CHAPTER 21

Driving, Starting and Stopping Mechanism

THE LINOTYPE MACHINE may be driven by various types of motive power, which are described herewith:

1. A belt from a convenient line shaft or other shaft which, preferably, has an independent source of power.

2. A belt from an individual electric motor mounted either in close proximity to the machine or on the frame of the machine itself.

3. By what has been proven the most satisfactory method, an individual motor mounted on the frame of the machine and having on its shaft a pinion which drives a large gear fastened to or forming part of driving pulley of machine.

It should be noted that, irrespective of the means selected for applying power to the driving pulley, that pulley, being belted to the intermediate shaft of the machine, supplies continuous power for assembling and distribution, as long as it turns, whether or not it is clutched to the driving shaft which is geared to the cam shaft of the machine.

The driving of the assembler and also of the distributor having been described in previous chapters, only the mechanism for driving the cam shaft and the control of that mechanism are described in this chapter.

Whatever source of power is employed, the inside diameter of the driving pulley, engaged by the clutch, and the outside belted to the intermediate shaft, are kept standard. It has been found best, under most conditions, to have the driving pulley make 72 revolutions per minute. The driving shaft, to which the pulley is connected by means of the clutch, is geared to the cam shaft so that 11 revolutions of the driving shaft cause the cam shaft to make one complete revolution, thereby allowing the machine to produce approximately 6½ lines per minute if the operator composes that quickly.

The inside circumference of the driving pulley rim is turned smooth and concentric with the bearing in the pulley hub so that the friction clutch, fastened to the driving shaft and having on it two friction shoes provided with leather buffers, may be forced in contact with the inside of the pulley rim so as to make the pulley and shaft revolve as a unit.

The driving shaft runs in bearings attached to the base of the machine. It is in two sections—the driving shaft to which the friction clutch is attached, and an extension carrying a pinion which engages the large gear on the cam shaft. The shaft and extension are pinned together to form one continuous shaft. The outer end of the shaft is hollow, and has in its end an adjustable screw bushing for regulating the strength of the spring which acts upon the clutch to drive the machine. This spring is held on the clutch rod inside the hollow end of the shaft, between the adjusting bushing and a collar pinned to the clutch rod. The outer end of the clutch rod is attached to friction link collar, which is part of clutch.

At about the center of the length of the driving shaft itself, there is a slot extending through the two sides which surround the hollow portion of the shaft.

Through this slot, which extends longitudinally in the shaft, is a screw passing also through the inner end of the clutch rod and connecting this rod to the driving shaft clutch flange which is adapted to slide on the outside of the driving shaft, and turn with the shaft, because of the long screw through the slot in the shaft. Close to one side of the clutch flange are the two prongs on the end of a forked lever which is operated, either automatically or manually, by mechanism described later in this chapter, to press against the sliding clutch flange in order to hold the clutch out of action.

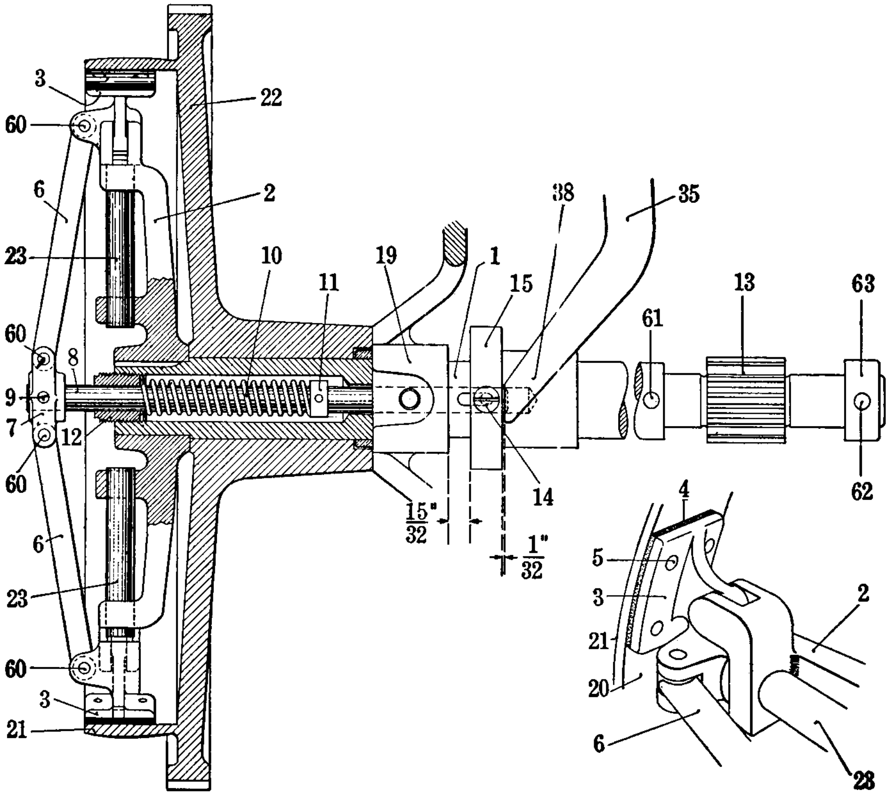

FIG. 1-21. View, partly in section, through the clutch end of the driving shaft. The driving shaft *1* has the friction clutch arm *2* keyed and clamped on its end. The friction shoes *3*, sliding in bearings on the clutch arm *2*, carry on their ends the leather buffers *4* held by the screws *5*. The friction shoes *3* are operated by a toggle composed of the links *6* and friction link collar *7*, held to the clutch rod *8* by the screw *9*, passing through a hole in the end of the rod *8*. The clutch rod *8* has around it the compression spring *10* confined between a collar *11* on the rod *8* and an adjusting bushing *12* threaded into the hollow end of the shaft *1*.

The clutch rod *8* has also at its end, beyond the collar *11*, a hole through which passes a long screw *14* which serves to connect the clutch rod *8* to the clutch flange *15*. The clutch flange *15* is slidable along the shaft *1*, because the screw *14* connecting it to the clutch rod *8* passes through a longitudinal slot which extends through both walls of the hollow end of the shaft *1*.

The sliding clutch flange *15* is operated to release the clutch by the operation of the forked end *38* of an automatic forked stop lever *35* pivoted on the base of the machine.

19 is a bearing attached to the machine base. When the clutch is engaged by pressure of the spring *10*, there should be $\frac{15}{32}''$ clearance between the end of the bearing *19* and the side of the clutch flange *15*, as shown. Also, the other side of the sliding clutch flange should clear the operating faces of the forked lever end *38*, by $\frac{1}{32}''$, as also shown.

It is readily understood that the $\frac{15}{32}''$ clearance depends upon the thickness of the leather buffers *4*, which tend to wear away gradually. After a long time the $\frac{15}{32}''$ clearance will increase and the $\frac{1}{32}''$ clearance will decrease; but, because it is very important that both of these dimensions should be maintained, they should be tested occasionally and, if necessary, the leather buffers *4* should be replaced in order to re-establish the $\frac{15}{32}''$ clearance, as specified. The adjustment for the $\frac{1}{32}''$ clearance between the other side of the clutch flange and the forked lever end is described later in this chapter.

The tension of the spring *10* which holds the clutch in engagement, is adjusted by the adjusting bushing *12*, and should be 16 pounds. This tension can be easily tested by hooking a balance spring on the toggle joint and pulling on the rod. The balance should register 16 pounds at the instant the sliding flange *15* begins to move.

As shown, the friction shoes of the clutch grip the inside surface *20* of the rim *21* of the driving pulley *22*, the outside surface of which serves to drive the intermediate shaft by means of a belt. The rim of the outside surface of the driving pulley carries a large gear which is driven by a small pinion on the shaft of the electric motor.

STARTING AND STOPPING MECHANISM

This mechanism is more easily understood if it is considered as a combination of three more or less distinct mechanisms.

The first mechanism to be described consists of those parts carried by the cam shaft, and which are acted upon by some other part of the machine, either to allow the clutch to engage or to prevent the clutch from disengaging; and, if not acted upon by some other part of the machine, they themselves act to throw out the clutch.

The action of the line delivery mechanism upon the automatic starting and stopping pawl has been described in Chapter 9. The action of the transfer slide mechanism upon the automatic safety pawl has been described in Chapter 17. Therefore it is necessary to show here only the correct settings of these two pawls with relation to a finished surface on the cam which carries both of them. The correct setting of the automatic starting and stopping pawl is shown in Fig. 3-21, and the correct setting of the automatic safety pawl is shown in Fig. 2-21. Each pawl bears ¼″ on the upper stopping lever when at rest.

The second mechanism to be described consists of the several levers which are acted upon by the automatic pawls in order to throw the clutch out of action. These parts are shown in Figs. 4, 5 and 6-21, and their actions detailed in the descriptions which accompany these figures.

As previously stated, and shown in Fig. 1-21, when the clutch is engaged, there should be $\frac{1}{32}''$ clearance between the end of the forked lever *35* and the sliding clutch flange *15*. This clearance is adjusted by means of the set screw *33*, Fig. 4-21, in the lower arm of the upper stopping lever *26*. And, because the forked lever *35* is loosely pivoted on the stud *36*, this adjustment may be made while keeping the other arm *37* of the lever *35* in contact with the lower end *39* of the lower stopping lever *27*; or by another method which gives practically the same result. That is, by holding the forked lever end *38* in contact with the sliding clutch flange and adjusting the screw *33* so that there is a clearance of $\frac{1}{32}''$ between the end *39* of the lower stopping lever *27* and the arm *37* of the forked lever *35*, as shown in

Fig. 5-21. Of course, the stopping levers *26* and *27* should hang down normally when testing the adjustment.

When the automatic starting and stopping pawl, or the automatic safety pawl comes to rest on the upper stopping lever *26*, it forces the adjusting screw *33* against the upper arm of the lower stopping lever *27*, and thereby forces the lower arm *39* of that lever against the arm *37* of the forked lever *35* so that the forked end *38* of that lever, acts against the sliding clutch flange to overcome the clutch rod spring which has been holding the clutch in engagement. Therefore, the clutch is disengaged, and the cam shaft is stopped.

The third mechanism to be described consists of those parts which are acted upon by the vise automatic in order to throw the clutch out of action, and those parts which are operated by hand in order to either throw the clutch out of action or to allow it to engage.

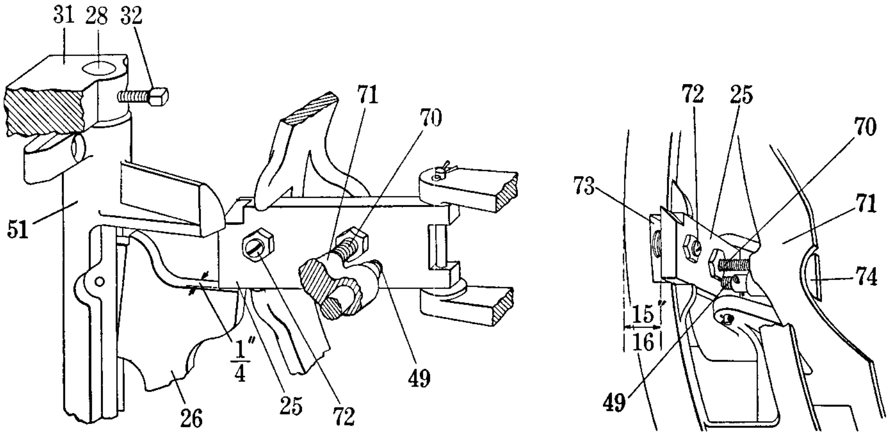

FIG. 2-21. View showing the automatic safety pawl setting with relation to the side of the delivery and elevator transfer cam which carries it, and showing also the relation of the pawl to the upper stopping lever when the pawl is stopped on that lever.

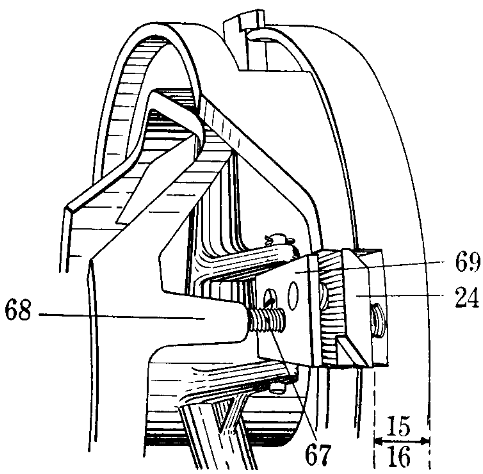

FIG. 3-21. View showing the automatic starting and stopping pawl setting with relation to the side of the delivery and elevator transfer cam which carries it.

Most of the parts comprising this mechanism are shown in Fig. 7-21, and the others in Figs. 4, 5 and 6-21.

The action of the mold disk dog upon the vise automatic rod is described in Chapter 10 and need not be repeated here, except to show how the lower end of the vise automatic rod, when pushed by the mold disk dog, pushes forward the short arm of the vise automatic stop lever, which has its fulcrum on the vise

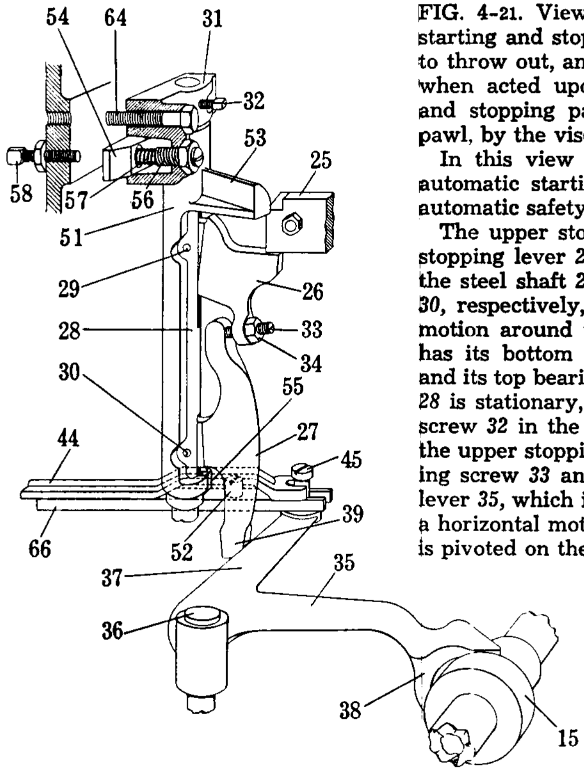

FIG. 4-21. View showing those parts of the starting and stopping mechanism which serve to throw out, and hold out, the driving clutch when acted upon by the automatic starting and stopping pawl, by the automatic safety pawl, by the vise automatic and by hand.

In this view *25* may represent either the automatic starting and stopping pawl or the automatic safety pawl.

The upper stopping lever *26* and the lower stopping lever *27* are mounted in slots cut in the steel shaft *28* on the fulcrum pins *29* and *30*, respectively, so that they have a limited motion around these pins. The steel shaft *28* has its bottom bearing in the machine base and its top bearing in the bracket *31*. The shaft *28* is stationary, being held tightly by the set screw *32* in the bracket *31*. The lower end of the upper stopping lever *26* carries the adjusting screw *33* and its lock nut *34*. The forked lever *35*, which is for the purpose of obtaining a horizontal motion from the levers *26* and *27*, is pivoted on the stud *36* on the machine base.

frame, and so causes the long arm of this lever to move toward the rear of the machine and push ahead of it the connecting bar which contacts a stud on the end of the straight arm of the forked lever and so releases the clutch.

The hand-operated mechanism is also shown and described.

Referring to Fig. 7-21, the pawl *41* on the vise automatic stop rod *40*, when pushed forward by the mold disk dog *42*, carries forward with it the lower end of the stop rod *40* which moves the left-hand end of the stop lever *43* toward the front and the right-hand end toward the rear of the machine. The stop lever *43* has its fulcrum on the vise frame.

The lever *43* pushes the connecting bar *44* also toward the rear. The rear end of the connecting bar *44* contacts the stud *45* on the end of the arm *37* of the forked lever *35*, and causes the forked arm *38* of this lever to move the sliding clutch flange *15* toward the right against the action of the clutch spring *10*, and so releases the clutch.

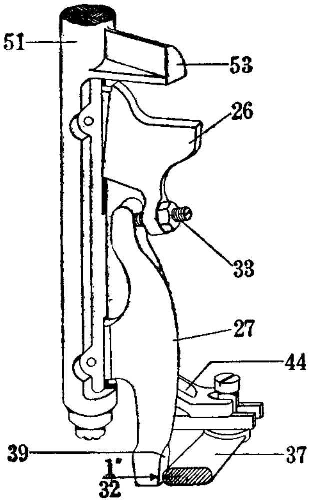

FIG. 5-21. Diagram of a portion of the starting mechanism showing the clearance between the lower end *39* of the lower stopping lever *27* and the arm *37* of the forked lever *35*.

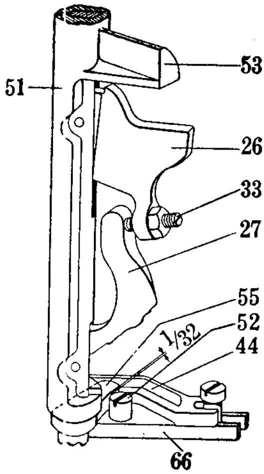

FIG. 6-21. Diagram of a portion of the starting mechanism showing the clearance between the arm *55* and the eccentric stud *52*, with the rod *66* in normal position.

Hand Operation

The starting and stopping lever *46* has the arm *47* to which the link *48* is attached. The other end of the link is attached to the connecting rod *66*. Because the lever *46* has its fulcrum on the bracket *50* which is fastened to the machine column and the parts are supported on the bracket *50*, this construction provides a toggle joint which is operated by hand to move the connecting rod *66* forward or backward. The rear end of the connecting rod *66* also contacts the stud *45* on the end of the arm *37* of the forked lever *35*. Therefore, when the connecting rod is pushed all the way toward the rear, by hand action, it operates to release the clutch in exactly the same manner as does the connecting bar when it is forced to the rear by action of the vise automatic stop rod.

When the starting and stopping lever handle is pushed all the way back it moves the toggle just enough past dead center so that the lever is automatically locked in that position, and remains so until pulled forward.

Stopping the machine is only one function of the starting and stopping lever. It is also used to start the machine by hand, and it must be automatically brought to, and held in a neutral position while the cam shaft turns.

When the starting and stopping lever is pulled all the way forward it allows the clutch to re-engage; but if either the automatic starting and stopping pawl or the automatic safety pawl is resting on the upper stopping lever *26*, the cam shaft cannot turn until the pawl is pushed off the top of the lever *26*. This action is through the operation of the vertical starting lever *51*. This lever is in action only when the machine is started by hand, and is operated by means of the eccentric stud *52*, carried by the connecting rod *66*, near its rear end.

The vertical starting lever *51* is an upright casting having at its upper and lower ends, bearings on the vertical starting lever shaft *28*. A web which partly surrounds the shaft *28* connects the two bearings. At the top of the vertical stopping lever, in line with its top bearing, are two lever arms *53* and *54* which are nearly at right angles to each other. At the bottom, in line with the bottom bearing, is an arm *55*, about in line with the arm *54* at the top, but extending in the other direction. The arm *54* at the top is hidden from view by bearing casting *31*.

The vertical starting lever *51* has a limited motion around the shaft *28*. On the bearing *31* is an adjusting screw *56*, around the point of which is a small compression spring *57* which bears against the lever arm *54* and holds it against a stop screw *58* in the web of the machine column on the other side of the lever arm *54* in line with the spring *57*.

When the starting and stopping lever *46* is pulled all the way out, the eccentric stud *52* on the connecting rod *66* engages the lower lever arm *55* of the vertical lever and causes the upper lever arm *53* to push from the top of the upper stopping lever *26* whichever automatic pawl happens to be resting on it. Having, at the same time, allowed the clutch to engage, the cam shaft is free to turn.

The side of the upper lever arm *53* which strikes the automatic pawls is beveled and rounded so that in case it should be moved into the path of either automatic pawl just before the pawl reaches the upper stopping lever *26*, while cam shaft is turning, the pawl will be cammed over, and cam shaft will continue to turn.

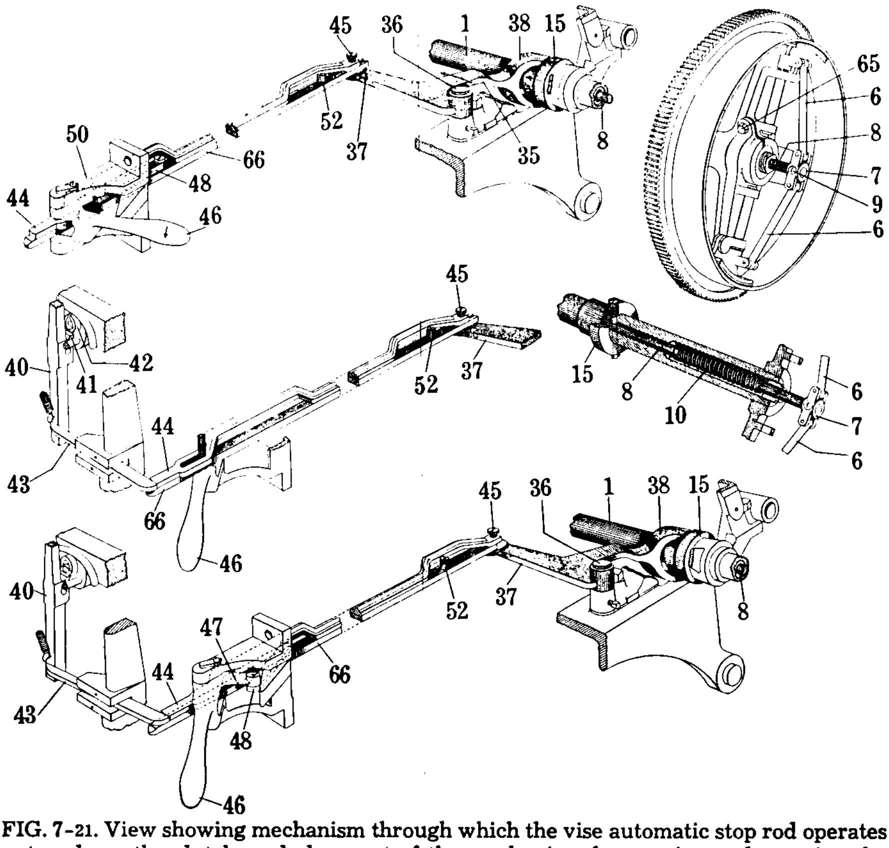

FIG. 7-21. View showing mechanism through which the vise automatic stop rod operates to release the clutch, and also most of the mechanism for starting and stopping the cam shaft by hand.

Adjustments

Both pawls are adjusted to be $\frac{15}{16}''$ from face of cam, as shown in Figs. 2 and 3-21, and each is normally held against its stop by a small compression coil spring.

For this adjustment of the stopping pawl *24*, that pawl carries the screw *67* with its lock nut. The screw *67* stops against the lug *68* on the cam casting. For the similar adjustment of the safety pawl *25*, that pawl carries the screw *70* with its lock nut. The screw *70* stops against the lug *71* on the cam casting.

Having been so adjusted, each pawl when stopped by the upper stopping lever *26*, will rest ¼″ on the top surface of that lever which has been located sidewise by the squared end of the set screw *32* in the bracket *31* against a flat surface on the vertical shaft *28* which carries the stopping levers *26* and *27*.

No stop on the cam is required to limit the movement of the stopping pawl *24* when pushed off the stopping lever *26* either by action of the line delivery slide or by manual action. The line delivery slide itself is stopped by a set screw in a bracket on the face plate frame, and the vertical lever *51*, operated only by hand, is stopped by its lever arm *54* against the adjusting screw *56* in the vertical shaft bearing bracket *31*. The screw *56* is adjusted to allow the lever arm *53* of the vertical lever *51* to push either of the pawls *24* or *25* to clear the upper stopping lever *26* by $\frac{1}{16}''$. The lever arm *53* of the vertical lever *51* is held normally $\frac{1}{64}''$ away from the pawls *24* and *25* by the action of the coil spring *57* holding the lever arm *54* against the adjusting screw *58* in the machine column. The spring *57* not only returns the vertical lever to this position after it has been operated, but it also causes the starting and stopping lever *46* to be returned a short distance to its normal or operating position. The eccentric stud *52* on the connecting rod *66* should be adjusted so that when the lever *46* is pulled all the way forward the arm *54* of the vertical lever *51* is against its adjusting screw *56*. The eccentric stud *52* when so adjusted will clear the lower lever arm *55* of the vertical lever *51* by $\frac{1}{32}''$ when the starting and stopping lever is in normal position.

A stop on the cam casting is required to limit the movement of the safety pawl *25* when pushed off the upper stopping lever *26* because that stop in conjunction with adjusting screw *49* for the safety pawl buffer *74* controls the travel of the transfer slide on its first stroke. To provide an adjustable stop for this purpose the safety pawl *25* carries the screw *72* with its lock nut. The screw *72* stops against the surface *73* on the cam casting, and is adjusted to allow the safety pawl *25* to clear the upper stopping lever *26* by $\frac{1}{16}''$. The screw *49* should not be adjusted until after the screws *70* and *72* have been adjusted. It should then be adjusted so that when the screw *72* is against its stop *73*, the cut in the delivery slide finger comes just flush with the right-hand end of the first elevator back jaw when the transfer slide is all the way over to the right.

When this adjustment is correct, the matrices in a 30-em line will not be forced against the second elevator delivery pawl.

MAINTENANCE

Removing the Driving Shaft—Fig. 1-21 shows a sectional view of the driving shaft, and also the pinion driving gear *13*. If this gear becomes worn it should be replaced, otherwise it will impart an uneven motion to the main cam shaft.

To replace this gear it will be necessary to remove the driving shaft. First take out the screw *9* which holds the toggle link collar *7* to the clutch rod *8*. Then loosen the binding screw *65*, Fig. 7-21, in the friction clutch arm *2* and slide the arm off the driving shaft. Then unscrew the threaded bushing *12*, which will release the spring *10*.

It will also be necessary to disconnect the flange *15*. This is held in place by a screw *14* which passes through a slot in the driving shaft, and also through a hole in the end of the clutch rod *8*. Before the screw *14* can be taken out, a cotter pin in its end must be removed. Drive out the tapered pin *61* and force the driving shaft away from the pinion gear *13*. If the shaft is hard to loosen, soak with kerosene before driving apart with a pig of type metal. Remove the tapered pin *62* from the collar *63* and the pinion gear will slide out.

When the driving shaft is reassembled, connect the pinion gear to the driving shaft before fastening the end collar *63*. Have the machine in normal position and fasten the friction clutch arm temporarily to the driving shaft. When the pinion gear is meshed with the main driving gear, see that the friction clutch arm is parallel with floor. If clutch arm should be in a vertical position when machine comes to rest, it will cause friction and excessive wear on one clutch leather.

When shaft is in correct position fasten the collar *63* and put screw *14* through the flange *15*, making sure that the screw passes through the hole in the end of the clutch rod *8*. Replace compression spring and turn adjustable bushing into place.

Do not use belt grease, rosin or dressing of any kind on the clutch leathers to make them pull. If the clutch slips, it may be that the rollers on the justification levers do not turn freely on their pins, or perhaps the main bearings of the cam shaft are gummy or not properly lubricated. If the main shaft does not turn freely run a wire through the grease cup and pour kerosene into the opening made. This will remove any gummy substance which may have collected; then follow up with machine oil. Grease cup should then be filled and its cap screwed into place.

If the compression spring should become too weak to pull the machine, it is best to replace it with a new one. In case of emergency, the old one may be stretched—be careful to get the same amount of spread between each coil.

The Friction Clutch Arm—There are four ¼″ pins *60*, Fig. 1-21, where the toggle links *6* are connected to the friction shoes *3* and the link collar *7*. If these pins are worn, they should be replaced; otherwise the clutch leathers will have to be thicker than the regular size to give the proper $\frac{15}{32}$″ clearance between the flange *15* and the edge of the bearing *19*. The rods *23* on the friction shoes *3* should receive a small amount of oil. This will allow the clutch to expand evenly.

Clutch Collar Clearance—This clearance is shown in Fig. 1-21. Before this measurement is taken, shut off the power, turn the cam shaft backward and pull out on the starting lever *46*. Then measure the distance between the flange *15* and the bearing *19*.

Friction Clutch Leathers—If the various parts of the friction clutch arm *2* are not worn, the approximate thickness of the leather buffers should be about .125″; but if the $\frac{15}{32}$″ clearance before mentioned cannot be obtained using leathers of that thickness, it may be necessary to put thin strips of cardboard between the leathers and the ends of the shoes *3* to which they are fastened.

In Chapter 2 of this book, mention was made of a circular wire brush for cleaning matrices. This wire brush can also be used to advantage in cleaning the clutch leathers. It leaves a good gripping surface and removes very little from the body of the leathers. The leathers can also be cleaned by scraping with a knife or by rubbing the surface with coarse sandpaper.

The use of home-made leathers is not recommended. The leathers furnished by the Linotype Company are of the correct material and proper thickness.

After new clutch leathers have been put on, it is advisable to check the vise automatic to see that the adjustment has not been changed. Instructions for making this adjustment are given in Chapter 10.

Driving Pulley—The inside rim *20* of the driving pulley *22*, Fig. 1-21, must be kept clean, and the clutch leathers must be dry and free from gum. Also see that the heads of the screws *5* in the leathers *4* are below the surface of the leather, so they cannot come in contact with the inside surface of the driving pulley.

The pulley must turn freely on the driving shaft. There is a grease cup on the hub of the pulley and this should be turned down occasionally to lubricate the driving shaft. Do not use an excessive amount of grease as it might get on the friction clutch leathers and cause them to slip.

The Vertical Lever—Fig. 4-21 shows the details of the vertical lever, and it may be removed as a unit for inspection or repairs.

To remove the vertical lever from the machine, push in on the starting lever *46*, and turn the main cam shaft backward a short distance, then remove the upper bracket screw *64*, and the entire unit may be lifted out.

If necessary to replace either the upper stopping lever *26* or the lower stopping lever *27*, loosen the set screw *32* in the upper bracket *31*. Then the rod *28* with the stopping levers may be passed through a slot in the bottom of the vertical starting lever *51*. The stopping levers *26* and *27* are fastened to the shaft *28* with the fulcrum pins *29* and *30*. If these pins become worn they should be replaced to take up the side play of the stopping pawls so that a closer setting may be made on the automatic starting and stopping pawls.

As shown, *56* is an adjusting screw, and on its end there is a spring *57* which holds the vertical lever lug against the stop screw *58*.

When a line is being recast the eccentric screw *52* is brought in contact with the lower arm *55* of the vertical lever *51*, and forces the automatic starting and stopping pawl *25* from the stopping lever *26* to allow the clutch to come into operation. The spring *57* must be of sufficient strength to bring the vertical lever into place when the pressure is released from the starting lever handle.

The end of the adjusting screw *33*, where it comes in contact with the lower stopping lever *27*, should be well lubricated, as there is a sliding movement at this point each time the machine comes to normal position. The adjustment for the $\frac{1}{32}''$ clearance on the forked lever is made with the adjusting screw *33*.

Testing Clearance of Forked Levers—To make this test, shut off power, turn the cam shaft backward, pull out the starting lever handle, and see if the lower stopping lever *27* is free to be moved slightly where it rests against the arm *37* of lever 35, Fig. 4-21. If it binds against this lever, loosen the adjusting screw *33* until there is a slight shake to the stopping lever *27*.

If there is too much clearance, tighten the set screw *33*; otherwise the machine will have a tendency to slightly overrun when it comes to normal position.

Failure of Clutch to Disengage—It sometimes happens that the machine will "run away," that is, the main cam shaft will not stop when the machine comes to normal stopping position, due to failure of the clutch to disengage, especially after the starting lever handle has been pulled out to recast a line.

The following conditions may be responsible if this should happen: The spring *57* which returns the vertical lever to its position may be broken or too weak. Metal chips may have collected between the starting lever handle link and the connecting rod, causing it to bind; or the lever may not be free in its bearings. The inside rim of the driving pulley may be sticky, and there may be gum on the clutch leathers. Driving pulley may not be free on the driving shaft due to insufficient lubrication. It is also possible that the upper edge of stopping lever *26* has become rounded where it comes in contact with automatic starting pawl.