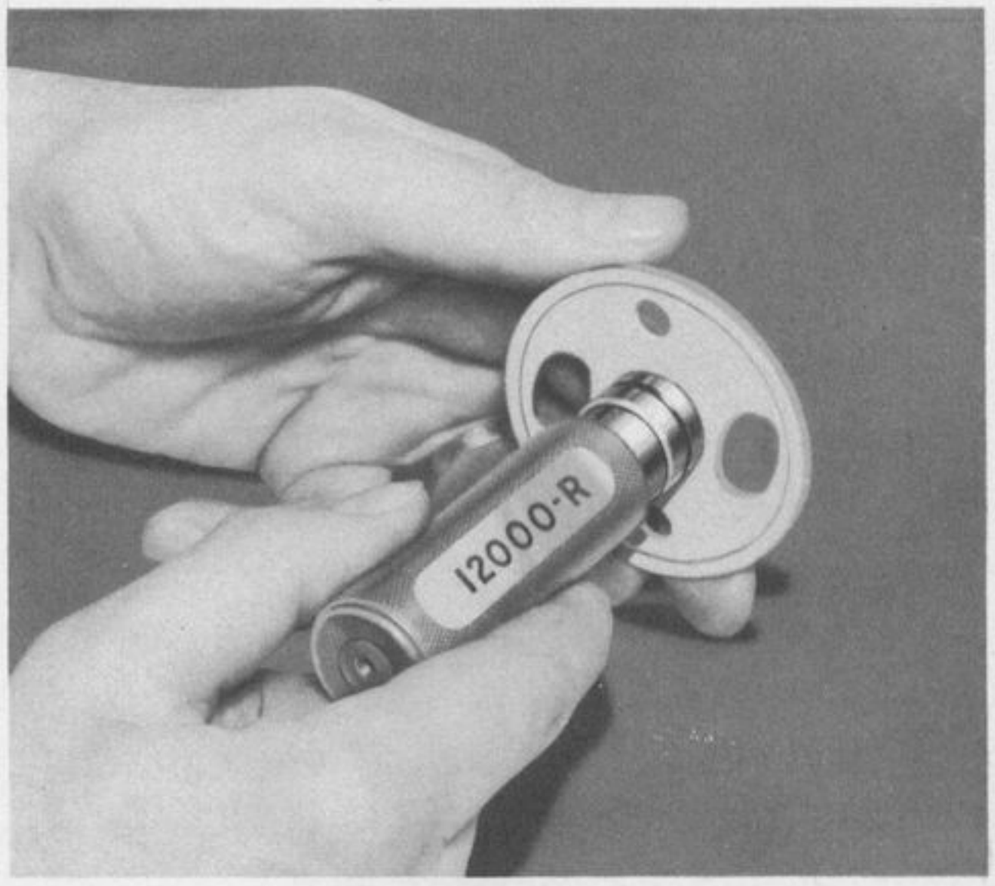

Figure 197—Checking Governor Plate

Use a plug gage "R" to check the center hole in the retarded disc (12185) (Fig. 197). At the same time inspect the outer edge of this plate very carefully for nicks or burrs.

The cam and weight assembly (12176) must be free on the pivot pin when tested as shown in figure 198 (clearance must be from 0.006 to 0.010 inch). If the test shows too much clearance between the cam plate (12184) and the weight assembly (12188), use tools "A", "D", "DD", "AG" and "AJ" to drive the pivot pin (12183) (Fig. 199).

Check the pivot pin hole in weight assembly (12188) (Fig. 200). Use gage "X", "W" or "U" to determine which oversize may be needed. If oversize pin is needed, select

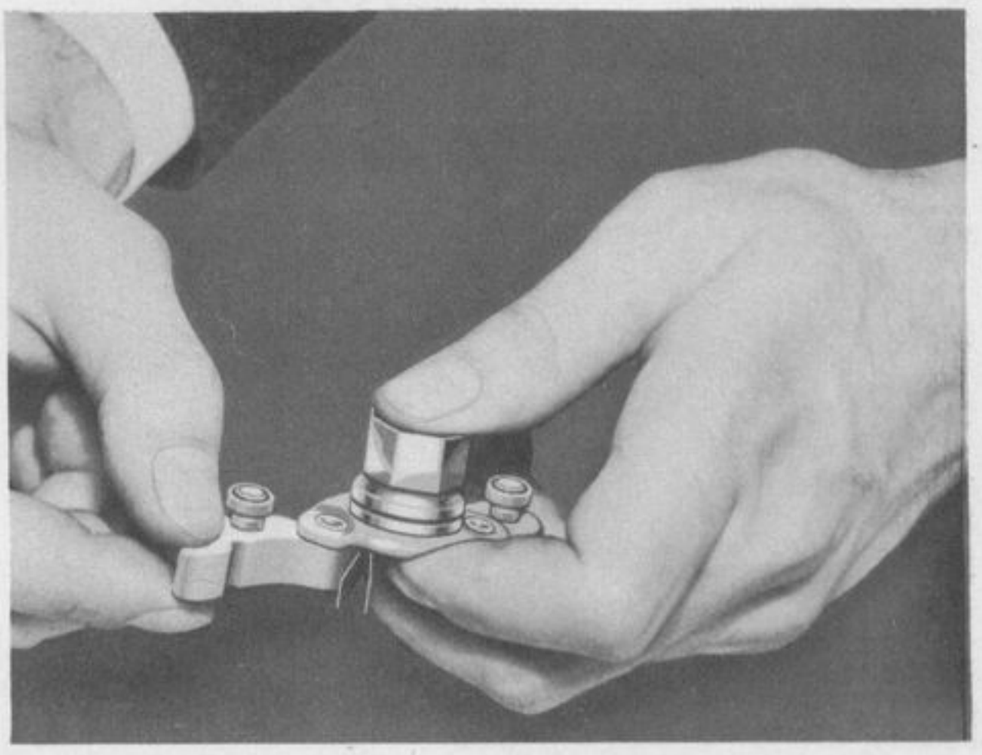

Figure 198—Checking Pivot Pin

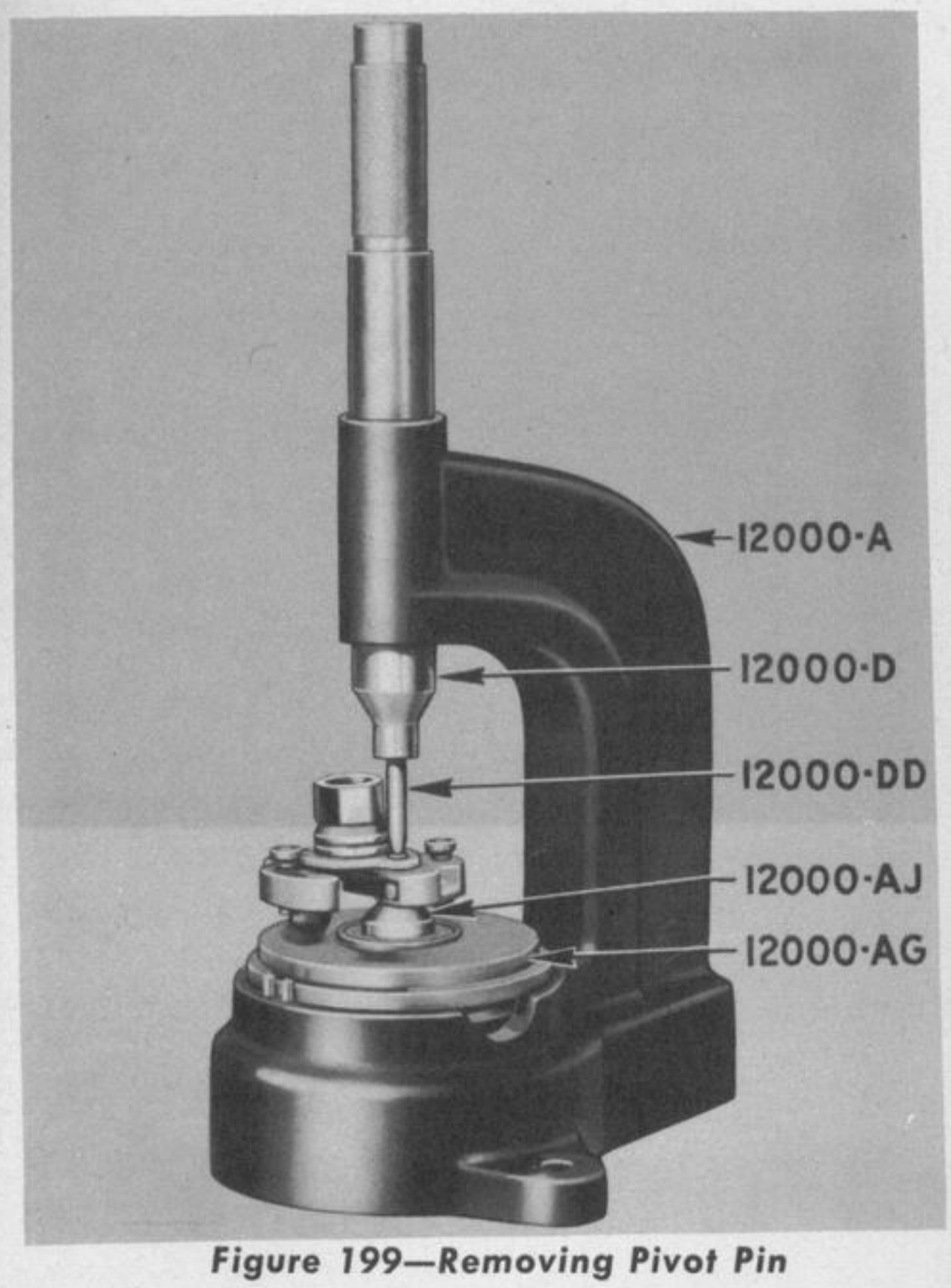

Figure 199—Removing Pivot Pin

the correct reamer and pin and ream the bushing to fit (Fig. 201). Available oversize

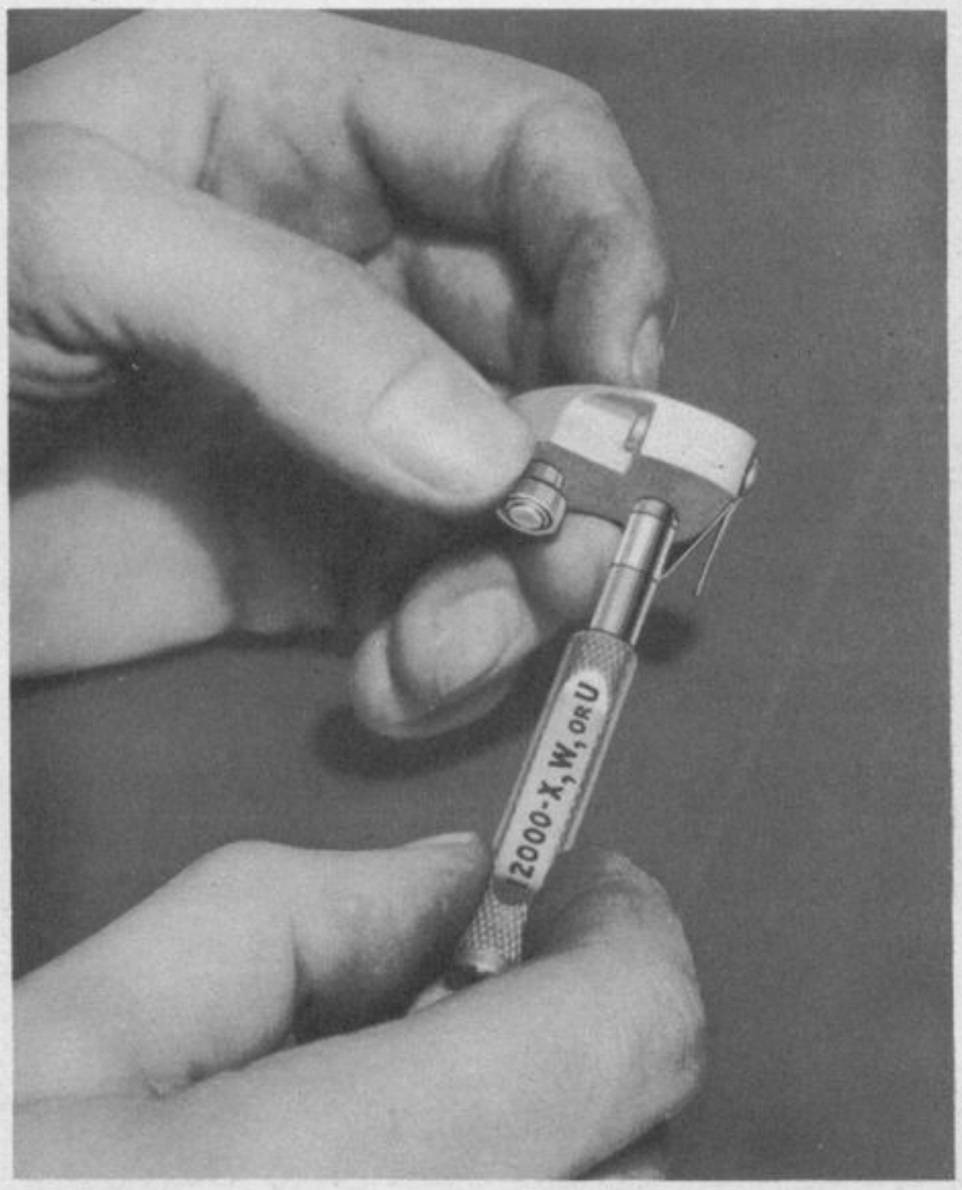

Figure 200—Checking Pivot Pin Hole

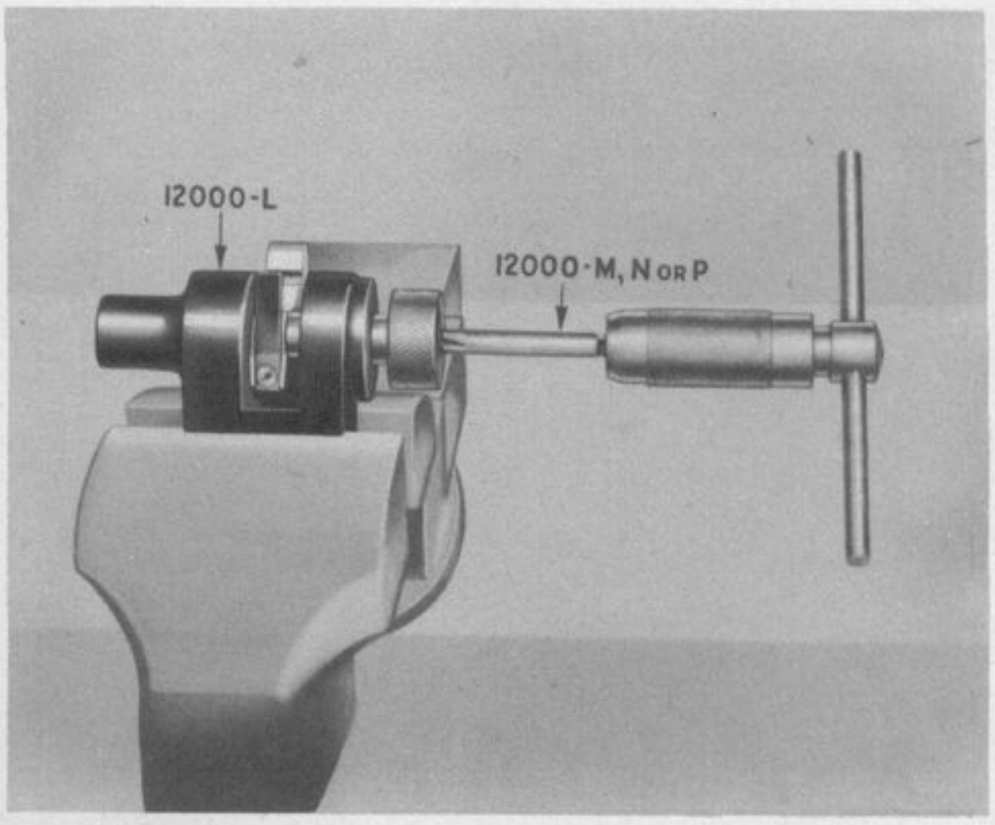

Figure 201—Reaming Hole in Weight

pins and correct reamer to use for each size are:

Part No.	Tool No.	Size
12183	U	0.250 (std.)
12183 (O/S)	W	.02525
12183 (O/S)	X	0.2545

Check the springs on the weight assembly for looseness (Fig. 202). If the springs are loose, tighten rivet by tapping the side of the weight (12189) lightly with a hammer at the point where the springs are secured to the weight.

Check the cam assembly (12210) for looseness of the cam where it is assembled to

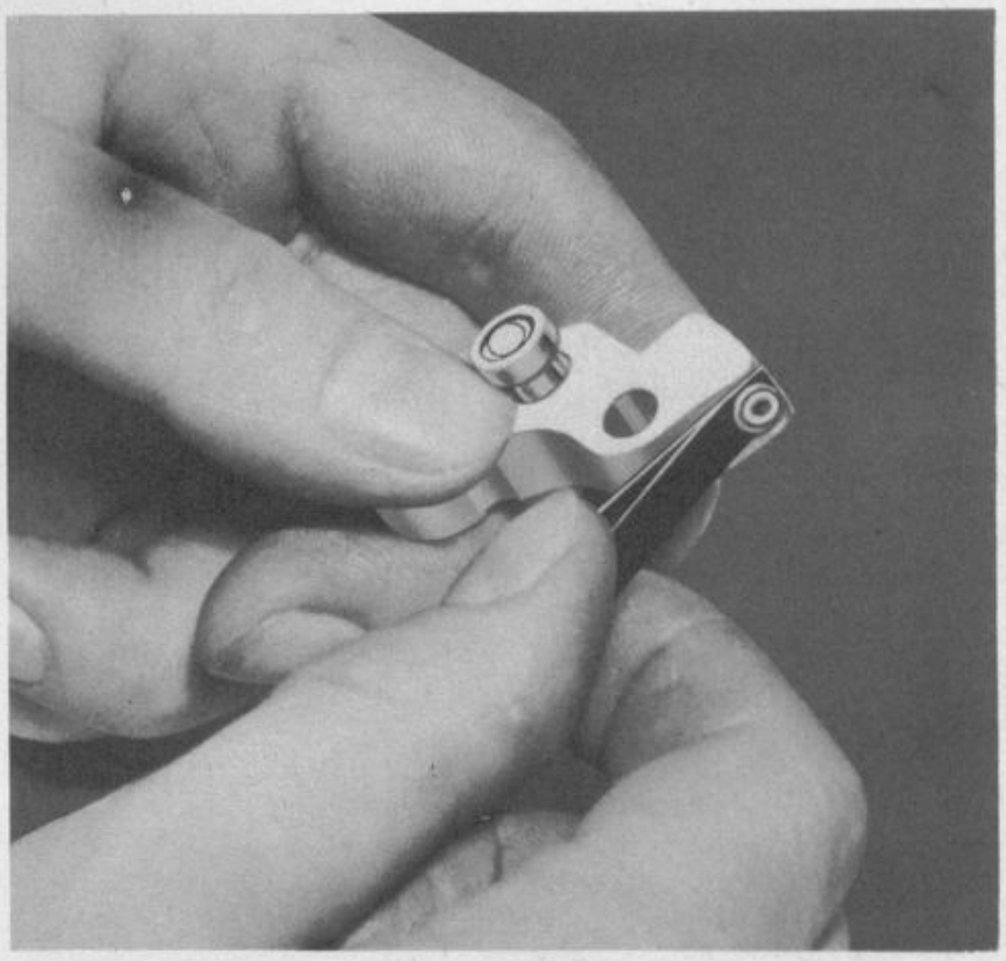

Figure 202—Checking Weight Spring

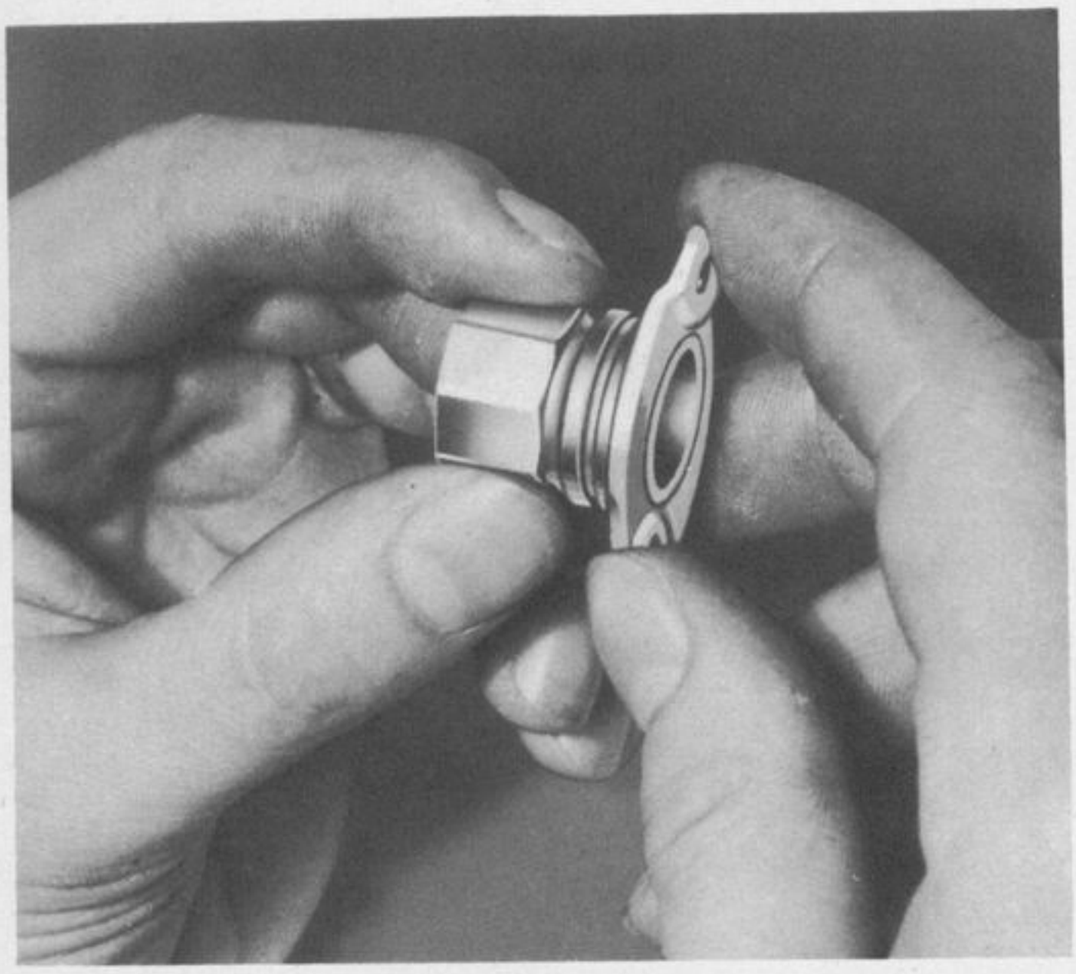

Figure 203—Checking Cam Assembly

its base (Fig. 203). If the fit is sloppy, scrap the assembly.

Figure 204 shows adapter and tools for "upsetting" the pivot pin in the cam and weights assembly. This must be done very carefully so the necessary clearance of 0.006 inch between the weight and cam plate will be maintained. Use fixture "A" with base "AG", anvil "AJA", driver "D" with point "DH".

Use tool No. "AL" to spin the metal down

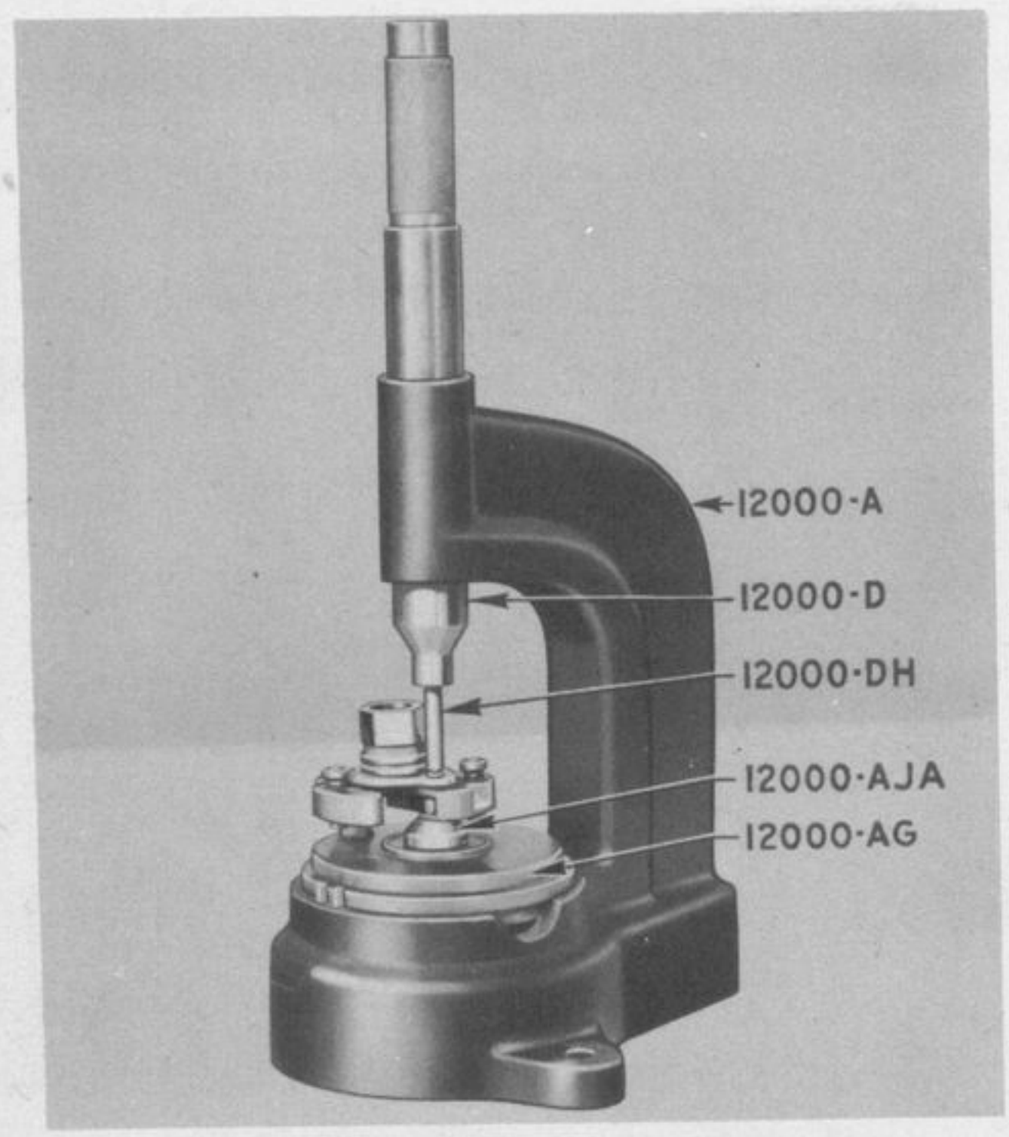

Figure 204—Upsetting Pivot Pin

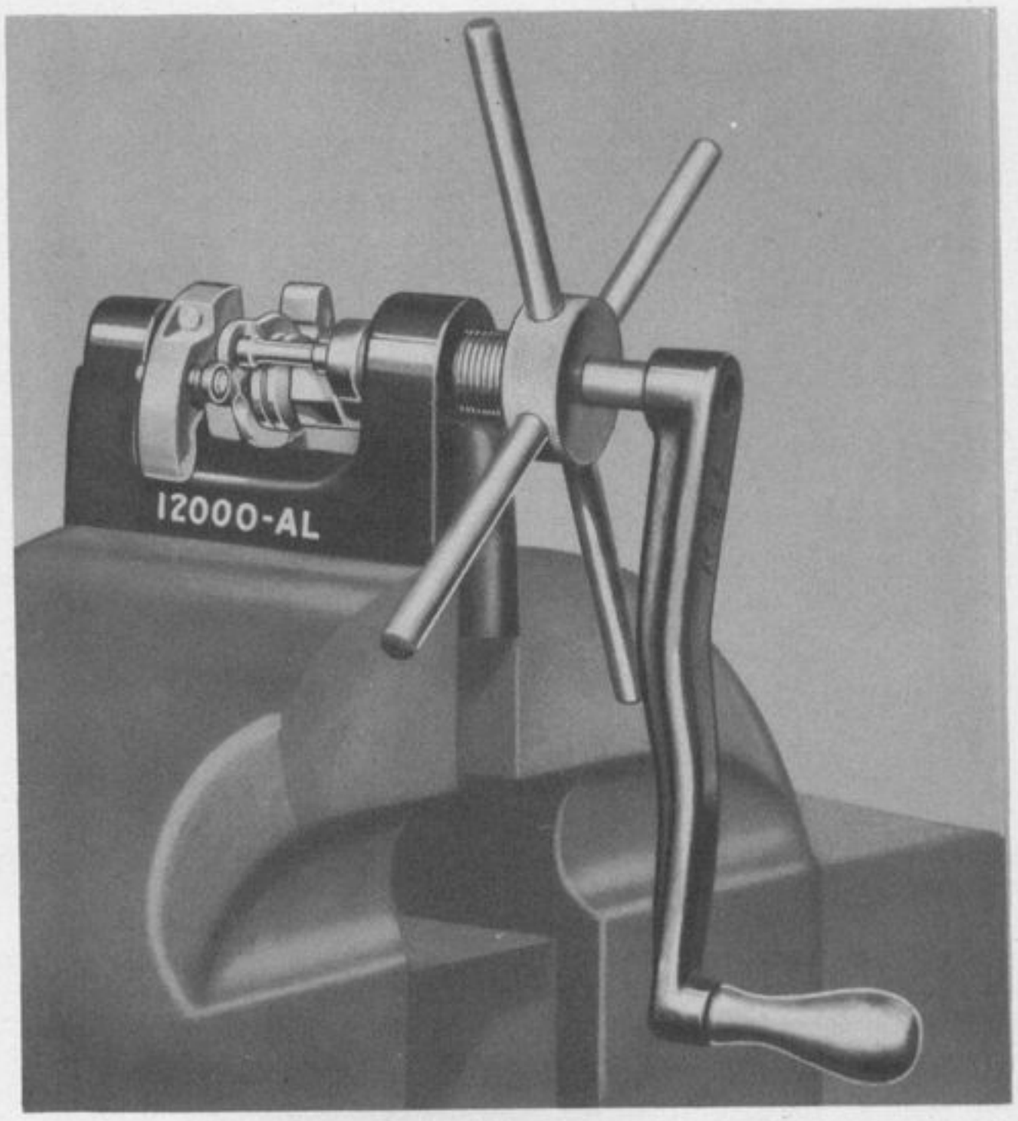

Figure 205—Spinning End of Pivot Pin

on the pivot pin (Fig. 205). Place the flat head of the pivot pin against the knurled anvil and screw in the spinning tool so as to place considerable pressure on the end of the pivot pin and then turn spinning tool handle. Maintain pressure on the end of the pin by screwing in the tool as the handle is being turned. The top of the pivot pin must be "swedged" down level with the cam base, check with a straight edge (Fig. 206). Also make sure the flat head of the pin is level with

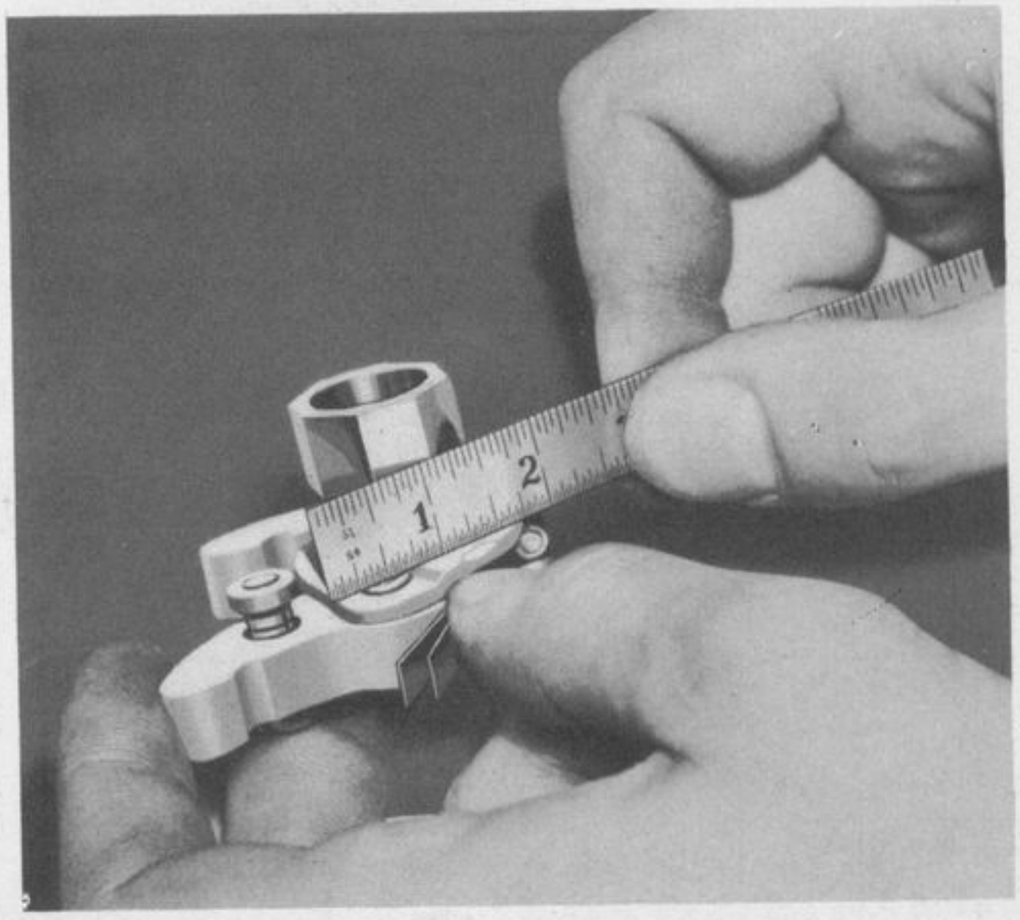

Figure 206—Checking Top of Pivot Pin

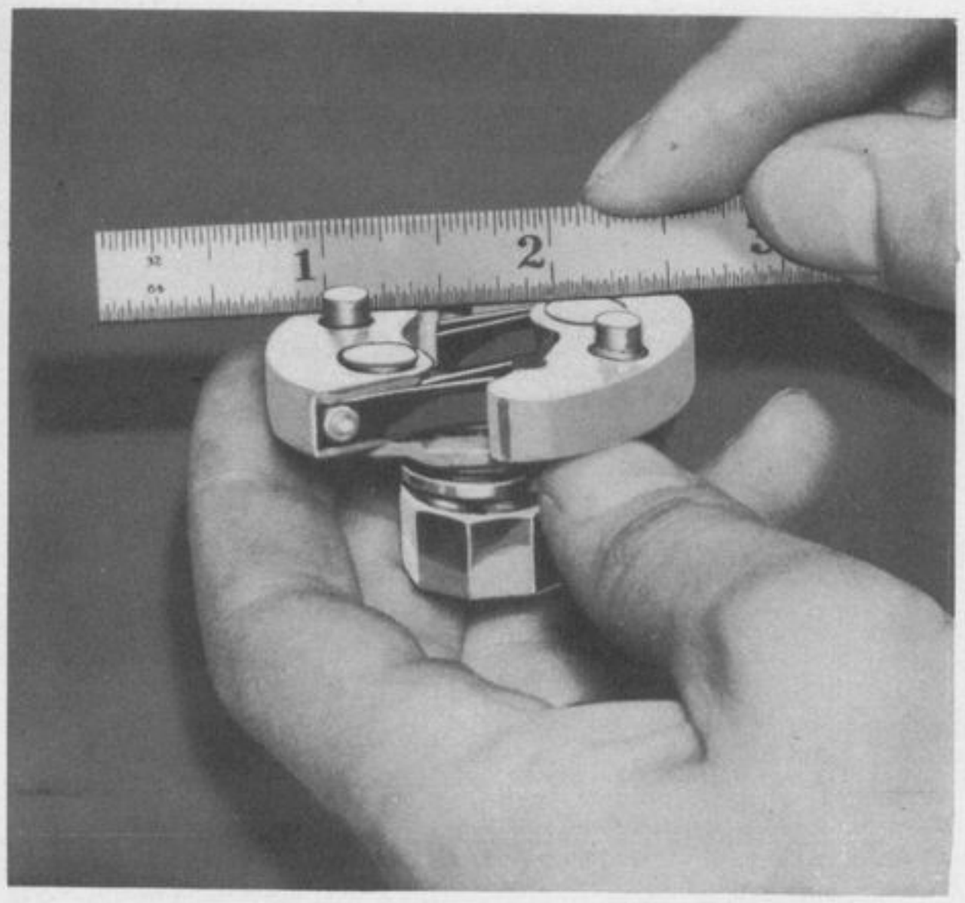

Figure 207—Checking Head of Pivot Pin

the weight (Fig. 207). Check each weight to make sure it swings freely on the pin (Fig. 198). Fasten the governor plate (12185) to cam and weight assembly by installing the snap ring. Use tool number "AE" and "AF".

Place this assembly in the gage "AM" and

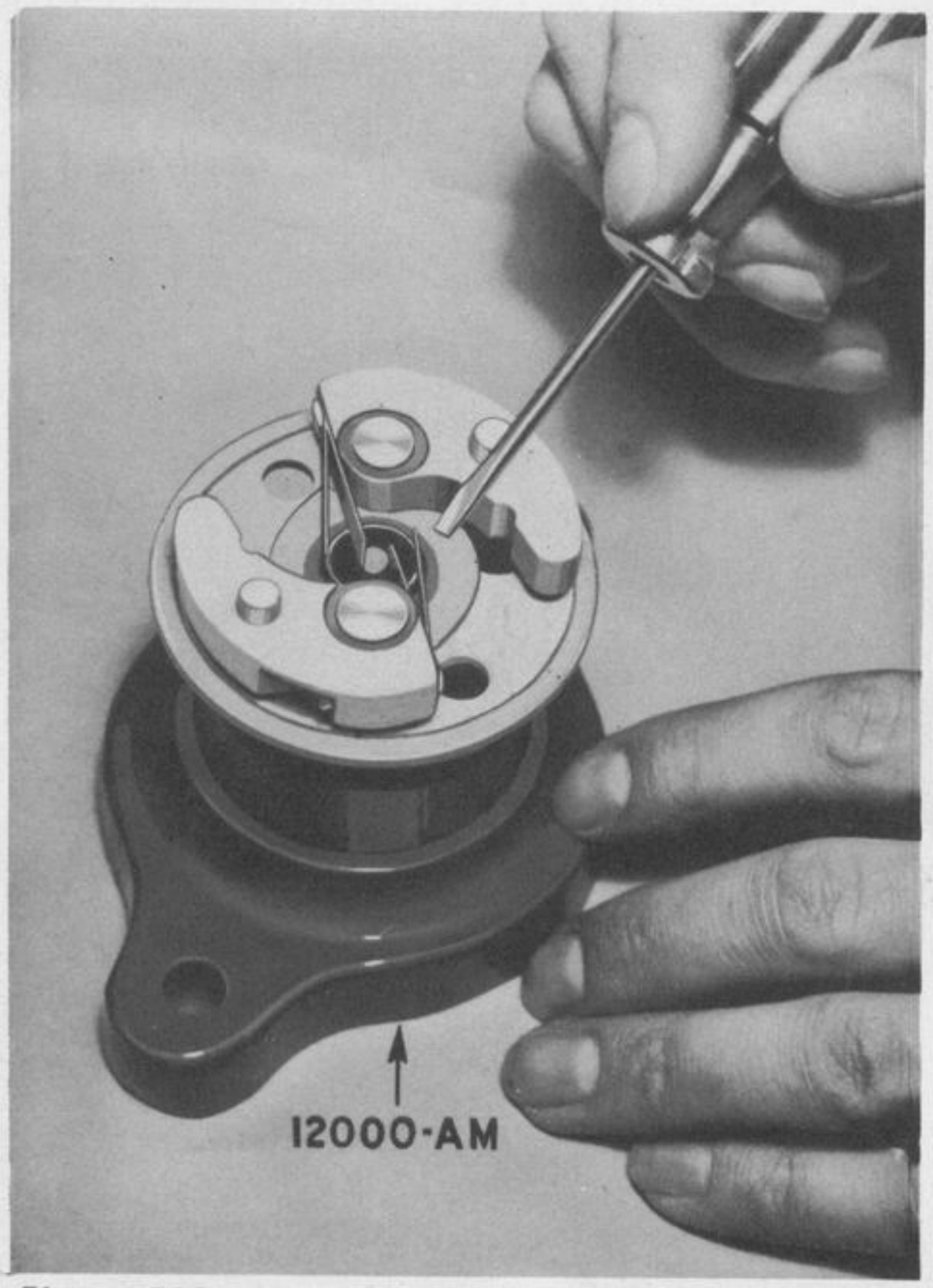

Figure 208—Checking Breaker Arm Spring Angle

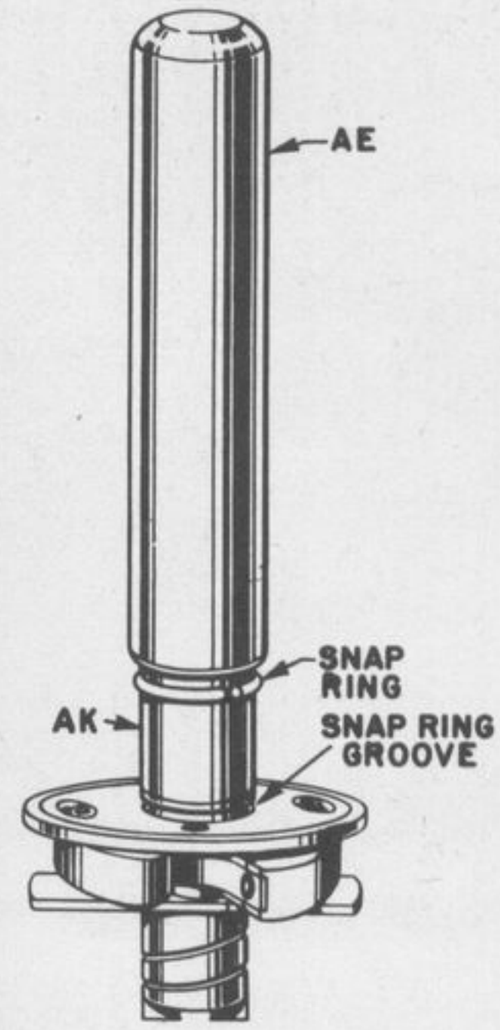

Figure 209—Installing Snap Ring

screw in the set screw so it exerts a very slight pressure on the cam. Then adjust the angle of the springs (Fig. 208). Bend the springs if necessary so that the inner spring is on the edge of the inner circle and the outer spring is on the edge of the outer circle.

Assemble the governor plate assembly to the distributor shaft and install the snap ring (Fig. 209), using tools "AK" and "AE".

Inspect the breaker plate assembly (12151) and install new contact points if

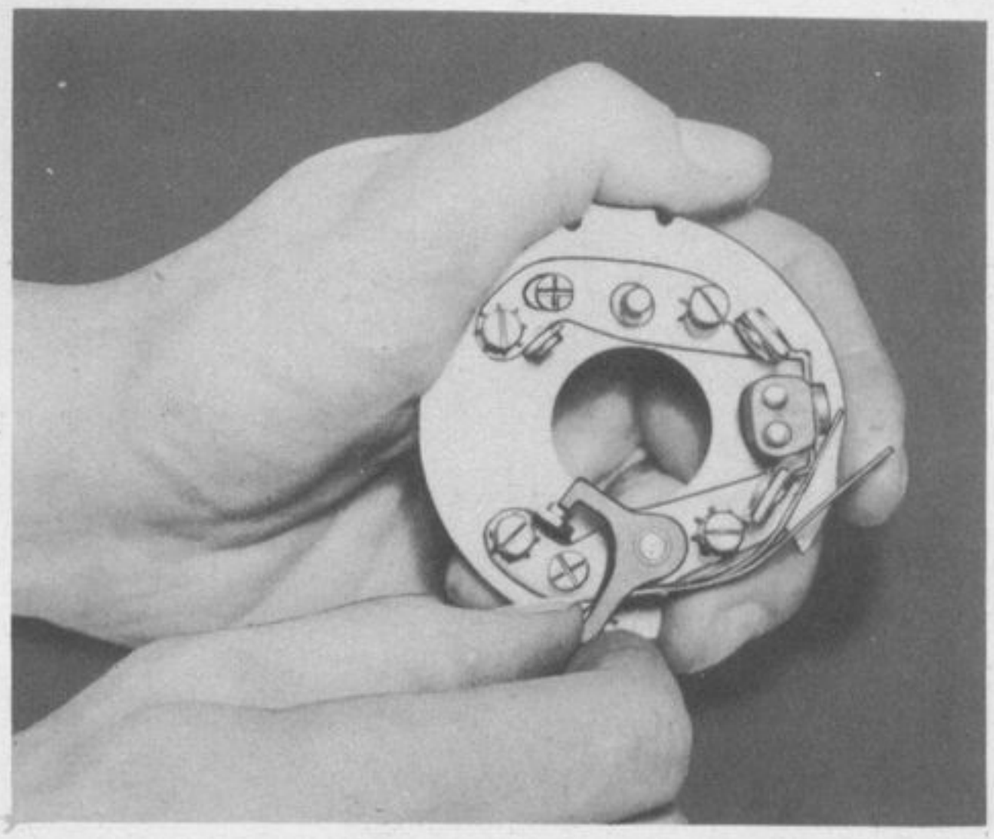

Figure 210—Checking Fit of Breaker Arm

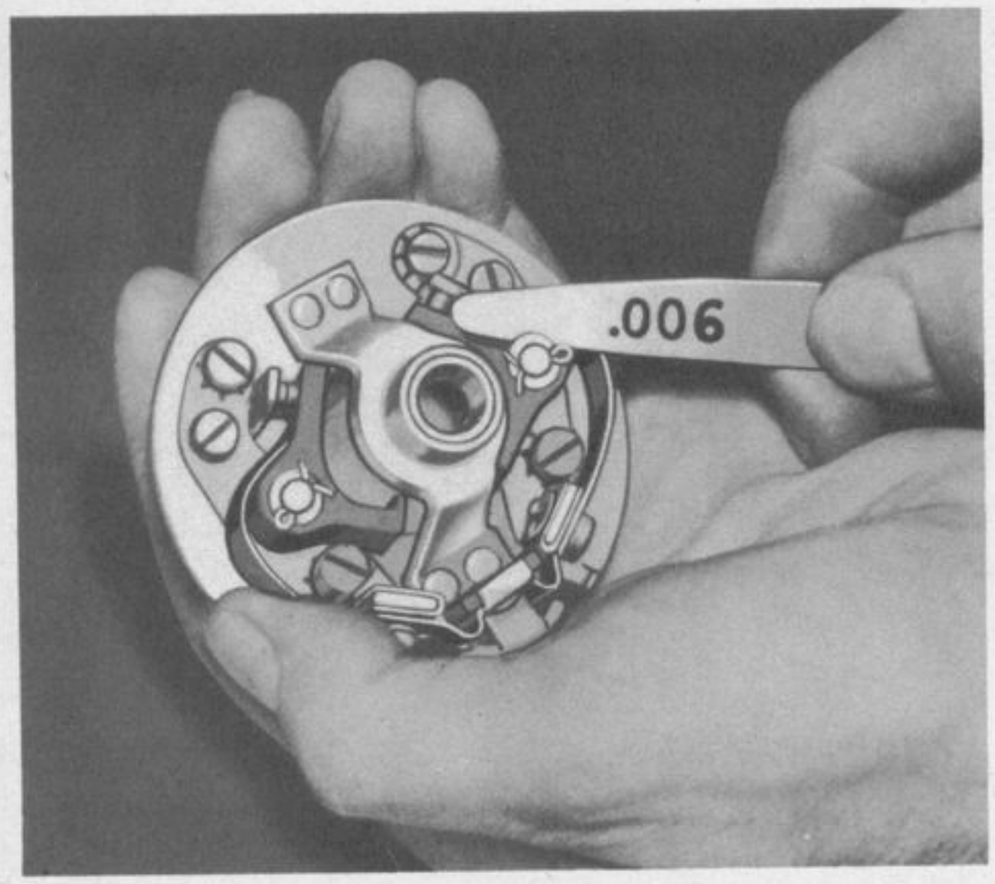

Figure 211—Checking End Clearance of Breaker Arm

needed. Check the breaker arm pin for looseness on the plate.

Check the fit of the breaker arm on the pin (Fig. 210) (arm must have free action). Install the breaker arm assembly on the plate and check the end play with a 0.006 inch feeler gage as shown in figure 211 to insure free movement of the breaker arm on the pin.

Figure 212—Checking Breaker Arm Spring Tension

Test tension of spring on breaker arm assembly (Fig. 212), using tool V-108. This tension should be between 20 and 24 ounces.

Figure 213—Installing Distributor Base Spring

D—ASSEMBLY

Place the breaker assembly (12150) over the shaft, cam and weights assembly (12176). Grease the end of the shaft and assemble it to the housing assembly (12130) installing retainer ring (12146) (Fig. 213).

Thoroughly clean and inspect the rotor (12201) for any cracks, carbon tracks, etc. Rotor contacts must not be filed down as it is necessary to maintain the 0.016 inch air gap between the contacts and terminal cap. Place the rotor (12201) on the distributor shaft assembly. Make sure the flat surface inside the rotor seats firmly on the flat of the shaft.

Install breaker plate adjustment (12174). Install a new vacuum brake piston (12220). Leave the lock nut (12227) loose for final adjustment on the testing and adjusting stand.

E—TEST

Test and adjust the distributors following the instructions given for testing and adjusting all of Ford distributors as outlined in the Ford Service Bulletin under Subject number 12000.


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