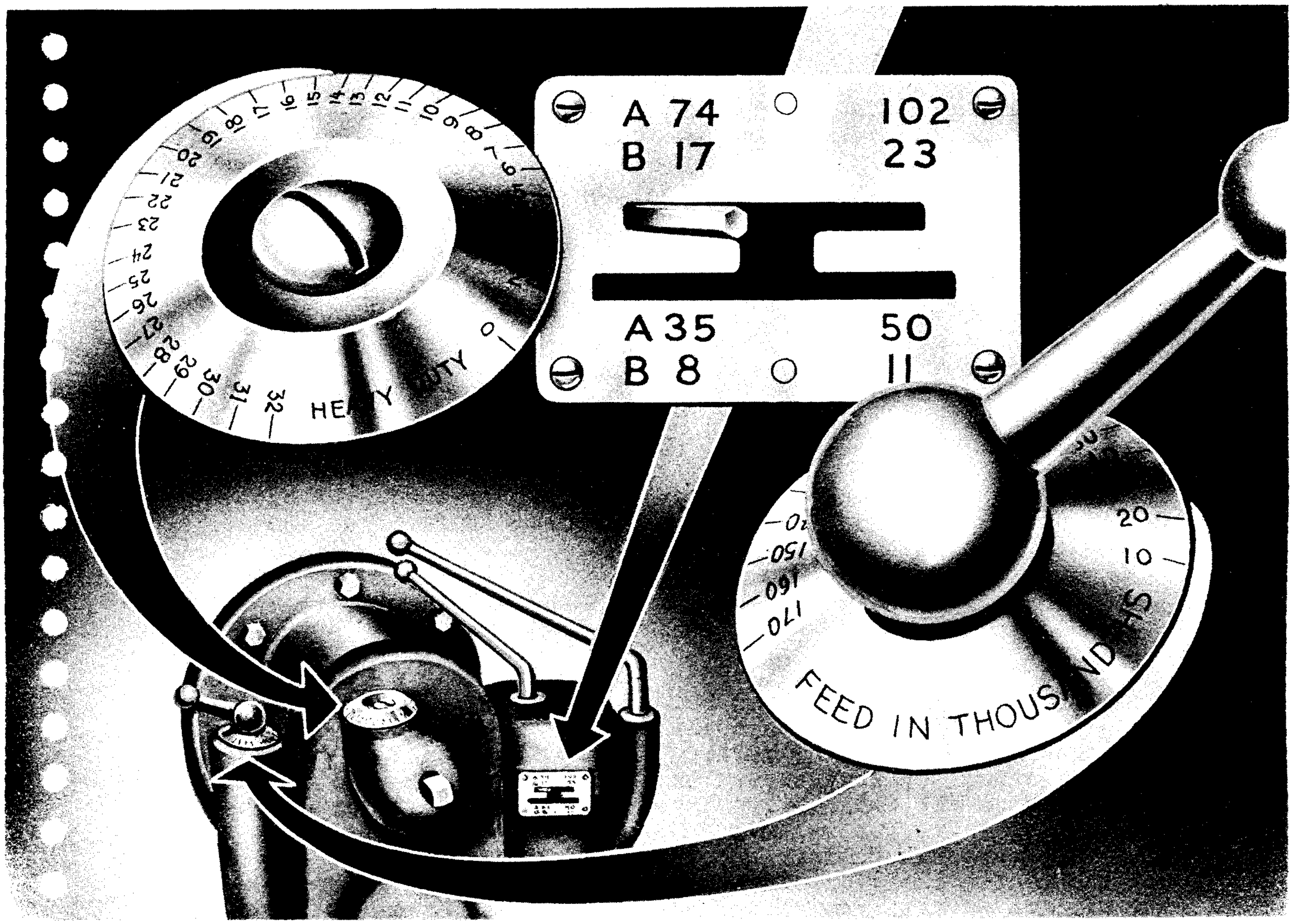
DESCRIPTION OF SPEEDS & FEEDS

Unit 1-T53(D) Pages 293 to 308



UNIVERSITY OF THE STATE OF NEW YORK
STATE EDUCATION DEPARTMENT
BUREAU OF INDUSTRIAL AND TECHNICAL EDUCATION

DESCRIPTION of SPEEDS and FEEDS

OBJECTIVES OF UNIT

1. To explain the meaning of speeds and feeds as related to shaper work.

2. To explain the principles governing the selection and the application of shaper speeds and feeds.

3. To explain how shaper speeds and feeds are calculated.

INTRODUCTORY INFORMATION

The rate at which metal can be removed from the surface of the job determines to a considerable extent the amount of time required to produce a finished piece of work in the shaper. Therefore, in order to operate the shaper efficiently, the worker should have an understanding of those factors and conditions which have the greatest influence in establishing, and, at the same time, controlling this rate.

Outstanding among these factors are the following: the cutting speed at which the tool operates, the rate of feed per stroke, and the depth of the cut.

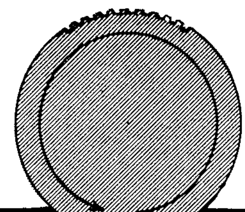
Each of these factors in turn is affected by many conditions, such as the kind of material in the job and the material in the tool. Because of the wide variation in these conditions, it becomes impossible to give a definite rule for determining which combination of these factors — the cutting speed, the rate of feed, and the depth of cut — can be applied to the work, inasmuch as all of these factors must be varied to suit the nature of the job and the operation. The best results in any situation will be obtained only when all the factors involved are properly coordinated.

The beginner will find it helpful to refer to existing and well-established tables of cutting speeds and feeds which are based on average cutting conditions, and to use the recommendations in these tables as a general guide for determining both the amount of metal which can be removed per stroke and the rate of speed best suited to a given cutting material.

The knowledge resulting from judicious use of these tables, combined with the experience gained in applying this information to the job, should enable the operator to distribute his time equitably between the roughing and the finishing cuts to the end that the job may be planed in the shortest time possible, consistent with the amount of metal to be removed and the kind of finish specified.

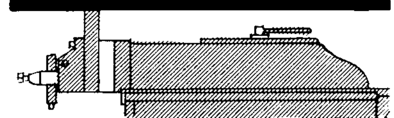
DESCRIPTION OF THE SHAPER SPEEDS

The term speed, as used in connection with shaper work, has two distinct denotations — one to the speed of the machine, and the other to the average rate of speed at which the cutting tool moves over the surface of the work during the cutting stroke.



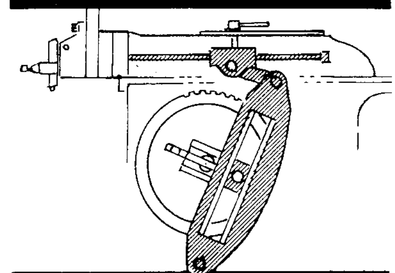
MACHINE SPEED IS DETERMINED BY THE SPEED OF THE MAIN DRIVING GEAR —

The speed of the machine (on the crank shaper) is indicated as the number of cutting strokes made by the ram during one minute of the shaper's operation and is determined by the speed of the main driving gear or bull wheel.



CUTTING SPEED IS THE SPEED OF THE RAM DURING THE CUTTING STROKE -

The speed of the cutting tool, more specifically known as the cutting speed, is the average rate of speed the tool attains when the shaper has been adjusted to make a given number of cutting and return strokes of a given length in one minute. The cutting speed is determined by the total distance the tool travels during the cutting strokes made in a minute and by the ratio of cutting-stroke time to return-stroke time.



CHANGES IN CUTTING SPEED ARE EFFECTED BY CHANGING THE RATE AND THE AMOUNT OF ROCKER ARM MOVEMENT

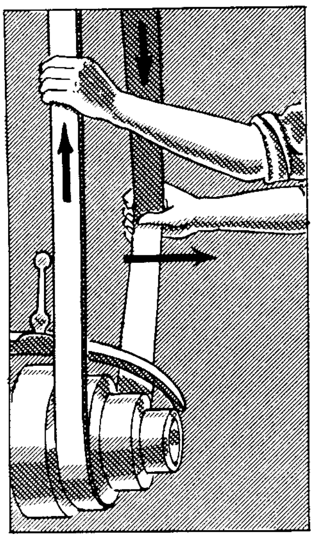
This information gives us the two factors — time and distance — which are needed for determining the rate of speed; the fractional part of a minute required for the cutting stroke represents the elapsed time; the total length in feet of the cutting strokes made in this period represents the distance.

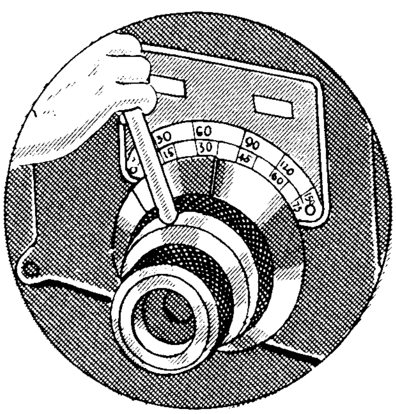
The speed of the shaper, that is, the number of strokes made by the ram in one minute, remains constant for a given speed of the driving gear, whether the stroke is long or short.

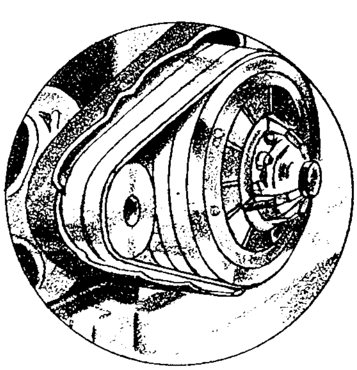
The cutting speed in the crank shaper changes, however, whenever the stroke is made longer or shorter, for distance is one of the factors affecting the rate of speed. Obviously then, if the speed of the machine remains constant, the distance traveled by the tool in one minute increases or decreases in direct proportion to the change in the length of the stroke. For example, when the stroke length is increased from 3" to 6", the resultant cutting speed will be doubled, inasmuch as the tool travels twice as many feet in one minute when it is operating at the longer stroke than it does when it is operating at the shorter one.

Conversely then, if the cutting speed of the tool is to be maintained at the same rate for the six-inch stroke as for the three-inch stroke, it will be necessary to reduce the speed of the shaper

— the number of strokes per minute — by one half. Only in this way will the total distance traversed by the tool in one minute be the same for both of these stroke-lengths. Therefore, inasmuch as the cutting speed for a given material remains the same, a change in the length of the stroke must be accompanied by a corresponding change in the speed of the shaper.


CONE PULLEY


HYDRAULIC DRIVE


SINGLE PULLEY

It is for this reason, and for the additional reason that all materials cannot be planed at the same rate of speed (refer to page 308), that the shaper has been provided with several speeds. Then, by changing the speed of the shaper, the cutting speed of the tool can be maintained at established rates even though the length of the stroke and the material in the job may vary considerably.

In the shaper with the cone-pulley drive it is necessary only to change the location of the belt, moving it from one step to another on the pulley in order to change the speed of the machine. The method used to change the speed on a shaper using this type of device has been fully explained on page 83.

In the hydraulically driven shaper the cutting speed for which the machine has been adjusted can be ascertained immediately and at all times, simply by noting the position of the indicator with relation to the figures on the speed-index plate. A change in the cutting speed of a shaper using this type of drive can be made only by changing the position of the speed indicator. The relationship between the position of the speed indicator and the functioning of the flow-control valve to which it is attached has been explained on page 42.

In the shaper with the single-pulley drive, speed changes are effected by changing the positions occupied by the back gears and by the sliding gears located within the transmission case. Eight different speeds are usually provided, four direct speeds and four back-gear speeds.

A sectional view of the transmission on a Cincinnati shaper is shown in Fig. 519. The gear arrangement is typical of that employed in other shapers having a sliding-gear transmission. The eight machine speeds available are indicated as ram strokes per minute on the speed indicator shown on page 293. Any one of the speeds on this plate becomes available when the back gears and the sliding gears have been correctly arranged by means of the gear-shift levers. Thus, when the back gears — numbered 9 and 10 — are engaged and occupy the positions shown, any one of the slower series of speeds can by used by shifting one of the sliding gears on the lower shaft into mesh with the gear intended for its use on the shaft above.

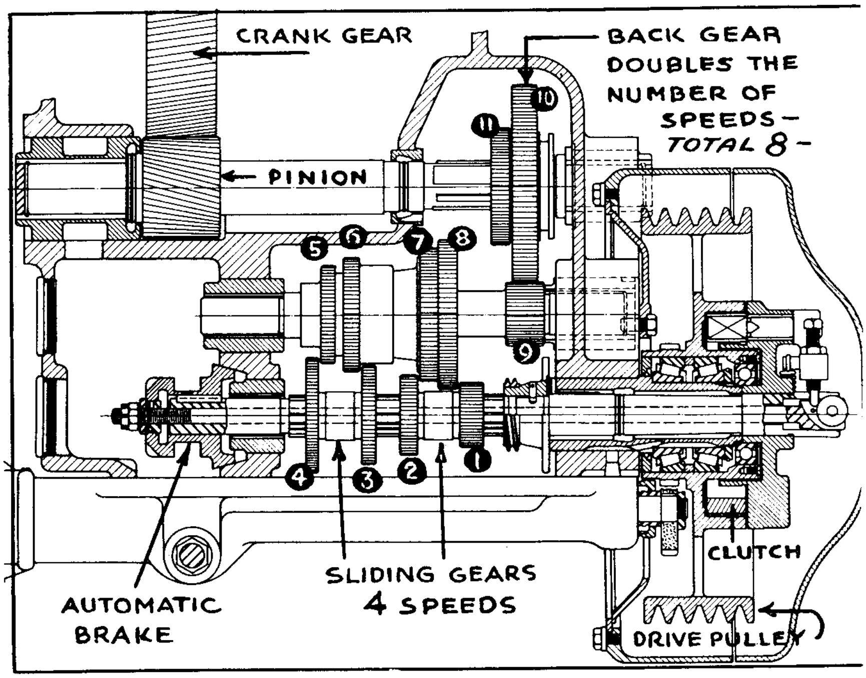


FIG. 519

For example, when sliding gear number 1 has been shifted to the left so that its teeth mesh with those on gear number 8 just above it, the main drive gear will rotate at its slowest speed, and, consequently, the ram too will make the fewest number of strokes per minute possible (eight per minute) on this shaper.

The shafts and the gears utilized in transmitting power through the transmission for this slow speed, have been shown in black in Fig. 520. By means of this gear arrangement, power from the drive pulley is transmitted first to gear number 1; then it is transmitted successively through the gears numbered 8, 9, and 10, and by their connecting shafts; and then, finally, the pinion sets the main drive gear in motion.

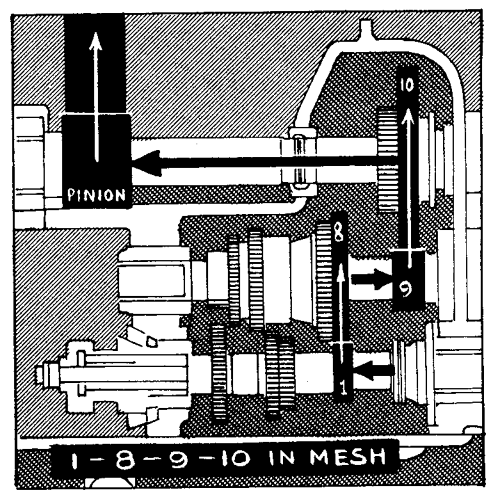


FIG. 520

It should be noted that in each pair of gears, the driver — gear number 1, gear number 9, and the pinion — is the smaller with the result that a reduction in speed occurs in each set of gears in use. This accounts for the reduction in speed from approximately 500 R.P.M. of the drive pulley to 8 R.P.M. of the crank gear and 8 strokes per minute of the ram. Additional and progressively faster speeds in the back-gear series can be obtained by shifting, in the order mentioned, gear number 2, number 3, or number 4, into mesh with the proper one on the shaft above.

Any one of the four faster speeds indicated on the speed plate becomes available when the back gears have been disengaged and motion is transmitted directly through the transmission.

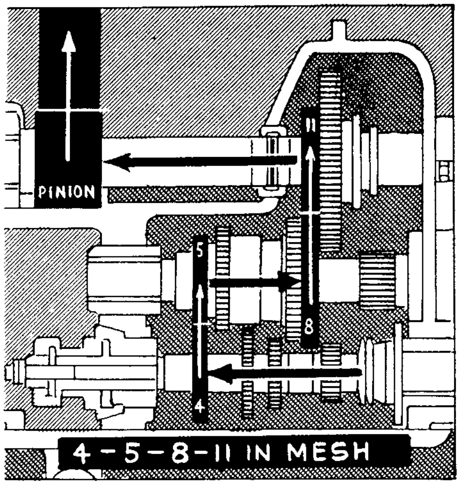


FIG.521

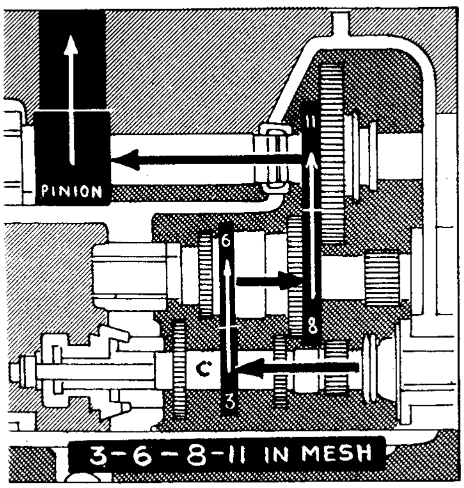


FIG.522

The change from back-gear drive to direct drive is made by moving the back-gear lever from its position B to its position A, causing the gears numbered 10 and 11 to be shifted to the left. As a result of this shift, gear number 8 now turns the pinion shaft directly through gear number 11, instead of indirectly through the back gears as formerly.

For example, when sliding gear number 4 on the lower shaft has been moved to the right and meshed with gear number 5 on the shaft above, the main drive gear will make the greatest number of revolutions per minute possible on this machine and, as a result, the ram will make the greatest number of strokes per minute possible (102 strokes per minute).

The gears and shafts used in this example of direct drive have been shown in black in Fig. 521. Power applied to the drive pulley is now transmitted through the clutch to gear number 4 on the lower shaft and successively to the gears numbered 5, 8, and 11, and then, finally, by means of the pinion, to the main drive gear. It should be noted that now, the driving gears numbered 4 and 8 are larger than the gears numbered 5 and 11 which they drive. Consequently, there is an increase in speed in both pairs of gears, for the relative speed of a pair of gears is directly proportional to their diameters.

Another example of direct drive which produces a somewhat slower speed of the shaper has been indicated in Fig. 522. Now, cluster gear C has been shifted to the left instead of to the right. With this gear arrangement, gear number 3 on the drive shaft transmits power to gear number 6 on the countershaft and then to the main drive gear as in Fig. 521. Inasmuch as the difference in the diameters of this pair of gears is not as great as that of gears number 4 and number 5, which were utilized in Fig. 521, the main drive gear will not make as many revolutions per minute as before, and, consequently, the ram will make fewer strokes per minute also.

It follows then, that still slower speeds will result when a smaller drive gear, number 2 or number 1, is shifted into mesh with the proper gear on the countershaft.

The four speeds indicated opposite B on the speed chart on page 293 are made available by first engaging the back gears and then shifting the proper sliding gear as for the direct series of speeds.

DESCRIPTION OF CUTTING SPEED

Cutting speed for the shaper has been defined as the rate of speed attained by the tool as a result of its making a given number of strokes of a given length in one minute.

This speed is the average rate and not a constant rate at which the tool travels over the work's surface, for it takes into account the slower movement of the tool at the beginning and at the end of each stroke. Moreover, owing to the construction of the driving mechanism in the crank shaper, the tool does not operate at a constant rate at any time during the entire stroke of the ram. Instead, the cutting speed changes continually, for the tool travels at a slow rate near the beginning of the stroke when the rocker arm is in an angular position, and at a rate which increases steadily as the tool nears the center of the cut and the rocker arm moves from its angular to a vertical position. Then, as the tool passes the center of the cut and continues to move toward the end of the cutting stroke, its speed again diminishes gradually, for after passing the center of the stroke, the rocker arm gradually assumes an angular position similar to the one it occupied at the beginning of the stroke. (Refer to Fig. 523.)

An even greater variation in speed occurs during the return stroke than occurs during the cutting stroke. At this time the crank pin which causes the oscillating movement in the rocker arm, rotates nearest the pivot shaft where a given movement of the crank pin produces the greatest movement of the rocker arm as has been explained in the Description of the Quick Return Mechanism on page 19.

The diagram of a typical full stroke of the ram (Fig. 523) indicates graphically (by the use of lines) the relative rates of speed attained by the cutting tool at various points during each forward and each return stroke. It also illustrates why the cutting speed must be given as the average speed.

The horizontal line in the velocity diagram represents the length of the ram stroke. The vertical lines extending upward from the horizontal

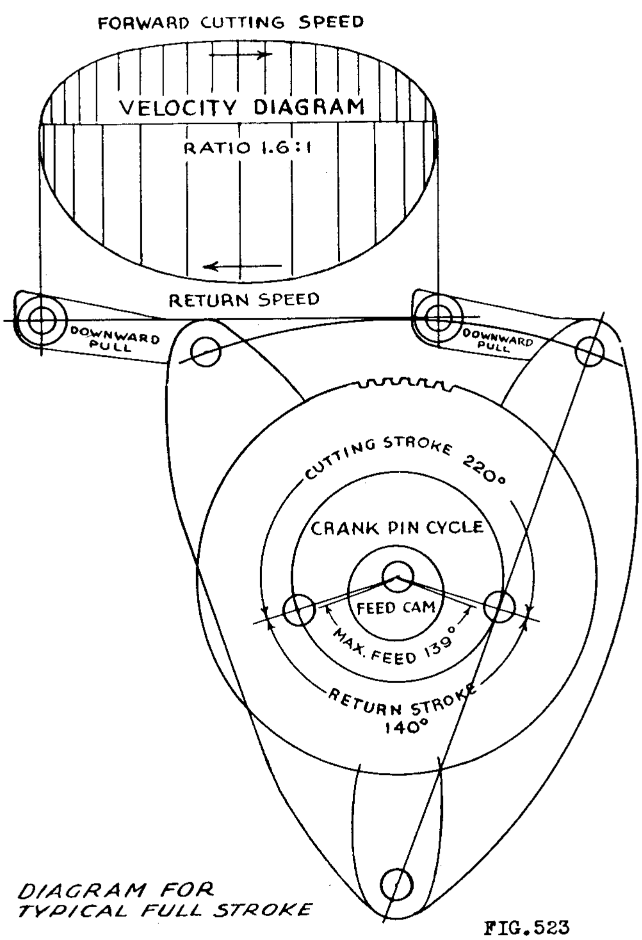


FIG.523

line represent the cutting speeds attained at various points during the forward stroke. At this time the crank pin rotates in a clockwise direction through that portion of its cycle marked "cutting stroke" and moves the rocker arm from its position at the left in the diagram to that shown at the right.

The vertical lines extending downward represent the various rates of speed attained by the tool during the return stroke. Now the crank pin, still rotating in a clockwise direction and in that portion of its cycle marked "return stroke," moves the rocker arm back to its original position at the left. At this point the crank pin has made one complete revolution, and, as a result, the ram has made a forward and a return stroke.

Above the horizontal line, the curve formed when the outer ends of the vertical lines are connected, indicates the fluctuation which occurs in the cutting speed from end to end of the cutting stroke; below the horizontal line, the curved line, more pronounced than the one above, indicates the greater fluctuation in speed occurring during the return stroke. As a consequence of this variation, the only speed which can be given is an average of that attained at the various points during the stroke.

In addition to indicating the speed of the ram by their lengths, the vertical lines in the velocity diagram indicate by their spacing the relative distance which the ram is caused to move for every 10° rotation of the crank pin throughout one complete cycle. Thus, the 22 spaces above the horizontal line represent the 220° through which the crank pin rotates during the cutting stroke while the rocker arm moves from the position shown at the left to the one at the right in Fig. 523. The 14 spaces below the line represent the 140° through which the crank pin rotates while returning the rocker arm to the position it occupies at the beginning of the stroke.

It should be noted in this connection that the vertical lines are most closely spaced near the ends of the stroke. At this time the rocker arm is in an angular position wherein a 10° rotary movement of the crank pin produces a smaller amount of movement in the rocker arm (and in the ram) than does a similar movement of the crank pin when the rocker arm occupies a more nearly vertical position.

Inasmuch as 220° of the crank-pin cycle are utilized while the tool is making the cutting stroke and only 140° remain in which it can make the return stroke which is of equal length, the tool must travel at a proportionately faster rate during the return stroke than it does during the cutting stroke.

HOW TO DERIVE AND USE THE FORMULAS FOR CALCULATING THE CUTTING SPEED FOR THE SHAPER

The method of calculating the cutting speed for the shaper differs somewhat from that used for calculating the cutting speed for machines in which the tool cuts continuously. To begin with, the shaper tool cuts only during the forward stroke and, moreover, the return stroke is faster than the cutting stroke.

It is necessary, first of all, therefore, to ascertain the ratio of the cutting-stroke time to that of the return-stroke time, in order that a proportionate amount of the total time required to make one full stroke can be assigned to each phase of the stroke.

Since the crank pin makes a constant number of revolutions per minute, the time required to make the cut is to the time required to make the return stroke as the distance traveled by the crank pin during the cutting stroke is to the distance traveled by the crank pin during the return stroke. In Fig. 523 the distance traveled by the crank pin is given as 220° and 140° respectively for the cutting and for the return strokes. The relationship these numbers bear to each other, therefore, establishes the ratio of the cutting-stroke time to the return-stroke time and can be found in the following manner.

Distance traveled by the crank pin during the cutting stroke = 220°
Distance traveled by the crank pin during the return stroke = 140°

Let the missing term be expressed by X.
Then,

Let X = the ratio
$220 : 140 = X : 1$
$140 X = 220$
$X = 1.57$

The ratio can then be expressed as

$$220 : 140 = 1.5 : 1 \text{ or } 3 : 2.$$

This means that the ratio of the cutting-stroke time to the return-stroke time is as 3 : 2, and that it takes approximately 1-1/2 times as long to make a cutting stroke as it does to make a return stroke.

The sum of the terms of this ratio (3 : 2) equals 5 and represents the time required to make one complete stroke; 3/5 of this time equals the time of the cutting stroke and the remainder, 2/5, equals the time of the return stroke.

Two factors necessary for calculating the cutting speed, represented as C.S. in the formula, are usually known or else they can be ascertained very readily by referring to the proper dials on the shaper. These factors are

1. the number of the strokes per minute, represented by N;
2. the length of the stroke in inches, represented by L.

The product of these factors, N x L, equals the number of inches cut during one minute of shaper operation. Since the cutting speed is expressed in feet, this product must be multiplied by 1/12 to reduce it to feet cut per minute. The partial formula thus far reads

$$N \times L \times \frac{1}{12}.$$

As explained previously, the actual time for cutting this distance is 3/5 of a minute. Therefore, in order to determine the cutting speed, the formula above must be divided by 3/5 or multiplied, instead, by the inverted fraction 5/3, for distance divided by time equals rate. The completed formula for finding the cutting speed then appears as

$$C.S. = N \times L \times \frac{1}{12} \times \frac{5}{3}.$$

Since it is necessary in each problem to multiply by 1/12 to reduce to feet, the distance traveled by the tool during the cutting stroke, and then by 5/3 to establish the rate of speed, this formula can be simplified somewhat by multiplying these factors (1/12 x 5/3) and using the result as a constant in the formula.

Thus, $\frac{1}{12} \times \frac{5}{3} = \frac{5}{36} = .14$. The formula in its simplified form will

then read

$$C.S. = .14\ N\ L.$$

Below is an illustration of the use of the formula in solving a problem.

PROBLEM: What is the cutting speed of the tool when the shaper makes 60 strokes per minute, 12 inches long?

FORMULA: $C.S. = N \times L \times \frac{1}{12} \times \frac{5}{3}$

SUBSTITUTION: $C.S. = 60 \times 12 \times \frac{1}{12} \times \frac{5}{3}$

CANCELLATION: $C.S. = \overset{20}{\cancel{60}} \times \overset{1}{\cancel{12}} \times \frac{1}{\underset{1}{\cancel{12}}} \times \frac{5}{\underset{1}{\cancel{3}}} = 100$ feet per minute. Ans.

The solution of the same problem by means of the simplified formula is shown below.

FORMULA: $C.S. = .14\ N\ L$

SUBSTITUTION: C.S. = .14 x 60 x 12 = 100 feet per minute. Ans.

HOW TO DERIVE AND USE THE FORMULA FOR DETERMINING THE NUMBER OF STROKES PER MINUTE REQUIRED FOR OBTAINING A SPECIFIED CUTTING SPEED

Two factors must be known in order to determine the number of strokes per minute the shaper is to make. They are

1. the required cutting speed of the tool, represented by C.S.;
2. the length of the ram stroke in inches, represented by L.

The cutting speed recommended for planing various materials can be obtained from the table of Allowable Cutting Speeds — Feet Per Minute on page 308, and the length of the stroke can be ascertained by consulting the proper dial on the shaper. When these factors are known, the number of strokes per minute, represented by N, can be found by transposing (changing about the terms) the cutting speed formula.

FORMULA: $C.S. = .14\ N\ L$

TRANSPOSITION: $$N = \frac{C.S.}{L \times .14} = \frac{C.S. \times 1.00}{L \times .14}$$

CANCELLATION: $$\frac{C.S. \times \overset{7.2}{\cancel{1.00}}}{L \times \underset{1}{\cancel{.14}}} = \frac{C.S. \times 7}{L}.$$

An example showing the use of the formula in solving a problem follows:

PROBLEM: How many strokes per minute are required to take a roughing cut on cast iron with a high-speed steel tool with a stroke 12" long? Note: In the table on page 308, a cutting speed of 60 feet per minute is recommended for roughing cuts on cast iron.

FORMULA: $$N = \frac{C.S. \times 7}{L}$$

SUBSTITUTION: $$N = \frac{60 \times 7}{12}$$

CANCELLATION: $$N = \frac{\overset{5}{\cancel{60}} \times 7}{\underset{1}{\cancel{12}}} = 35 \text{ strokes per minute. Ans.}$$

The above calculations need not be made when a hydraulically driven shaper similar to the one shown on page 33 is being operated. In a machine of this type the range of cutting speeds in feet per minute has been indicated on the speed-index chart which forms a part of the flow-control and overload-relief valve. The particular speed in use is determined by the position the speed indicator occupies in relation to this chart, for it regulates the control valve. Therefore, once the cutting speed has been determined on the basis of the material in the job and the material in the tool, and after this speed has been set by the adjustment of the speed indicator to the desired figure on the speed-index chart, the cutting speed will not change even though the stroke is made longer or shorter.

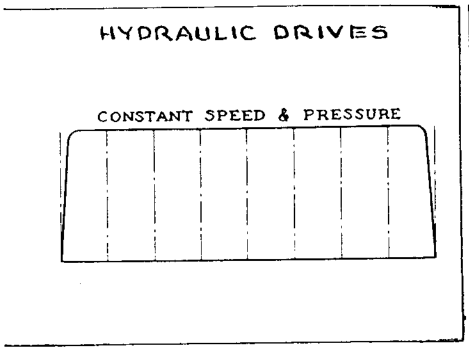


FIG.524

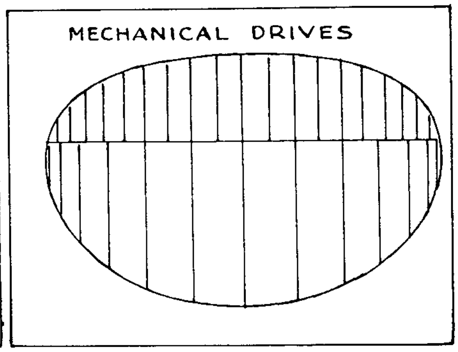
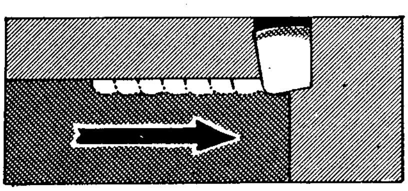
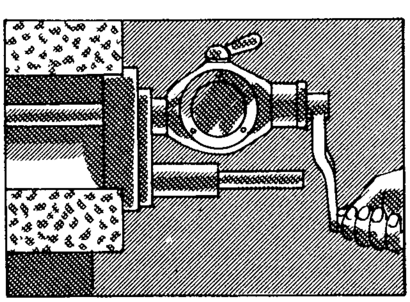


FIG.525

The speed of the hydraulic shaper during its cutting stroke has been shown graphically in Fig. 524. A comparison of this diagram with the velocity diagram for the crank shaper (Fig. 525) reveals considerable difference in their shapes. This dissimilarity is due to the difference between the driving mechanisms of these two types of shapers, for the curve in each diagram is formed by connecting vertical lines representing the cutting speed of the ram at various points during the cutting stroke. In the hydraulic shaper, for example, the ram attains its speed almost immediately after beginning the cut and continues at a constant rate throughout almost the entire stroke as the upper straight line in the diagram above indicates; but in the crank shaper the ram speed changes continually as revealed by the upper curved line in Fig. 525.

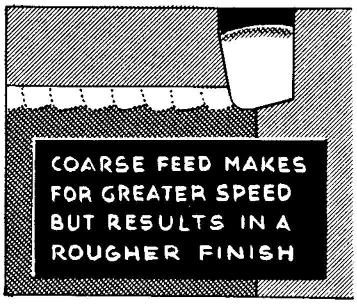




DESCRIPTION OF THE SHAPER FEED

When considered in connection with horizontal cuts, the feed on the shaper is defined as the distance that the work is moved toward the cutting tool for each forward stroke of the ram. For example, a .020" feed means that the table is moved toward the tool twenty thousandths of an inch each time the ram makes a cutting stroke. The feeding may be done either by hand or by an automatic feeding mechanism which functions in a manner quite similar to that of one of the mechanisms described in the section beginning on page 23, the type varying according to the make and age of the shaper.

The amount of feed used is an important factor in determining the time required to complete the work. Furthermore, this factor has considerable influence on the finish obtained. If the feed is doubled, that is, if the work is fed over .040" per stroke instead of .020", the time required to take a cut from a surface of a given width is cut in half, providing the speed of the shaper remains constant. Obviously then, a coarse feed should be used whenever practicable on account of the saving in time effected.

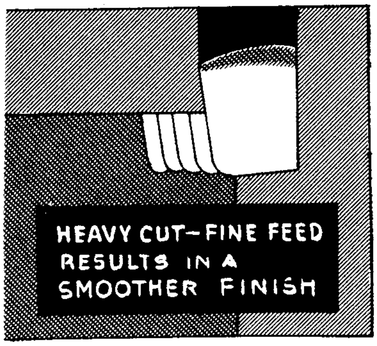


The selection of the rate of feed, however, is governed by certain equally important factors that limit the amount of feed per stroke which can be used, for the pressure of the cut increases as the rate of feed increases. The design of the job which is to be planed is one of the factors which influences the rate of feed, for if its shape prohibits its being clamped securely either in the vise or onto the table, a coarse feed cannot be used at this time.

The character of the metal also influences the rate of feed which can be used to best advantage on the job. For example, if the material in the job is soft cast iron or steel, and the job can be clamped solidly in the machine in one way or another, a reasonably coarse rate of feed can be used; on the other hand, if the metal is somewhat harder, or if it is tough, a reduced rate of feed will be advisable because of the inability of the tool, and sometimes the machine also, to withstand the strains resulting from cutting these materials using a coarse feed. Some grades of tool steel, for instance, offer considerable resistance to being cut, and, consequently, when this type of material is being planed, a fine feed will be required.

From the foregoing it might be assumed that a coarse feed can be used for planing some of the nonferrous metals, such as brass and aluminum and their alloys, inasmuch as metals of this type offer comparatively little resistance to cutting. Actually, however, this is not the case, for since the thick chips resulting from a coarse feed do not pass freely from the tool, the surface of the work becomes torn and rough.

The depth of the cut, too, affects the rate of feed which can be used. A limited amount of metal, for example, can be removed in a shaper of a given size, providing the job is capable of withstanding the pressure exerted upon it by the cutting tool. This amount of metal can be removed in one of two ways, either by taking a heavy cut with a fine feed, or by taking a lighter cut with a coarser feed per stroke. The use of a very coarse feed is objectionable, frequently, because of the rough surface condition resulting from a feed of this kind. Then, instead of the usual single finishing cut, several may be necessary in order to remove the tool marks left by the roughing tool used with a very coarse feed.



Usually, therefore, a heavy cut with a finer feed is preferred to the lighter cut and the coarser feed. The recommended procedure is to set a rate of feed which will result in the kind of finish desired, and then to take the greatest depth of cut possible, giving consideration, also, to the rigidity of the setup and the nature of the material in the job.

Finally, the rate of feed is influenced also by the angle the cutting edge of the tool makes with the surface being planed, in that the thickness of the chip is affected by this angle. For example, throughout the illustrations in Fig. 526, the depth of the cut D and the rate of feed F are the same, but because of the difference in the angle at which the cutting edge approaches the cut, the chip varies in thickness T, the chip becoming thinner as the angle is increased.

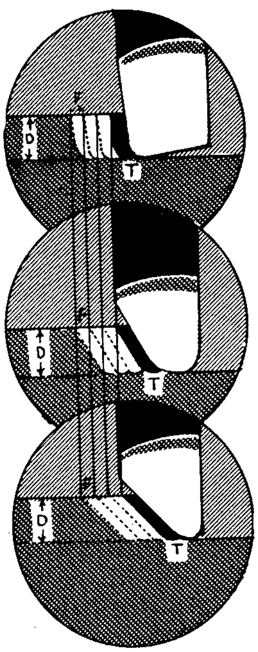


FIG. 526

Best results in roughing out ferrous metals have been obtained when the cutting edge of the tool assumes an angle of about 20° with the work's surface. This angular approach of the cutting edge to the work can be obtained in two ways: (1) by the preferred method of setting the tool holder vertically in the tool post and then grinding the tool bit to the desired angle; or (2) by the method wherein the position of the tool holder in the tool post is changed to obtain the desired 20° setting of the cutting edge. The last method, however, becomes objectionable when it is necessary to set the tool holder at such an angle that it points into the cut; for if the tool holder shifts from this position, as it is likely to do from cutting pressure, the cut will become deeper than intended.

HOW TO CALCULATE THE TIME REQUIRED TO TAKE A CUT IN THE SHAPER

The time required to take a cut depends on three factors, namely: the number of strokes the tool makes per minute; the rate of feed per stroke of the tool; and, finally, the width of the surface which is to be planed.

The values assigned to these factors differ for each job and therefore must be determined before a computation of cutting time can be made. For example, the number of strokes per minute is dependent on the cutting speed which it is advisable to use, the rate of feed selected is dependent on the factors discussed on the pages immediately preceding this section, and, obviously, the width of the cut is dependent on the width of the surface to be planed.

When the values for these three factors have been established, the time required for taking a cut can be determined by dividing the width of the surface in inches by the product of the feed per stroke and the number of strokes per minute.

A formula for this computation follows:

$$T = \frac{W}{F \times N}$$

in which

- T = the time required to make the cut
- W = the width of the surface to be planed
- F = the feed in inches per stroke
- N = the number of strokes per minute .

<u>HOW TO USE THE FORMULA FOR CALCULATING THE TIME REQUIRED TO MAKE A CUT</u>

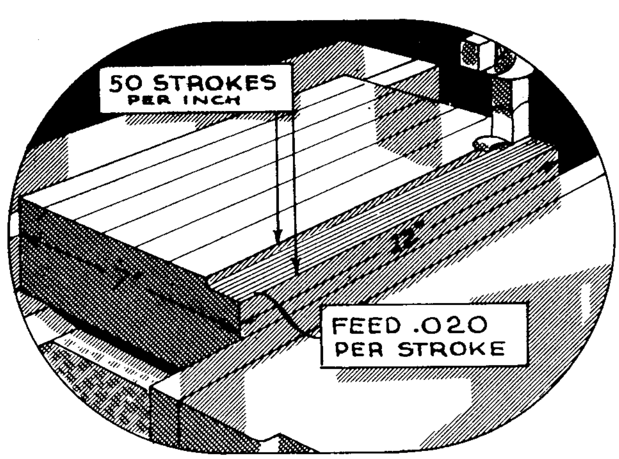
PROBLEM: How much time will be required to take a cut from a cast-iron plate 7" wide and 12" long, with a high-speed steel tool and a feed of .020" per stroke? Note: Refer to the problem on page 303 for calculating the number of strokes per minute.

FORMULA: $$T = \frac{W}{F \times N}$$

SUBSTITUTION: $$T = \frac{7}{.02 \times 35}$$

CANCELLATION: $$T = \frac{\overset{.2}{\cancel{7.0}}}{.02 \times \underset{1}{\cancel{35}}} = \frac{.2}{.02} = 10$$

ANSWER: 10 minutes .



ALLOWABLE CUTTING SPEEDS - FEET PER MINUTE

Material to be Planed	MATERIAL IN TOOL			
	High-Speed Tool Steel		Carbon Tool Steel	
	Cutting Speed in Feet Per Minute			
	Roughing Cut	Finishing Cut *	Roughing Cut	Finishing Cut *
Aluminum	150	Max. Safe Speed	100	150
Brass	150	Max. Safe Speed	100	150
Bronze (Hard)	60	100	30	50
Cast Iron	60	100	30	50
Machine Steel	80	120	40	60
Annealed Tool Steel	50	60	25	35

* These cutting speeds are not recommended for wide finishing tools.

SELECTED REFERENCES

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Machine Tool Operation,
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Colvin & Stanley
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