III. Casting Mechanism

THE third general division of the Linotype machine is the casting mechanism. We have followed thus far the path of the matrices and the spacebands until they are assembled in the assembler elevator. They must now be transferred to the casting mechanism and a slug, or Linotype bar, cast from the line of matrices.

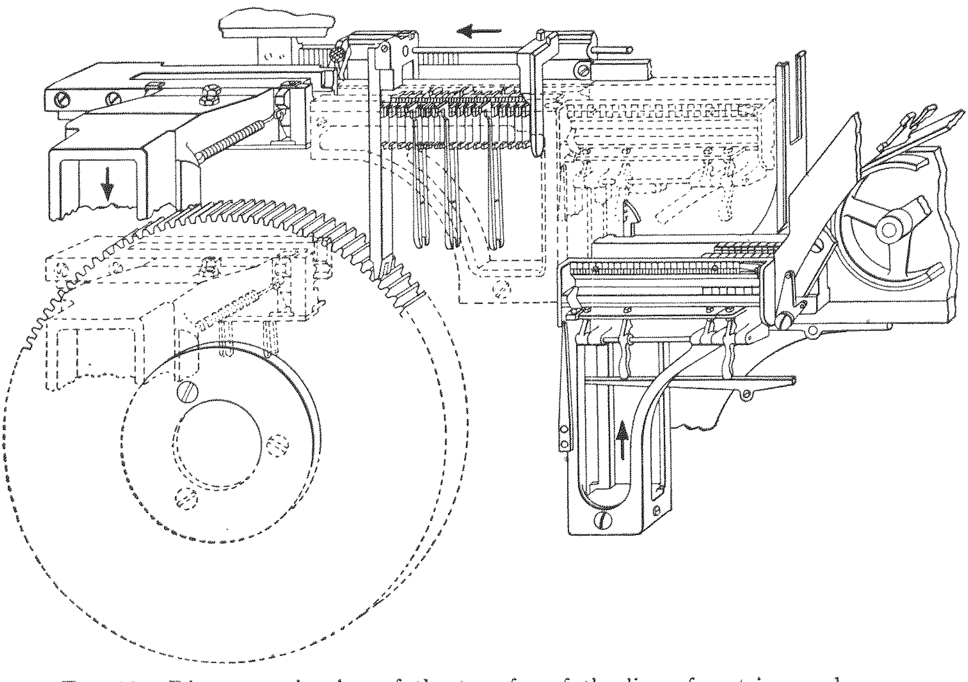

FIG. 33.—Diagrammatic view of the transfer of the line of matrices and spacebands from the assembling elevator to the first-elevator jaw to the position to cast. In this view is shown a part of a line of matrices assembled in the assembler stick. The dotted lines show a line raised to the delivery channel, a line passing through into the first-elevator jaw is shown in full lines, and in dotted lines the first-elevator jaw having descended in front of the mold and the mold disk.

To effect this transfer the assembler elevator is lifted a distance of about four inches. This brings the assembled line of matrices and spacebands between two fingers, one called "the long finger," and the other "the short finger." The long and short fingers are mounted upon a sliding mechanism commonly called the "line delivery slide" or the "line delivery carriage." This sliding mechanism is mounted in the face plate. The delivery carriage and the two fingers are clearly shown in perspective in Fig. 34. In this mechanism there is a bar having teeth cut in it one em apart. The two fingers are mounted on the bar; the short finger is fast, the long finger is adjustable. The ends of this bar are fastened to two blocks. These blocks have beveled edges and are adapted to slide in two grooves milled in the face plate. On the left-hand side of the long finger there is a small

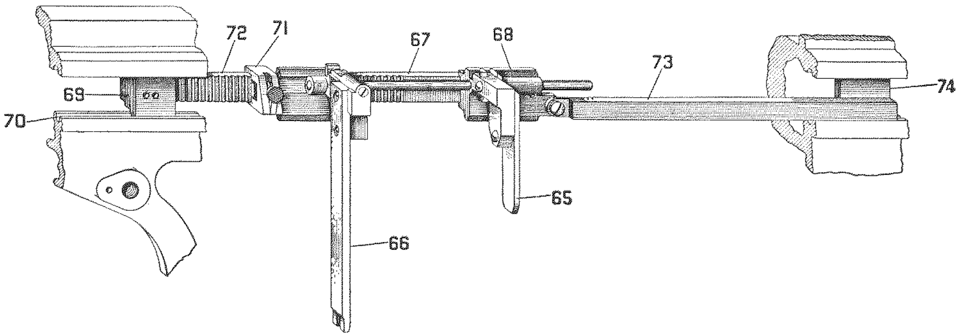

FIG. 34.—Perspective view of the delivery carriage. *65* is the short finger and *66* the long finger. The long and short fingers are mounted upon short slides *68* and *69*, which run in a groove in the face plate. The two ends of slides *68* and *69* are fitted to move easily in the groove *70* in the face plate. *71* is a small locking device adapted to fit in the grooves *72* and the slide *67*. These grooves *72* are one em apart. The long finger *66* can be adjusted for any length of line by this locking device *71*.

At the right of the view is shown assembling elevator releasing bar, commonly called "trail", consisting of bar *73* and a slide at the right *74* to guide the bar *73*. When slide finger *65* transfers the last matrix on right of line to and on delivery channel rails, the left-hand end of bar *73* trips the hook that holds the assembling elevator in position when the line is being transferred to delivery channel. The bar *73* also prevents an operator from hooking up the assembling elevator when there is a waiting line in the delivery channel.

locking mechanism, which is shown at *71* in Fig. 34. The projecting lug in the locking mechanism can be adjusted by picas along the notched bar. Between the long and short fingers there is a round rod that supports the long finger. The short finger is never adjusted, as the line always begins at the same place, but the long finger is adjusted to different lengths of line by the locking mechanism above mentioned.

The delivery carriage is connected on its back side to a lever through a link with a spring detachable detent, as shown in Fig. 36. The action of this lever is shown in Fig. 78. The lever *153* is urged to the left (as the operator faces the machine) by a spring *162*. Mounted on the carriage is a pawl detent having two teeth upon it. These teeth, shown in Fig. 35, are made so as to register with a lever having teeth in its end, which lever is mounted on the face plate. Mounted on the assembling elevator is a wire, or rod, which is adapted to strike the toothed lever, as shown in Fig. 35, and disengage it from the fixed teeth on the carriage. The instant this is done the spring *162*, acting upon the lever *153* through the link, drives the delivery carriage to the left into the first-elevator jaw. This action of the spring is instantaneous, and would cause a pounding action were it not prevented by a dash pot, shown in Fig. 78. The dash pot consists of a cylinder, open at one end, and a piston adapted to slide in the cylinder. The piston is connected by a link and arm to shaft *154*. The piston in this dash pot compresses the air as the delivery carriage is driven over, forcing

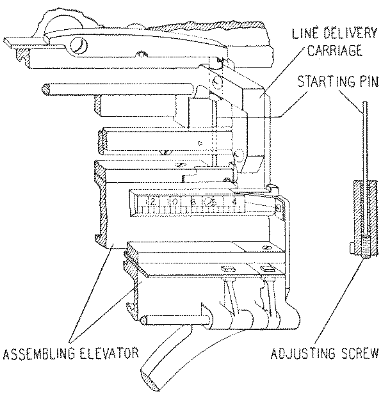

FIG. 35.—View showing the line-delivery carriage, the starting pin in a separate view, and the way in which the starting pin trips the latch, allowing the transfer carriage to transfer the line from the intermediate channel into the first elevator jaw.

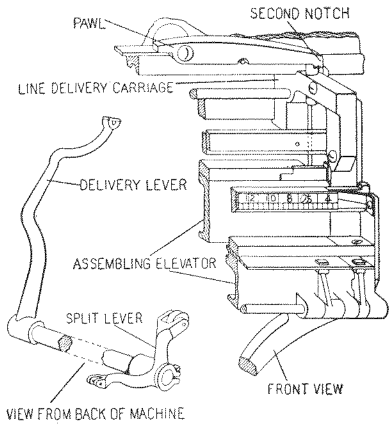

FIG. 36.—Diagram showing the parts of the transfer carriage, starting pin, assembling elevator and delivery lever in a separate view, showing how the line is carried over by said lever into the first-elevator jaw.

the air out through a small hole in the closed end of the cylinder. This cushions the blow of the delivery carriage so that it glides into the first-elevator jaw, coming to a stop gradually and smoothly. There is a little washer, shown at *163* in Fig. 78, that regulates the size of the hole in the cylinder through which the air escapes, as previously described. By adjusting this so as to make the hole larger or smaller, the escape of the air is controlled so as to obtain the proper cushion effect of the action of the spring on the delivery carriage.

The arm *153*, previously described, is pinned upon the shaft *154* in such a position that when the line of matrices has been carried just inside of the first-elevator jaws, the roll *157* will strike the starting pawl and throw it off sidewise, thereby starting the main cam shaft. The arm *155* with its roll *157* is clamped upon the shaft *154* in its proper position when the machine leaves the factory, and it is seldom necessary to adjust this, because it very seldom slips upon the shaft. If it should do this, however, it may be reset in the following manner. While the machine is standing still, the delivery carriage should be allowed to go over until the short finger *66* is just inside of the pawls of the first elevator. The arm *153* on the shaft *154* should then be turned over until the roll *157* just strikes the starting pawl and moves it off the automatic stopping lever *159*. Then the bolts in the sleeve should be clamped down tightly. This adjustment is seldom necessary.

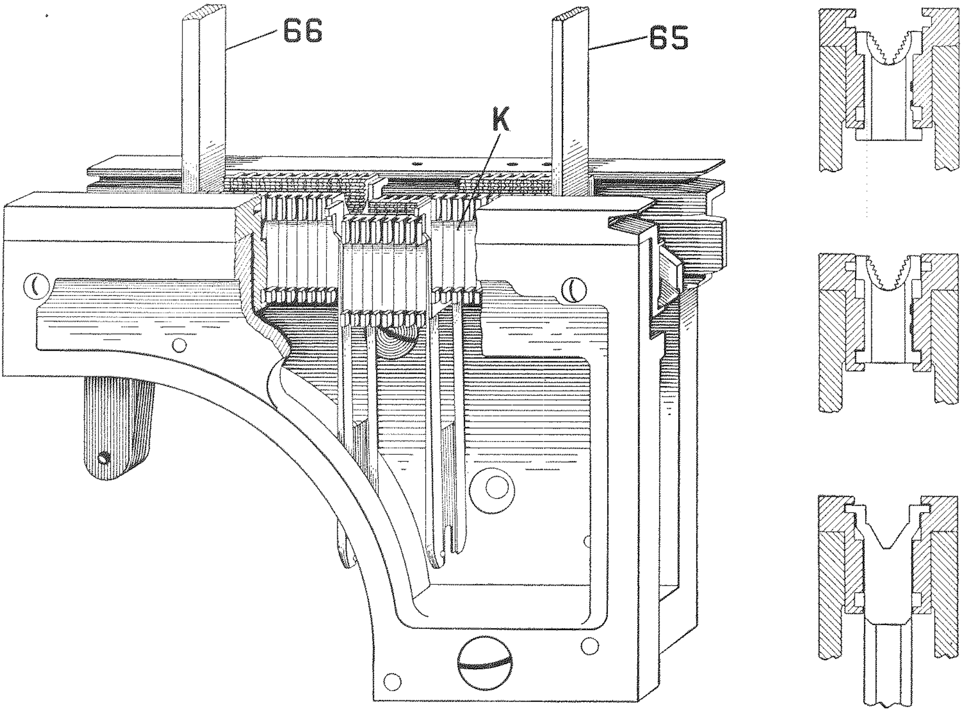

FIG. 37.—View of the intermediate channel with part of the channel cut away to show the matrices and spacebands in the different positions. This channel is simply a passageway for the matrices from the assembling elevator to the first-elevator jaw. The rails in the delivery channel are designed to support the matrices in the same position in which they are received from the assembler.

The sectional views at the right show how the matrices and spacebands are supported while passing through the intermediate channel.

INTERMEDIATE CHANNEL

The distance that the line of matrices travels to the first-elevator jaw is about nine inches, and as they pass out of the assembler into the intermediate channel two grooves in the intermediate channel register with the assembler in such a way that the lower ears of the matrices, which may be either in the upper or lower position in the assembler, are sustained in their corresponding positions while passing through the intermediate channel until they arrive in the first-elevator jaw, shown in Fig. 37.

Just as the delivery carriage reaches the end of its motion in the first-elevator jaw, the lever *153*, actuated by the spring *162*, strikes upon the pawl mounted in the cam, which, being tripped, engages the clutch on the cam shaft, causing it to make one full revolution before it stops in the pawl again.

Returning to the assembled line of the matrices and spacebands, the transfer of the line of matrices and spacebands, which has been mentioned before, is shown in diagrammatic form in Fig. 33.

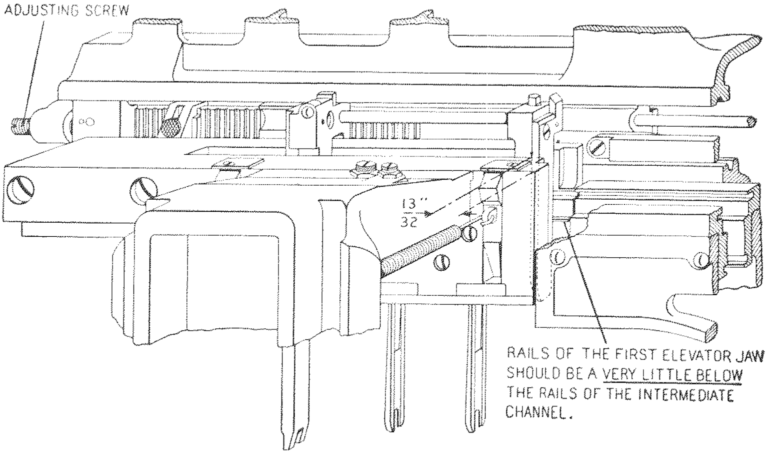

FIG. 38.—View showing the relation of the rails in the first-elevator jaws with the rails, or grooves, in the delivery channel, and the adjusting screws for same.

In Fig. 33 the assembler is shown in heavy lines in the normal position. Its upper position is shown in dotted lines. The line of matrices passing through the delivery channel is shown in full lines, and the first-elevator jaw in its normal position is shown in full lines, while in the lower or casting posittion it is shown in dotted lines. This transfer of the matrices should be smooth without pounding.

The line of matrices, as previously mentioned, passes into the first-elevator jaw. The first-elevator jaw is built up of two pieces called "the front and back jaws" and a middle piece called the separating block. These three parts are bolted together at the left-hand end, and the front jaw is bolted to the first-elevator slide, as shown in Fig. 39, leaving the right-hand end of the jaw open. At the right-hand, or open, end of the first-elevator jaw there are two small spring pawls *49*, which are bent outward by the incoming line of matrices and spacebands and allow the line to pass through, but spring back as soon as the short finger of the transfer carriage has entered the jaw. These pawls prevent the matrices from falling backward out of the jaw during the movements of the first-elevator slide. The first-elevator jaw contains rails that register with and support the ears of the incoming matrices so as to maintain them in the upper or lower position of a two-letter matrix. One of these rails is fixed and the other movable. The first-elevator jaw contains also grooves with which the ears of the spacebands register, the ears of the spacebands being somewhat wider than the ears of the matrices. The short part, the wedge or sleeve, of the spaceband is held by these ears, so that when the long

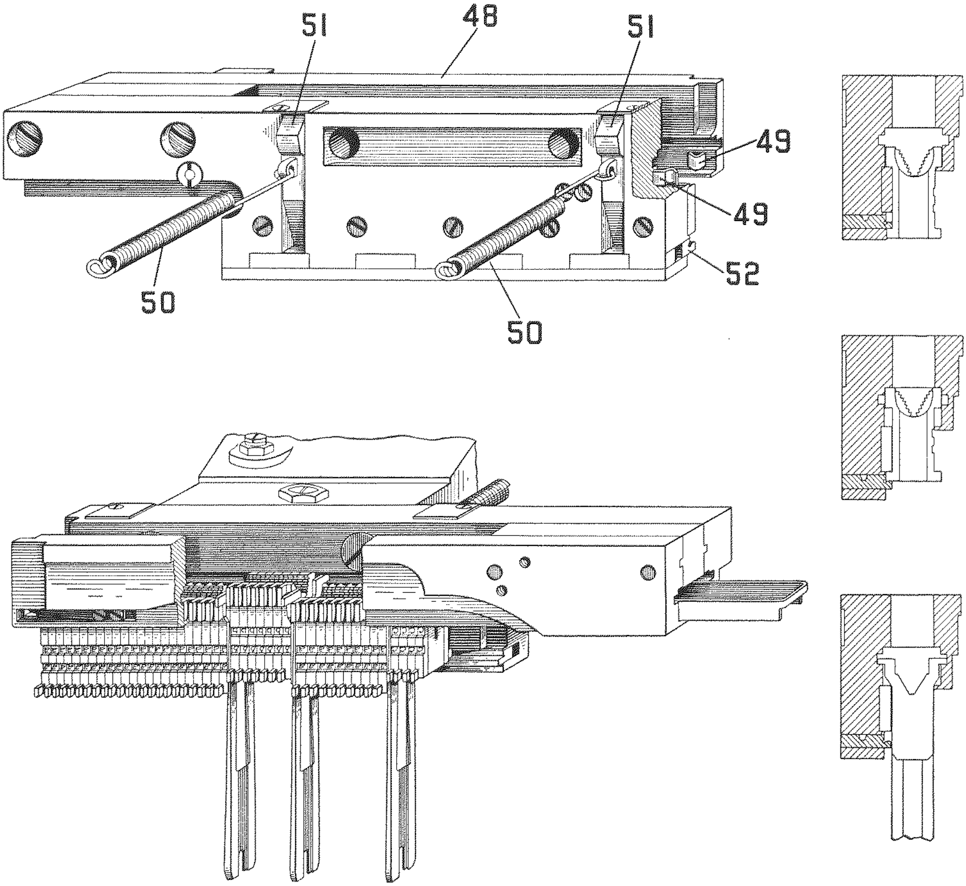

FIG. 39.—Front view of the first-elevator jaw. The lower figure is a view of this jaw from the rear of the machine, with the jaw partly broken away to show the different positions of the matrices and spacebands. *50-50* are the springs which return the shelf, called the duplex rail, upon which the matrices stand. *51-51* are the levers which move the shelf *52* in or out of position. The shelf *52* sustains the matrices which are in the italic, or upper, position until the matrices are to be distributed. When, through the levers *51*, the shelf is withdrawn, it allows all the matrices to drop to the lower, or roman, position, so that they may pass into the upper channel and onto the second elevator for distribution.

The sectional views shown at the right illustrate the matrix in the lower and upper, also called the regular and auxiliary, positions, and the spaceband, having ears wider than the matrix, running in the proper groove.

wedges or slides are driven up for justification, the wedge or sleeve part of the spaceband does not move.

The elevator jaws are fastened by screws to the first-elevator slide. The elevator slide is a long casting running in gibs mounted on the vise frame, as shown in Fig. 42. At the lower end of this slide there is a link composed of a cylinder with a piston and a spring inside of the cylinder, as shown in Fig. 40. The spring can be compressed slightly between the piston and the end of the cylinder. The lower end of this link is connected

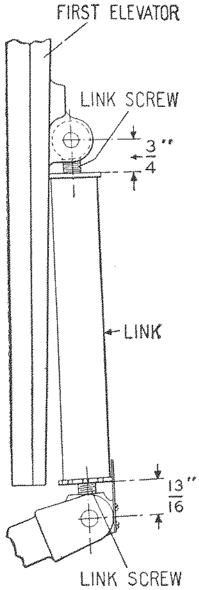

Fig. 40.—Diagram showing the link which connects the first-elevator lever to the first-elevator slide and gives the distances for adjustment, which ordinarily are right in the machine when first set up.

by a pin to a long lever running to the rear of the machine. This lever connects with another lever called the first elevator auxiliary lever, which has mounted upon it a roll adapted to engage a cam. The cam through the levers raises the first elevator at the proper time and the reverse motion is caused by gravity and a spring, as shown in Fig. 84. The alignment of the matrices is made by this cam and lever.

When the main cam shaft begins to revolve, after the starting pawl is tripped off by the delivery carriage (as shown in Fig. 36), the revolution of the cam shaft allows the first-elevator slide to descend, carrying with it the first-elevator jaw, in which is a line of matrices. This descent is about four inches. The first-elevator jaw settles down upon the vise cap in such a position that the lower, or small, ears of the matrices will register with one of the two grooves in the mold if the line has matrices in both the italic and roman position. This descent of the elevator slide is caused by the weight of the slide, and is permitted by the shape of the cam, as shown in Fig. 84.

It is very important that the first-elevator jaw should descend to exactly the right position in the vise, so that when the mold is advanced the lower ears of the matrix may enter the grooves of the mold. If for any reason the elevator slide should not descend to the proper position, when the mold comes forward it would smash or cut the ears of the matrices, because the ears do not enter the grooves in the mold. While this failure of the first-elevator slide to descend to the proper position does not very often happen, it is necessary to provide a device to prevent damage to the

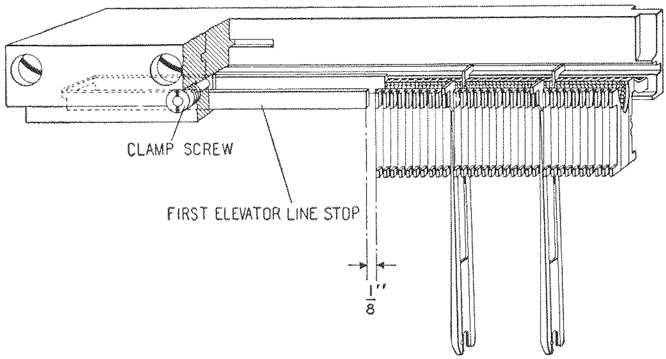

Fig. 41.—View of the inside of the first-elevator jaw, which is toward the mold, showing a line of matrices in position, and showing the first-elevator line stop and clamp screw for same.

matrices and the machine in case of this failure to descend. This device is called the "vise automatic." It consists of a vertical rod passing through a hole in the vise cap. The upper end of this rod is directly under an adjustable screw in the first-elevator slide, so that when the first-elevator slide descends it pushes the rod downward a short distance, about one thirty-second of an inch. Mounted on this rod is a projecting piece of steel with a sharp edge, as shown in Fig. 42. Mounted in the vise frame is a plunger called the "vise-automatic mold disk stop dog," as shown in Fig. 43. When the mold disk comes forward it presses the plunger forward in its guide, and if this comes in contact with the sharp edge, previously mentioned, it carries the vise-automatic rod toward the front of the machine. The lower end of the vise-automatic rod connects with a short lever which in turn operates through a series of levers to release the clutch, so that the cam shaft stops. This is clearly shown in diagrammatic form in Fig. 85.

Ordinarily, the descending first-elevator slide, coming down upon the vise-automatic rod, pushes the sharp edge downward so that the plunger operated by the advancing mold disk will just pass over it, as shown in Fig. 85. This clearance should be quite small, never more than one sixty-fourth of an inch. If the first-elevator jaw comes within one sixty-fourth of an inch of the proper position, the ears of the matrices will not be

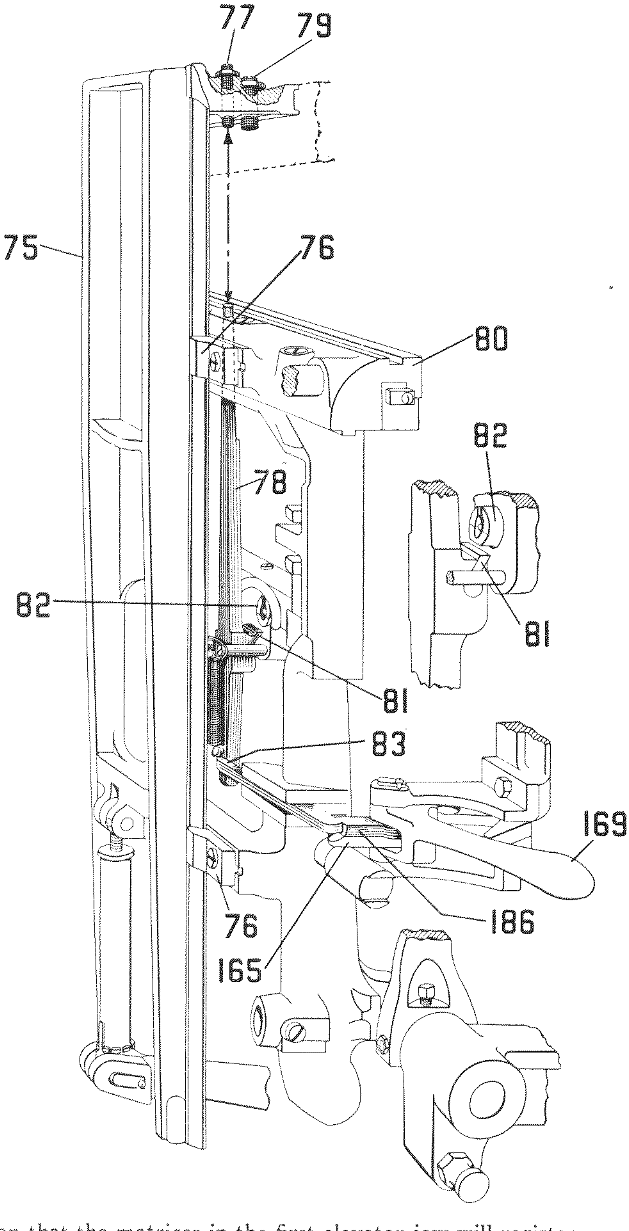

FIG. 42. — View of the first elevator and its connection. The first-elevator slide *75* is a long casting which rides in gibs *76* upon the vise frame. Mounted in the top of the slide *75* is the screw *77*, which, when the slide descends, strikes directly upon the vise automatic lever *78*. This screw is adjustable so as to depress the lever *78* to a greater or less extent. *79* is the stop screw, also mounted in the head of the slide *75*, and which strikes upon the vise cap *80*. This screw is also adjustable and limits the downward movement of the first-elevator slide *75*.

When the screw *79* strikes upon the vise cap *80* and stops the downward movement of the slide, the screw *77* should depress the lever *78* so that the blade *81* will come just below the edge of the plunger *82*. The plunger *82* is pressed forward by the mold disk, and if the blade *81* is not below the plunger *82*, the plunger *82*, striking the blade *81*, will push the lever *78* toward the front of the machine and, striking against the lever *83*, will operate the lever *186*, which will throw out the clutch, as explained in another view, and stop the revolution of the cam shaft.

In making the adjustments above described, the screw *79* should stop the slide *75* in such a position that the matrices in the first-elevator jaw will register with the groove in the advancing mold. As previously mentioned, at this time the screw *77* should have depressed the lever *78* so as to bring the blade *81* about fifteen thousandths of an inch below the dog *82*. The space between the blade *81* and lip of the dog *82* should be the thickness of thin cardboard or a thick sheet of writing paper.

damaged. The descent of the elevator slide and the register of the matrices with the mold is controlled by an adjustable stop consisting of a screw and nut in the elevator slide, as shown at *79* in Fig. 42. This adjustable stop, when once properly set, never needs adjustment, and should not be touched, except when it is jarred loose by accident. The proper setting of this stop, however, is very important in relation to the vise automatic, for

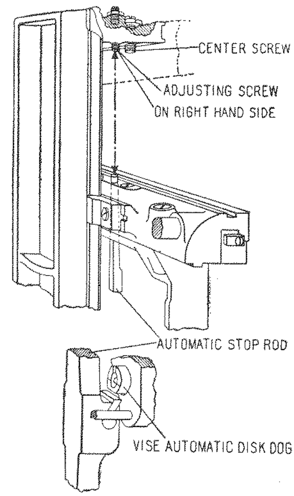

Fig. 43.—View of stop screw and adjusting screw for the automatic stop rod, showing vise-automatic disk dog just passing over the lip on the automatic stop rod.

if the elevator jaw is not in proper position the ears of the matrices will not register with the grooves in the mold, and there will be trouble. When the vise automatic is properly set, however, it is almost impossible for the machine to damage the ears of the matrices.

In case the elevator slide does not descend to the proper distance and the plunger operated by the advancing mold disk stops the machine, as previously described, it is necessary for the operator to turn the cam shaft of the machine backward slightly by hand and find out why the first-elevator jaw has not come down to its proper position. This is usually caused by a tight line.

A tight line is one where the matrices and spacebands make the line a little too long to descend between the jaws that limit the length of the line.

It is possible for the operator, by pushing downward upon the first-elevator slide, to crowd the line through if it is only very slightly too long. This is a bad practice, and does great damage to the matrices and to the machine. It is much better to remove a matrix or two from the line, which can be done by lifting up the first-elevator slide, removing a matrix, and then allowing the line to cast. Of course this slug has to be thrown away and the line reset properly.

The first-elevator slide in its descent carries down the roll *295* mounted on a small bracket *296*, as shown in Fig. *44*. This roll *295* strikes a peculiarly shaped lever *294*, which, working through the link *292*, causes the knife wiper *290* to rise and fall, and thereby wipes off the small shavings that sometimes stick on the edge of the knife. This actual wiping is done

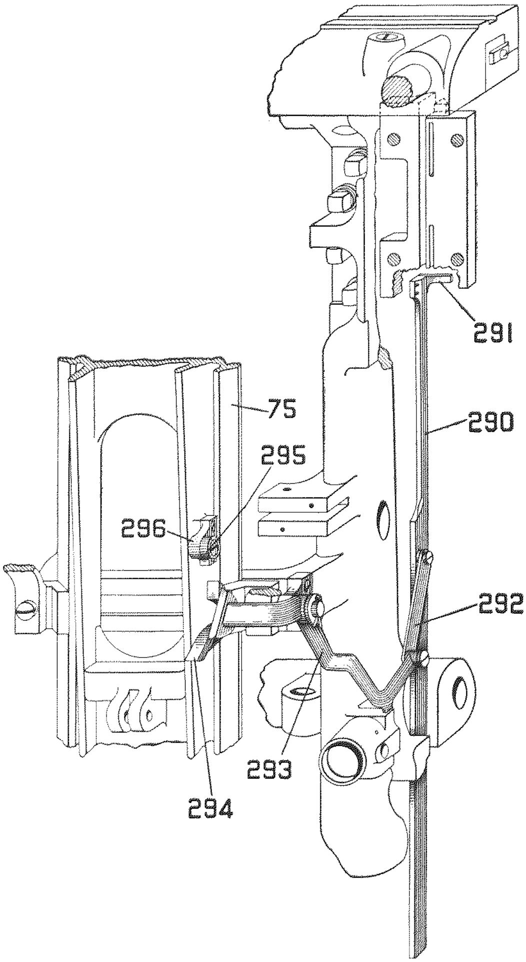

Fig. 44. — View of the knife wiper and its operating mechanism. *290* is a bar mounted to move up and down vertically, called the knife wiper bar. This bar *290* carries on its end a small lug, or projection, *291*, made out of thin brass. This projection *291* passes by the edge of the knives and wipes off the shavings that may have adhered to the sharp edges of the knives.

The lever *290* is caused to make its vertical motion through a link *292*, and a lever *293*, which is mounted on the vise frame. The other end of the lever *293* has a peculiar cam shape at its end *294*. This peculiar cam shape is adapted to engage with a roller *295*, which is mounted on a little bracket *296*, which is in turn mounted on the first-elevator slide.

As the first-elevator slide moves downward and upward, it engages with the peculiar cam shape *294*, causing the lever *290* to make the movement before mentioned. The shape of this cam *294* is such that the roller *295* can pass by it both in its upward and downward motion.

by a little brass piece *291*. This is made thin so that if it ever gets caught in the knives it will be sheared off and then must be renewed.

The line of matrices and spacebands is now between the right- and left-hand vise jaws. The first-elevator slide is resting upon the vise cap, and the automatic rod has been pushed down so as to allow the plunger to come forward over the blade. At this time the justification of the line takes place. The line of matrices and spacebands should always occupy a little less space than the distance between the right- and left-hand vise jaws. This slack in the line which varies constantly on different lines, must now be taken up by driving up the slides, or long wedges, in the spacebands. This is done by a block, shown at 86 in Fig. 45, mounted on two vertical rods in the vise frame. The lower ends of these two rods rest upon the ends of long levers that run back to the cam shaft. Underneath

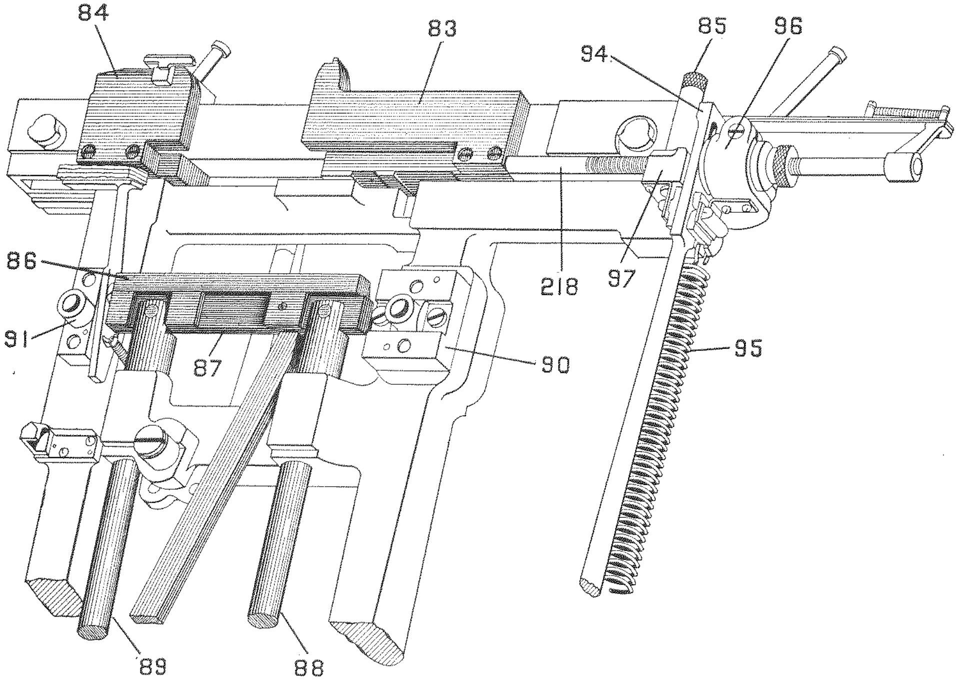

Fig. 45.—Inside view of the vise frame, or a view looking down upon the vise frame when it is lowered to second position. *83* is the left-hand vise jaw, and *84* is the right-hand vise jaw. The right-hand jaw *84* has only a slight movement to operate the pump stop elsewhere described. The left-hand jaw *83* may be set at different positions for different lengths of line. The left-hand movement of the jaw *83* is limited by the rod *218*. The rod *218* has a number of circular grooves turned in it, and these grooves are one-half pica apart, so that the jaw *83* can be set for any length of line by one-half picas. This jaw is held in place by a pin *85*, which has longitudinal grooves cut in it one-half pica apart and registering exactly with the circular grooves in the rod *218*.

When the pin *85* is lifted by hand, the rod *218* can be set at different positions, and when the pin *85* is pushed down again it locks the rod *218* in position.

86 is the vise justification block, which is mounted upon the vise justification bar *87*. The justification bar *87* is mounted upon two rods *88* and *89*. The action of these rods and the justification bar are described and illustrated in another view.

90 is the left-hand mold disk locking stud block. This is sometimes called the "floating block", as it is not absolutely fixed, but has a slight motion. *91* is another mold-disk block, which is fixed. It has no motion, and is doweled so as to have no movement.

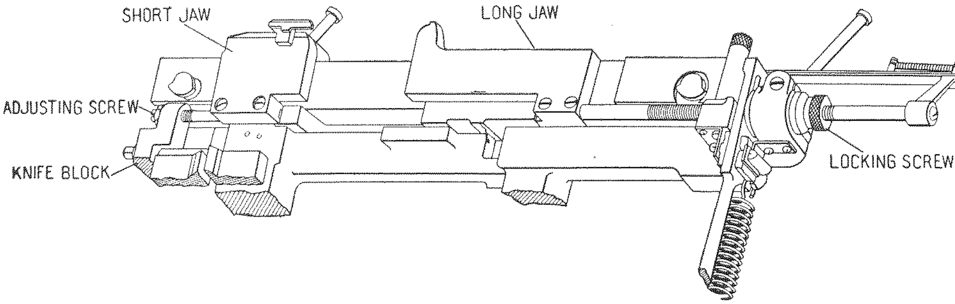

Fig. 46.—Diagram of the vise jaws looking at them when the vise is lowered. The view shows the adjusting screw for the right-hand, or short, jaw; also for the left-hand, or long, jaw; also the knife block screw for adjustment.

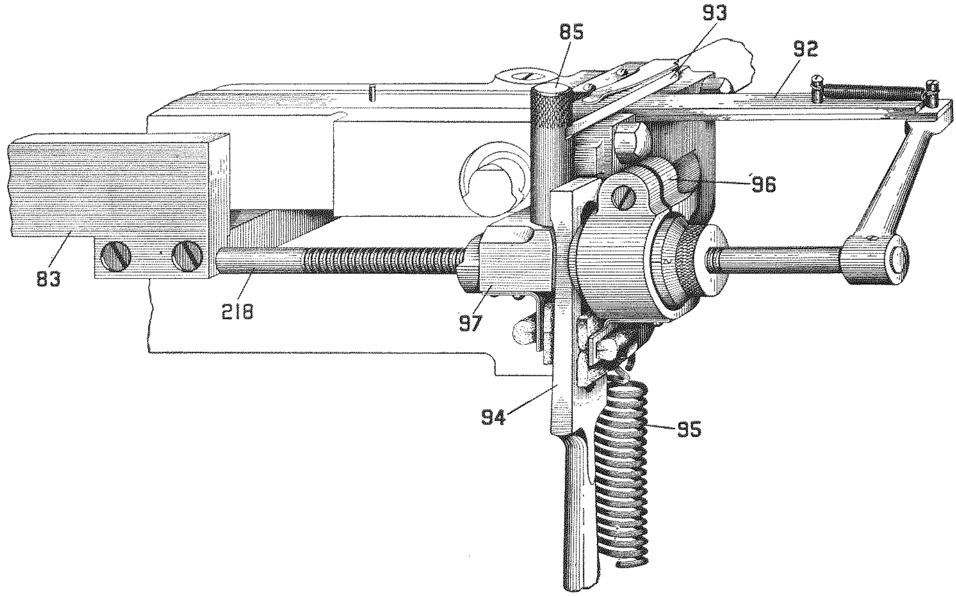

Fig. 47.—Enlarged view of the left vise jaw *83*, the adjusting rod *218*, and the locking pin *85*. The locking pin *85* in the later machines is not operated by hand, but by the rod *92*, which operates the lever *93*, which raises the pin *85*, and allows it to rise, to release, or descend so as to lock the rod *218*. By this device the operator is enabled to set the pin *85* by means of the rod *92*.

94 is a wedge which is pulled upward by a spring *95*. This wedge has two inclined surfaces and works between a bearing *96* and a block *97*, in which the locking rod *218* is mounted. The action of the upper wedge is to push in the jaw *83* a slight distance just before the first justification takes place. After the first justification the downward movement of the wedge allows a slight looseness in the line of matrices and spacebands so that the alignment of the matrices can take place. A second upward movement of the wedge *94* takes place before the second justification and presses the line of matrices and spacebands together with great force through the pull of the spring *95* and the wedge action of *94*. The downward movement of the wedge *94* against the pull of the spring *95* is caused by cam action.

these levers are powerful springs that tend to drive them upward. When the justification-slide block *86* first goes up, to drive up the wedges, it stands at a slight angle, and when the bands are driven up those at the right of the line are driven a little farther than the ones at the left. The action of the cams on the cam shaft now depresses the levers and then permits them to rise again, carrying up the justification block, but this time on a level or parallel with the floor, against the wedges of the spacebands, the lower ends of which stand at a slight angle with the floor. Therefore, the force of this second justification thrust is mainly against the spacebands at the left of the line. These are driven up successively until the line is wedged out as far as the jaws will permit and spaces each word uniformly. These actions are shown in Figs. 48, 49, 50, 51 and 83.

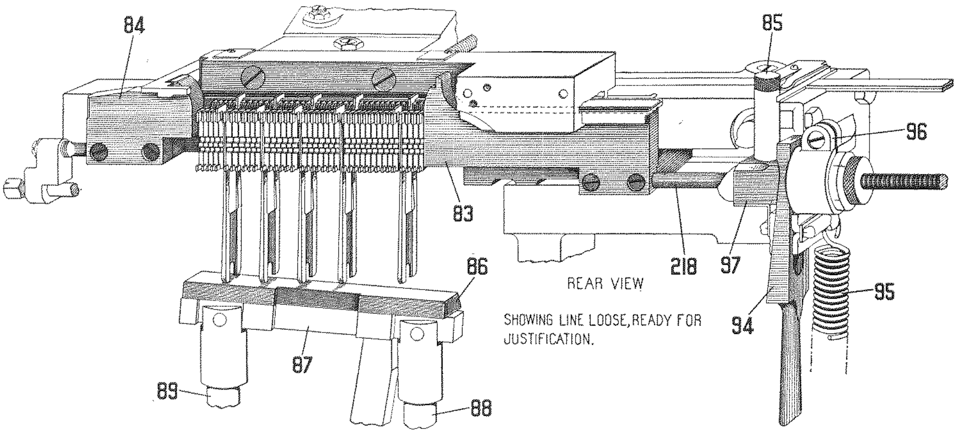

FIG. 48.—View of the justification showing the line between the jaws *83* and *84* loose, the spacebands hanging down.

It also shows the inclined position of the vise justification bar block *86*. The wedge *94* is at its lowermost position and the distance between the jaws is a little less than the slug is eventually to be.

Just before the first justification the wedge *94* rises, closing the vise jaws to the exact length of the line to be cast. Between the first and second justifications the wedge descends a little, taking off the pressure on the line of matrices so that alignment can take place.

If the descending line of matrices and spacebands is all right in length, that is, a little less than the distance between the jaws, the first elevator carries the line of matrices and spacebands between two jaws, called "vise jaws." These jaws are mounted in the vise cap, as shown at *83* and *84* in Fig. 45. The left-hand vise jaw is restrained in its movement by a toothed rod, *218* in Fig. 47. This toothed rod is locked by a toothed rod called the locking pin *85*, as shown in Fig. 47. In most of the machines now in use this locking pin is lifted by the fingers, and the toothed rod *218* can be moved in either direction and then locked by pressing down upon the pin.

In the later machines this locking pin is raised by a device mounted on the vise cap. The teeth in this toothed rod are one half-em apart. The left-hand jaw rests against this toothed rod, as above described, the

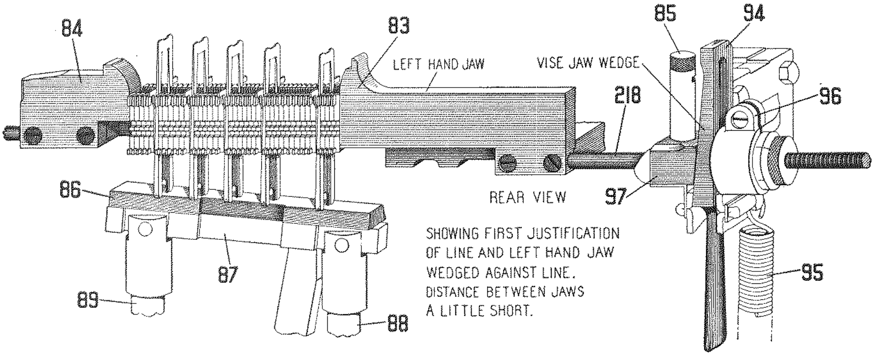

FIG. 49.—First justification of the line. The wedge *94* has gone up to its highest position and the left-hand jaw *83* is forced in, making the line the proper length. The spacebands are driven up by the inclined block *86*, being driven up an unequal distance. This view is from the rear of the machine with all the parts left out.

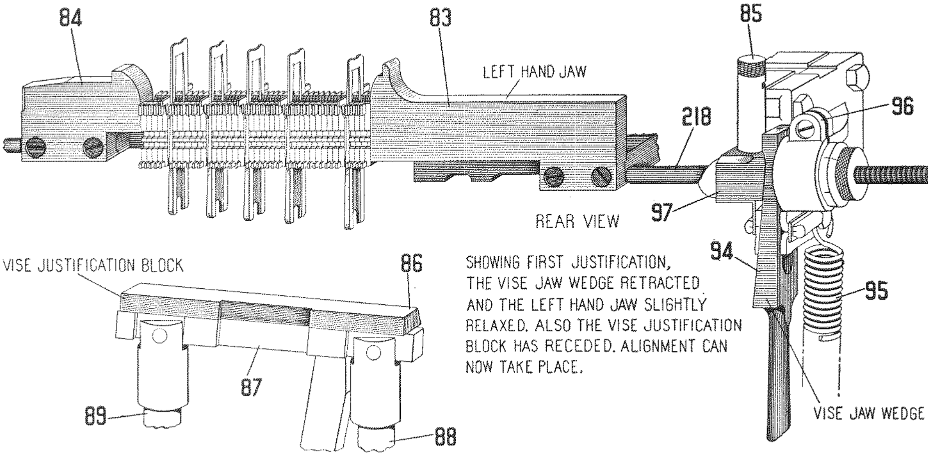

FIG. 50.—View showing the vise justification block *86* withdrawn after the first justification. The line of matrices and spacebands is between the vise jaws *83* and *84*. The wedge *94* is now drawn downward by the cam, relaxing the pressure which has been made by the spacebands in the first justification. This leaves the line of matrices and spacebands a very little loose but not enough so that the spacebands fall down again. At this time the alignment of the matrices takes place by the lifting of the first-elevator jaw.

toothed rod running through the block *97*, which carries the locking mechanism. Back of this sleeve there is a wedge *94* that is pulled upward by a powerful spring *95*. This wedge has two inclined surfaces and is the upper part of a rod, the lower end of which contains a slot, as shown in Fig. 83. Registering with the slot is a pin fastened to a lever that runs to the rear of the machine. This lever is operated upon by a cam and tends to pull the rod downward against the action of the spring, as previously described. All this is shown in Fig. 83.

The wedge *94* when in normal position is pulled down so that the short wedge at the top pushes the block *97* and the vise jaw inward a very little so that the distance between the vise jaws is slightly less than the proper length of the line to be cast.

The action of the wedge *94* as just described is called the "locking and unlocking of the line."

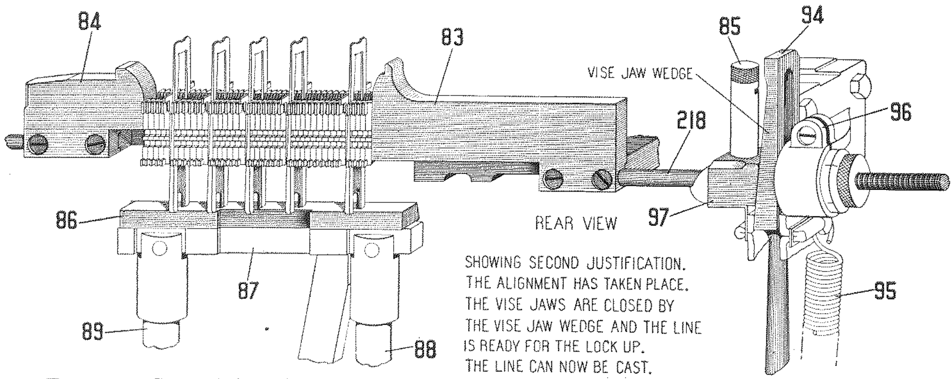

Fig. 51.—Second justification having taken place. The wedge *94* has risen, again compressing the line to proper length. The justification block *86* rises again, but this time the block is parallel to the floor and its force is exerted against the first spaceband as shown in the previous figure, and then successively on the others. If the line is fairly loose it will finally come to position as shown in the figure. It may be, however, that the entire force of the second justification will be expended on only one or two bands.

The line of matrices is now aligned and justified and is ready for the mold to come against the line, the pot following the mold, and the slug is cast.

The descent of the line in the first-elevator jaw and the spreading or justification of the line between the vise jaws having taken place, the mold moves forward against the justified line of matrices and spacebands, and is ready to have the metal pumped into it to form the slug. The mold will now be described.

THE MOLD

The mold most used in the Linotype machine is known as "the Universal Adjustable Mold." It is composed of three principal parts, the body, the cap, and the liners, as shown in Fig. 52. The body is composed of two parts, known as the body *112* and the keeper *113*. The keeper forms one of the grooves for the matrices in the upper, or italic, position, and is fastened onto the body of the mold by two screws. Four screws hold the body to the mold disk. The cap is held down upon the liners by three screws mounted in the rim of the mold disk. The body and the cap are separated by two parts called "liners" *119*. The right-hand liner varies in thickness, but not in length, and is parallel to the surface of the mold. The left-hand liner is of varying length, and varies in thickness to match the right-hand liner. The thickness of the liners determines the size of the body of the slug, and the length of the left-hand liner determines the length of the slug.

In the cap of the mold there are a number of shallow grooves. These grooves taper in width from the front, or side, toward the operator, to

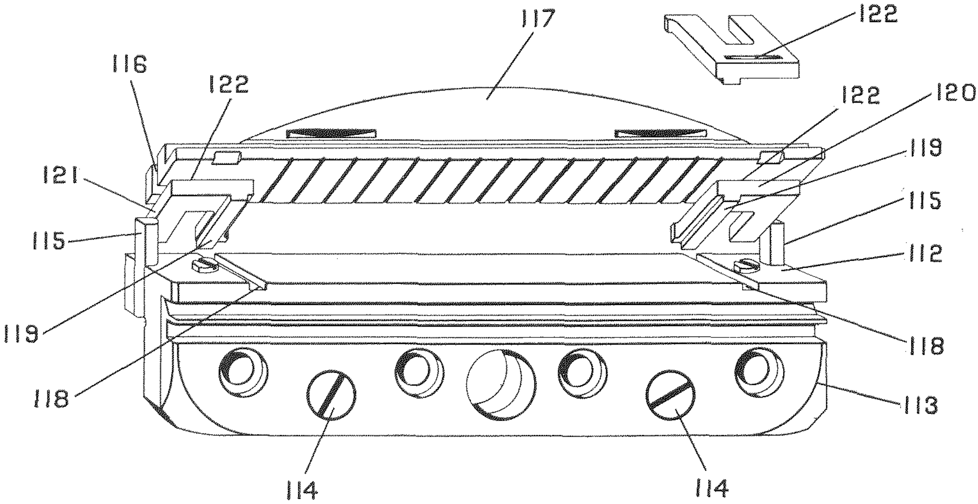

Fig. 52.—View of the mold. *112* is the mold body. On this mold body is a separate piece having a groove in it, *113*, which is called "the keeper". The keeper is fastened to the mold by screws *114*. The mold is fastened to the disk by four screws, the holes for which are shown. At each end of the mold body are two upright posts *115*. These posts fit into two notches *116* at each end of the mold cap *117*. The mold body has also in it two grooves from front to rear *118*. These grooves are for the purpose of affording a seat to a projecting rib *119* upon the liners *120* and *121*.

The right-hand liner *120* is always of the same dimension, except in the matter of thickness, which varies for every thickness of slug. The left-hand liner *121* not only varies in thickness but also in length. The distance between the liners *120* and *121* forms the limits of the length of the slug. In the mold cap *117* there are a number of transverse grooves. These grooves are about five thousandths of an inch deep on the front side, or the side toward the operator, and taper to nothing toward the rear. These grooves form recesses into which the metal flows, and form the ribs on the slugs. These ribs form a shaving surface which is more easily and accurately trimmed than if the knife cut the whole width of the slug.

In the liners *120* and *121* there are on the upper side two small notches *122*. These notches are more clearly shown in the perspective view at the right hand of the main view.

the rear, and taper also in depth. When the slug is cast, the type metal flowing into the grooves forms ribs that appear on the upper side of the slug. Their object is to afford a surface that the knives can shave, offering less resistance to this shaving than the solid body of the slug.

When the large sizes of slugs are to be used, the grooves are made much wider and deeper in the cap of the mold, to take up a large part of the space which would be occupied by the slug if cast full size. These molds are called "recessed molds." Their object is to save the use of type

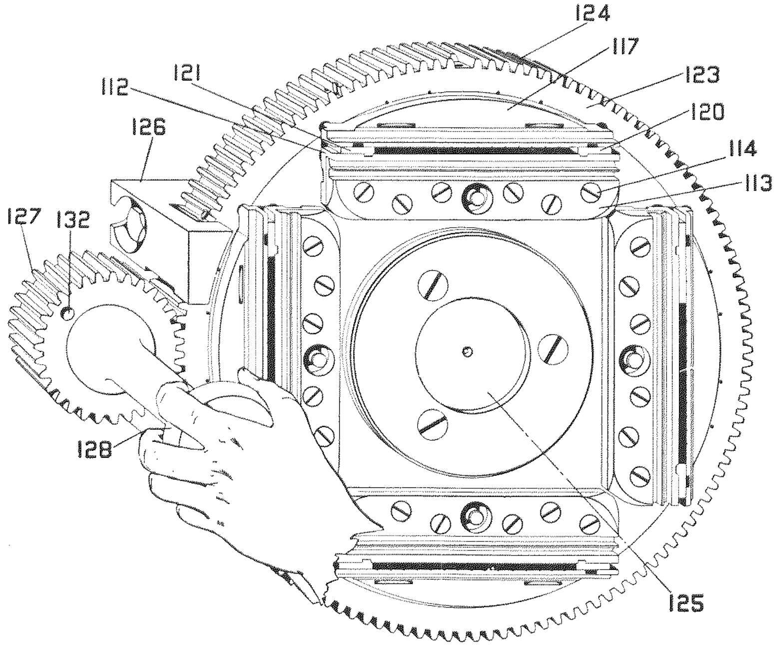

Fig. 53.—Perspective view of the mold disk containing four molds, described in another view. The mold disk *123* has teeth *124* cut in its circumference. The mold disk *123* is mounted upon the mold-disk stud *125*. In some of the machines there is a water-cooling arrangement by which water is circulated around the mold-disk stud to keep the mold disk cool.

On the left-hand side of the mold disk there are two supports called "mold disk supports" *126*. They support and hold the mold disk against the thrust of the back knife when shaving the bottom of the slug, shaving it to a uniform height to paper.

The mold disk *123* is caused to revolve by the pinion *127*. This pinion is connected to a shaft running from the front to the rear of the machine, shown in another view. On the front side of the pinion *127* is a handle *128* which may be grasped by the hand. Through this handle *128* the mold-disk pinion *127* may be disconnected from its driving shaft, and the mold disk *123* can be revolved by hand. At the proper place the mold-turning pinion *127* is reconnected to the driving shaft, and by the means just described any one of the four molds in the disk can be brought into operative position.

metal, and a better face is cast on the type than can usually be obtained on a slug of large thickness.

By unscrewing slightly the screws in the mold wheel, the cap is permitted to rise slightly, and it is possible to remove both the right-hand and the left-hand liners, inserting others that are thicker or thinner, or with a different length of left-hand liner, and by screwing down the screws in the mold cap the mold becomes a solid slot of the size of the slug desired. This operation is shown in Fig. 60. Care should be taken to see that the liners are constantly kept clean.

CARE OF THE MOLD

The mold is made of special steel, very carefully case-hardened and ground. It has to be made with very great accuracy in all its dimensions. Screwdrivers, or other instruments of the kind should never be used around the mold, except to tighten or loosen screws. Occasionally, the mold should be removed from the machine and the surface against which the metal is cast rubbed with graphite on the end of a soft-pine stick. This will remove the slight particles of metal that adhere in the form of an oxide. This oxide usually comes off without much trouble, but sometimes it adheres quite firmly to the mold. If this oxide is allowed to accumulate in too large a degree, the slugs will be ejected with great difficulty, and there will be frequent "sticks-in-the-mold", as they are called. When inserting liners, care should be taken to see that they are clean, as before mentioned, and that the part of the mold into which they go is also free of any dirt or small pieces of metal.

The mold keeper may be damaged if the vise automatic is not properly set, as previously described. The back side of the mold may also be cut by what is known as the "back knife," which trims off the back of the slug, if it is not correctly set.

Damage to the mold may be caused by "squirts." Theoretically, squirts of metal should never occur. They do, however, happen, especially when there is carelessness in the matter of the lock-up, or in the care of the machine in other ways. When a squirt occurs, a little time and patience should be used in clearing away the type metal, and screwdrivers and other sharp instruments should not be used around the mold. If it is necessary to use anything of the kind, it should be a piece of brass or of hard wood. The mold is expensive and easily damaged, and especial care should be taken not to injure it.

In all machines there are two molds, and in many machines four molds are used, and by turning the disk by the hand wheel on the mold pinion it is possible to bring either one of the two, or any one of the four molds into position to cast. Of course, when using the four-mold disk it is possible to cast four sizes of type and four lengths of line without changing the liners as heretofore described.

MOLD WHEEL AND MOLD SLIDE

The mold or molds are carried in a circular disk having teeth on the circumference and flanges on the rear side, called the "mold wheel," or "mold disk," as shown in Fig. 53. The mold disk has two or four openings in it to receive the molds as above described. The mold disk is mounted on a spindle in its center, and this spindle is mounted in an arm that extends to the right and is one casting with a slide having beveled edges, the arm being at right angles to the slide. This slide, called the "mold slide," is mounted in beveled bearings in the column of the machine. At the rear end

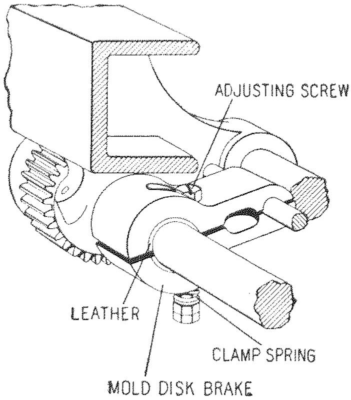

FIG. 54.—View showing the mold-disk brake with adjusting screw for holding the same for clamping it upon the shaft. The object of this brake is to prevent the momentum of the mold disk when revolving from carrying it by the proper position to go forward on the locking pins. The clamp should be adjusted so that the mold disk stops in the proper position.

As the leathers wear, the brake must be adjusted from time to time. This will usually, however, be at quite long intervals.

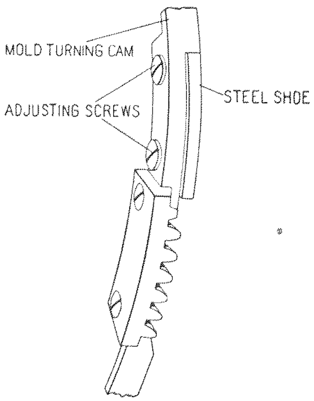

FIG. 55.—Segment of the rack which revolves the shaft turning the mold disk.

It also shows the steel shoe which runs alongside of the square block and holds the mold disk in position to slide freely on mold-disk bushings 90 and 91, Fig. 45, at casting and ejection.

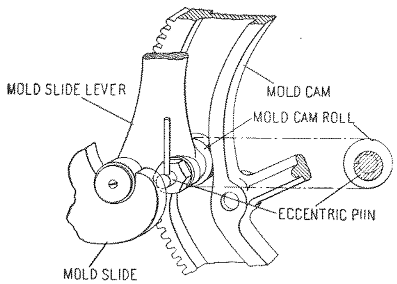

FIG. 56.—Mold slide lever in position to operate the mold slide, and also an eccentric pin and adjustment for the roll which moves the mold slide forward and back, in order to take up a slight wear.

of the slide is a semi-circular notch into which fits a roll on an arm, which arm gives the mold slide its backward and forward motion. This arm is called the mold cam lever.

The mold cam lever is mounted upon another arm in such a way that the roll can be lifted out of the notch in the mold slide so as to disengage the slide from the lever that operates it. It is then possible to pull the

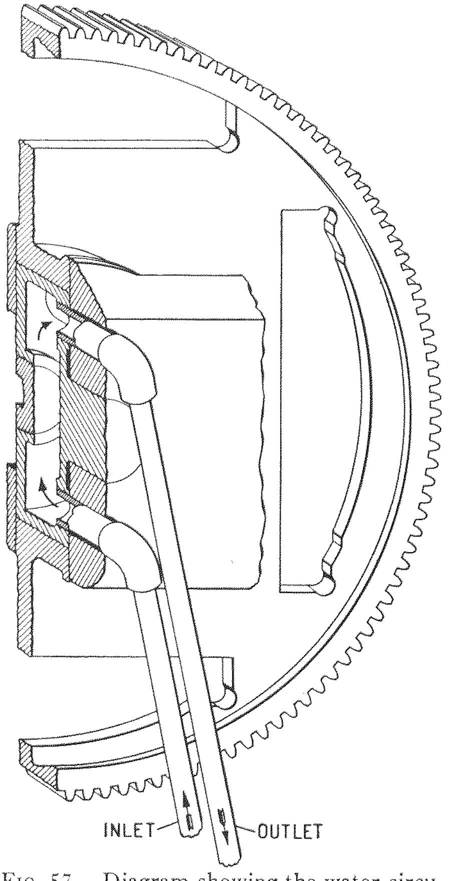

Fig. 57.—Diagram showing the water circulation in the water-cooled mold disk.

mold slide forward a few inches, or to remove it entirely from the machine by lowering the vise frame. These parts are shown in Fig. 79.

When the roll on the lever is in the notch described it is held in this position by a spring pin.

Mounted on the shaft which turns the mold disk turning pinion there is a brake shown in Fig. 54. This brake can be tightened up by means of a nut working on a clamp spring. The side of the brake is composed of two pieces of leather which bind slightly on the mold shaft. The object of this brake is to prevent the momentum of the mold disk or wheel from carrying beyond its position when it should be stopped, and making the starting and stopping more easy and uniform.

MOLD-TURNING PINION

The revolution of the mold disk (which has been previously described), in order to bring it into the casting and then the ejecting position, is caused by two sectors of circular racks fastened upon the cam. One of these sectors is longer than the other. These racks engage and turn a small beveled pinion *127*, as shown in Figs. 53 and 61. Just in front of the pinion is a square block, which is hardened and ground, and which

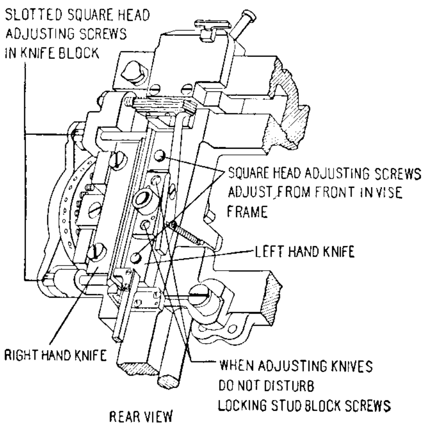

FIG. 58.—Diagram of the knife block and knives and screws when the vise is lowered. The adjustments for the knives are shown. When the right-hand knife is adjusted it should not be disturbed, and if necessary the left-hand knife should be adjusted to it.

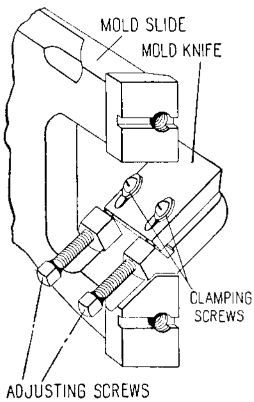

FIG. 59.—View of the back knife and the adjusting and clamping screw for bringing the edge of the knife in exact position against the mold disk, so that it will shave the back or bottom of the slug and at the same time will not cut the mold disk.

runs upon an interrupted surface on the cam. The arrangement is such that while this surface is passing by one of the sides of the square block *180* in Fig. 83 the pinion shaft is held from rotation, but when the section of the circular rack comes into register with the pinion it revolves the shaft. This arrangement is one form of a "Geneva lock."

The sectors *177* and *178* in Fig. 83 mesh with a bevel pinion on a jack shaft that runs toward the front of the machine. Fastened to this shaft is a spur gear driving a pinion on the mold disk driving shaft *129*, Fig. 83. Just opposite the mold wheel there is another pinion on this shaft which is called the "mold-turning pinion" *127*, previously mentioned. The teeth on this pinion are wider than the teeth on the mold wheel, so that when the mold disk slides forward and back in the casting operation previously described the teeth on the pinion will remain in mesh. The mold-turning pinion is not keyed or pinned to the jack shaft in the ordinary way. Just back of the mold-turning pinion upon the jack shaft there is a collar, or disk, which has a hole in it. This disk is pinned to the jack shaft. In the

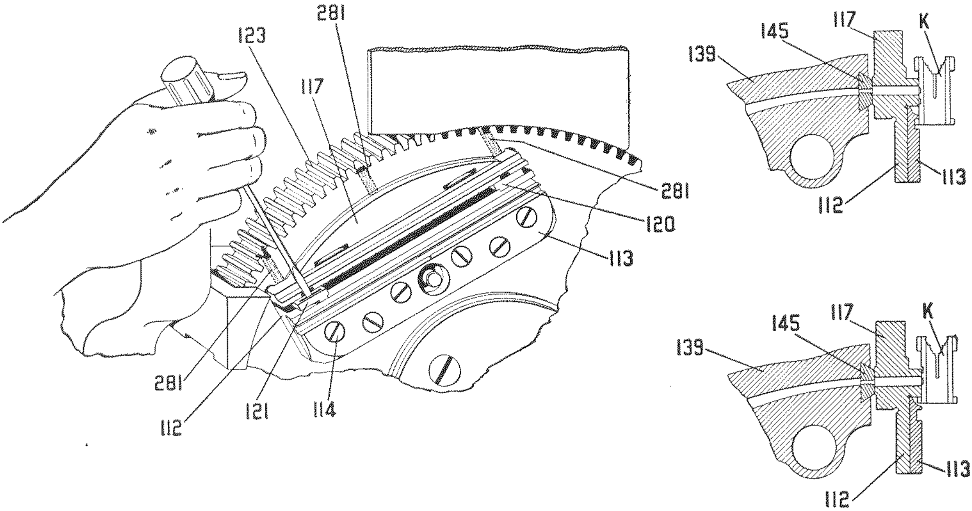

FIG. 60.—View showing the method of removing and replacing liners in the mold.
In the figure *123* is the mold disk, *121* is the liner, which has in its upper edge a small groove adapted to take in the end of the screwdriver. The screws *281* have been turned backward a little so as to relieve the mold cap *117*.
The two liners *120* and *121* can then be removed and replaced. When the length only of the line is to be changed, the liner *121* is the only one that is removed and replaced. When the body of the slug is to be changed, both the liners *120* and *121* are removed.
In making this change, it is most convenient to revolve the mold disk a little to the left (by means of the handle), as shown in the illustration.

mold-turning pinion there is a projecting pin. A spring, shown at *189* in Fig. 61, holds the mold-turning pinion against this disk. Normally the projecting pin is seated in the hole in the disk and connects the disk and pinion. In front of the mold-turning pinion there is a handle that can be grasped by the operator. The pinion can be pulled forward, pulling the pin out of the disk. It is then possible to revolve the mold wheel with the pinion by hand, so as to bring it to any one of four positions, which brings any one of the four molds in the disk into operating position. The mold-turning pinion is then allowed to be forced back by the spring, and when the pin enters the disk the mold wheel and mold-turning cam are in register. This operation is shown in Figs. 53 and 61.

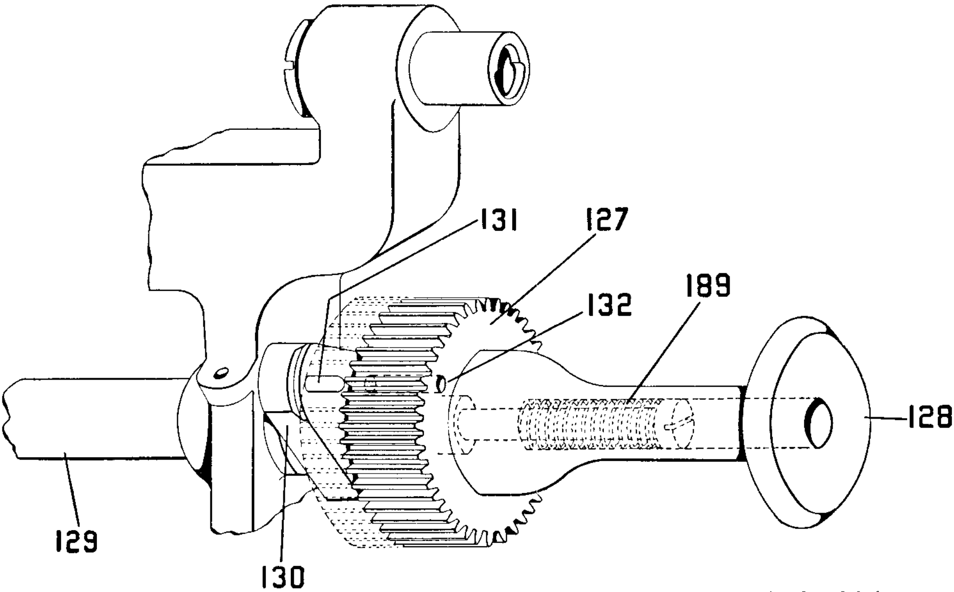

Fig. 61.—Another diagram of the mold-disk turning pinion *127*. *129* is the driving shaft for the mold disk, running from front to rear of the machine. Mounted on the shaft *129* is a sector *130*. In this sector *130* is a pin *131*. In the mold-disk turning pinion there is a hole passing entirely through it *132*. The shaft *129* drives mold-disk pinion *127* through pin *131*. When the mold-disk turning pinion *127* is pulled backward by hand, pin *131* is disengaged and the mold disk can be turned by hand. Inside of mold-disk turning pinion *127* there is a spring which urges it toward the rear of the machine and holds it in place when pin *131* is seated in the pinion.

The diameter of the mold-disk turning pinion *127* is exactly one quarter of the diameter of the mold disk, and hence one complete turn of the pinion *127* turns the mold disk one-quarter turn. It is evident that for any whole number of turns of the pinion *127* the pin *131* will register with the hole *132*.

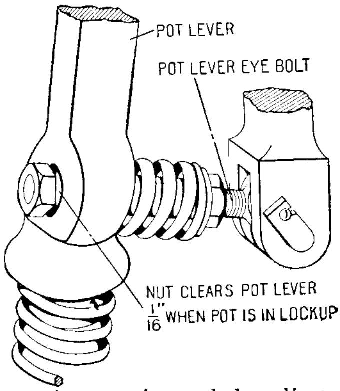

Fig. 62.—Diagram of the pot-lever spring and the adjustment therefor. The adjustment is made by the nuts and shows that the nut on the back side of the pot lever should clear the lever by about one sixteenth to one eighth of an inch when the pot crucible is locked up against the mold at the time of casting.

THE POT CRUCIBLE

The pot crucible is a casting that contains, when full, about forty pounds of type metal. It is contained in a jacket which is mounted on two rather crooked legs which come forward and are mounted on a shaft, which is in turn mounted in the base frame. At the bottom of the legs there are three bolts with lock nuts. There is one bolt at the front and one at the back side of each leg, and by these bolts the adjustment of the

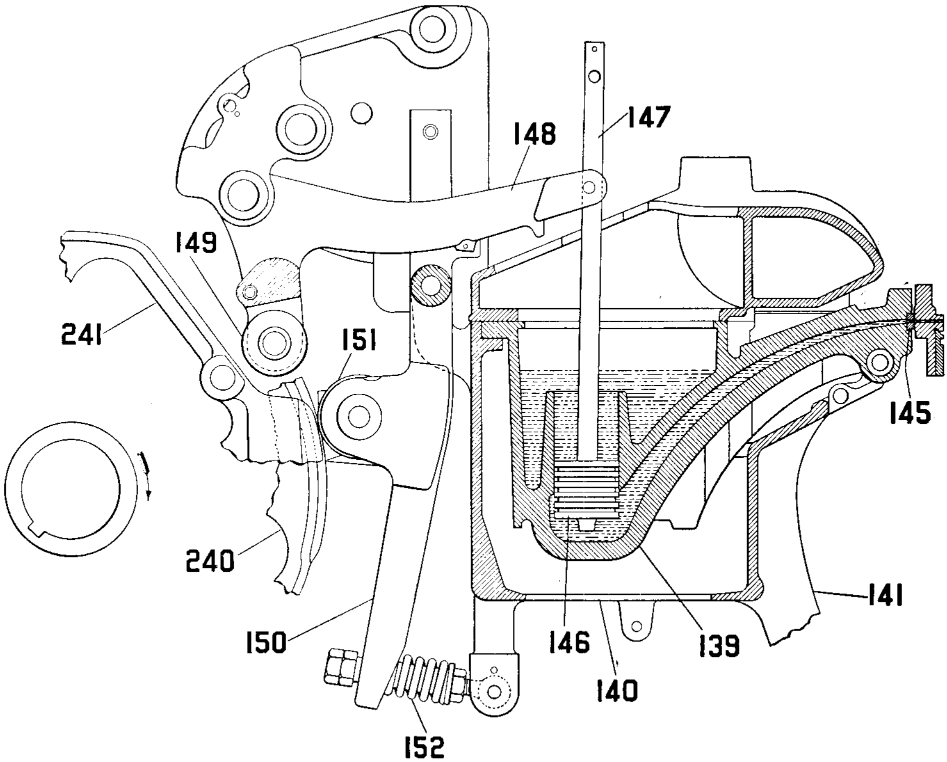

FIG. 63.—Diagram of the pump plunger at the bottom of its stroke, showing the cam *240* forcing the pot forward through the roller *151* and the spring *152*.

pot is made so as to bring the pot crucible nearer to or further away from the mold disk and to align with it. A third bolt in each of the legs gives a vertical adjustment to the pot crucible, so as to make it align perfectly with the mold slot. The pot crucible is mounted in the pot jacket. Between the pot jacket and the crucible the space is filled up with a paste made of asbestos meal, which becomes hard. The object of this asbestos, which is a poor conductor of heat, is to retain the heat in the crucible. At the top of the pot jacket there is a cover having a door through which pigs of metal can be dropped into the melting pot.

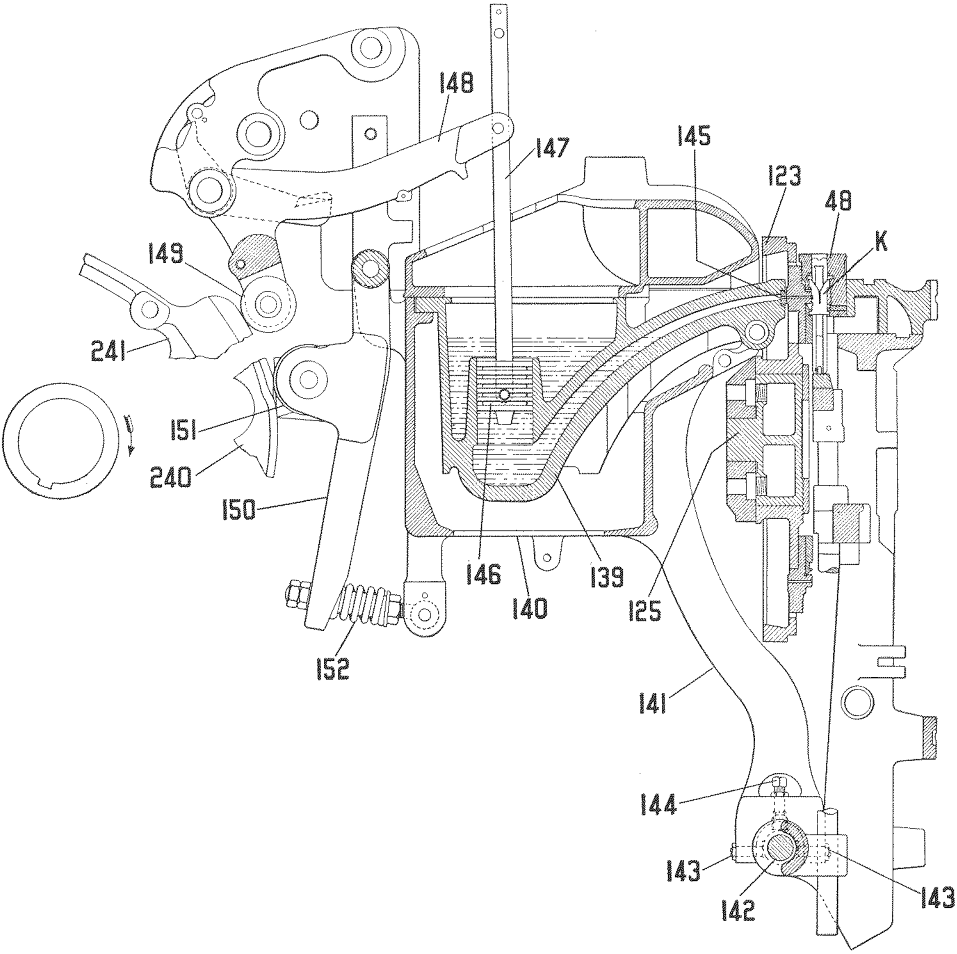

FIG. 64.—View, partly in section, of the metal pot, the mold, the first-elevator jaw, and the vise-frame; also the levers which operate the metal pot and the pump. *139* is the metal pot; *140* is the pot jacket, which surrounds the metal pot. The jacket *140* is mounted on two long crooked legs *141*. These legs rest upon trunnions *142*, and the legs of the metal pot *141* are adjustable by the screws *143*. The height is adjustable by the screw *144*. *145* is the mouthpiece, through which the metal is pumped into the mold. *146* is the pump plunger, which is operated through the lever *147* by the pump lever *148*. The pump lever *148* has at its lower end a roller *149* which rides upon the cam.

The metal pot *139* is moved forward against the line by the lever *150* which carries a roll *151*. The roll *151* rides upon a cam of the proper shape to move the pot forward and back at the proper part of the revolution of the cam shaft.

152 is the compression spring, which stands between the lever *150* and the lower part of the pot jacket *140*. This spring is very strong, and through it the pressure of the lever *150* is applied to the pot jacket and metal pot. If there is any unusual resistance this spring may compress and allow the cam shaft to go through its revolution; or, in other words, the spring *152* is a safety device.

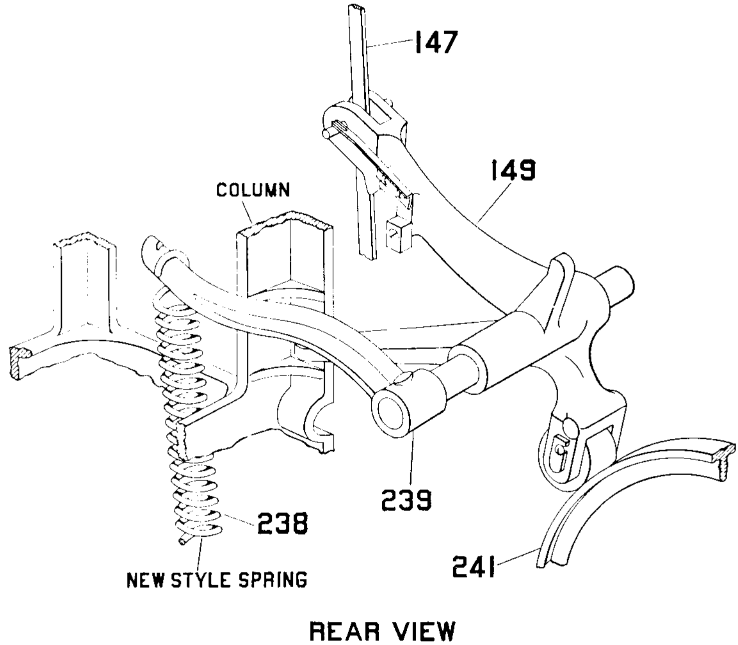

FIG. 65.—Diagram showing the action of the spring which works the pump. It is the device which has the spring *238* inside of the column.

The pot crucible contains a well in which there is a plunger. When the plunger is in normal position the bottom of it is just above two holes through the side of the well, and through these holes the metal flows into the space below the plunger. These holes must be kept open. When the plunger descends below these holes it drives the metal forward and up into the throat and through the holes in the mouthpiece into the mold and against the matrices, forming the slug. See Fig. 64.

POT JACKET AND BURNER

The pot jacket is a casting having two legs on it, as previously described in Fig. 64, and is of such shape as to contain the crucible, or pot, which is to hold the molten metal, and form a wall around said crucible. As stated before, the space between the pot jacket and the crucible is filled with a packing made of asbestos, which retains the heat imparted to the crucible and to a certain extent prevents its escape to the surrounding parts of the machine.

Underneath the pot crucible there is a burner. Three methods of heating the metal in the pot crucible are now in use. The most commonly used is the gas burner, using either natural or illuminating gas. The second in most common use is the electric pot, where electricity is used to melt the metal, and this method is described in a special pamphlet on electric pots which will be sent on request. The third, much less common than either of the others, is the oil burner, using either gasoline or kerosene. An illustration and directions for using the gasoline burner will be sent on request. Special arrangements are usually necessary on account of insurance requirements when using gasoline.

VISE FRAME

The vise frame consists of a casting having two legs joined together by bridges, and is pivoted at the lower end of the legs on a shaft with bearings in the base, which shaft also supports the pot legs. The vise frame carries the guides for the first-elevator slide, the justification slide, the vise cap in which the vise jaws slide, the mechanism for closing the vise jaws, the knife block, the knife wiper, the slug lever, and on its front the galley for holding the slugs. The vise cap *80*, Fig. 42, is fastened to the top of the vise frame with four screws, and has on the underside of the rear a longitudinal groove in which the vise jaws *83* and *84*, Fig. 45, slide. The vise cap also takes the thrust, and supports the first-elevator jaw, when the line is locked up for casting the slug. Through the vise cap, at either end, are the vise locking screws, which hold the vise in its vertical position and lock it to the frame of the machine. The vise locking screws, which are threaded in the vise cap, have on the end a cam, which enters into two vise locking studs, one attached to the column, and the other to the mold gear arm, so that when the screws are turned they lock the vise firmly against the frame of the machine through the action of the cams.

By unlocking these studs the vise frame can be opened so as to be out of the way for the removal of the mold slide, the pot crucible, and other parts when it becomes necessary. In the later machines there is in the upper surface of the vise cap a transverse groove, in which rest two flat

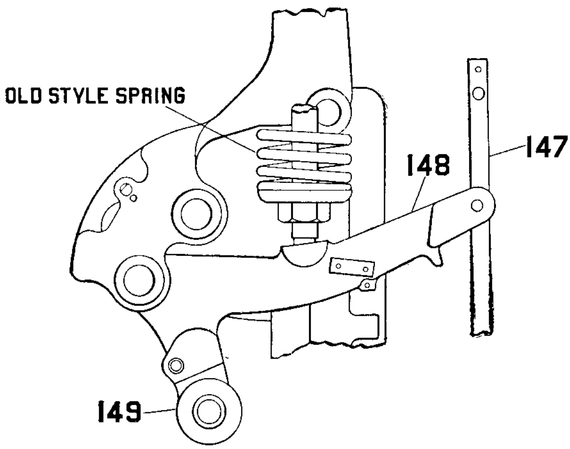

Fig. 66.—Diagram showing the action of the spring which works the pump. It shows the old-style spring which was directly over the lever which works the pump plunger.

rods that lock and unlock the toothed rod which supports the right-hand vise jaw for different lengths of a line.

At the left-hand end of the vise frame a casting is bolted on that carries the wedge mechanism for locking and unlocking the line of matrices at the time of casting, as described in Figs. 47 and 83. In the earlier machines, instead of a wedge, a screw mechanism was used for the purpose of locking and unlocking the line. At the right-hand side of the vise frame, just underneath the vise cap, the casting has a planed surface upon which the knife block is fastened. This knife block consists of two knives that trim the edges of the slug as it is being ejected. These knife blocks have various forms, which will be hereinafter described. All these parts that are mounted upon the vise frame are securely fastened to it and form a unit that can be assembled separately and added to the machine. The form now used is called the universal knife block.

EJECTING THE SLUG

After the slug has been cast and the pump-plunger lever has been raised by the cam, the pot, or crucible, rocks backward, following the cam and being forced to do so by a projecting lug on the lever *245* in Fig. 80. It usually follows the cam by gravity alone. The mold wheel is then caused to revolve through three-quarters of a turn of its circumference. While doing this, the back of the mold passes by a knife, termed the "back knife." This is mounted on the end of the arm that supports the mold disk. It presses closely against the back of the mold and shaves off any surplus metal, trimming the back of the slug so as to make it smooth and type high. At the end of the three-quarter turn of the mold disk mentioned, the slug is opposite the knife block. It must now be pushed forward out of the mold and between the knives, so as to trim the edges and ribs of the slug.

The ejection of the slug is done by means of a thin steel blade called the "ejector blade." This blade is mounted so that it can be easily removed and replaced. The width and thickness of the blade must correspond to the mold slot. This ejector blade is mounted upon a secondary slide called the "ejector slide," which runs in grooves in the mold slide. The motion of this ejector slide is obtained through a link connected to the rear side of the ejector blade, as shown at *214* in Fig. 79, and at the other end fastened to a lever *210*, as shown in Fig. 79. The motion of this lever is imparted by two lugs upon two cams. One of these lugs registers with a hook mounted on the upper end of this lever, which is called the "ejector lever," and about half way down from the top of this lever there is another lug which engages with the cam, which gives the return motion to the ejector slide. These motions are described and illustrated in diagrammatic form in Fig. 79.

At the upper end of the ejector lever there is a handle. If for any cause the slug sticks in the mold and is not ejected by the machine, it is necessary for the operator to turn the cam shaft back a little so that the lug on the cam will be withdrawn, and then the operator, by taking hold of the handle, can push the slug out by a succession of pushes or light blows. This handle is shown in Fig. 67.

Before performing this operation the operator should be sure the proper ejector blade, which corresponds to the size of the mold, is in the machine. If a wrong size is used the ejector blade will come against the sides of the mold or against the left hand liner. If the operator forgets and goes through the operation described for pushing out the slug by hand, he

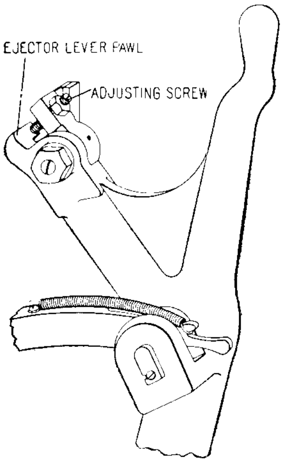

Fig. 67.—Diagram of the ejector lever and the ejector-lever pawl and screw for adjusting same so that when the cam comes around it will engage with the pawl, driving the ejector lever forward and ejecting the slug.

will do the mold or the liners damage. If, therefore, a slug sticks in the mold, the operator should be careful to see whether he has made the mistake above mentioned before he undertakes to push out the slug.

The old style ejector blade was in a single piece, as shown in Fig. 69, and this illustration shows the means of taking out and putting in an ejector blade of different width and thickness. Care should be taken that the right blade is selected.

UNIVERSAL EJECTOR

In the later machines the universal ejector blade has been used. The universal ejector consists of a series of blades connected with the ejector slide by links and so arranged that by the use of a lever, which is under the starting and stopping lever, and within easy reach of the operator, any desired number of blades can be brought into operation, thus making the width of the blade to correspond with the length of the mold slot. A scale back of a hole in the delivery channel indicates the measure for which the blade is set. In the universal ejector the thickness of the blades is never changed, but these blades are held in a guide so rigid that they

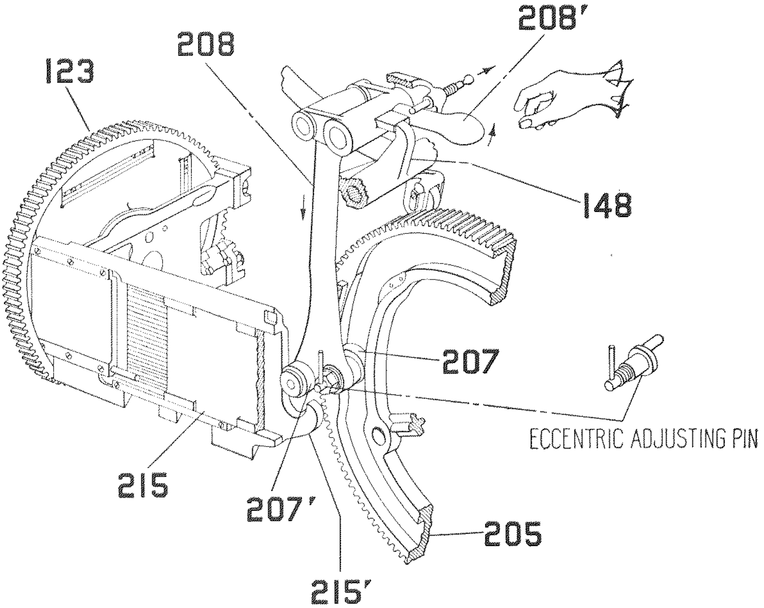

Fig. 68.—View showing the mold mechanism and the means of connecting and disconnecting the mold slide. In the view given the rolls *207'* and *207* mounted on the mold cam lever are shown lifted, the handle *208'* being underneath a little spring pin which holds it in its position. By pulling this spring outward the handle *208'* is allowed to rise, lowering the mold cam lever *208* into position to connect with the ejector slide.

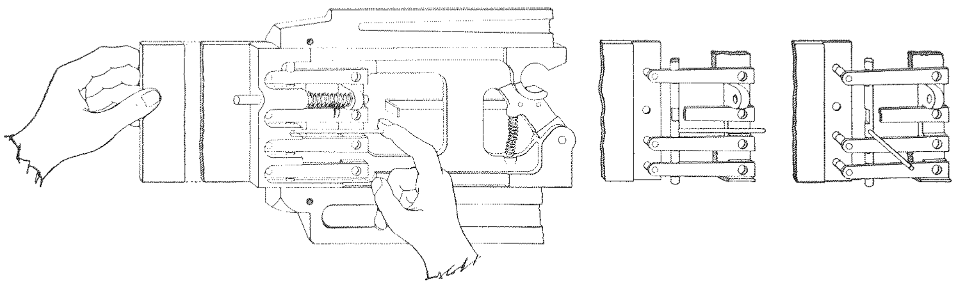

Fig. 69.—Diagram of the old-style ejector and the means for inserting and removing an ejector blade.

will eject slugs of any thickness. The universal ejector blade can be adjusted so as to eject any size or length of slug instantly.

When the ejector slide has pushed the slug forward through the knives, it passes into what is called "the galley."

There are two forms of galley. The one shown in Fig. 70 is the one which was used for many years on the machine and is still used on most newspaper machines which are not used for ad purposes. This galley, often called the "chase," as shown in Fig. 70, goes in directly behind the first-elevator slide, and an arm *101*, worked by the mold slide, pushes the slugs along into the galley. In some machines the slug lever *101* is moved by a cam on the first-elevator slide. This action interfered with the motion of the slide and it has been discontinued.

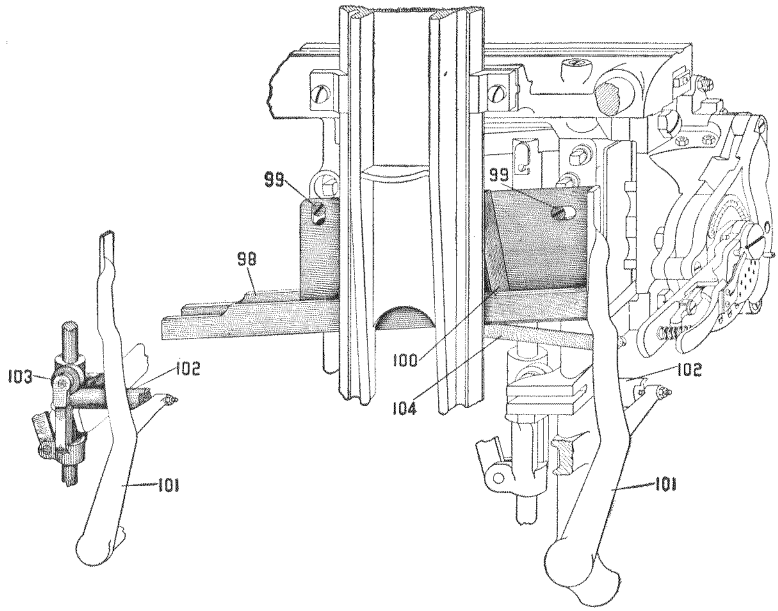

FIG. 70.—View of the vise frame and elevator slide, showing the galley or chase into which the slugs are ejected. *98* is the galley, mounted upon two button-head screws *99*, which are fast in the vise frame. *100* is the slide against which the slugs are packed, and this slide moves along as the slugs are successively fed into the galley. This sliding movement of the slugs and the slide is caused by the lever *101*. The lever *101* is operated by a small push rod *102*, which is operated by a small roller *103* mounted on the right-hand justification rod collar.

The lever *101* is returned by the spring *104* (as shown at left of the main view).

The inclined galley shown in Fig. 71 is designed to deliver the slug face up in a position to be read at a glance. The inclined position of the galley permits the slug to slide easily into place. The face of the slug does not come in contact with the metallic portion of the galley, preventing damage to slugs. It permits removal of any of the slugs or the entire galley without disturbing the operator.

With this galley there is used a long-handled mold disk pinion, permitting the mold disk to be turned by hand, which lightens the task and prevents any possible injury to the hand of the operator.

When short slugs are being cast, a secondary stop is used, and also a slide which answers the same purpose as the slide in the regular or vertical galley, as shown in Fig. 70. There is also an adjustable guide for different lengths of line.

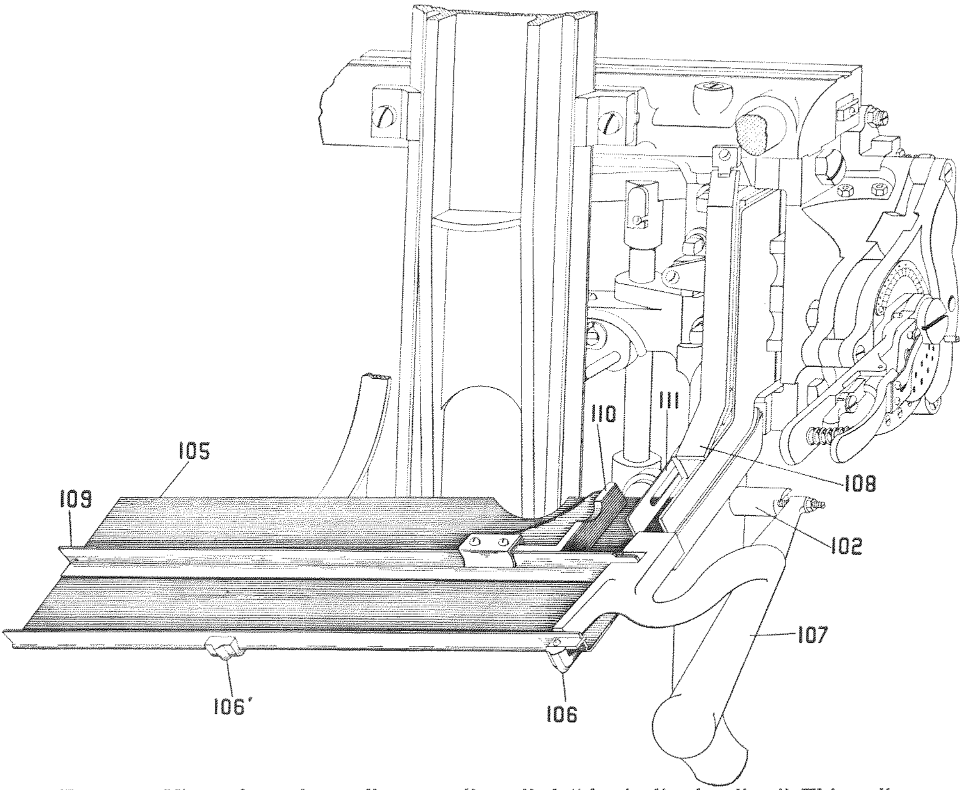

FIG. 71.—View of another galley, usually called "the inclined galley." This galley *105* is mounted on two brackets *106*, which are fastened to the vise frame and hold the galley *105* at an angle. The lever *107* corresponds to the lever *101* in the other view, but is of a different shape, though operated in the same manner. In this galley there is a suspended flap *108* which serves to cause the slugs to take a quarter-turn as they pass down the incline into the galley, instead of standing upright as in the vertical galley.

When the slugs are short, a secondary stop strip *109* is used, and on this there is a slide *110* which answers the same purpose as the slide *100* in the regular galley. There is also an adjustable guide *111* which assists in guiding the slugs into their proper position in the galley. This guide is adjustable for different lengths of slug.

This galley is mounted on two brackets which are fastened to the vise frame and hold the galley at an angle. In this galley there is suspended a flap which serves to cause the slugs to take a quarter-turn as they pass down the incline into the galley, instead of standing upright, as in the vertical galley shown in Fig. 70.

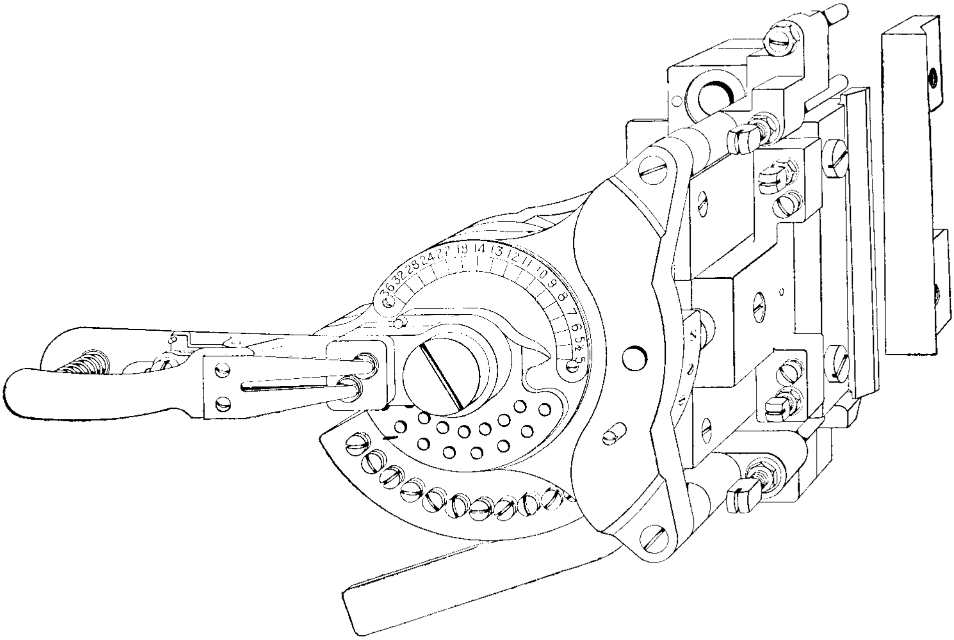

FIG. 71a.—The knife block can be instantly set to lines of any body from 5 to 36 point inclusive. It also permits an independent adjustment of knives for special bodies without affecting the adjustment for other body sizes. For example, the knives may be set to trim extremely close on 8 point, and large or leaded on 10 point, without affecting the setting for normal trimming of other bodies.

UNIVERSAL KNIFE BLOCK

The universal knife block as shown in Fig. 71a has been in use for a number of years and the majority of the machines now in use are equipped with this block.

In general, the block consists of two castings fastened to the vise frame. The left-hand knife as you sit in front of the machine is fastened to the vise frame by screws running through from the back, and is called sometimes the constant knife, as when once properly set it is not moved. This knife shaves the smooth side of the slug and should be set so as to just trim off any surplus metal on the edge of the slug but should not shave any portion of the body. The other knife shaves the ribs and brings the thickness of the slug to body size.

The vertical adjustment of this left-hand knife is made by two long screws which run through the right-hand casting, one above and one below the right-hand knife. The left-hand knife is held in position after the vertical adjustment by binding screws. The long screws mentioned give the adjustment for the knife so that it is perpendicular and in line with the smooth side of the slug, and the binding screws hold it firmly to the casting. The right-hand knife is not fastened to the vise frame but is mounted upon a slide. There are two springs which tend continually to press this slide to the right. This slide has its bearing against a set of screws having set screws to hold them. These screws are mounted in a sector and are set so that when the slide comes against them the distance between the constant knife and the right-hand knife corresponds to various sizes of thickness of the slugs. The right-hand knife has two short set screws for setting it in vertical position and lock nuts hold these screws after the knife is in proper position, and binding screws also hold the knife firmly to the slide. The right-hand knife should be exactly parallel to the left-hand knife. The right-hand knife shaves off the ribs on the side of the slug.

Mounted on the knife block is a handle for setting the right-hand movement of the slide so as to give the proper thickness of the slug. This handle has a spring locking handle on it and this spring locking handle has two spring actuated plungers, one of which registers with one of a number of holes drilled in the casting so that when the plunger enters the hole the knife cannot be shifted until the operator compresses the handle with his hands and unlocks it. The locking screws with their nuts are mounted on a sector and the handle revolves this sector so as to bring one of these screws opposite to the slide which is forced to the right by the spring. When the operator pushes down on the handle, longer screws are introduced and the right-hand knife is pushed inward so as to shave slugs of a lesser thickness. When the handle is raised shorter screws are brought into register, the slide carrying the right-hand knife is pushed further over to the right, and wider slugs are trimmed. The slide, the knife on it, the movable sector, and locking handle are all mounted on a casting which is fastened to the vise frame by two large screws.

One of the good features of the universal knife block is that the screws which determine the thickness of the slug can be set for any desired thickness. It sometimes happens that on a job instead of even points, half or quarter points are desired, so as to shave the slug closely and make no leading, or on the other hand, sometimes to shave very little and make the ribs equivalent to a lead. By this means an adjustment of each body size may be made independently.

HOW TO ADJUST TRIMMING KNIVES

The left-hand knife should be adjusted so as to be exactly in line with the left side of the mold. This knife should remove fine metallic hairs or fins which may be formed at the edge of the slug. It is not intended to remove metal from the smooth side of the slug.

The right-hand knife, which trims the ribbed side of the slug, must be adjusted so that its edge is exactly parallel with the opposite knife, in order to make the slugs of equal thickness at the two ends. If there is any variation in the distance between the knives at the two ends, such variation should be corrected by the adjusting screws. Before adjusting

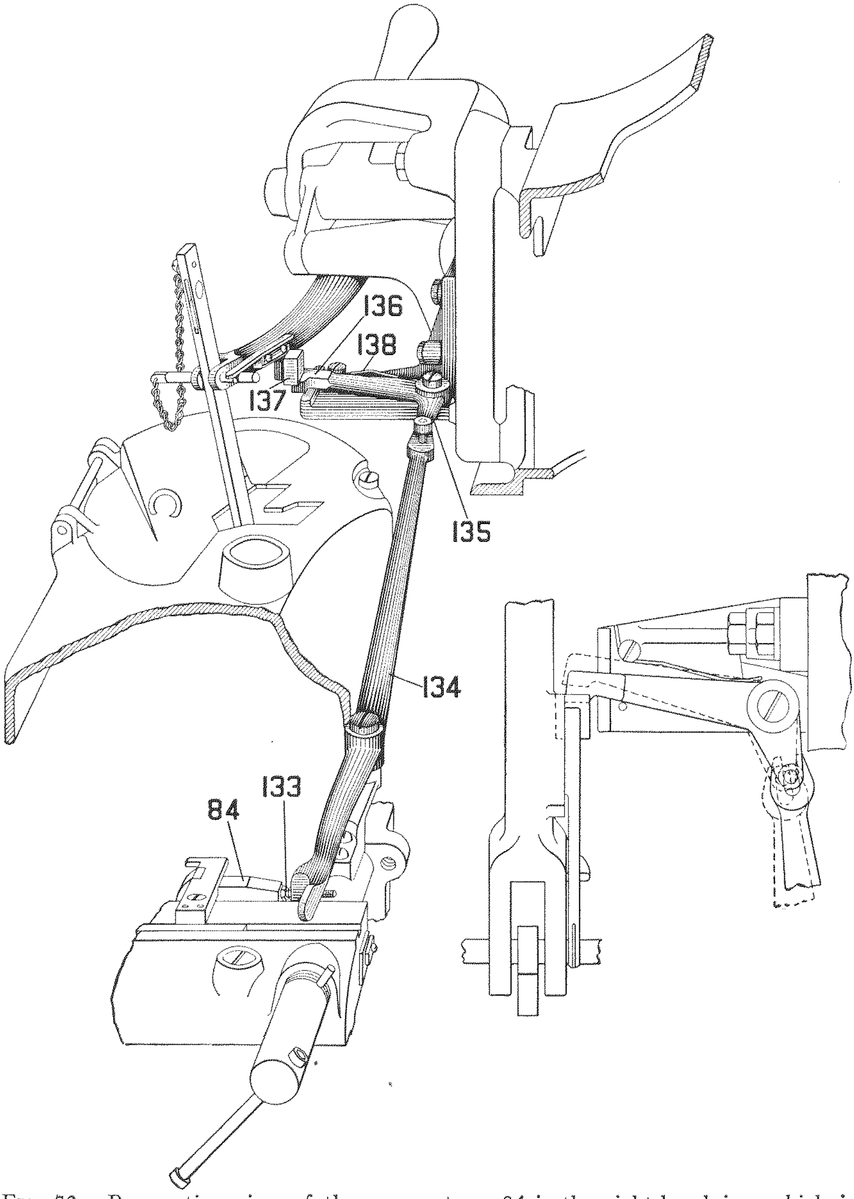

FIG. 72.—Perspective view of the pump stop. *84* is the right-hand jaw which is mounted in the vise frame so as to have a slight movement. The jaw *84* strikes against a screw *133*. The screw *133* is adjustable and is mounted on the short arm of a lever *134*. The long arm of this lever is connected to the short arm of another lever *135;* the long arm of the lever *135* has upon its outer end a hardened block. Mounted upon the pump lever is another block *137*. The block *136* is normally under the block *137*, being held there by a spring *138*.

When jaw *84* is moved to the right by the justification of the line, the motion of the vise jaw *84* is multiplied through the levers *134* and *135*, and the block on the end of the lever is moved so that it is not under the block *136* on the pump lever. In this position the pump lever is free to descend and the metal is pumped into the mold.

If the line is too short, so that the justification wedges do not move the jaw *84*, the lever remains underneath the block *137* and the pump lever cannot descend; hence no metal is pumped.

The screw *133* should be adjusted so that the block *136* just clears the lever when the jaw *84* is at its full right-hand movement.

the right-hand knife, slightly loosen the binding screws by which it is held to the knife block.

After the knife is adjusted the screws should be slightly tightened to hold it in place. Never use a hammer to adjust the left-hand knife; see that the spring is in place, and use the wrench provided for that purpose. (See under caption "Knife Block Liners.")

PUMP-STOP LEVER

Mounted on the column of the machine, just to the right of the mold disk, is a lever running parallel with the floor. This lever has upon its forward end a screw adjustment, as shown at *133* in Fig. 72, and the rear end of the lever connects with another lever that passes under a lug on the pump cam lever. The long arm of the lever *135* is normally held by a screw underneath a lug on the pump cam lever. The right-hand vise jaw *84* has a short motion to the right. When the line is justified it presses the right-hand vise jaw to the right against the lever *134* and the long lever *134* pulls the long arm of the small lever *135* out from underneath the pump lever, allowing it to descend and drive the metal into the mold. It is manifest that if the line of matrices and spacebands when justified, *i.e.*, when the wedges of the spacebands are driven up their full length, does not fill out the line, the right-hand vise jaw will not be pressed to the

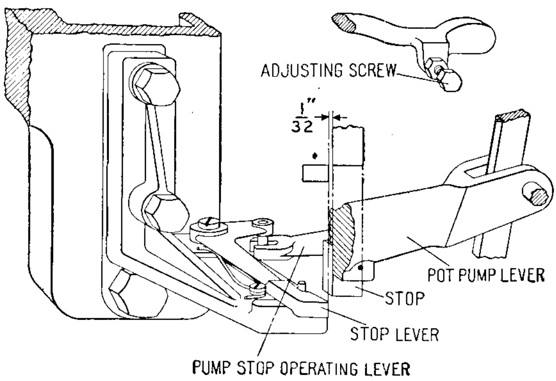

FIG. 73.—View of the pump stop mechanism showing the adjusting screws and the distance for adjustment on the device.

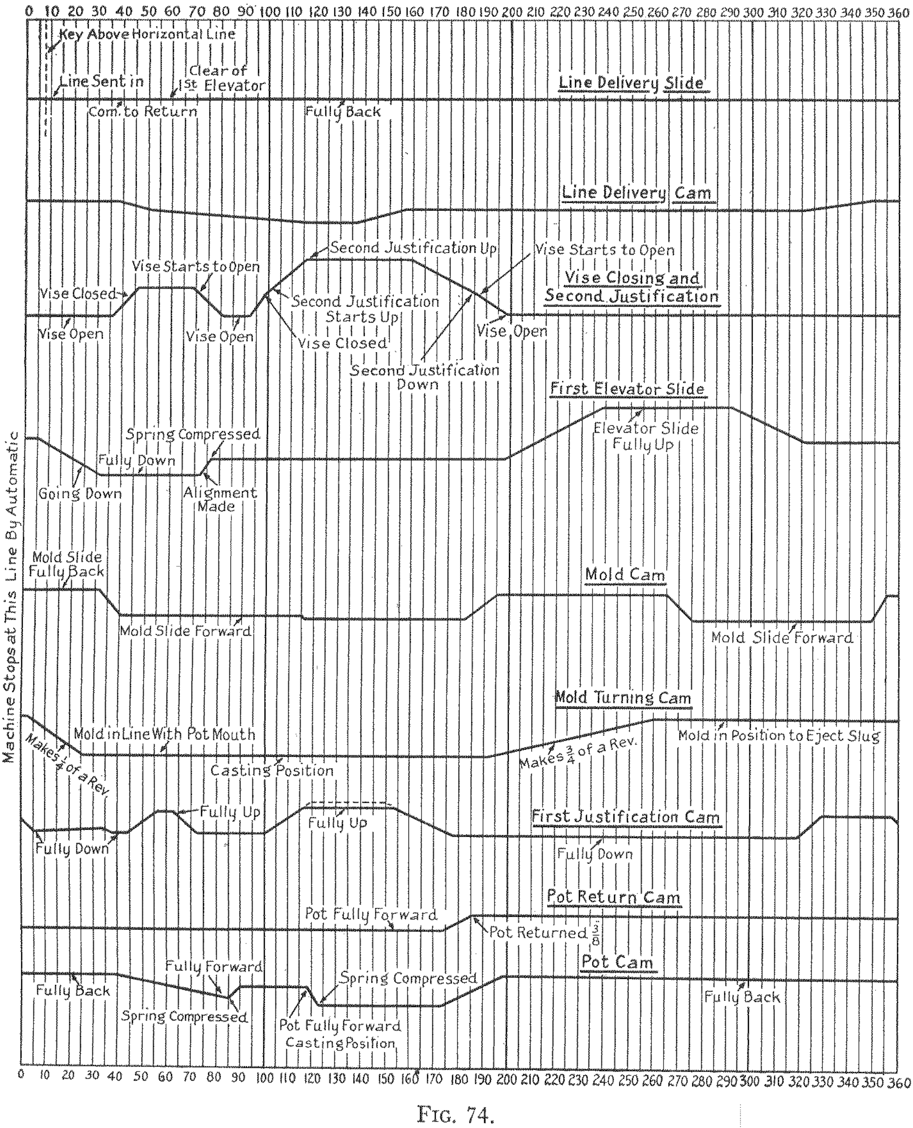

FIG. 74.

Figures 74 and 74a show the cam shaft actions by degrees of a circle. At the top of the chart are the degrees running by 10 degrees from zero to 360. The vertical lines, therefore, indicate 10 degrees of one revolution of the cam shaft. In this chart the cams do not follow the order of their number as given on Page 79. They follow the order of the actions of these cams.

The line delivery slide, which is not a cam at all, goes over to the left as you stand in front of the machine, and starts the main cam shaft. The straight line shows the number of degrees that the line delivery slide remains in position, and its return is indicated by the change in position of the line.

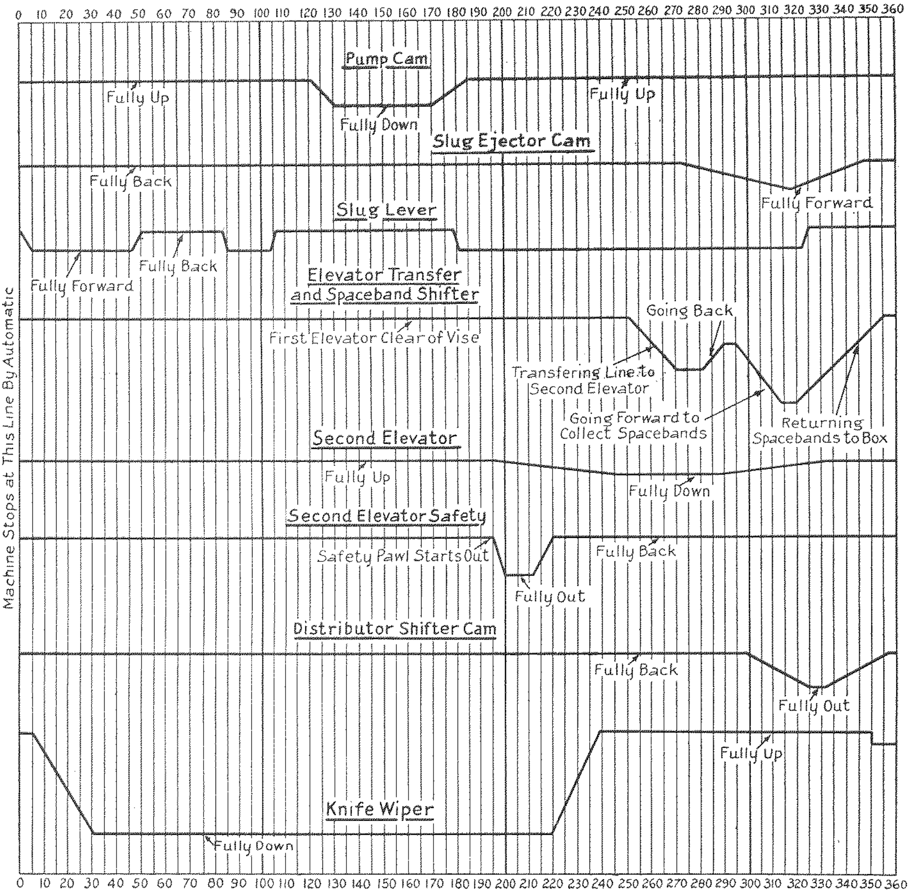

FIG. 74a.

In all these charts when the line goes downward it indicates a depression in the periphery of the cam. When the line goes upward it indicates a projection or "steep," as it is usually called, on the cam, and the number of degrees is indicated by the number of vertical lines traversed by the line indicating the cam.

This cam chart shows the relation of one cam to another and where the pockets or "steeps" of the cams come in relation to each other. A little study will make the action of the cams plain. In these charts the actions follow one another as is done in one full revolution of the main cam shaft.

Fig. 74 shows performance of line-delivery slide (by Cam No. 1), line-delivery cam (Cam No. 10), vise-closing and second justification (Cam No. 4), first-elevator slide (Cam No. 1), mold cam (Cam No. 9), mold-turning cam (Cam No. 3), first justification cam (Cam No. 5), pot return cam (Cam No. 9), pot cam (Cam No. 8).

Fig. 74a continues with: pump cam (Cam No. 7), slug ejector cam (Cam No. 9), slug lever (Cam No. 9), elevator transfer and spaceband shifter (Cam No. 10), second elevator (Cam No. 6), second elevator safety (Cam No. 10), distributor shifter cam (Cam No. 2), and knife wiper (Cam No. 1).

right, the short lever will remain underneath the pump lever, and the pump plunger will not be allowed to descend. The object of this is manifestly to prevent a "squirt" of metal into the loose line of matrices.

THE CAM SHAFT

All the motions previously described, and others that have not yet been mentioned, are caused by the revolution of the cam shaft. This cam shaft is mounted on bearings at the rear of the machine. These cams are very large in size, in proportion to the general dimensions of the machine. This has proved, however, to be good designing, because the wear on the cams is distributed over so large a surface. Many of these cams have run for twenty years or more without serious wear.

The timing of the different motions in the Linotype machine is caused by the shape of the cams and their position on the cam shaft. All of the cams are fastened to the cam shaft by a spline running the full length of the shaft, and the timing of the cams starts from this point. Fig. 74 is a cam chart, where the circumference is represented by vertical lines. The distance between these vertical lines represents five degrees of the circle of three hundred and sixty degrees traversed by the cam shaft in one revolution. On the cam chart, a line running parallel to the bottom of the sheet means that this portion of the cam is a circle having for its center the center of the cam shaft. When the line ascends it means that the "steep" of the cam departs from the center; and where the line descends, it means that the cam surface descends nearer to the center of the cam shaft. There are ten main cams upon the cam shaft, and their names, which are given on the cam chart, are as follows: 1, first elevator cam; 2, distributor-shifter cam; 3, mold-turning cam; 4, vise-closing cam; 5, justification cam; 6, second-elevator cam; 7, pump cam; 8, pot cam; 9, mold cam and driving gear; 10, delivery and elevator-transfer cam.

Fig. 75 is a rear view of these cams, and the names of the cams are indicated by the numbers.

In nearly all cases the surfaces of these cams act upon levers through rolls, most of which are about two inches in diameter. Care should be taken that the bearings of these rolls are oiled occasionally, so that they do not get stuck, in which case the roll ceases to revolve and sometimes wears a flat place on the cam roller, entirely ruining it. Some operators oil the surface of the cam where the roll bears upon it. This is of no particular use.

The operation of the large cams on the cam shaft will at this time be described. The numbering of these cams was done a long time ago and to prevent confusion these numbers are retained. Reading from left to right as you stand in back of the machine cam No. 10 is at the left and so the cams are described in their numbering order.

Cam No. 1 is the first-elevator cam. This cam operates through the first-elevator lever upon the first-elevator slide. The cam, which is of a

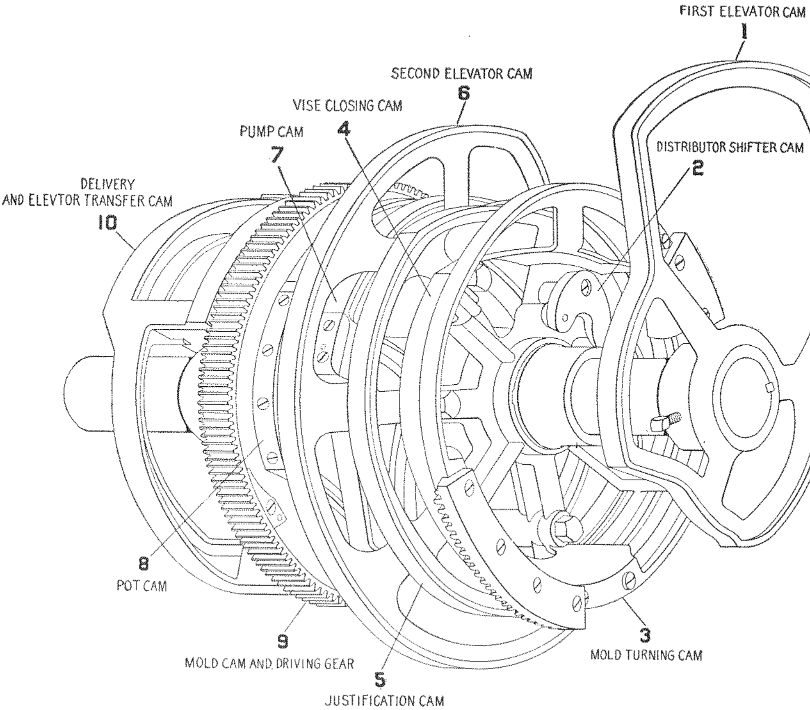

FIG. 75.—Cams assembled on the cam shaft. The cams are numbered, beginning from the right toward the left.

very peculiar shape, operates to place the first-elevator slide in five successive positions. First, the normal position, where it holds the first-elevator jaw in position to receive the line of matrices when sent from the assembler elevator; second, when the first elevator jaw is lowered to a point opposite the mold; third, after a slight upward movement to cause the alignment of the matrices; fourth, the raising of the slide so that the matrices and spacebands can be transferred to the intermediate channel; and last, bringing back the slide to normal position at which time the first-elevator jaw is ready to receive the line of matrices.

No. 2 is the distributor shifter cam which operates the distributor shifter lever and through it the distributor shifter slide, transferring the line of matrices from the second elevator at its highest position to the distributor box.

No. 3 is the vise-closing and mold-turning cam. This is a double cam or two cams in one casting. It operates the mold disk through two toothed segments, commonly called the long and short segments, to turn the mold disk at the proper time. The short segment turns the mold disk one quarter of a turn from the ejecting position to the casting position. The long

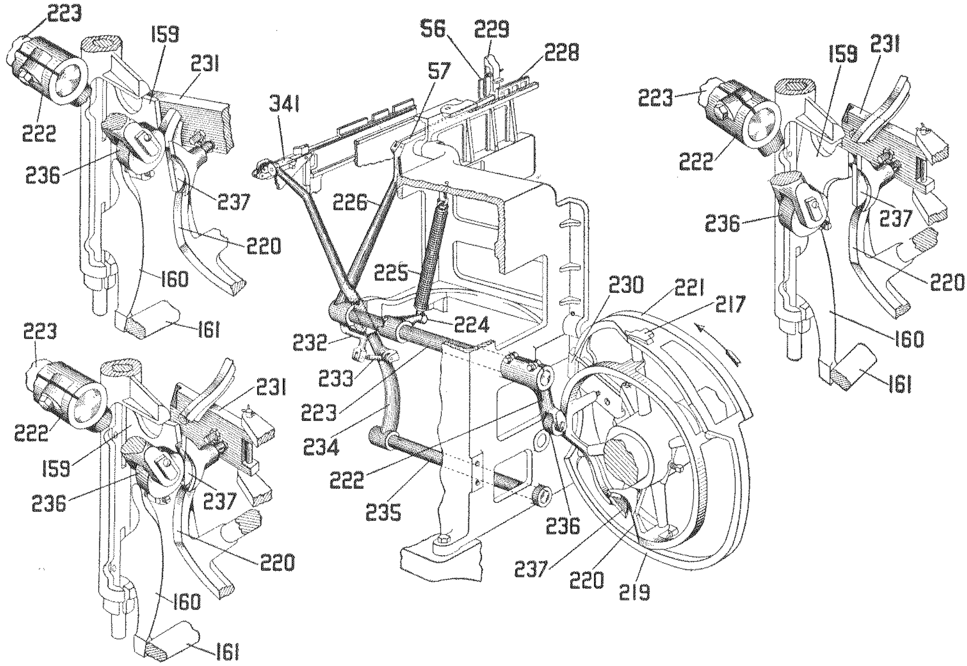

FIG. 76.—View showing line-delivery cam, starting and stopping cam, and elevator-transfer cam. These cams, while they work separately, are in one casting.

219 is the cam surface which controls the delivery of the line of matrices and spacebands from the assembler elevator to the first-elevator jaw and returns the slide, or transfer carriage after the line has descended to the casting point.

220 is the surface which controls the transfer of the line of matrices from the first-elevator jaw into the intermediate channel after the cast has taken place, and also controls the spaceband-delivery lever, which carries the spacebands into the spaceband box after the matrices have gone up on the second-elevator lever.

The cam *219* carries in the same casting the starting and stopping pawl *230*. The cam *220* carries the safety pawl *231*. The cam surface *221* operates to return the ejector lever and holds this lever so that it cannot move forward against the mold.

The functions of these cams will now be described separately. The line-delivery cam *219* has its surface so shaped that it delivers the line into the first-elevator jaw from the assembler stick. This has been more fully described in another view.

220 is the surface which operates the transfer carriage and the spaceband-delivery lever. Cam *220* operates through a short adjustable arm *222*, having a roll on the end which bears against the cam. The arm *222*, is mounted on a shaft *223*, which is mounted in the column. The shaft *223* has upon it another short arm *224* operated by a spring *225*.

The operation of the spring *225* tends to revolve the shaft *223* when the shape of the cam *220* allows it to do so. On the end of the shaft *223* is a lever *226*. The long arm of this lever *226* connects with a link *227* which connects to a sliding carriage *228*. Mounted upon the carriage *228* is an arm *229* of a peculiar shape, which is adapted to carry the matrices out of the first-elevator jaw into the intermediate channel on second elevator. The other end of the lever *226* is a short arm *232*, which connects by an adjustable link *233* with the spaceband-return lever *234*. This lever *234* is operated through the link *233*. The lever *234* is mounted upon a shaft *235*, which is mounted in the column of the machine.

The three small views are enlarged views of the safety device on the cam *220*. The arm *222* carries on its end a roller *236*. The shape of the cam *220* is such that when the roller *236* descends into the hollow, it strikes against the safety pawl *231* through a projection *237*. This pushes the safety pawl *231* out of the way so that it misses the starting and stopping pawl *159*. If, however, for a reason which will hereafter be explained, the lever *226* has not moved to the right, the roll *236* does not strike against the projection *237*, and the safety pawl coming against the lever *159*, operating through the lever *160* against the lever *161*, throws out the clutch and stops the machine.

segment turns the mold disk three-quarters of a turn from the casting position back to the ejecting position.

No. 4 is the vise-closing cam. This cam also has two actions. The first operates through the wedge the vise-closing mechanism, and the second action operates the justification lever in making the second justification.

No. 5 is the justification cam which operates the justification lever. The action of the cam presses down the justification lever and the motion upward is permitted by the shape of the cam, and this motion is caused by a powerful spring.

No. 6 is the second-elevator cam which operates the second-elevator lever. The second elevator transfers the matrices from the intermediate channel to the highest position where the matrices can be transferred to the distributor box. The second elevator is raised by the cam and goes down by gravity, being started by the operation of the second-elevator starting spring.

No. 7 is the pump cam. This operates the pot pump plunger through the link and the pump pot lever. The roll on the pot pump lever is continually urged downward by the pot pump spring and the shape of the cam allows this spring to act on a certain portion of the revolution of the

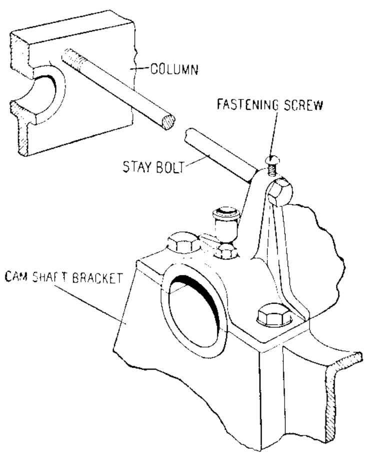

Fig. 77.—View of stay bolt supporting column against camshaft bracket.

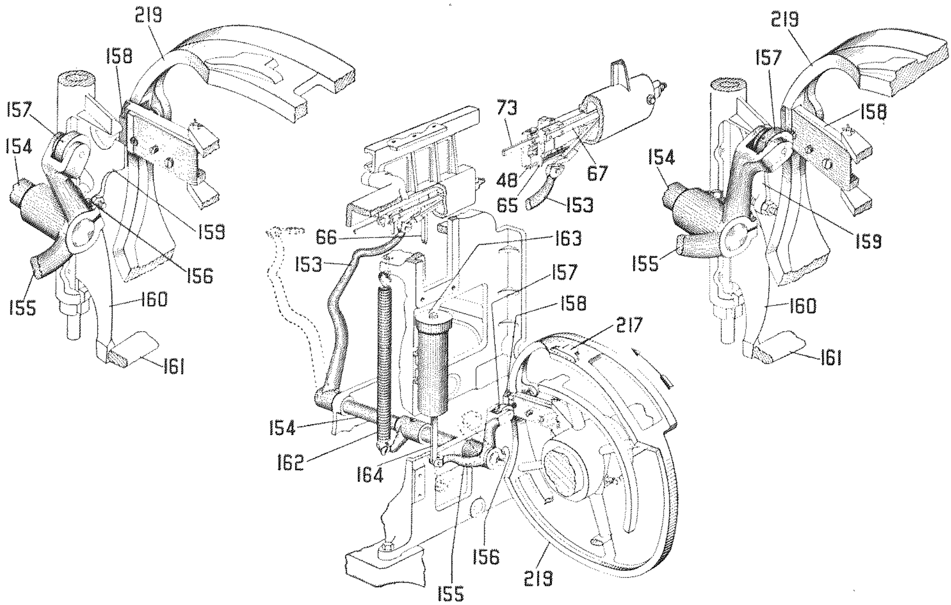

Fig. 78.—View of the automatic starting device, which causes one revolution of the cam shaft when the line of matrices is sent in to the first-elevator jaw. In this view *153* is the line-delivery lever. *154* is the shaft on which this lever is mounted. *155* is a short lever having two arms also mounted on the shaft *154*. The lever *155* is adjustable through the bolt *156*, which clamps the lever *155* upon the shaft *154*. At the end of the lever *155* is a roll *157* which strikes upon the automatic pawl, *158*. The starting pawl, *158*, is pushed sideways off the automatic starting and stopping lever *159*.

The right-hand figure shows the roll *157* at its innermost position, at which time the line has been delivered into the elevator jaw. As soon as the pawl *158* is pushed off the lever *159*, the lower part of this lever is thrown outward, the lever *160* is thrown inward, and through the forked lever releases the clutch spring, which causes the clutch to engage, and the cam shaft begins to revolve, and continues until the automatic stopping pawl *158* strikes upon the automatic stopping lever *159*, thereby throwing out the lever *160* and through lever *161* and the forked lever throws out the clutch and stops the machine.

The movement of the shaft *154* is caused by the strong spring *162*. The sudden action of the spring *162* is resisted by the piston inside of the cylinder *163*. The piston is connected by the shaft *164* to the lever *155*, and as this lever is clamped on the shaft *154*, as the piston compresses the air in the cylinder *163*, the sudden action of the spring *162* is cushioned so that the line when delivered into the first-elevator jaw comes to a stop slowly and not with a bang.

main cam shaft to pump the metal into the mold and against the matrices. After this pumping action has taken place the shape of the cam raises the pot pump lever and through it the pot pump plunger, thereby sucking back the unsolidified metal from the mold.

No. 8 is the pot cam. This cam acts on the pot lever to force the pot forward against the mold and matrices at the time the slug is cast. The shape of this moves the pot forward first against the mold and matrices making the face alignment. The pot is then withdrawn slightly for alignment and justification. The next movement forces the pot against the mold and matrices with great force and at this time the pump plunger descends casting the slug. The cam does not act directly upon the pot but on a pot lever. Between the pot and this lever there is a pot-lever spring. This acts as a safety device in case anything interferes with the proper movements of the pot.

No. 9 is the mold cam and driving gear. The periphery of this cam is circular and has 132 teeth in it. In the side of the cam there is a groove. This grooved cam operates to advance the mold slide carrying the mold disk to a position where the lugs of the matrices register with the grooves in the mold for the alignment of the matrices. After the slug has been cast it returns the mold disk to allow it to revolve and then moves the mold disk forward again at the time the slug is ejected. Mounted on this cam there is also a lug which withdraws the pot from the mold after casting and there is also mounted on it a pawl called the ejector pawl which operates the lever for ejecting the slug from the mold. This one casting, therefore, causes four operations.

No. 10 is the line-delivery and spaceband-shifter cam. This actuates the lever which transfers the matrix line from the first-elevator jaw into the intermediate channel. It actuates the lever which returns the spacebands. A lug on the cam carries the ejector lever back. This cam also acts to release the safety hook which locks the second elevator in position. It also carries the stopping pawl and the safety pawl, the first of which stops the shaft after it has made one revolution, and the safety pawl acts when some of the proper motions of the levers have not taken place.

The safety pawl operates usually when for any reason the second elevator does not come down to receive the line to be transferred from the first elevator jaw. This occurs when for any reason a line of matrices has not been pushed off the second elevator bar by the distributor shifter. This occurs when the distributor stops and the operator does not notice it and continues to send in a line. It occasionally happens when the operator is using a long line and is setting it very rapidly so that the line does not get out of the way before it is time for the second elevator to descend. In any of these cases the safety pawl acts and stops the revolution of the cam shaft until the line is cleared from the second elevator bar and the second elevator lever is lowered into position. When the transfer levers work they automatically knock off the safety pawl, thus permitting the cam shaft to complete its revolution.

It is sometimes necessary to hold the second elevator lever back a little so as to keep the second elevator bar and the bar in the distributor box in exact alignment. As soon as the matrices have been pushed off the second elevator bar the second elevator lever can be lowered.

Whenever the safety pawl acts, stopping the revolution of the cam shaft, the operator must immediately lock the spaceband transfer lever with the pawl on top of the intermediate channel until the second elevator bar has been cleared and lowered into position, at which time the operator unlocks the pawl and allows the transfer levers to work, thereby starting

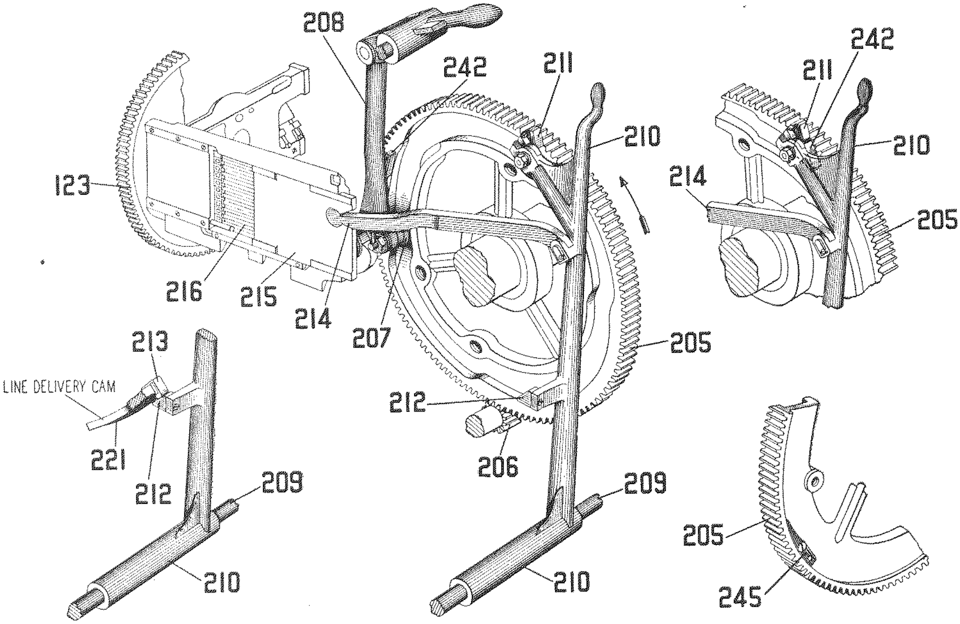

FIG. 79.—View showing the ejector lever and the cam which operates it, together with the large gear meshing with the pinion on the jack shaft. This gear causes the revolution of the main cam shaft.

205 is the gear meshing with the pinion *206*. There are 132 teeth on the gear *205* and eight teeth on the pinion *206*.

Near the circumference on the gear *205* there is a groove cam in which runs the roller *207*. This roller is mounted on a shaft which is mounted in a dependent lever *208*, and is connected with the mold slide.

When the gear *205* revolves, the shape of the groove cam causes the mold slide to go forward, carrying the mold against the matrices at the proper time, holding it there during the casting operation, and withdrawing it again to its normal position.

Mounted on a shaft *209* is the ejector lever *210*. This lever *210* has upon it two lugs *211* and *212*. Mounted on the rim of the wheel *205* is another lug *242*. This lug *242* engages with the lug *211* at a certain point in the revolution of the gear *205* and carries the lever *210* forward.

On the lever *210* there is a link *214*. This link *214* connects with a slide *215*, called the "ejector slide." This ejector slide *215* pushes the ejector blade or blades *216* forward so as to eject the slug. The ejector blade is described more at length in another place.

When ejector cam *242* has passed ejector pawl *211* the lug *213* on delivery cam engages the ejector lever shoe *212* and pushes the ejector lever *210* back to its normal position.

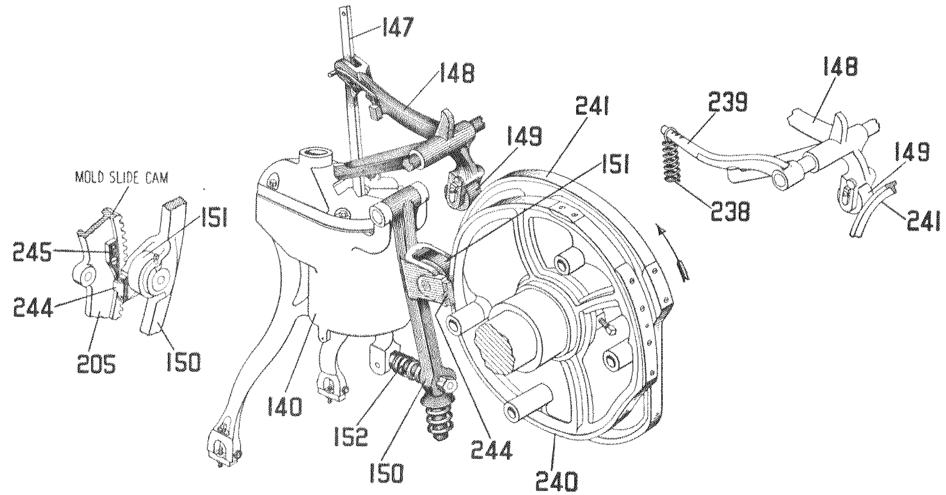

FIG. 80.—View showing the pot cam *240*, the pot lever *150*, and the spring *152* in their relation to the pot jacket *140*. This figure also shows the pump cam *241*, the pump lever *148*, the pump roll *149*, and the pump plunger lever *147*.

The shape of the pot cam *240* is such as to press the pot forward through the roll *151*. Through the lever *150* and the spring *152* the pot crucible goes forward to effect the face alignment of the matrices at the proper time, goes back a little for vertical alignment, and holds the pot firmly against the mold at the time of casting, and then retracts it after the casting.

The pot, after the cast is made, usually goes back by its own gravity. In case, however, it does not, there is a lug *244* on the lever *150*. A small cam *245* in the mold-slide cam engages with this lug *244* and pulls the pot back positively.

The shape of the cam *241* is such as to hold the roller *149* in a position to keep the pump shaft *147* and the pump plunger stationary until the time when the cast is to be made. A "steep" on the cam then allows the roller *149* to descend toward the center of the cam very quickly, and through the force of the pump spring *238*, the pump plunger is caused to descend and force the metal into the mold.

the machine. It is best to hold the spaceband transfer lever with the fingers so that the action of the transfer levers which is caused by a spring, shall not be too violent. After a little practice and experience the operator can make this transfer very smoothly.

DRIVING MECHANISM

The main cam shaft is caused to revolve by a mechanism that will now be described. A short shaft is mounted below the main cam shaft, sometimes called the "jack shaft." The jack shaft has a small pinion upon it, as shown at *206*, Fig. 79. This pinion registers with the teeth on the large driving cam *205*, shown in Fig. 79. The outer end of this jack shaft is hollow and inside of it there is a rod carrying a smaller shaft. Around this rod there is a spring, bearing against a collar, shown in Fig. 85. The spring tends to push the rod inward. The inner end of the rod is held by a long screw, having a pin on the end of it, to the collar, shown in Fig. 85.

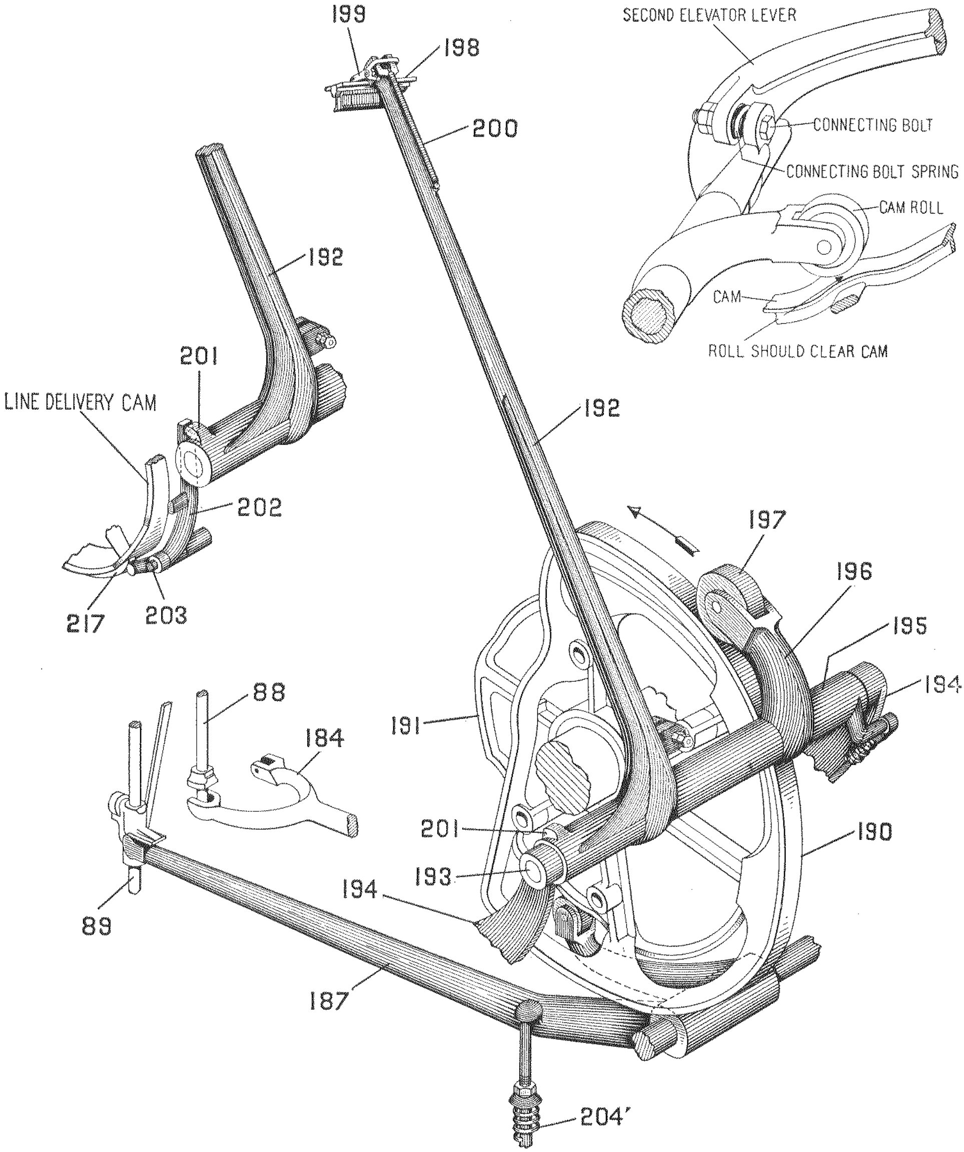

FIG. 81.—View of the second-elevator lever cam *190* and the justification cam *191*. These two cams are in one casting. The second elevator *192* is mounted on a shaft *193* supported by bearings *194* which fasten on to the main frame.

The lever *192* is in one casting with a sleeve which bears on the shaft *193*. Another casting, *195*, is also mounted on the shaft *193* and this casting has upon it an arm *196* and roller *197*. The casting *195* and the casting which carries the lever *192* are connected together by a bolt and screw. This bolt passes through two projections on each of the castings. Between these lugs or projections is a short spring. This spring performs several important functions. It is used for final adjustment and it also prevents damaging the distributor shifter slide if a sudden mishap occurs to it, causing it to stop in the path of second elevator. The spring cushions the blow and saves distributor slide and prevents breaking the second elevator cam lever *195*. It acts as a cushion when second elevator enters the distributor shifter guide.

The roller *197* bears on the cam *190* and the periphery of the cam is such as to raise and lower the second-elevator lever *192* at a certain portion of the revolution of the main cam shaft and hold it stationary in its upward position during the remainder of the revolution of the main cam shaft.

At its upper end the second-elevator lever carries a short section of distributor bar mounted in a plate *198*. *198* is held to the lever *192* by a short lever *199*. This bar *199* is held normally in a certain position by a spring *200*. The bar *199* is constructed so that it may have a limited motion around its pivot point.

The sleeve carrying the elevator lever has at its left-hand end, as you stand behind the machine, a lug, or projection *201*. This lug, or projection, *201* engages with a short lever *202* which is mounted on a short shaft *203*. A short arm of this lever is engaged by a projection *217* on the cam *190*. (See also Fig. 76, delivery cam *219*.)

In the revolution of the machine, if the upper transfer lever has acted properly, the projection *217*, acting upon the short arm of the lever *202*, pushes the upper part of said lever out of the way of the projection, or lug, *201*, allowing the lever *192* to descend to receive a line of matrices. If, however, the transfer lever has not functioned properly the lever *202* will not be thrown out of the way, and will cause the second-elevator lever *192* to be stopped in its descent. In this case the safety pawl on the starting and stopping cam will stop the revolution of the cam shaft so as to prevent harm to the mechanism.

This pin passes through a slot in the shaft. The collar goes around the shaft. The slot in the shaft extends lengthwise of the shaft, so that when the collar is moved longitudinally the rod is likewise moved. Resting against this collar is a fork formed on the end of a lever *161*. When the forked lever *161* presses upon the collar it overcomes the pressure of the spring *171* and tends to move the rod outward. When the pressure upon the forked lever is released the spring *171*, acting upon the rod, tends to draw the rod inward. The outward movement of the rod releases the clutch; the inward movement of the rod engages the clutch.

Very little attention needs to be paid to this mechanism in the jack shaft. This spring ordinarily will last a long time. The only cause for difficulty in this part of the mechanism is due to the leathers mounted on the arms which press against the inside of the main driving wheel. These leathers should be kept clean and should not be allowed to get soaked with oil and dirt. It is necessary once in a while to take off these leathers, clean them, and replace them with a piece of hard paper underneath the leathers to compensate for the scraping that has been done which lessens the thickness of the leather.

Once in a great while the spring gives out and must be removed and stretched a little to give it more tension. The inside rim of the main driving clutch should be cleaned every day and wiped dry. Graphite, oil or greasy dirt will make the clutch slip and it will fail to eject.

Some machinists use rosin, printers' ink, belt dressing and other substances of this kind to make the clutch leathers adhere and pull. This prac-

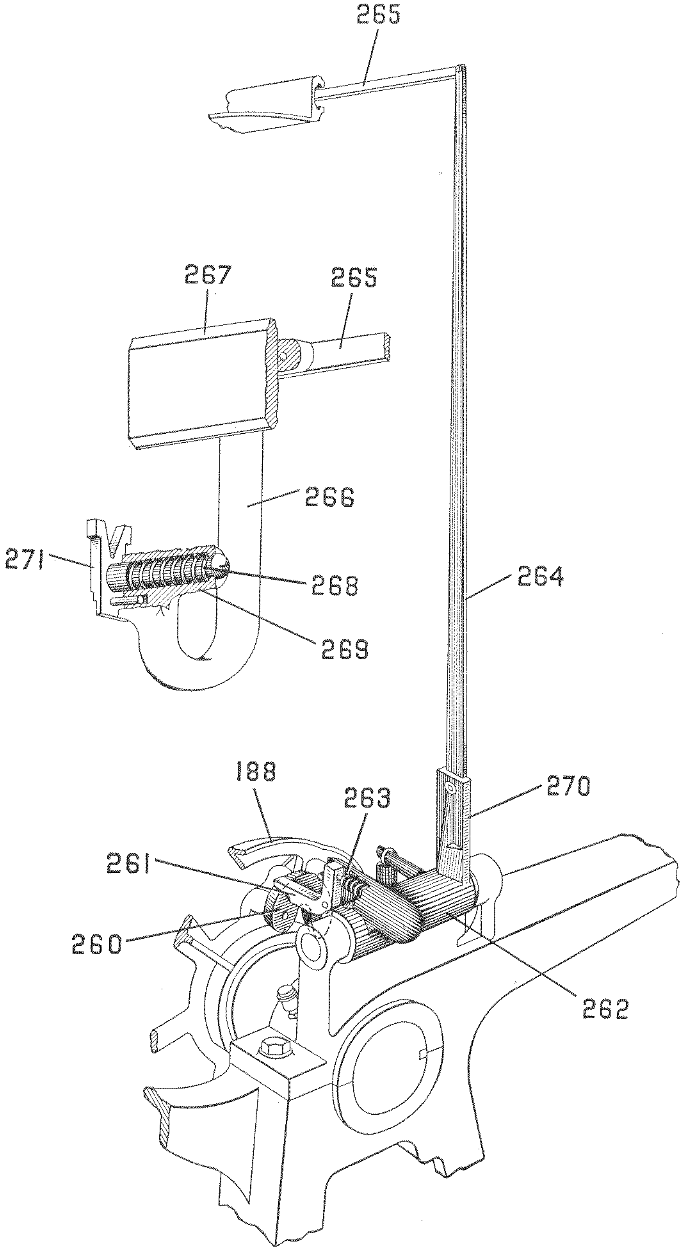

FIG. 82.—View shows distributor shifter cam *260* mounted on mold-turning cam. This cam operates through a small bell crank lever *261* through a spring *263* which acts as a safety device if distributor slide *266* catches or stops, as stated in previous Fig. 81. The spring compresses and prevents the lever *266* from breaking. The lever

262 is mounted on a shaft on the mold-arm bracket. The lever *262* has a short arm *270*, in which is mounted a long lever *264*, which carries at the upper end a link *265*. The link *265* at its upper end is connected with the distributor-shifter pusher *266*. The distributor-shifter pusher *266* has at its upper part a slide *267* adapted to run in grooves in the distributor beam.

The lower end of the distributor-shifter pusher *266* is curved and carries a pusher *271*, mounted on the spring in a short barrel. The spring *268* has a slight movement in the barrel *269*, which is in one casting with the distributor-shifter pusher, with which it functions.

tice is not a good one and should never be necessary. If the leathers are clean, the spring has the proper tension, and there is nothing wrong with the other mechanism in the machine, the clutch should work perfectly and give no trouble in ejecting the slugs or in revolving the main cam shaft with a regular motion.

On the outer end of the rod are mounted two levers, that act upon two spindles. These spindles are mounted upon the clutch wheel. These levers *174* act upon these spindles through a sort of toggle joint. At the outer side of these toggle joints there are surfaces faced with leather. When the rod *172* is pushed outward by the forked lever *161*, previously described, the leather surfaces are drawn away from the inside surface of the driving pulley. When the forked lever is withdrawn, allowing the spring *171* to act, the spring pulls the rod inward, and acting through the levers and the toggle joint described, presses the leather surfaces against the rim of the driving pulley, making a friction clutch. This clutch carries the pulley around, which drives the cam shaft through the pinion *206* mentioned. The cam being fast to the main shaft carries it around. When one revolution of the cam shaft has taken place, a dog on the cam strikes against the forked lever *161*, pushing the collar, overcoming the spring *171* on the rod, pushing the levers *174* outward, releasing the pressure of the leather surfaces upon the driving wheel, whereupon the cam shaft stops.

It is important that the leather surfaces of the clutch be kept dry and free from oil and dirt, and that the inner surface of the driving pulley be kept clean. It is necessary at times to unscrew the nut *173* and remove the clutch arms and scrape the leather surfaces to cleanse them and roughen them up so that they will take hold promptly. Before doing this, the position of the nuts should be noted, so as to replace them as before removal. This nut *173* is the adjustment for the pressure of the spring, and by screwing it in or out a little, the tension of the spring may be increased or diminished. Sometimes after long use the spring loses its tension, and it is necessary to take out the spring and stretch it. As the friction clutch described is the driving mechanism for the whole machine during its cycle of operation, for the smooth and effective working of same it is important that the clutch should work smoothly and effectively; hence this part of the mechanism should not be neglected.

In this connection it may be well to speak of the driving power.

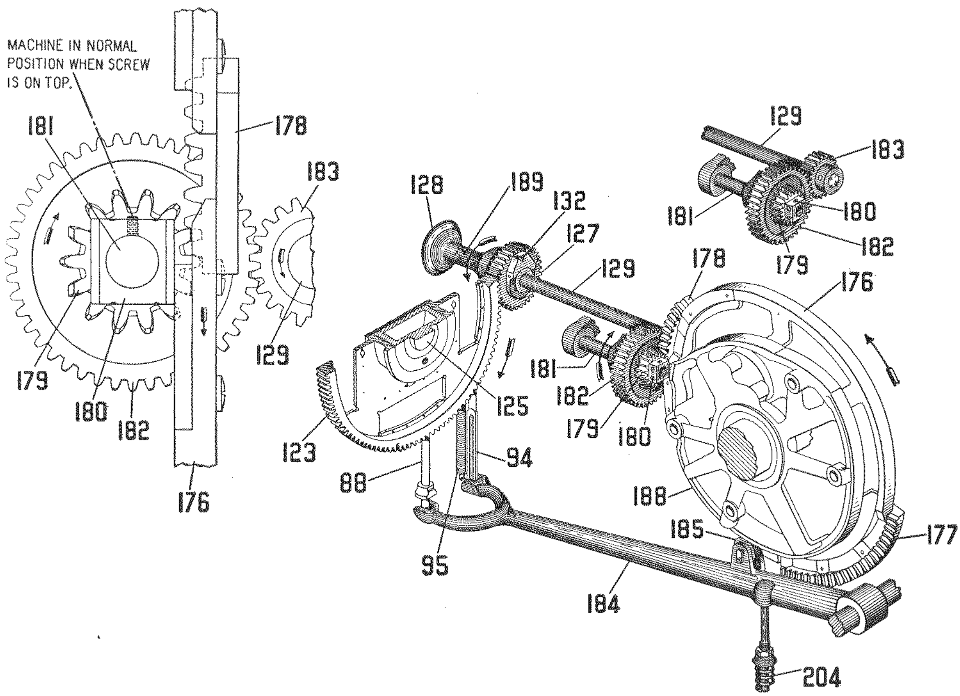

FIG. 83.—View showing the mold-turning and justifying cam and the method by which the mold disk is revolved and held in position at the points of casting and ejection. *176* is the cam casting. *177* is the long segment and *178* the short segment. These segments *177* and *178* are portions of a circular beveled gear and are fastened to the cam casting *176*. These segments in the revolution of the cam at certain parts of the revolution engage with the beveled pinion *179*.

Just back of the beveled pinion *179* is a square block *180*. This block rides on a surface of the cam casting *176*. This surface is cut away at certain points so as to permit the block *180* to revolve. At this time the segments *177* and *178* are in mesh with the beveled pinion *179*.

While the block *180* is riding on the inside surface of the cam *176*, the beveled pinion *179* cannot turn and the shaft *181*, on which the beveled pinion is mounted, is also held against revolution.

In front of the beveled-gear pinion is a spur pinion *182* mounted on the shaft *181* and fastened to it. This pinion *182* is in constant mesh with a pinion *183* mounted on a shaft *129*. This shaft runs forward and has at the front end of it another pinion *127* mounted.

When the segments *177* and *178* are in mesh with the beveled pinion *179*, the shaft *129* is caused to revolve through the spur pinions *182* and *183*. When the segments *177* and *178* are not in mesh, the block *179* holds the shaft *129* stationary. This arrangement is what is known in mechanics as a "Geneva lock".

It will be noted that on the pinions *177* and *178* the tooth that engages first with the beveled-gear pinion is partly cut away.

The pinion *127* is not fast to the shaft *129*, but is held to the shaft by a device which embraces a hand wheel *128* and a pin *132*, shown in another view. The pin *132* engages in a hole in the pinion *127*, and is held in this position by a spring *189*, not shown because it is inside of the pinion.

It will be readily seen that the revolution of the cam *176*, acting through the sectors *177*, *178*, the beveled pinion *179*, the spur gears *182* and *183*, will revolve the shaft *129*, turning the pinion *179*, and thereby revolving the mold disk *123*.

On the other hand, when the block *180* is riding upon the surface of the cam *176* and the sectors are not in mesh with the beveled pinion *179*, the shaft *129* is held against revolution and the mold disk is likewise held. This is at the time when the casting and ejecting take place.

184 is one of the justification levers which also carries the locking and unlocking devices described in another place. Through the roller *185* this cam bears against the justification cam surface *188*. The justification lever *184* is urged upward continually by the justification spring *204*. The cam surface *188* is of a shape to allow the spring *204*, acting through the lever *184* to force upward the spacebands for the justification of the line illustrated and described elsewhere.

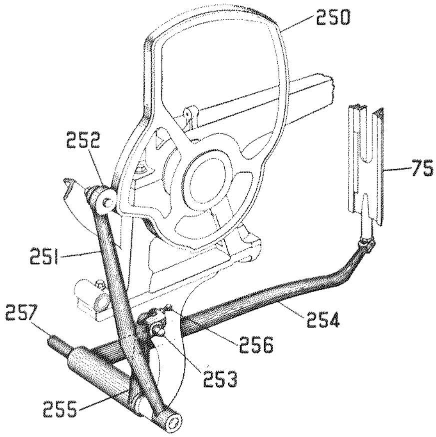

Fig. 84.—View of the first-elevator slide cam. In this view *250* is the cam surface. This surface has a very peculiar shape and gives to the first elevator five different movements in the course of one revolution.

The cam surface *250* acts against the lever *251* through the roll *252*. The lever *251* has a lug, or projection, upon it, and in this lug, or projection, a bolt *253* passes through, connecting the elevator lever *251* to another lever *254* through a short arm *255*.

The bolt *253* passes through a hole which is not round, but slightly enlarged laterally, and a bolt *256* makes a slight adjustment between the levers *251* and *254*.

The outer end of the long lever *254* connects with the first-elevator slide *75* through the spring barrel.

Both the levers *251* and *254* are mounted on a shaft *257* which is supported in bearing on base.

Just above has been mentioned the subject of the clutch and sometimes the clutch is suspected of being wrong and attempts are made to fix the clutch when the trouble is with the power or the application of it to the driving of the machine. Most Linotypes are now driven by individual motor and these motors are nominally one-third horse power and use both A.C. and D.C. current. In different places and offices on account of the voltage and various other causes the machine sometimes runs irregularly, running faster at one time than another. It is important that when the cam

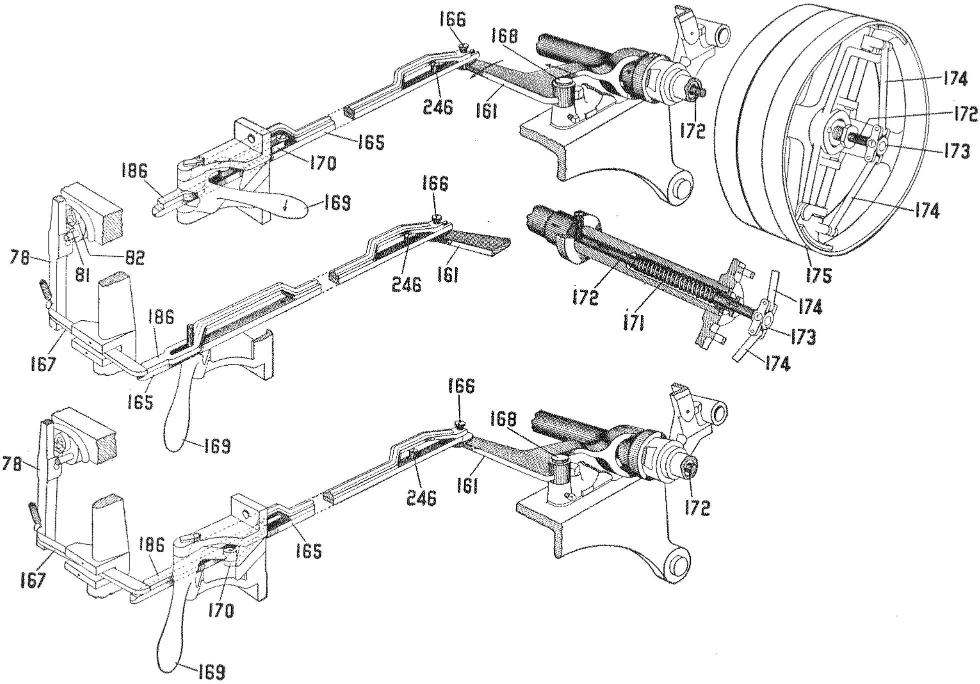

FIG. 85.—View of the starting and stopping lever in various positions and the connections of this lever to the driving shaft friction clutch.

169 is the hand lever by which the operator can start or stop the cam shaft at any period of its revolution.

165 is a rod which connects the lever *169* with the lever *161*. This lever is forked over the driving shaft. This fork works against a collar on the driving shaft to throw out the clutch.

172 is a rod running inside of the driving shaft and is actuated inward by a spring. When this spring is permitted to act it engages the clutch causing the driving shaft to revolve and the cam shaft to make its revolution.

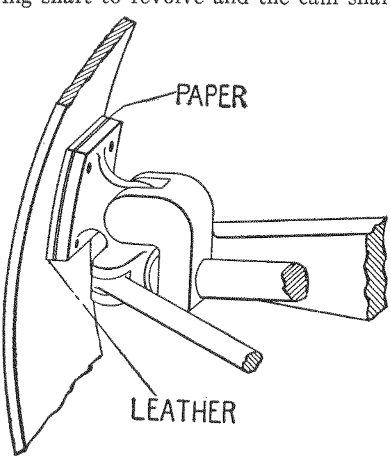

FIG. 86.—Diagram showing a method of packing out the leathers in the clutch. If these leathers become worn, if the clutch is removed from the machine and a piece of hard manila paper placed underneath the leathers, it will pack them out so that they can be used for a longer period. This packing operation with paper can be renewed several times before the leather is completely worn.

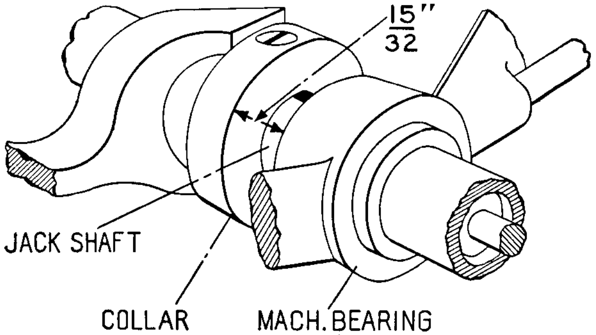

FIG. 87.—Diagram of the operation of the clutch, showing the jack shaft, collar, the bearing of the machine, and the distance that the collar should stand from the bearing of the machine, as set forth in the description.

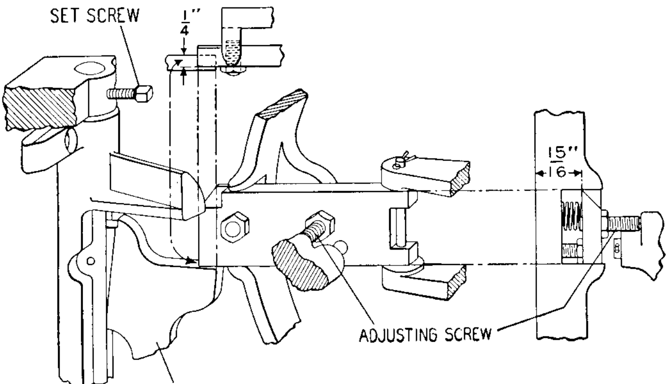

FIG. 88.—View of the stopping mechanism of the machine, showing the distances for adjustment when the machine stops in normal position.

shaft starts to revolve that it should revolve at a regular speed and that the power required to drive it be furnished so that when the cam shaft is revolving the distributor and other parts of the mechanism of the Linotype will not slow down. When this occurs it may cause transpositions in the assembler and bad distribution.

In some cases the machine is driven by a belt connected to a main shaft. When this is the case the shaft should have an independent power. It is not well to have the machine connected to any shaft that drives other mechanism because in this case there may be irregular motion of the cam shaft, resulting in the troubles above mentioned.

THE LOCK-UP

The lock-up of the pot crucible against the mold, and the mold against the matrices, and the matrices in the jaw against the vise cap at the time of casting, have been previously mentioned, but will now be described in more detail. The smooth working of the machine depends very much upon a good lock-up. A good lock-up requires that the mouthpiece be straight and smooth, and exactly parallel to the mold. At the bottom of the lugs on which the pot crucible is mounted is an adjustment, both vertical and

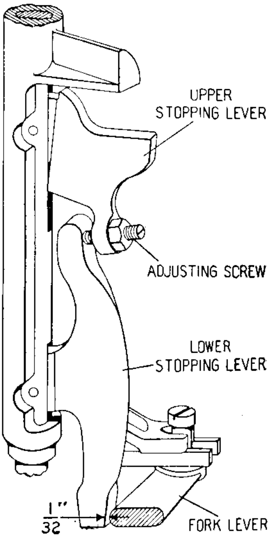

FIG. 89. — Diagram of the starting mechanism, showing also the adjustments and the distances for clearance.

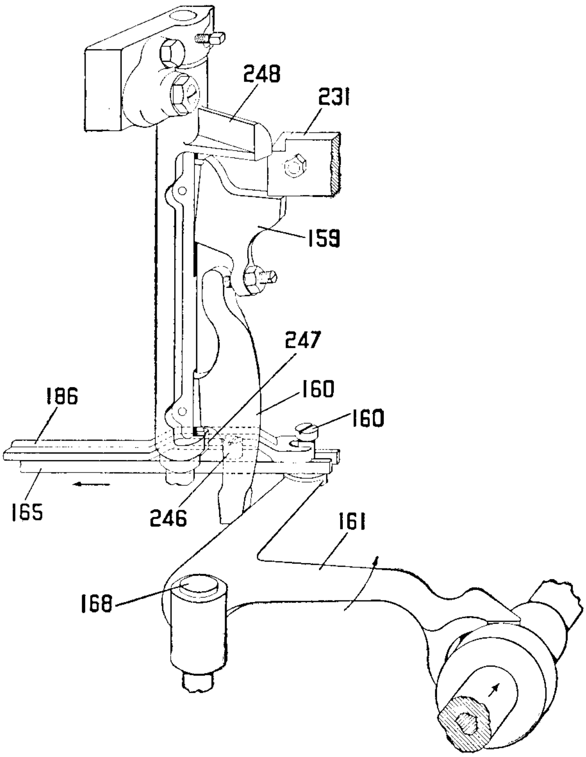

FIG. 90.—Diagram of the starting and stopping pawls, levers, and bell-crank, which act on the driving clutch.

161 is the bell-crank. *160* is the lower lever. *159* is the pawl. *231* is the starting and stopping dog. *248* is the lug on lever which knocks off the automatic stopping pawl when the handle *169*, shown in Fig. 85, operates the lever *186*.

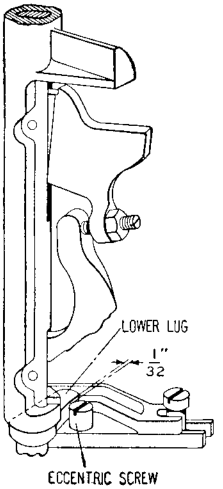

FIG. 91.—Adjustment and distances for the hand-stopping lever.

horizontal, as shown in Fig. 64, by which the pot and the mouthpiece may be adjusted, so as to get this parallelism. The mold is mounted in the mold disk, which is mounted on the mold slide. The mold slide does not fit closely in its guides, and should not do so. There should be a slight looseness in the mold slide sideways, so that the mold can adjust itself to a slight degree when it comes upon the mold-banking pins on the vise frame. The first-elevator jaw, in which the line of matrices is contained, is backed up at the time of casting by the vise cap and the vise frame. Therefore it is necessary that the vise frame and the vise cap should be also exactly parallel to the mold. There is no mechanical adjustment for the vise frame, but a slight change can be made by putting in thin washers in the locks that hold the vise frame to the main frame of the machine.

TESTING THE LOCK-UP

The Linotype machine, as it leaves the factory, has the lock-up in proper relation. In the operation of the machine, however, the heat is suddenly applied to the mold from fifteen hundred to two thousand times a day, and a quick cooling process follows. This very rapid heating and

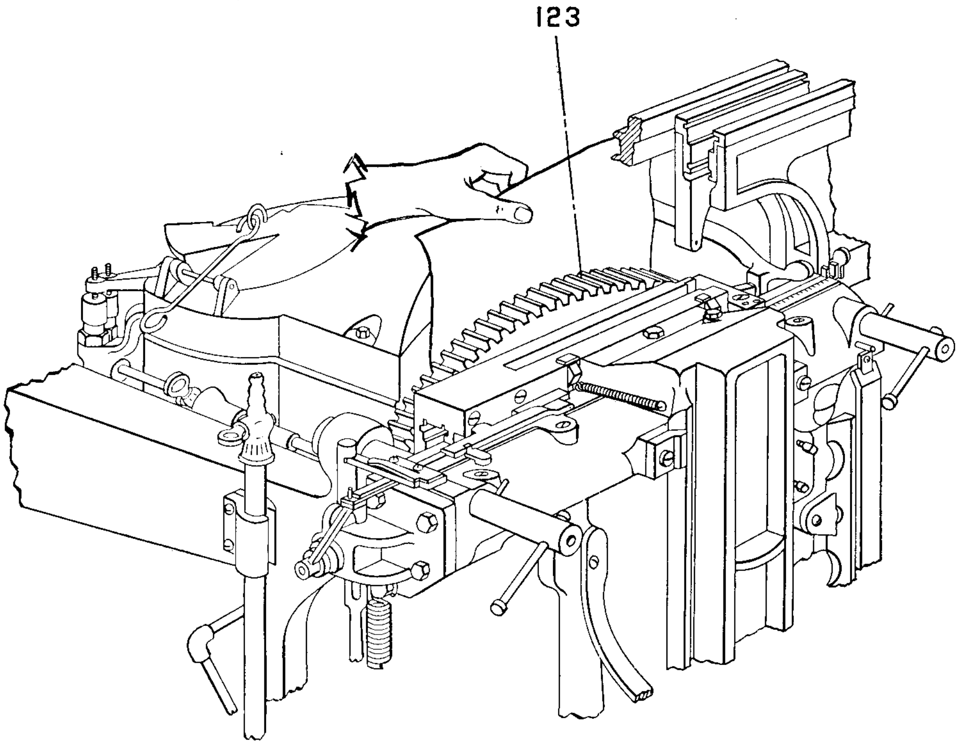

FIG. 92.—View showing the means of inserting a piece of tissue paper between the mouthpiece and the mold in testing the lock-up.

cooling of the mold sometimes causes it to warp slightly. The action of the machine may in time derange the lock-up so that it must be brought back to proper position. The same conditions of heating and cooling make the mouthpiece go out of shape slightly at times. Any derangement of the lock-up permits the escape of the molten metal, which, of course, must be avoided.

It may be generally assumed that the vise cap is in the proper position and the first thing to find out is whether the first-elevator jaw comes back against the vise cap properly. This will always be the case unless

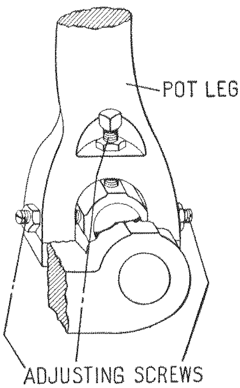

Fig. 93.—View of the bottom of the pot jacket leg, showing three adjustment screws and lock nuts. The adjusting screw at the top is for height and the adjusting screws on the sides for the position from front to rear. By the use of these adjustments the holes in the mouthpiece can be brought into exact line with the mold in the mold-disk.

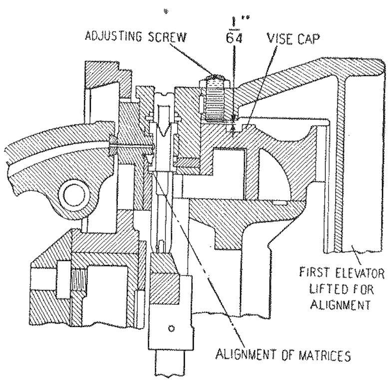

Fig. 94.—This is a small view of the "locker," as it is called, showing the first-elevator jaws, the vise cap, the line of matrices and spacebands, the mold against the same, and the pot crucible against the mold, at the time when the cast takes place.

This view also shows the means by which the alignment takes place through the lifting of the first elevator, bringing the lower lugs of the matrices against the mold.

the first-elevator jaw has been bent or sprung in some way, in which case, of course, it must be straightened. The vise cap must support the first-elevator jaw at the time of the lock-up.

The mold should then be brought against a line of matrices (using a full 30-em line) with a piece of tissue paper between the matrices and the mold. This will show whether the mold is warped on its front side. In making this test care should be taken that the mold is in its proper position in the mold disk and that the screws holding it to the disk are tight.

If a smooth even bearing is obtained along the whole length of the line of matrices a piece of tissue paper should be put in back of the mold disk between the mold and the mouthpiece. The mouthpiece should then be brought up against the mold and the line of matrices. The tissue paper will show whether there is a good bearing along the whole line. Some machinists prefer to use red lead on the mouthpiece instead of using the tissue paper. It is at this point that the lock-up is most likely to be found defective. If there is not a good bearing of the mouthpiece against the mold, the mouthpiece must be trued up and made to fit against the mold. This is an operation requiring some skill in the use of a file and should not be done by any one who has not such skill. If the machinist or operator has never adjusted the lock-up it is better to have an experienced Linotype machinist perform this operation, and he should be carefully watched by the one in charge of the machine. Like many other things, the adjustment of the lock-up is not a very difficult matter if you know how. A good lock-up, however, is absolutely essential to the efficiency of the machine. Much time is lost in cleaning out squirts and it is easy to damage matrices and the machine in such cleaning.

GAS BURNER

The ordinary gas burner using illuminating gas is of the Bunsen type, and contains a device for mixing air and gas in proper proportion, so that the mixture will burn with a blue flame. A subsidiary pipe is carried from the burner underneath the pot to a burner directly underneath the mouthpiece. The control of the gas is by means of an ordinary stop-cock and a device known as a "thermostat governor."

The metal should have a temperature of between five hundred and thirty and five hundred and sixty degrees Fahrenheit. The governors must be adjusted so that when the machine is working regularly the metal will not fall below five hundred and thirty degrees, and when it gets to five hundred and sixty degrees will be partially shut off, so as not to allow the heat to increase beyond that point.

THERMOSTAT GAS GOVERNORS

The action of the Thermostat and the method of regulating it should be thoroughly understood in order to get the best results from the gas burner.

The principle upon which the Thermostat is built, is the difference in expansion of two metals under heat.

That part of the Thermostat which is immersed in the metal, being cast iron and having a hole or pocket in it, in which is a rod of composition metal the upper end of which.operates a lever due to the expansion of the rod being greater than the cast iron, and the lower end pushing against the bottom of the hole, or pocket. The lever in turn at its other end operates a valve which closes the gas inlet when the heat from the metal expands the rod, and as it contracts the gas inlet is again opened.

In Fig. 95 *A* represents thermostat casting, *B* expansion rod pushing against lever *C*, which is hinged at *D*. The other end of lever *C* operates valve *E*, through screw *F* and spring *G* with locknuts *H*. Spring *I* raises valve as expansion rod *B* contracts, which opens gas inlet, and also keeps expansion rod pushed to bottom of pocket. Spring *G* is simply a safety spring, and only works when for any reason the gas valve is entirely closed and the expansion rod keeps on expanding. It provides for an overthrow and prevents breaking of other parts. This spring *G* should always be

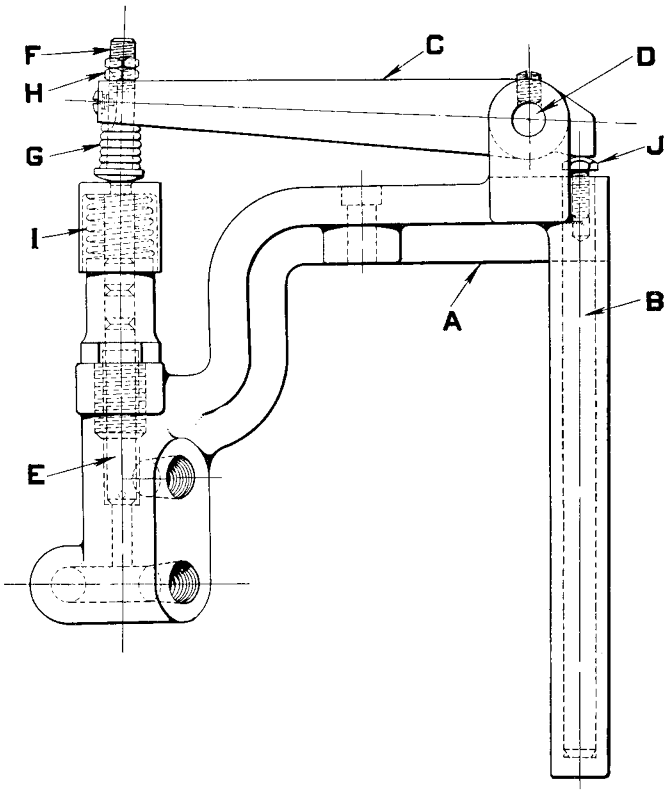

FIG. 95.—*A*, Thermostat Casting; *B*, Expansion Rod; *C*, Lever; *D*, Fulcrum Pin; *E*, Valve; *F*, Adjusting Screw; *G*, Safety Spring; *H*, Locknuts; *I*, Overthrow Spring; *J*, Adjusting Screw.

stronger than spring *I*, but locknuts *H* should never be screwed down far enough to close coils of spring *G* so it will not operate.

To adjust thermostat if metal is not hot enough, screw locknuts *H* farther down, so as to raise screw at *F* in Fig. 95, which makes it necessary for expansion rod *B* to expand farther to close off gas. If metal is too hot, unscrew locknuts *H*, which makes gas valve close quicker.

Do not disturb or adjust screw *J*, unless in making adjustment for too hot metal, locknuts *H* are unscrewed so far as to make spring *G* weaker than spring *I*. If this occurs it will be necessary to unscrew *J* so as to make expansion rod longer and readjust locknuts *H*, until spring *G* is stronger than spring *I*. To adjust screw *J* it will be necessary to take out hinge pin *D*, and take expansion rod *B* out of the casting.

In the lower end of valve *E* is a small hole to prevent the burner going out if valve is entirely closed. *This hole must not be enlarged.*

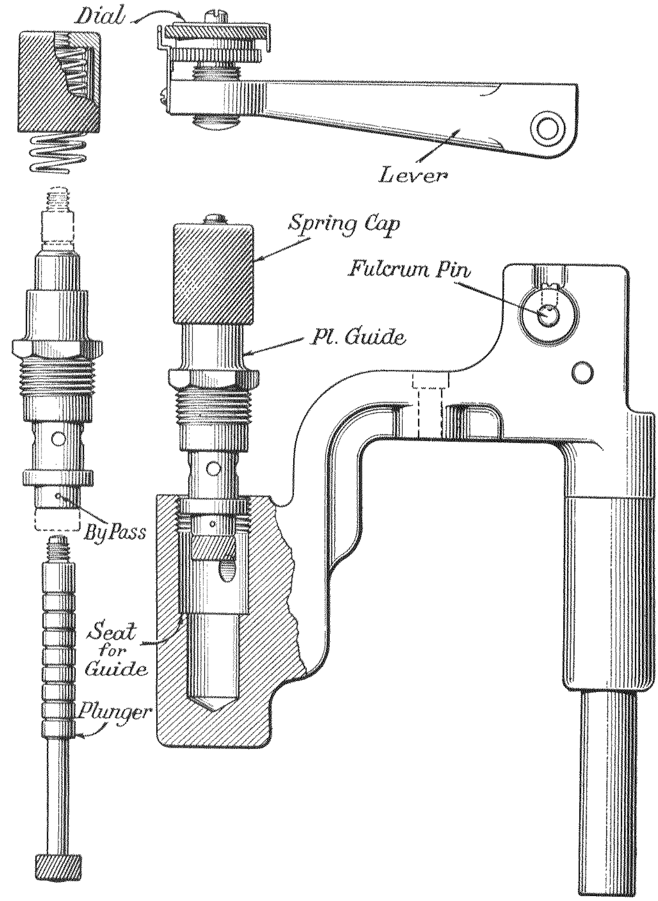

Fig. 95a.—Improved Thermostat.

IMPROVED THERMOSTAT

Above, in Fig. 95a, is shown a greatly improved thermostat which is now applied to all new Linotypes. The basic principle is somewhat similar to that shown in Fig. 95, but its mechanical design and operation permits of greater ease in adjustment and sensitivity in action. This thermostat is easily disassembled for cleaning if the directions are followed closely. It is extremely sensitive to fluctuation of gas pressure and will control the temperature of metal within close limits. Each thermostat is calibrated and tested under actual working conditions at the factory and adjustments should not be disturbed unless it becomes absolutely necessary.

Disassembling and Cleaning.—The Thermostat shown in Fig. 95a, like similar gas controlling devices, should be taken apart and cleaned occasionally. This can be done quickly and easily if the following instructions are observed and reference made to the accompanying illustration.

Remove fulcrum pin by loosening set screws, and then take out lever. Unscrew and lift out plunger guide. Hold the plunger guide *in your hands,* unscrew the spring cap and remove the plunger. These parts are assembled by hand in the factory. The use of tools or vise may destroy alignment. Clean out by pass, wipe off and rub plunger with graphite.

Reassemble—Do not try to screw plunger guide down to the hexagon head, as it seats on bottom, as shown.

Graphite fulcrum pin—*don't use oil.*

Setting—This thermostat was calibrated and set at the factory, where the gas pressure may vary from yours; therefore, test the thermostat by using a thermometer in the metal pot. When the thermometer registers 550 degrees Fahrenheit, loosen the screw at top of the thermostat and turn the dial plate until it corresponds with the thermometer, thus insuring its future accuracy.

IMPERFECT JUSTIFICATION

After the mold disk comes forward the first time, bringing the mold against the matrices, it should retract a little, about .01 of an inch, so that, during the operations of alignment and justification, the mold will *not be against the matrices.* If the mold does rest against the matrices at this time, the friction of the matrices against the mold will be so great that when the justification levers are driven up they will stop before the line of matrices is completely spread out, or justified, and a "squirt" of metal may result. Whether the mold rests against the matrices can be tested by a strip of paper, as shown in Fig. 92, which is inserted between the mold and the matrices. After the slight retraction of the mold mentioned, it should be possible to pull out this piece of paper. If the paper is still tight, it shows that the mold has advanced too far, or has not retracted enough, and it should be adjusted by the adjustment shown at *152* in Fig. 64.

REMOVING THE MOLD SLIDE

If the operator has occasion to remove the mold slide, as shown in Fig. 96, it is necessary, when it is returned, that the mold-turning pinion should mesh with the proper tooth in the mold wheel. There is a small circular mark made with a punch on a tooth in the mold-turning pinion and a corresponding mark on a tooth on the mold wheel. When the mold slide is returned to the machine, the mold wheel or pinion should be turned so as to bring these two marks in register. The mold-turning pinion and mold wheel will then be in proper mesh.

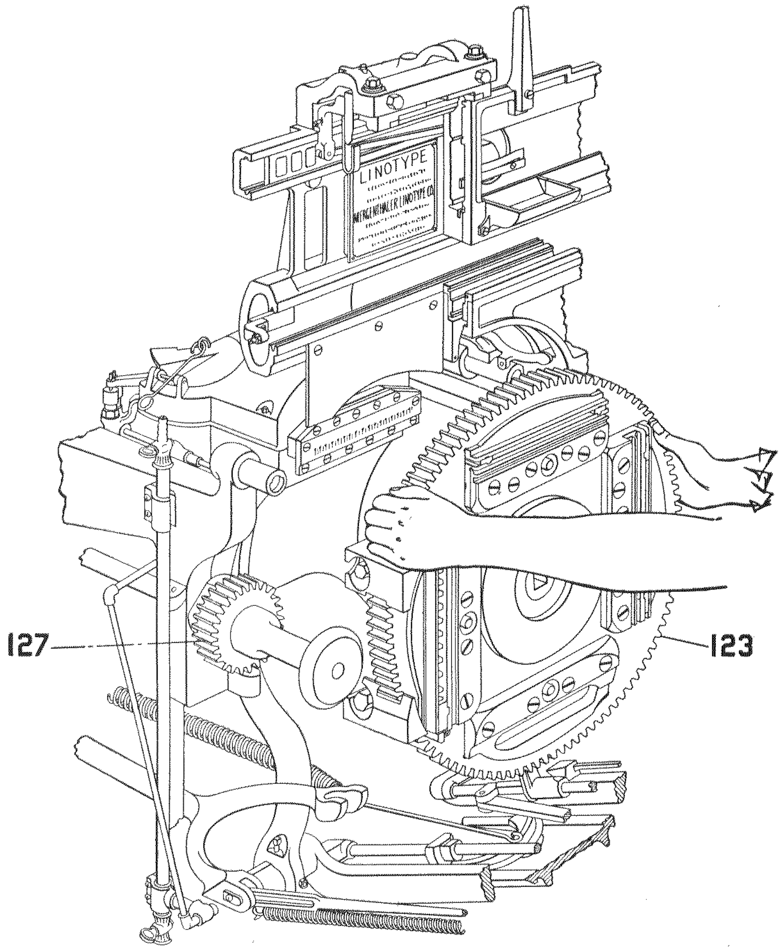

Fig. 96.—View showing the vise lowered and the mold disk and slide being pulled forward.

REMOVING THE WEDGE MOUTHPIECE

It is necessary at somewhat long intervals to remove the mouthpiece and clean out the throat of the pot. This operation requires some skill and care, particularly in connection with the old style wedge mouthpiece, which is no longer standard. The tapered wedge holds the mouthpiece tight in the beveled groove in the forward edge of the pot. To remove the mouthpiece it is necessary to drive it a short distance to the right, as you stand in front of the machine. This should be done while the mouthpiece is hot, and a pot-mouth drift, or its equivalent, should be used in driving the mouthpiece. A small steel drift is used but care must be taken that it does not burr the end of the mouthpiece. As soon as the mouthpiece has been driven a little to the right, the tapered wedge will be released, and it can be driven in the opposite direction, and the mouthpiece and wedge can then be removed from the crucible, giving access to the front side of the pot. A peculiar tool is used to scrape out the throat of the pot.

In driving the mouthpiece and the tapered wedge a succession of light blows should be tried. If the pot has been run for a long time there forms around the joints, between the pot, the mouthpiece and the wedge, a white oxide of lead. This oxide goes into the cracks in the form of a gas and finally deposits or precipitates, as chemists would say, a white substance that they call "dioxide of lead." This white substance forms a tight joint that makes it quite difficult at times to drive out the wedge and the mouthpiece. This deposit of white powder can be partly prevented if the bearing surfaces of the wedge and mouthpiece are rubbed with a mixture of linseed oil and graphite, or red lead and glycerin. A thin film of this rubbed on the wedge and the mouthpiece diminishes the formation of this white deposit, and will make it very much easier to remove the mouthpiece and the wedge next time.

In replacing the mouthpiece and the wedge, care must be taken not to drive the wedge in too tightly. This may spring the cast-iron mouth so that it takes a permanent "set" and a leakage of the metal will take place. Sometimes the mouthpiece will not leak for a time, but after a while, under the strain, the cast-iron will warp. In this case, when the wedge and mouthpiece are removed, the beveled face of the mouth of the pot must be filed straight. This requires considerable skill and should not be attempted by one who is not an expert with a file. To one who knows his business, however, it is possible to bring the seat for the mouthpiece straight again and fit the mouthpiece to it. If this warping is not very bad, a paste made of litharge and glycerin, painted on the bearing surfaces of the mouthpiece and pot, and allowed to harden before the machine is used, will sometimes cure a leak.

THE MOUTHPIECE

The throat of the pot crucible, where it fronts the mold, is closed by a part called the mouthpiece. This is a strip of metal having beveled edges and tapered to correspond to beveled grooves in the pot-crucible casting. To hold this mouthpiece firmly in position a wedge is used, tapered in the opposite direction from the mouthpiece, and arranged to fit in the casting of the pot crucible, the other part of the wedge bearing against the mouthpiece. When the wedge is driven home it presses the mouthpiece firmly into the beveled grooves in the pot crucible and makes a tight joint, leaving only the holes in the mouthpiece through which the metal can escape when the pump plunger descends. This mouthpiece is shown on Fig. 96. It is fastened to the pot with screws instead of gib.

To remove it, first use a pot screw loosener. Insert the lip in screw slot; hold the tool firm against the head of screw. With a hammer strike the head of tool several light blows. This jolt will loosen the screw. It is important to have a good screwdriver that fits the slot of screw to unscrew them.

In replacing mouthpiece, be sure to remove all metal, both from the mouthpiece and face of pot. If, for any cause, the face of pot is warped it can be straightened by lapping seat with mouthpiece. This requires some skill and should not be attempted by one who has not had some experience. When replacing the screws, apply a mixture of linseed oil and graphite. This will facilitate the removing of screws.

THE PUMP PLUNGER

At least once a week, better every day, the pump plunger should be removed from the well in the pot, while the metal is hot, and thoroughly cleaned. A wire brush is furnished for this purpose. When using the wire brush in the well, be sure to turn it always to the right, otherwise the bristles may break off and stay in the well. While the pump plunger is out the inside of the well of the pot should be thoroughly cleansed. Various scrapers and cleaners have been invented for the purpose of cleaning the inside of the pump well. These should be used with great caution, as it is very easy with such devices to enlarge the well so that the metal will escape around the plunger as it descends, and a good slug will not be obtained. The two holes in the side of the well should be kept open, using the end of the mouthpiece wiper, which is bent at right angles and pointed. If the pump plunger is clean, the metal in good condition, and the throat cleaned out at intervals, as previously described, there will be no trouble about the passage of the metal.

SUNKEN FACES ON SLUGS

If the pump plunger is dirty, or if the throat of the pot is clogged, there will result sometimes a sinking in of a letter or letters on the slug, and on examining, a hollow or bubble of air will be found beneath these sunken letters.

There is one other cause for the sinking of the letters, which is a lack of proper venting. The vents are little grooves or cuts made alongside or underneath the holes in the mouthpiece through which the metal is forced into the mold. The object of these vents is to allow the air to escape. When the metal is forced into the mold by action of the pump, if the metal flows freely, the most solid part of the slug is directly underneath the letters, and the air that is in the mold is either forced out alongside of the matrices or is driven back toward the bottom of the slug. Part of the air will escape through these little vents, a small portion of the metal following the air and filling the vents. These little particles of metal in the vents adhere to the bottom of the slug and are shaved off by the back knife.

These vents will need to be more numerous in some machines than in others. The better the lock-up the more vent is needed. It will be plain that if the mold fits tightly against the matrices and the mouthpiece tightly against the mold, everything is parallel and exact in the lock-up, the only chance for the air to escape is through these vents. If the mold should be slightly warped, or the mouthpiece, or there should be any lack of parallelism in the lock-up, the air has a better chance to escape, and the vents do not need to be so large or so many in number. On the other hand, in this case, more metal escapes alongside of the mouthpiece, and the mold and the machine is said to "spit," and a considerable amount of metal will be driven downward, finally lodging upon the floor. This is to be avoided, as with a good lock-up and proper venting, little or no metal will "spit," and the slug will be clean and solid, with a clear, sharp face.

LINOTYPE METAL

To get the *best* results from your Linotype it is absolutely necessary to use the *best grade of Linotype metal.* Anything less than that simply *won't do.* The metal used must be the *best grade obtainable.* And even that *best grade* must be *kept* that way; that is, kept clean and correctly balanced at all times. To keep that good metal good and giving best results at every cast, the following must be observed:

The one doing the remelting must be competent and conscientious.

A good-sized modern remelting furnace must be used.

The molten metal must never be overheated or allowed to stand very long while molten. (600 degrees is about right.)

All foreign matter must be kept out—especially copper, brass and zinc.

The molten metal must be thoroughly and continually stirred, and correctly treated with Reductio before being skimmed and poured.

When the dross has been removed, the metal must be poured quickly and from the bottom of the pot.

On the Linotype itself the temperature of the molten metal must be maintained at from 525 to 550 degrees.

The machine pot must be kept fairly full at all times, with the surface of the molten metal kept above the top of the well.

Cold metal must be introduced gradually—not too much at a time.

Slugs must not be remelted on the Linotype, but in the remelting furnace.

Dross must be removed from the surface of the metal once a day, but seldom oftener, for the dross forms a blanket that helps to retain heat and minimizes oxidation.

The burner of a gas-equipped Linotype must be adjusted to produce a steady blue flame; and the pressure of gas in the supply pipes must be kept as low as possible consistent with the production of such a flame.

That it is a simple task for a competent person to keep good metal clean and up to standard we shall show later on; but first let us consider the chief characteristics of Linotype metal.

"Combination" metal should not be used on the Linotype. By "combination" metal is meant metal alloyed for use not only on the Linotype but in the stereotype department and possibly on other machines. Such metal can be alloyed to work fairly well for both linotyping and stereotyping, but only fairly well. It will not be ideal.

The ideal metal for use on the Linotype must have proper composition, purity, and microstructure. This is attained by the alloying of as nearly pure as possible lead, antimony and tin in proportions of about eighty-five per cent of lead to eleven of antimony and four of tin.

Lead alone is too soft; but the fact that it has a low melting point makes it a good basic metal for use with antimony and tin. Antimony lends both hardness and fluidity to lead (hardness when cold and fluidity when molten), and fills out the mold by expanding just as solidification occurs. Tin, by combining the lead and antimony, holding them together, as it were, lends body to the metal. It also adds considerably to its toughness and gives the resultant characters smooth, even faces. Moreover, by enhancing the fluidity of the alloy, tin permits the use of the metal at a lowered temperature with good results.

Dross.—Dross is the waste substance resulting from oxidation—from the metal absorbing oxygen from the air. The hotter the metal becomes, and the longer it remains molten, the more dross results. Undue agitation of the metal, by continually exposing fresh surfaces to contact with the air, makes for increased dross production. Every bit of dross removed, of course, reduces the original supply of metal, and for that very reason every pound of dross removed should be replaced with a pound of new metal, the new metal being added to the older in the remelting furnace, *and not in the metal pot of the Linotype.* This procedure must apply even when the new metal is received in pig form for use in metal feeders.

Naturally, the metal of lowest melting point oxidizes faster than the others. Tin oxidizes faster than lead, and lead faster than antimony. An alloy which contained originally, say, about eighty-five per cent of lead, eleven per cent of antimony, and four per cent of tin, after many remeltings may have changed to about eighty-four and three-quarters per cent of lead, twelve and one-quarter per cent of antimony, and three per cent of tin. The percentage of antimony rises in proportion as the lead and tin percentages decrease through oxidation.

Undue loss of tin necessitates increased temperature, and makes for poor faces and hollow slugs. Undue loss of antimony causes the alloy to become too soft to withstand long press runs; an excess of it tends to clog up the crucible throat and the mouthpiece holes.

Dross loss should not amount to more than two per cent, and can and should be kept down to one and one-half per cent. But carelessness may cause a much greater loss.

Remelting.—The important business of remelting must be done by a person (preferably a grown man) thoroughly aware of his responsibilities, and conscientious enough to perform his duties properly. Many alleged "metal troubles" are directly traceable to the fact that the remelting has been entrusted to some mere lad unqualified for the task. Such important work must not be turned over to a boy who may care little whether harmful foreign substances get into the metal, or who, to rush things through, may improperly stir the alloy or skim it too soon, or let it get too hot, or even leave it in a molten state for so long a time that much needless loss of antimony and tin will result. When it is considered that in one hour's time, say, it is possible to pig an entire week's supply of metal for a Linotype, and that any carelessness in pigging taking place in that one hour may affect the output of a machine and operator for a whole week or more, it will readily be appreciated that the remelting must be entrusted only to competent and conscientious persons.

Heat must be applied slowly to the remelting pot (so that the whole mass of metal will become fairly evenly heated and no portions greatly overheated), and gradually increased until a temperature of about 600 degrees has been attained. A thermometer should be used to take the temperature, but in the absence of a thermometer a piece of white uncoated paper may be used with fairly satisfactory results. The paper should be immersed in the molten metal for three seconds. If, upon being withdrawn, the paper is a chestnut brown in color, the temperature is about right. If the color is lighter, the temperature is too low; if scorched, too high.

The molten metal must be thoroughly stirred before the dross is removed or the metal poured. The stirring must be done from the sides of the pot, downward and across. The sides and bottom must be thoroughly scraped, to remove any dross that may be clinging there.

When the stirring is begun, a quantity of Reductio, a special preparation for purifying Linotype metal, and for sale by all agencies of the Company, must be stirred into the metal. Reductio quickly brings impurities to the top, promotes cohesion of the lead, antimony and tin, and, by saving a large percentage of the richer ingredients which usually are skimmed off with the dross, adds considerably to the life of the metal. A one-pound can is sufficient to clean three tons of metal. Full directions for the use of Reductio are carried on each dust-proof covered can.

If, just before the stirring is completed, the metal is given a circular motion, the dross will be attracted to the center of the surface and more readily may be removed.

Skimming must continue until the surface of the molten metal is like a mirror, and then becomes covered with light cobwebby lines.

After the dross has been removed, the metal must be ladled quickly, and from the bottom of the pot, to avoid separation of its elements and to minimize the dross-loss.

Dross should be remelted at least once. When a sufficient quantity has accumulated, it should be placed in the remelting furnace on top of enough regular metal to cover the bottom of the pot. The regular metal on the bottom, by holding the heat, makes it easier to attain the required higher temperature. When the temperature reaches 600 degrees, the contents should be treated with Reductio and then skimmed. The heat should then be increased, another treatment of Reductio given, and additional skimming done. Then the contents should be quickly poured.

Too much emphasis cannot be given the importance of stirring the molten metal well. The three basic elements of the alloy—lead, antimony and tin—are of three different specific gravities and when in a molten state will separate unless stirred thoroughly and constantly. If the metal is not properly stirred, a large percentage of the antimony and tin will rise to the top and may be skimmed off with the dross.

Another important point is the heating of the metal to the proper temperature—about 600 degrees. If the metal is stirred and poured when the temperature is too low, the alloy will be improperly mixed, and much antimony and tin will be removed with the dross. If the temperature is too high, excessive oxidation will result and an undue amount of antimony and tin will be lost.

Some Metal "Poisons."—Some of the things that most often contribute to the contamination of unbalancing of Linotype metal, in addition to dirt, improper stirring and overheating, are copper, brass and zinc. None of these metal "poisons" should be permitted to enter the metal pot.

Even the slightest amount of zinc is bad.

Copper, by unduly hardening the metal, will contribute to mouthpiece stoppage, and will have a bad effect on the trimming knives.

Zinc etchings, brass rules and matrices, battery plates, old lead pipes and foundry type must be debarred.

Electrotype trimmings that accumulate beneath saw trimmers must not be mixed with Linotype metal. If, by mistake, a copper shell gets into the remelting furnace, it will rise to the surface, and must be quickly removed.

Retoning.—Occasionally a proportionate quantity of new metal must be added to the old, the old, of course, having first been freed as much as possible from impurities. The new metal, we repeat, must be thoroughly mixed with the old in the *remelting furnace,* and not placed directly in the metal pot of the Linotype. Unless the old metal has become too impoverished, such treatment usually will serve to keep a metal supply in good working condition.

When Linotype metal has become unbalanced and is causing trouble of any sort, no chances should be taken on retoning the metal haphazardly, but the advice of some competent metal company should be solicited. And be sure to state the exact nature of the trouble.

An approved way to secure representative samples of a metal supply for analysis by a metal company is for some person in a plant to select one slug a day from the regular output of the plant, for from six to ten days. Such slugs will constitute a fairly representative sample, and will enable the metal company to prescribe the proper toning metal.

No single toning formula can be followed in all cases. Each case must be treated as a special problem. Sometimes it is found advisable to replace an old supply of metal with an entirely new one.

It is well to have the metal supply analyzed and retoned at regular intervals.