The Shaper

CHAPTER 1

Shaper Construction

The function of the shaper is, primarily, the production of flat surfaces. The work is held on an adjustable worktable, or more often in a vise fastened to the worktable, while the cutting tool, which is given a reciprocating motion, that is, caused to move forward and back, peels off a chip on the cutting stroke. At the end of the return stroke the feed operates to move the table (and work) the desired amount.

Shapers are classified as to size (14, 16, 20 in., etc.) by the maximum length of the cut that may be taken, and a standard shaper of a given size will hold and machine a cube of that size.

The *crank* shaper (Fig. 1-1), in which the tool carrier is driven forward and backward by an oscillating arm operated by a crankpin in the main driving gear, or "bull wheel," and in which the feed is transmitted to the worktable by ratchet-and-pawl mechanism, is so commonly used as to be termed standard.

In machine construction, circular motion may be changed to reciprocating motion in several ways; for example, through a cam, an eccentric, or a crankpin. In the standard shaper, the crankpin is used. The *reciprocating* motion (forward and return) is given to the ram by the circular motion of the large gear, called the *crank gear* or the *bull wheel*, acting through a crankpin and an oscillating arm, or *rocker* arm.

The lengths of shaper jobs vary, and as the length of the stroke should be only about $\frac{3}{4}$ in. longer than the cut to be taken, provision is made to change the stroke to any length from zero to maximum.

It should be noted, however, that the *hydraulic* shaper (Fig. 1-2) is becoming increasingly popular. The tools used, the work-holding

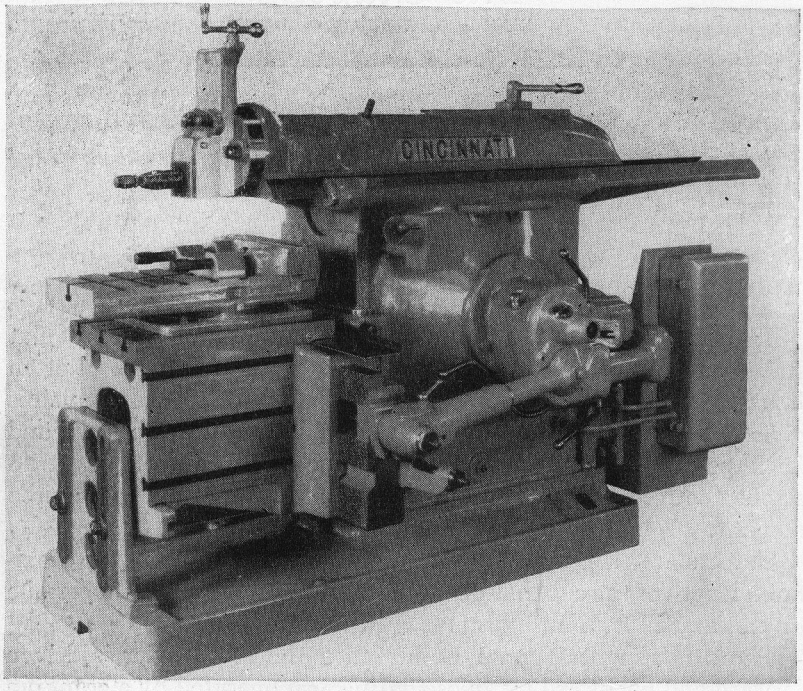


Fig. 1-1. A standard crank shaper. (*The Cincinnati Shaper Company*)

devices, the methods, and the general operations are the same for either type.

VALUE OF THE SHAPER

The relative values of different methods of doing a job, or of the kinds of machines to use, is one of the most profitable and interesting studies in machine-shop work. For example, for a small number of pieces it may be better to machine one piece at a time in a shaper; for a larger number of pieces it may be more efficient to set up and plane several at a time in a planer. It may be cheaper and quicker to take one or more cuts on, say, 25 pieces in a shaper or planer rather than in a milling machine; on the other hand, if there are enough pieces to make the extra initial expense worth while, it probably

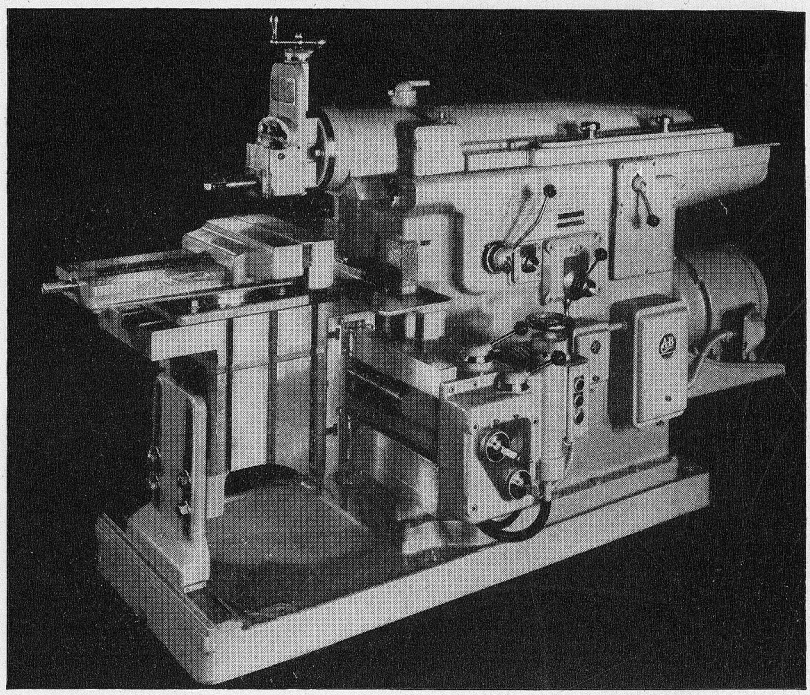


Fig. 1-2. Hydraulic shaper. (*The Rockford Machine Tool Company*)

would be much better to provide a special fixture and a special cutter, and to machine them in the milling machine.

The shaper is especially adapted to small work which may be held in a vise bolted to the worktable. The tool head is so constructed as to permit of horizontal, vertical, or angular cuts being taken. For toolroom work, such as punch and die work or jig and fixture parts, and on short work for other special tools or machines, the shaper is practically indispensable.

The cutting tool is easily ground to the desired shape for the cut to be taken and, when dull, may be quickly sharpened. The ranges of stroke and position of stroke, of vertical adjustment of worktable, of feeds—lateral, vertical, and angular—together with the adaptability of the single cutting tool, serve to make the shaper more efficient for many jobs than the milling machine would be. This is

especially true in model work or tool work involving only a few pieces. On the average shorter cuts within its capacity, the shaper is more efficient than the planer for the following reasons: It costs less to buy, it takes less power to run, occupies less space in the shop, is about one-third quicker, the work is more easily adjusted, and generally speaking less skill is required in operation.

A wide variety of very accurate work may be easily and quickly accomplished in the shaper if the machine is in good condition, clean, and well oiled, and if the operator understands its construction and the principles of its operation.

PARTS OF THE SHAPER

On the following pages, a standard crank-driven shaper is illustrated (Figs. 1-3 and 1-4) and the major parts are identified and their functions described. In connection with the job of operating a shaper, the learner should study the illustrations (and machine) and the text carefully, in order to become familiar with the names, locations, and functions of these parts.

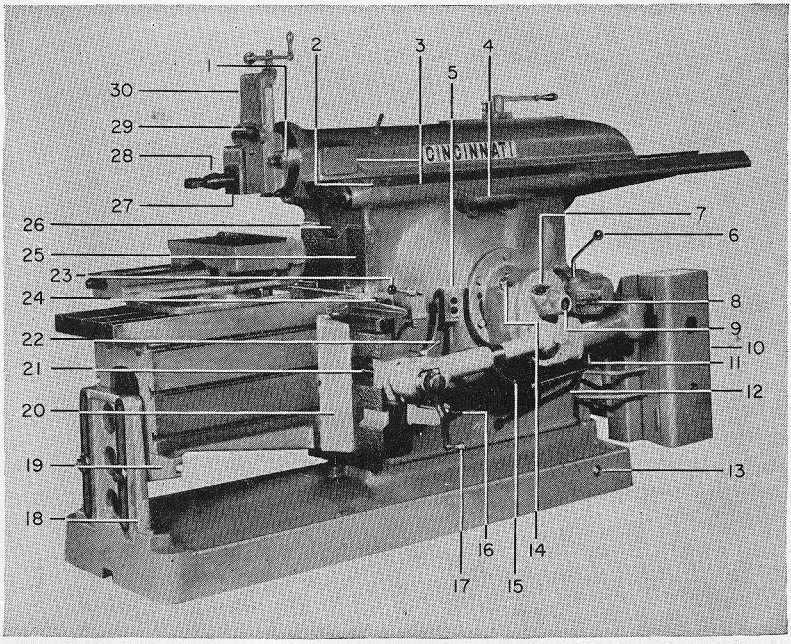
A machinist who can intelligently run a lathe made by a manufacturer in Cincinnati will have no particular difficulty in operating a lathe made by another company in Hartford. These lathes may have different features in design but, in principle, they are alike in construction and operation. So with shaper work. A shaper is built for certain operations, and the machinist who understands the construction of a given standard shaper will have no trouble in understanding quickly the constructional features, that is, the functions of the various levers, handles, etc., of any shaper.

Names and Functions. For the parts of the standard crank-driven shaper illustrated in Fig. 1-3 (front view), study the following:

1. *Toolslide Clamp Screw.* Used to clamp the head to the head swivel when shaping with the horizontal feed.

2. *Serial Number.* Each shaper manufactured is numbered. This number is the serial number and is used as a means of identification by the manufacturer as to its size, date of manufacture, type, etc.

3. *Finished Pads.* Used to attach the power feed to the head.



1. Toolslide clamp screw
2. Serial number
3. Finished pads
4. Tool shelf
5. Start and stop buttons
6. Back-gear lever
7. Stroke-indicator dial
8. Speed-indicator plate
9. Stroke-adjusting shaft
10. Motor starter
11. Gearshift lever
12. Transmission drain plug
13. Oil-sight gage
14. Power cross-feed selector
15. Power rapid-traverse lever
16. Rail-elevating manual control
17. Cross-feed safety crank
18. Table support
19. Table-support bearing
20. Apron
21. Cross-feed screw
22. Cross-feed engagement lever
23. Clutch and brake lever
24. Rail-clamp control
25. Column rail bearing
26. Column throat-chip guard
27. Clapper
28. Tool post
29. Clapper box
30. Toolslide

Fig. 1-3. Parts of the shaper, *front view.* (*The Cincinnati Shaper Company*)

4. *Tool Shelf.* A place for tools.

5. *Start and Stop Buttons.* Generally, *black* is used for starting the machine and *red* for stopping the machine.

6. *Back Gear Lever.* Gives two ranges of speeds with four changes in each range, making a selection of eight speeds.

7. *Stroke-indicator Dial.* Shows the length of the stroke in inches.

8. *Speed-indicator Plate.* A direct-reading indicator for speeds. Adjustments are easily made from the operator's natural working position.

9. *Stroke-adjusting Shaft.* Used to adjust length of stroke. The length of stroke is maintained without the use of a clamping nut on the stroke-adjusting shaft, the purpose of the nut being fulfilled automatically. The length of the stroke may be changed while the ram is in motion. A guard covers the stroke-adjusting shaft.

10. *Motor Starter.* Electrical device that helps to start the motor when the button is pushed. Thus, an electrical overload on the motor is avoided.

11. *Gearshift Lever.* Used to shift the gears in the internal transmission mechanism. This transmission provides eight selective speeds, covering a wide range of desired speeds. The changes are made by two levers brought within easy reach of the operating position. These speeds are shown on the speed indicator. The ease with which speed changes can be made encourages the operator to use the correct cutting speed at all times. The gears are housed in a gear chamber, which forms an enclosed reservoir, free from dirt and grit, for the oil in lubricating both the speed gears and the rest of the machine. *Do not change gears while machine is in motion.*

12. *Transmission Drain Plug.* Plug used to hold the oil in the gear chamber. It is opened to take out the old and worn oil.

13. *Oil-sight Gage.* Visible gage showing the height of oil in the oil reservoir.

14. *Power Cross-feed Selector.* Used to indicate the kind of feed desired. The unique feature of the feeding motion of this particular machine is that it is actuated by a series of cams and not by an eccentric and a ratchet. This gives a smooth, rather than an abrupt, movement and enables the entire feed under any conditions to be confined wholly within the return stroke.

There are 11 feeds, ranging from 0.010 to 0.170 in. Just a twist of

the wrist changes the feed. A second lever for feed engagement has three positions: "stop," "right-hand," and "left-hand," indicating the direction of the table movement.

15. *Power Rapid-traverse Lever.* Lever that operates the built-in power rapid traverse to the table. It instantly moves the work up to the tool for the cut. Also, when the piece is finished, time is saved, since the table can be quickly moved (traversed) to one side, so that the work can be loaded or unloaded without interference of the tool and the post.

16. *Rail-elevating Manual Control.* Used to raise or lower the rail by hand.

17. *Cross-feed Safety Crank.* Used for traversing the table right or left by hand feed.

18. *Table Support.* Supports table, the sliding action taking place at the bottom of the table instead of at the shaper base. With this type of support, parallel action is not dependent upon the exact alignment of the base.

19. *Table-support Bearing.* Holds the table and allows the table to feed horizontally.

20. *Apron.* Carries the table and is hooked over the rail, and moves right and left on the rail.

21. *Cross-feed Screw.* Moves the apron right and left on the rail.

22. *Cross-feed Engagement Lever.* Gives left, right, or neutral position.

23. *Clutch and Brake Lever.* Starts and stops the machine. This machine uses an electric clutch.

24. *Rail-clamp Control.* Clamps the rail to the column when shaping.

25. *Column-rail Bearing.* Bearing on which the rail operates to raise or lower the table.

26. *Column-throat Chip Guard.* Prevents chips from falling into the column.

27. *Clapper.* Holds the tool post that supports the cutting tool.

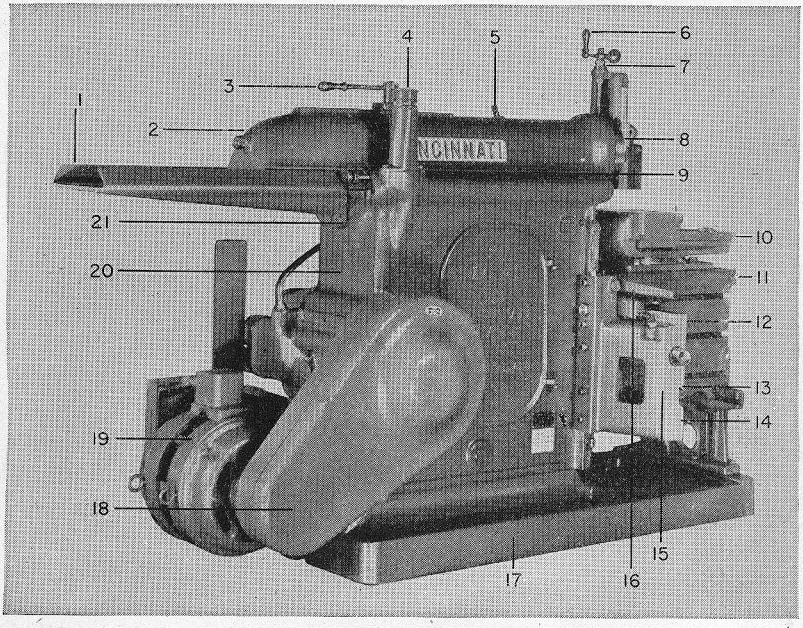
28. *Tool Post.* Holds the cutting tools.

29. *Clapper Box.* Holds the clapper.

30. *Toolslide.* Raises and lowers, to feed the tool down or up.

Figure 1-4 shows a rear view of the shaper with the parts identified. Study these parts carefully and note their locations.

1. *Ram Guard.* Covers the ram at the rear of the machine.
2. *Ram.* The movable part of the shaper which carries the tool.
3. *Ram Clamp.* Clamps the ram at different positions of the stroke.



1. Ram guard
2. Ram
3. Ram clamp
4. Sight-feed oil distribution station
5. Ram-positioning shaft
6. Ball crank
7. Feed-screw dial
8. Graduated-head swivel
9. Ramway
10. Vise
11. Table
12–14. Bearings
15. Crossrail
16. Crossrail chip guard
17. Base
18. Motor-drive guard
19. Motor
20. Column
21. Ram-gib adjustment

Fig. 1-4. Parts of the shaper, *rear view.* (*The Cincinnati Shaper Company*)

4. *Sight-feed Oil-distribution Station.* Shows whether oil is circulating in the automatic oiling system.

5. *Ram-positioning Shaft.* Used to change the position of the ram on the stroke.

6. *Ball Crank.* Used to raise or lower the toolslide.

7. *Feed-screw Dial.* Indicates the amount of feed on the toolslide.

8. *Graduated Head Swivel.* Used to swivel the head for angular shaping.

9. *Ramway.* Way on which the ram travels.

10. *Vise.* Device to hold work on table of the shaper.

11. *Table.* Support of the vise; work may be bolted to it.

12. }
13. } *Bearings.* Bearings for apron on the rail.
14. }

15. *Crossrail.* Used to carry the worktable and saddle; also part of the table feeding mechanism.

16. *Crossrail Chip Guard.* Used to prevent chips from getting in between the column and the crossrail.

17. *Base.* Pan-shaped, to keep oil off the floor.

18. *Motor-drive Guard.* Guard for the pulleys and belts used in driving the machine.

19. *Motor.* Electric motor used in driving the machine.

20. *Column.* Main support for the operating mechanism. The top is machined and scraped to form a flat bearing for the ram.

21. *Ram-gib Adjustment.* Used to adjust the bearing clearance between the ram and the ram bearing.

REASONS FOR GIB ADJUSTMENTS

Accuracy depends a great deal upon the proper adjustment of gibs. Gib adjustment also is important in smoothness of operation and cutting. Accordingly, *keep all gibs properly adjusted.*

In general, gibs should be adjusted with a minimum clearance. A small clearance on a properly fitted bearing is favorable to the formation of a strong oil wedge or film. When making adjustment, be sure that uneven wear has not taken place. That is, movements of the table, ram, and sliding block are usually confined to a certain portion of the entire travel. Accordingly, after a long period of time, there will be more wear in this portion than elsewhere. If a gib is adjusted for the worn portion, it will be tight for the portion that is little used. This condition exists only after a long period of operation and eventually requires refitting. However, in the meantime, the

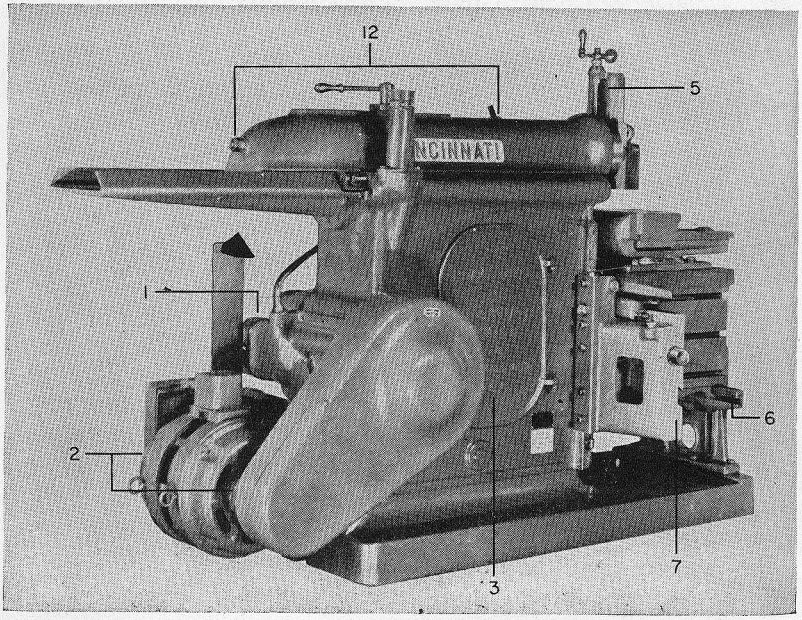
3 gibs located on shaper

gibs are still useful in keeping proper clearance between the working parts.

When adjustment is necessary, taper gibs should be drawn up snugly. The gib should then be backed off or relieved until a clearance of not less than 0.002 in. is obtained between the glazed bearing surfaces. Further adjustment may be required, depending on conditions and on the operation of the shaper.

LUBRICATING THE SHAPER

The most important factor in the life of any machine is *proper lubrication.* There are definite places on all machines that *must* be oiled daily while other parts may be oiled weekly, monthly, etc. An apprentice must learn very early in his training that an oiled machine is usually a trouble-free machine.



1. Oil reservoir
2. Motor
3. Return basin and main reservoir
5. Sliding surface of the tool head
6. Table support surface
7. Rail sliding surface
12. Oil holes of ram

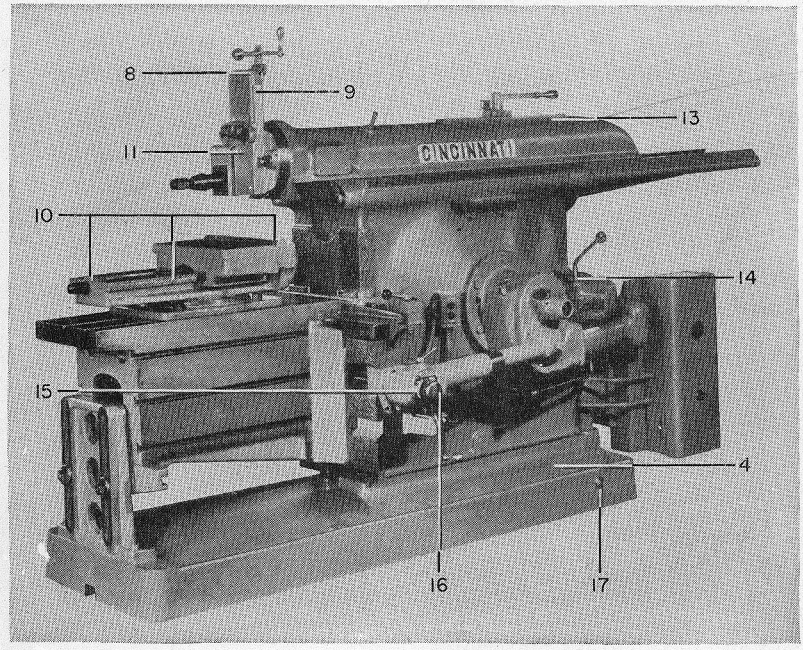
Fig. 1-5. Lubricating points. (*The Cincinnati Shaper Company*)

Figures 1-5 and 1-6 show the parts to be oiled. Study these illustrations very carefully and remember what parts are to be oiled daily, weekly, monthly, etc., *and be sure that you do the required oiling.*

Before Starting the Machine. Before the shaper is started, the following four items must be performed (see Figs. 1-5 and 1-6 for location of oiling points):

NOTE: Required *only* on new machines or when changing oil.

1. Fill transmission reservoir until oil overflows into the return basin.
2. Lubricate the motor according to the motor manufacturer's recommendations. *Do not overlubricate.*



4. Oil-pressure gage
8. Feed-screw bearing
9. Feed screw
10. Sliding surface of vise
11. Clapper pin
13. Ram-adjusting screw
14. Speed-change-lever bearings
15. Crank clutch
16. Oil feedbox
17. Oil-sight gage

Fig. 1-6. Lubricating points. (*The Cincinnati Shaper Company*)

3. After filling the transmission reservoir, open the column door and fill the return basin until oil overflows to the main reservoir.
4. After filling the return basin, remove the main reservoir cover and fill with oil until the level is ½ in. from the opening. Add oil as required.

Daily Oilings. These oilings *must* be done every day before the machine is started.

1. Clean and oil the sliding surface of the tool head.
2. Clean the surface of the table.
3. Clean the sliding surfaces of the rail.
4. Oil the feed-screw bearing.
5. Oil the feed screw.
6. Clean and oil the sliding surfaces of the vise. Fill oil holes.
7. Oil the clapper pin; clean frequently.

Weekly Oilings. These parts should be oiled every week. As a suggestion, choose Monday of each week to do the oiling job, or the first workday of the week if Monday happens to be a holiday.

1. Fill the oil hole at rear of the ram and the two oil holes near the ram adjustment shaft.
2. Oil the ram-adjusting screw through the opening in the ram.
3. Oil the speed-change-lever bearings.
4. Oil the crank clutch.

Monthly Oilings. Remove the plug and add oil to the feedbox.

NOTE: Do not allow the oil level to fall below the sight gage when the shaper is stopped.

OPERATION OF THE SHAPER

It is suggested that the beginner carefully study the following pages on the operation of the shaper, so that he may be able to go to the machine and, with a little help from the instructor, get to know how to operate the machine. Study the illustrations very carefully as you read the text material.

Starting

1. Put the gearshift lever in neutral position and see that the stroke dial reads zero.

2. Put the feed lever in the neutral position.
3. Start the motor and make sure it is running in the proper direction. Arrows on the belt and pulley guard show the correct direction.
4. Engage the clutch lever with gears in neutral and stroke at zero.
5. Allow the shaper to run from 3 to 5 min. to fill all oil tubes before the ram is set in motion.
6. Inspect the rocker arm and sliding block to see that they are getting oil.

Operation. Refer to Fig. 1-7 for the following reference numbers.

Stroke. The stroke is adjusted by turning the shaft 8 with the crank furnished with the machine. The stroke-adjusting shaft is self-locking. The length of the stroke is shown on dial 5, whether the shaper is in motion or stopped.

The ram is unclamped by lever 6 and adjusted to the required position by turning shaft 2. The same crank is used for positioning the ram and for adjusting the stroke.

CAUTION: Do not run the ram back into the column with the slide rest set at an angle.

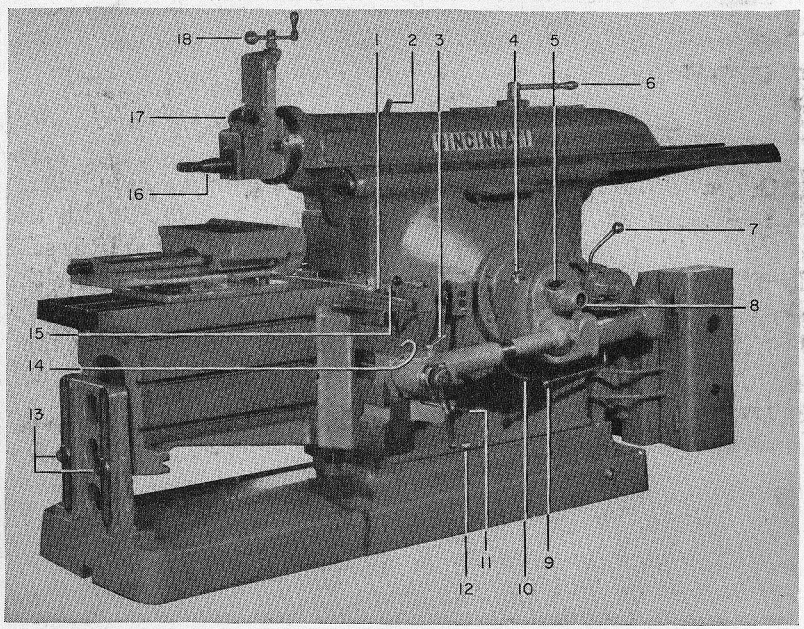
Speeds. This Cincinnati shaper has eight speeds, as shown on the direct-reading selector plate. Four speeds are obtained through lever 9. Four additional speeds are obtained through the back-gears control lever 7.

Feeds. The amount of feed to the table is regulated by lever 4. The automatic feed is engaged and disengaged by lever 3. This lever is directional; that is, it shows the direction of the table movement, whether for feed or for power rapid traverse.

A safety clutch is provided for feed and power rapid traverse, to prevent breakage in the event the table should run against an obstruction.

Vertical Adjustment of Table. Unclamp the rail by putting a large wrench on shaft 1 and pulling toward the front of the machine. Loosen table support nuts 13. Remove safety crank 12 from the cross-feed shaft and engage it on elevating shaft 11. Remove crank by placing the clutch teeth opposite each other and pushing the crank (see Fig. 1-8).

Raise or lower the table to the desired position and reclamp rail by turning shaft 1. Tighten front table support by pulling up nuts 13. *Always have apron centered on rail when pulling up nuts* 13, *to prevent cramping.* The large hexagon-head cap screw holding the rail clamp



1. Rail-clamp control
2. Ram-positioning shaft
3. Cross-feed engagement lever
4. Power cross-feed selector
5. Stroke-indicator dial
6. Ram clamp
7. Back-gear lever
8. Stroke-adjusting shaft
9. Gearshift lever
10. Power rapid-traverse lever
11. Rail-elevating manual control
12. Cross-feed safety crank
13. Table-support clamping nuts
14. Power elevating engagement lever
15. Clutch and brake lever
16. Tool post
17. Clapper-clamping nuts
18. Toolslide-control lever

Fig. 1-7. Operating points. (*The Cincinnati Shaper Company*)

at each side of the column should always be tight. Do not disturb the socket-head cap screw.

Power Rapid Traverse. This is a method by which the table is moved by power quickly as compared to moving it by hand.

Must remove Crank

HORIZONTAL. To operate the horizontal power rapid traverse (Fig. 1-9), place feed lever *J* in the direction of the desired movement and raise lever *KK*. The table will move under power very quickly.

VERTICAL. To operate the vertical power rapid traverse, loosen clamp shaft *L*, (Fig. 1-9); loosen table support bolts 13 (Fig. 1-7);

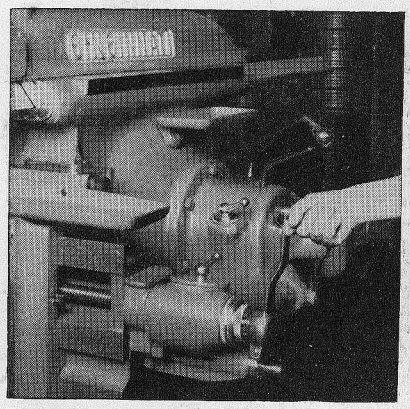


Fig. 1-8. Disengaging the safety crank. (*The Cincinnati Shaper Company*)

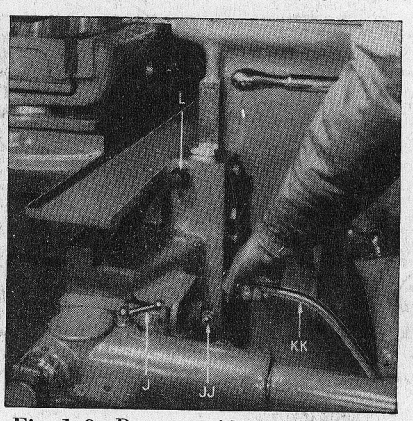


Fig. 1-9. Power rapid traverse for the horizontal and vertical movement of the table. *L*, clamp shaft; *J*, feed lever; *JJ* and *KK*, other levers. (*The Cincinnati Shaper Company*)

place feed lever *J* (Fig. 1-9), in neutral position; place lever *JJ* in the direction of movement and raise lever *KK*. *Do not use vertical power rapid traverse for feeding the table. Use head feed.*

OTHER CONSTRUCTION DETAILS

Further explanations are necessary for some parts of the shaper at this time. Such parts as the worktable, ram, power-rapid-traverse mechanism, etc., are explained. These parts should be thoroughly learned by all operators of the shaper for success in machine-shop work.

Power Rapid Traverse. The power-rapid-traverse mechanism on shapers simply uses power to move the table quickly. Hand power

is done away with. The greatest advantage of power rapid traverse is the amount of time saved by its use. It instantly moves the work up to the tool for the cut, thus reducing the time between cuts to little or nothing. Also, when the piece is finished, time is saved, since the table can be loaded or unloaded without interference of the tool

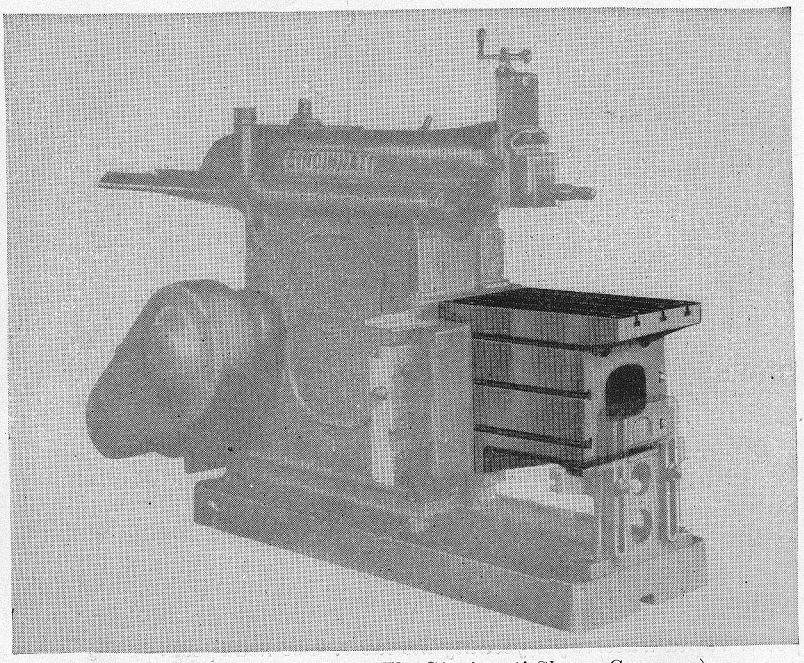


Fig. 1-10. A plain table. (*The Cincinnati Shaper Company*)

and the post. The operator's time used in moving the table from one side of the shaper to the other is now saved.

Feed. The unique feature of the feeding motion is that it is actuated by a series of cams and not by an eccentric and a ratchet, or by a single-step cam. This gives a smooth, rather than an abrupt, movement and enables the entire feed under any conditions to be confined wholly within the return stroke.

Thrust bearings on each end of the feed screw reduce friction at these points and make hand feeding particularly easy.

Eleven feeds, ranging from 0.010 in. to 0.170 in. are usually provided. The amount of feed is conveniently controlled by means of a lever, mounted on a direct-reading dial, indicating the feed in thousandths of an inch. All feed changes may be made while the machine is running.

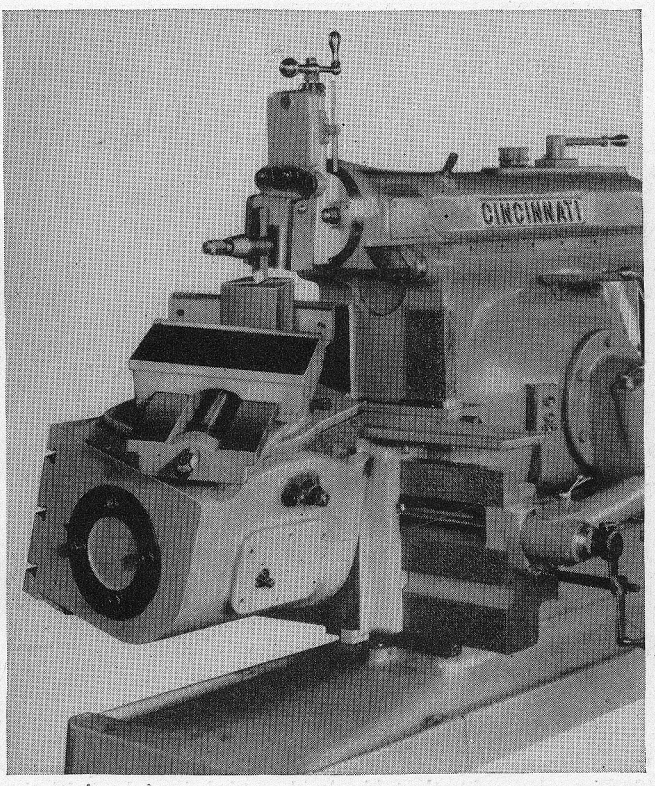


Fig. 1-11. The universal table. (*The Cincinnati Shaper Company*)

Check to see if table is parallel and square

Worktables. Worktables, usually supplied with shapers, may be of two kinds: *plain* and *universal*. The plain type is the one usually supplied unless the universal is specified. Figure 1-10 shows a plain type and Fig. 1-11, the universal.

The worktable may be fed horizontally either by hand or by power, and it may be adjusted vertically to provide for different

jobs which may vary considerably in height. This type of table cannot be swiveled or turned but is stationary in position, bolted to the saddle. It is provided with T slots on the top and on both sides, for the purpose of holding bolts for clamping the work or the work-holding devices. Figure 1-12 illustrates a casting being shaped while

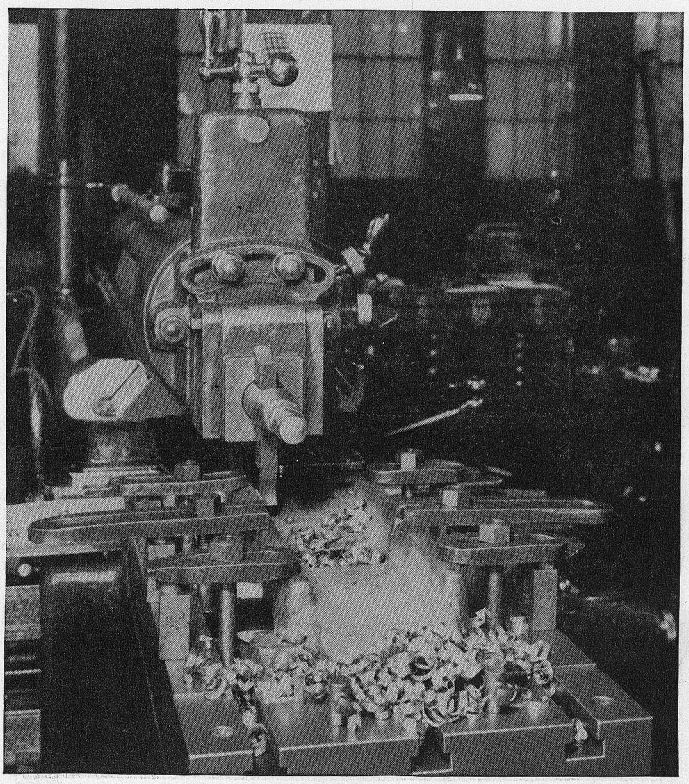


Fig. 1-12. Piece clamped to the table. A side cut is being taken with the clapper box in an upright position. In this position, the operator must make sure that it will clear the top of the work. Some machinists prefer to set the clapper box over in setting up the same job. (*The Cincinnati Shaper Company*)

bolted to the table. Figure 1-13 shows a piece held in a vise which is bolted to the table.

Universal tables, in combination with the swivel vise, permit the work to be rotated. This type of table is especially useful in tool and

die shops. The table usually has one solid face, similar to the plain table, and one tilting face with adjustment up to 15 deg. either way from the horizontal and on an axis at right angles to the trunnion. Figure 1-14 shows the use of such a table in combination with a swivel vise.

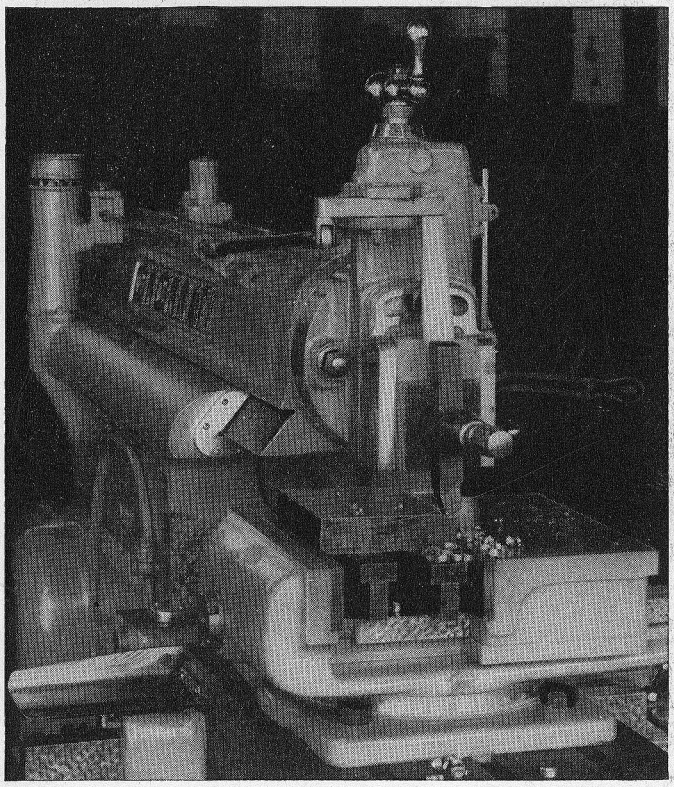


Fig. 1-13. A piece being held in a shaper vise. (*The Cincinnati Shaper Company*)

Tool Head: Vertical and Angular Downfeed. The toolhead (Fig. 1-15) is designed to hold the tool and also to be used in adjusting the tool for the desired cut. A graduated collar on the downfeed screw serves to indicate the movement of the slide (and tool) in thousandths of an inch. Moreover, the slide and the screw permit a

considerable amount of downfeed and, because of the swivel construction between the head and the ram, this feed may be vertical or at any desired angle in the plane of the swivel. That is, a vertical cut of considerable depth, or a fairly wide bevel cut may be taken in the shaper by means of the downfeed. The swivel headplate is

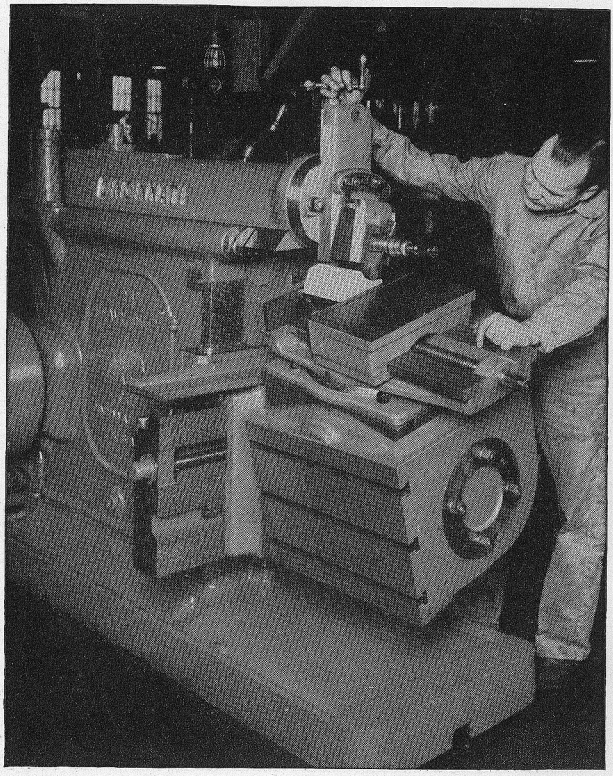


Fig. 1-14. Use of the universal table in combination with a swivel vise. (*The Cincinnati Shaper Company*)

graduated in degrees, and is easily adjusted after the binding bolts have been loosened.

The cutting tool is held in the tool post securely against the tool block, or "clapper block." The tool block fits snugly to the sides and back of the clapper box and is held by the hinge pin.

During the cutting stroke the tool block is rigidly supported in the clapper box, but on the return stroke the block hinges outward slightly on the hinge pin, allowing the tool to clear the work, and prevents the severe rubbing and consequent ruin of the cutting edge of the tool which would otherwise happen.

By loosening the apron clamping bolt the whole apron may be swiveled through a small arc in either direction, for the purpose of

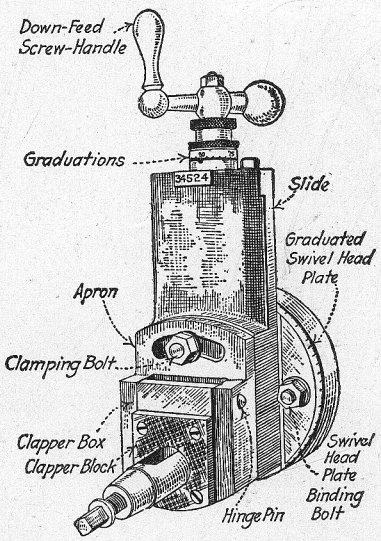


Fig. 1-15. A shaper tool head.

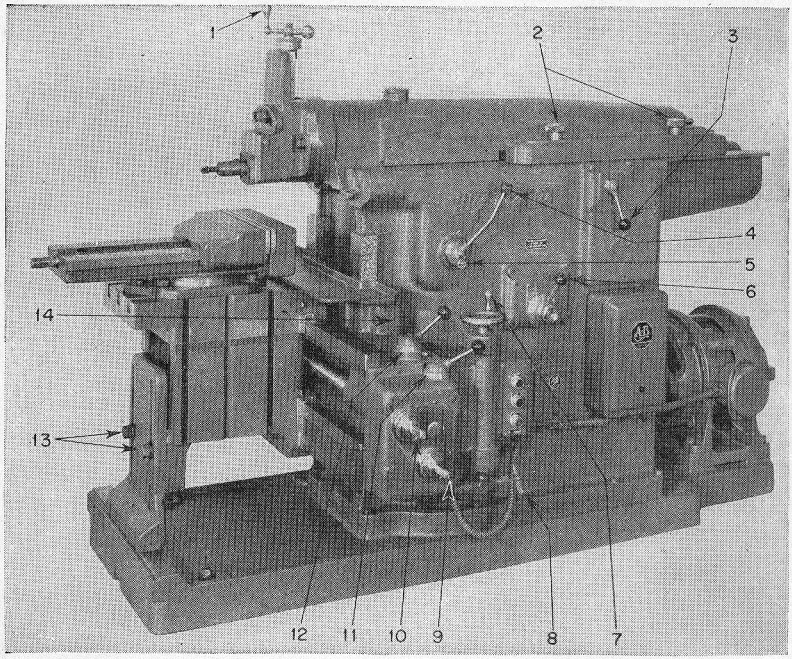
allowing the tool to clear the work when taking a vertical or angular cut.

The power downfeed is a comparatively recent development in shaper construction, but most manufacturers will now furnish this feature at the option of the purchaser. It is worth while for the reason that power feed is usually more efficient than hand feed.

NOTE: A. In the shaper, gibs are provided for three purposes—to adjust the saddle on the crossrail, to adjust the ram on the column, and to adjust the toolhead slide on the swivel headplate. The proper adjustment of these gibs is important, and the proper oiling of the bearings is imperative.

HYDRAULIC SHAPER

This type of shaper (Fig. 1-2) differs from the crank-type shaper, in that it operates under hydraulic power.[1] The main operating parts will be described and their functions noted.



1. Ball crank
2. Control knobs for the ram
3. Reversing lever
4. Lever
5. Knob and plunger
6. Valve
7. Handwheel
8. Valve
9. Safety crank
10. Screw
11-12. Levers
13. Clamp nuts
14. Plates

Fig. 1-16. Parts of a hydraulic shaper. (*The Rockford Machine Tool Company*)

Study Fig. 1-16 for the names and locations of the main parts of the hydraulic shaper. Below are given the names and functions of these parts:

[1] For a complete discussion of hydraulic power, see Chapter 15, page 503.

1. The ball crank on the top of the vertical feed screw is for manually feeding the tool head up or down. Directly below the crank is a graduated collar which shows the amount of travel. Each graduation of the dial represents a movement of 0.001 in. of the tool head. A power feeding mechanism may be obtained for the tool head when so ordered.

2. The length and position of the ram stroke is determined by the setting of these knobs.

3. Reversal of the direction of the ram stroke at any point during either cutting or return is accomplished by means of this lever.

4. This lever starts, stops, and selects the speed of the ram.

5. This knob and plunger must be pulled outward to allow lever 4 to be shifted to the high-speed range.

6. The valve operated by this lever varies the quantity of oil delivered to the ram cylinder and thereby governs the speed of the ram.

7. The amount of cross or vertical feed to the table is regulated by this handwheel.

8. This valve will be used quite frequently. It is for closing off the oil supply to the feed cylinder or, if the feed piston seems to have too much of a pounding action, it may be softened by adjusting this valve.

9. When the crossrail is to be raised or lowered by hand, the safety crank is to be used on this shaft.

10. This is the screw for moving the table along the crossrail. 11 and 12. These two levers are used in conjunction with each other. Lever 11 selects the setting for either vertical or horizontal movement of the table and, after it has been set, lever 12 selects the direction of movement for that setting.

13. Before lowering the table, be sure to loosen the clamp nuts on the outboard support. After the table has been moved to the desired position, these nuts should be tightened in order to provide a rigid support for the table during the shaping operation.

14. Plates used to hold the crossrail to the column.

QUESTIONS ON SHAPER CONSTRUCTION

1. What is the function of a shaper?
2. How are shapers classified as to size and type?

3. What is meant by reciprocating motion? How does it apply to the shaper?
4. What are the differences between crank and hydraulic shapers?
5. Of what value is the shaper in a machine shop? Be very specific in your answer.
6. Name 10 major parts of the shaper.
7. Describe the functions of these parts.
8. Why should machine tools be lubricated?
9. What parts of the shaper must be lubricated daily?
10. Why must the machine be kept clean at all times?
11. How many speeds has the standard shaper?
12. What is the usual range of feeds?
13. In what directions may the tool be fed to the work?
14. How is the table moved? In what directions may the plain table be moved? the universal table?
15. What advantages has the universal table over the plain table?
16. What is meant by power rapid traverse?
17. How does it work?
18. What is meant by manual feed? power feed? How do they work?
19. What is the function of the tool head?
20. How is the feed measured and by what?
21. What is the function of the clapper box?
22. Does the clapper box raise on the return stroke? Why?
23. What advantages, if any, has the hydraulic shaper over the crank type?