# II. The Matrix

THE matrix has been frequently referred to and illustrated, but will now be described a little more in detail. By far the larger number of matrices made by the Mergenthaler Linotype Company have two characters thereon and are called "two-letter matrices." There is room upon the matrix for two characters, up to fourteen point. Beyond this size only one character can be used on the matrix. In general the matrix is a parallelogram in shape, one and one-quarter inches long, three-quarters of an

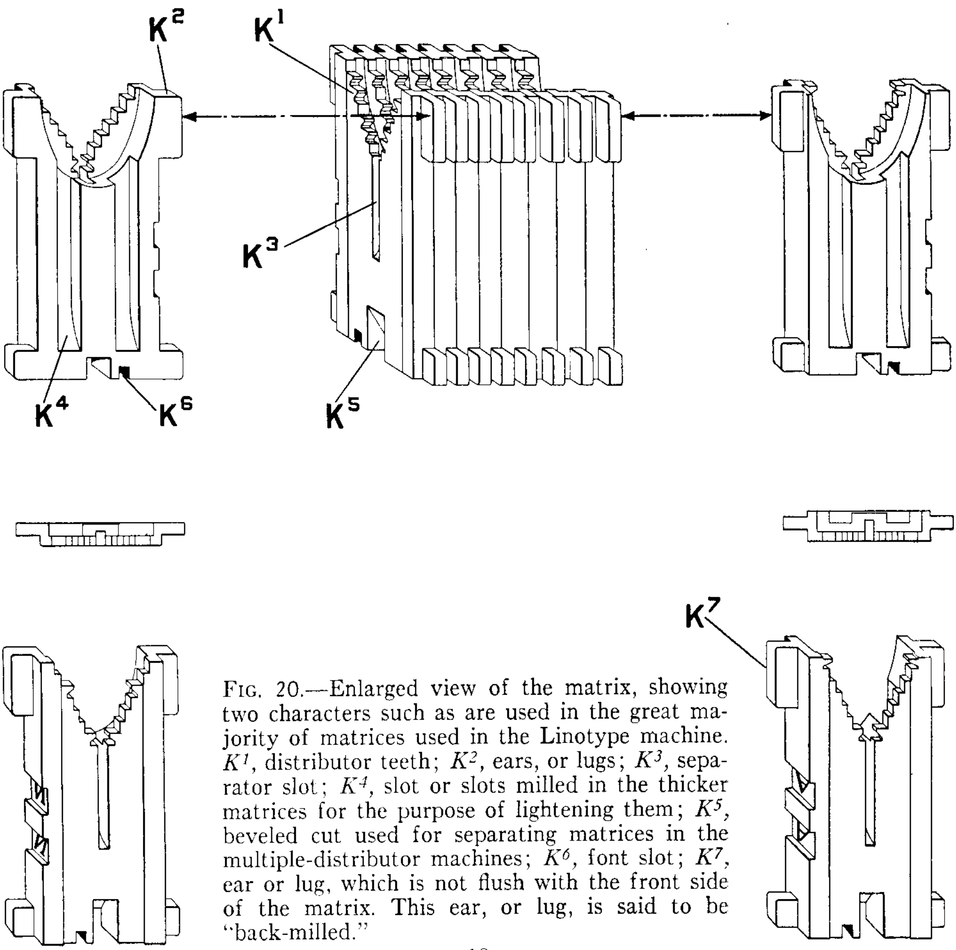


FIG. 20.—Enlarged view of the matrix, showing two characters such as are used in the great majority of matrices used in the Linotype machine. $K^1$, distributor teeth; $K^2$, ears, or lugs; $K^3$, separator slot; $K^4$, slot or slots milled in the thicker matrices for the purpose of lightening them; $K^5$, beveled cut used for separating matrices in the multiple-distributor machines; $K^6$, font slot; $K^7$, ear or lug, which is not flush with the front side of the matrix. This ear, or lug, is said to be "back-milled."

inch wide across the ears of the matrix, and nine sixteenths on the body of the matrix. The upper ears of the matrix are twice the length of the lower ears. The thickness of the matrices varies, of course, as do the widths of the characters to be stamped therein. The ears of the matrix are normally even, or flush, with the left-hand side of the matrix, as you look at the character. On some of the larger faces the ears are not quite flush with the left-hand side of the matrix, but are set over toward the tooth side thereof. This is called "back-milling," and such matrices are said to have "back-milled" ears. The object of this "back-milling" is to get larger faces into the magazine than it could otherwise contain. It is a case where the extra thickness of certain characters is allowed to project over on both sides of the magazine channel, instead of one side, as is generally the case.

At the top of the matrix there is a V-shaped notch, and in this notch there are combinations of teeth. These teeth are equilateral triangles one thirty-second of an inch on each side. The teeth are not the thickness of the matrix but are usually one thirty-second of an inch thick. On special matrices this thickness is increased. On the thicker matrices the teeth are usually on the opposite side from the ears.

Below the V-shaped notch is a vertical slot. It begins between the two lower teeth of the matrix and extends forward to the left side of the matrices, as you look at the character. This notch extends downward toward the foot of the matrix at least three sixteenths of an inch, and the object of this is to make all matrices of the same thickness at one point on their left-hand side. This thickness is also about one thirty-second of an inch. This slot registers with a projecting blade in the distributor box to prevent the lifting of two matrices at a time into the distributor screws.

## CARE OF MATRICES

The matrices should never be washed with benzine, or any similar liquid. It was supposed in the early days of the Linotype that washing with benzine was a good practice. As a matter of fact, it was very injurious, for it washed away the dirt that accumulated on the side walls of the matrix, and rendered the surface so clean as to make it easier for metal from the pot to adhere to the matrix walls by a sort of soldering action. The only parts of the matrices that ordinarily need attention on the part of the operator are the ears. As previously stated, if oil or gum gets upon the ears of the matrix, the ears should be wiped dry and a *very little* graphite rubbed thereon. The best way of applying the dry graphite powder is to rub it into a soft-pine board that is smooth and flat; remove the loose graphite, and then take the matrix and lay it with the ear side down and give it two or three rubs, as shown in Fig. 21. Then, grasping the matrix by the thumb and finger as shown in Fig. 21, the outside edge of the ears on both sides of the matrix should be rubbed clean, and the little particles of graphite that still adhere to them will make them run perfectly. (Method of removing burr or projection shown in Fig. 22.) In using graphite in this connection, or on any part of the machine, caution should be observed *not to use too much.* A little graphite is an excellent

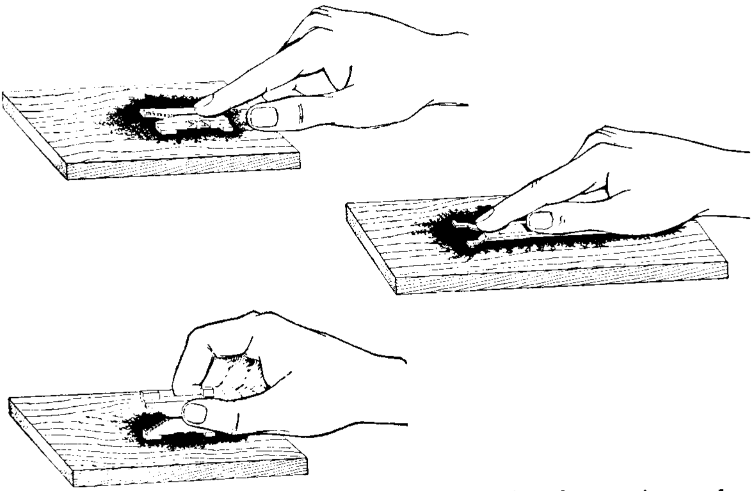

FIG. 21.—Three views illustrating the method of cleaning the matrices and space-bands and making a surface of graphite upon them so that they will pass through the machine more smoothly and rapidly.

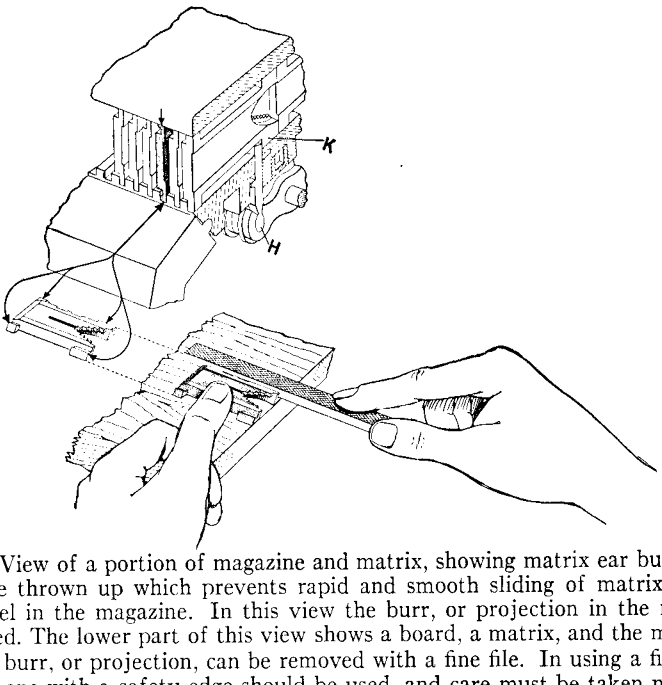


FIG. 22.—View of a portion of magazine and matrix, showing matrix ear burred or a sharp edge thrown up which prevents rapid and smooth sliding of matrix through the channel in the magazine. In this view the burr, or projection in the matrix is exaggerated. The lower part of this view shows a board, a matrix, and the method in which the burr, or projection, can be removed with a fine file. In using a file in this way, only one with a safety edge should be used, and care must be taken not to file away the body. or main portion of the ear; only the raw edge or burr upon the ear.

lubricant, but when too much is used it forms a basis for a sticky, gummy mixture of graphite, dirt, and a little oil, which is a great nuisance.

A little intelligent care of the matrices will make them answer their purpose perfectly, and will cause them to last for a long time. Sets of matrices thus cared for have been known to run as long as ten years in daily use, with the replacement of only a few of the most used characters.

### SIDE WALLS

On each side of the matrix there is a thin wall of brass, only a few thousandths of an inch high and very thin, which forms the pocket into which the type metal is cast. These side walls are so thin and delicate that they may be easily bruised and pressed or bent in, and thus an opening is formed between two matrices standing side by side in the line into which the metal flows when the line is cast, and this shows up in the print, causing what are known as hair lines. These hair lines are very objectionable and pains should be taken to avoid their appearance, as they will mar an otherwise perfect piece of printed matter.

The bending or pressing in of the side walls of the matrices is caused in various ways. The matrices will sometimes pound each other as they descend into the assembler elevator. Care should be taken that the assembler rails are in proper position and that the matrix is directed into the elevator at the proper angle, as shown in Fig. 19.

The most frequent cause of hair lines is the pressing or bending in of the side walls of matrices by a little metal adhering to spacebands at the casting point.

The spacebands must be taken from the machine at least once a day and these little pieces of metal that have become soldered to the side of the spacebands removed. This is done by laying each spaceband flat upon a pine board similar to that used for the matrices, and rubbing the spaceband until the type metal is entirely removed and the spaceband is clean, with a *very little* graphite adhering to the face of it. Many careful operators remove the spacebands *twice* a day from the machine and give the treatment above mentioned. If this matter is neglected for only a few days a set of matrices may be ruined. There is no known cure for a set of matrices with damaged side walls.

However, it sometimes does happen that dirt from the machine accumulates in the ragged edge of a broken side wall and forms a side wall which holds the molten metal so that the slug gives a clear print. This is the only known place in a Linotype machine where the accumulated sticky dirt above spoken of is of any use. Everywhere else it is a great detriment.

A third cause of the destruction of the side walls is the sending in of tight lines by the operator. Tight lines will be described in connection with the casting mechanism, so it is sufficient to say here that the operator allowing tight lines to go through a machine may speedily destroy a set of matrices.

Care in regard to the points mentioned will make a great difference in the satisfactory use and maintenance of the matrices and in the cost of sorts necessary to the maintaining of a set of matrices in first-class condition.

It is very important that this care should be a regular and methodical thing, and not a spasmodic case of attention one day and then forgetting for weeks or months to give the necessary care. In the latter case the harm is done, and the only way to cure the trouble is to go to a considerable expense in procuring sorts or a new set of matrices, which a little care would have rendered unnecessary. *This is a case where "an ounce of prevention is worth a pound of cure."* We stress this point most emphatically, because it is a source of much unnecessary trouble.

### TRANSPOSITIONS

As has been mentioned before, the assembling of the matrices in the Linotype machine is exceedingly rapid. Fast operators frequently touch twelve to fifteen keys in a second on certain combinations of characters. The *least hesitation* in the release of a matrix, or interference with it as it traverses its path from the magazine to the assembling stick, means a transposition. Nothing is more trying to a fast and accurate operator than frequent transpositions of characters. Some of the causes of transpositions have already been mentioned, but they will now be enumerated again, together with others.

First to be mentioned is undue pressure of the overthrow spring, shown at *T* in Fig. 6. In some cases the plunger is a little too long and presses upon the notched end of the keyboard cam yoke. There should be a slight clearance, about the thickness of a sheet of paper, between the notched end of the keyboard cam yoke and the end of the plunger. If the plunger actually rests upon the keyboard cam yoke when in normal position, it prevents the quick fall of the keyboard cam upon the rubber roll, and although this is a very small delay it is sufficient to cause transpositions. Care should be taken that the plungers have a clearance above the keyboard cam yoke. The place where this clearance should be is shown by arrow in Fig. 6.

Second, springs *Y* in Fig. 7, to hold down the reeds, should all have substantially the same tension. If two springs have different tensions the one that is lighter will be raised sooner by the keyboard cam yoke. Again, this difference in time of the release of the matrix cannot be detected by the eye, but it is sometimes sufficient to cause a transposition. The same thing is true of the springs that operate upon the verges of the escapement, as shown in Fig. 7 at *W*.

Third, the escapement verge (views which are shown in Figs. 23, 24 and 25), may be cut or get rough for lack of oil, and work hard in its guides or upon the pivot rod. Occasionally, at long intervals—say, once in three to six months—a very little *clock oil* should be placed upon the

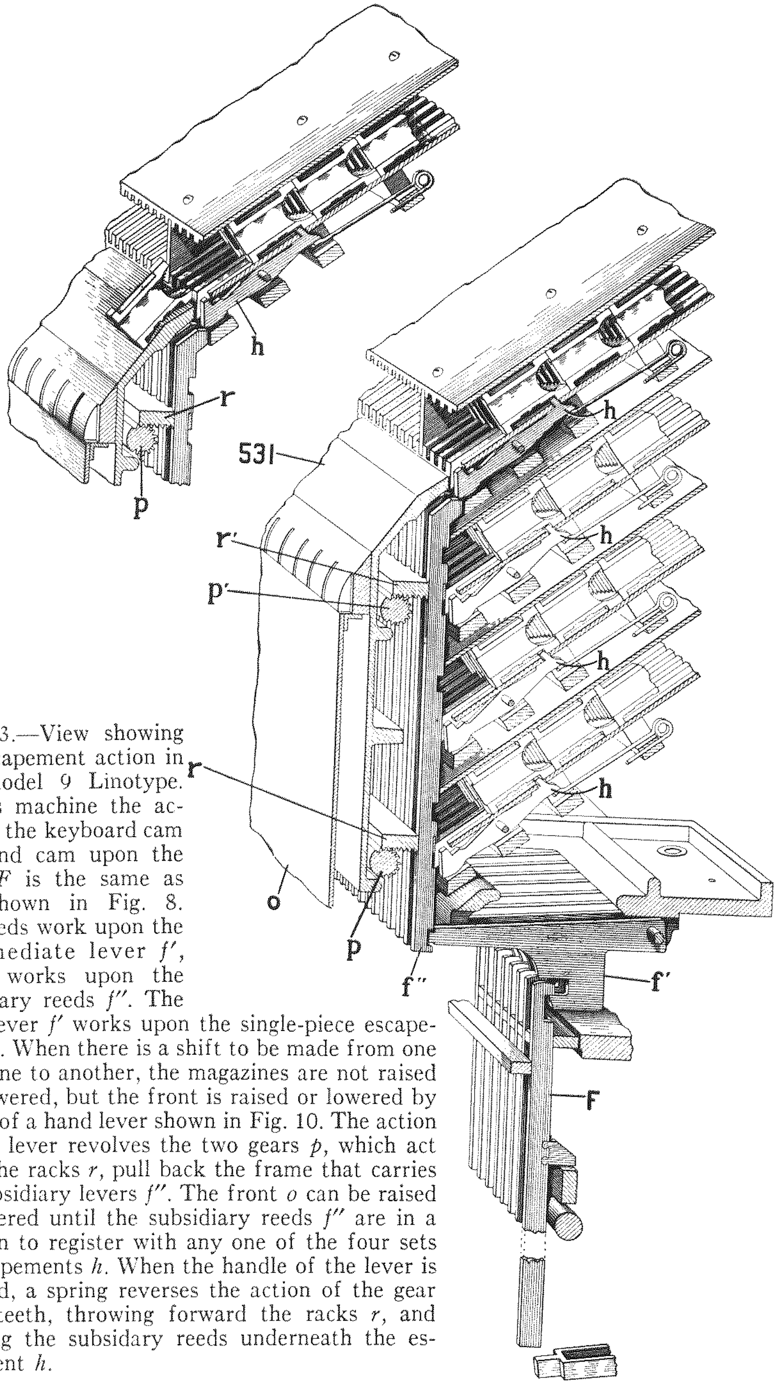


FIG. 23.—View showing the escapement action in the Model 9 Linotype. In this machine the action of the keyboard cam rolls and cam upon the reeds *F* is the same as that shown in Fig. 8. The reeds work upon the intermediate lever *f′*, which works upon the subsidiary reeds *f″*. The same lever *f′* works upon the single-piece escapement *h*. When there is a shift to be made from one magazine to another, the magazines are not raised and lowered, but the front is raised or lowered by means of a hand lever shown in Fig. 10. The action of this lever revolves the two gears *p*, which act upon the racks *r*, pull back the frame that carries the subsidiary levers *f″*. The front *o* can be raised or lowered until the subsidiary reeds *f″* are in a position to register with any one of the four sets of escapements *h*. When the handle of the lever is released, a spring reverses the action of the gear small teeth, throwing forward the racks *r*, and bringing the subsidary reeds underneath the escapement *h*.

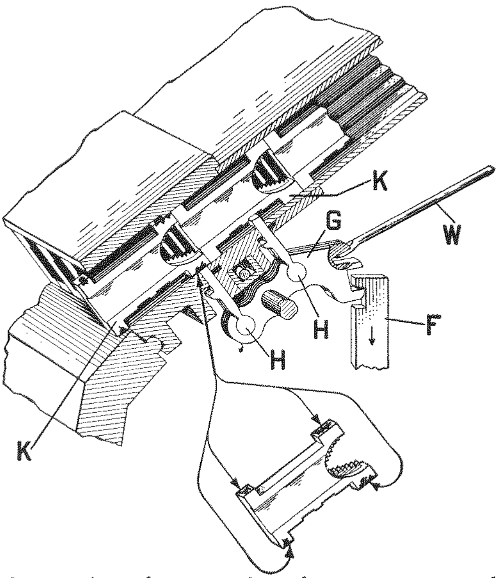


FIG. 24.—View of a portion of a magazine, the escapement and key reed, and an enlarged view of the matrix showing where dirt and gum may accumulate on the matrix and prevent its smooth and quick action.

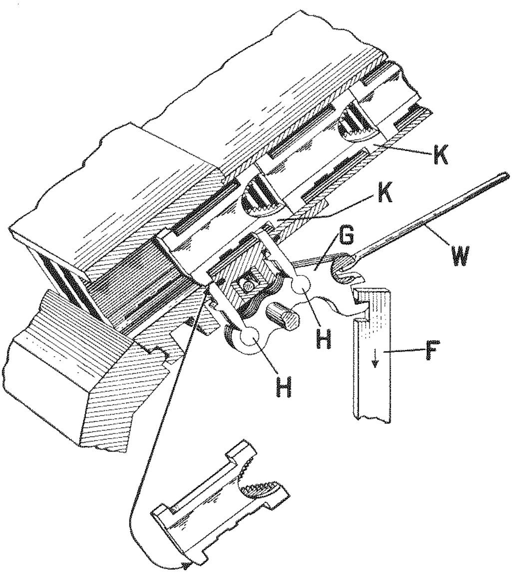


FIG. 25.—View of a portion of a magazine, the escapement and key reed, also a view of a matrix showing a worn ear. Just below the main view is a view of the matrix showing in an enlarged view the ear worn so that it may drop into the hole through which the escapement pawl *H* works. The view of the matrix shows a case of extreme wear. When worn as much as shown in the view, the matrix should be discarded. When only slightly worn, it is sometimes possible to restore the shape of the ear in the matrix swage block.

verges. This is best done with a wooden toothpick. *Care should be taken not to use too much oil,* as this is nearly as bad as none at all.

Fourth, the matrices may be sticky and gummy in one channel and not so in another. This is one of the most common causes of transpositions. The method of remedying this is by wiping the ears of the matrices clean and then rubbing them with a very little graphite, as shown in Fig. 21.

Fifth, the matter already referred to of a burr or damaged ear of the matrix. The method of correcting this is shown in Fig. 22.

Sixth, the short ear of the matrix may be so worn that the ear drops into the holes in the magazine through which the pawls pass. This is shown in Fig. 25.

Seventh, the interference of the assembler front partition with the overhanging part or body of the matrix. This is likely to occur in large faces. The partition must be adjusted so as to clear the body of the matrix.

Eighth, an irregular or uncertain motion of the assembler belt. This is caused sometimes by the belt being too loose or the friction disk 6 in Fig. 32 failing to hold; sometimes by a lack of oil upon the bearings of the assembler mechanism. The assembler belt should run very smoothly and with perfect steadiness. If any irregularity can be observed in its action see that the belt is fairly tight, that the friction disk is holding, and that all bearings are properly oiled. In oiling these bearings, only a small amount of good clock oil should be used and great care should be taken that the oil does not drip or run over in any way, so as to get on the matrices.

Ninth, the assembler chute spring must be so adjusted that it will not retard the matrices too much. No exact rule can be given for this setting of the assembler chute spring; it must be learned by experience. As a matter of fact, different operators like a slightly different setting of this spring. When just right no transposition will occur, but when out of adjustment it is one of the most frequent causes of transposition.

Tenth, one of the frequent causes of transpositions is a worn star wheel. When the points of the star wheel have worn down one sixteenth of an inch, the star wheel should be discarded and another substituted, and better results will be obtained where only one thirty-second of wear is allowed. The action of the star wheel is dependent upon the regular action of the assembler belt and the star wheel should be so kept in order that there is a smooth and regular action of the same.

Eleventh, dirty magazines will cause trouble. Once a month or so the matrices should be removed and the magazine thoroughly brushed out.

With a good magazine brush, clean all the dirt and gum from the inside of the magazine, using denatured, or wood alcohol, or gasoline on the brush. In cleaning be sure that all the little dark spots, which show where the lugs of the matrices set in the magazine, are removed. If these spots are not entirely removed, the matrices will be held back and will not drop regularly.

If there are numerous transpositions and no other cause is evident, the matter of the register of the magazine and the escapement bar should be carefully looked into.

Twelfth, the key reed sometimes gets bent or wears upon its guide, either at the top or bottom, so that it does not properly register either with the verge of the escapement at the top of the reed or with the end of the keyboard cam yoke at the lower end of the reed. This is not a very common occurrence.

Thirteenth, "doublets." It happens sometimes that when the key lever is touched the keyboard cam makes two revolutions instead of one, delivering two matrices instead of the one desired. The cause of this is the failure of the keyboard bar *C*, as shown in Fig. 2, to return the trigger in time to catch the descending cam yoke. This is almost invariably caused by dirt. Almost every form of dirt is objectionable, but the dirt formed by the action of a Linotype is one of the most objectionable forms of its kind. This dirt is composed of dust floating in the air, small bits of type metal, and the oil that must be used in any piece of machinery. This forms a peculiarly sticky and nasty compound, a very little of which causes trouble in various parts of the Linotype. The dirt on the keyboard bar *C* may be removed by taking a small can of gasoline or benzine and squirting it into the rack or guide, as shown in Fig. 26. This dissolves the sticky, gummy dirt, and allows the bar to fall freely. If the keyboard bar and the guide are washed out once a week this trouble will never occur.

*Caution:* Only a very little gasoline or benzine should be used. A few drops are sufficient. It should be remembered that in most cases there is a gas flame not far away from the gasoline. A small can should be used and only enough poured on to overcome the trouble.

Fourteenth, the keyboard cam rubber rolls sometimes become hard, and a sort of glazed surface forms upon them so that the keyboard cam, when it falls upon the rubber, does not take hold of it and immediately begin to revolve, but a slippage occurs between the revolving rubber roll and the cam. The cam usually takes hold after the rubber roll has revolved about one quarter of a revolution but if, when a rapid operator is touching the keys, the succeeding keyboard cam should take hold at once, it is manifest that there would be a transposition. Again, the rubber roll sometimes gets cut or worn, in which case the keyboard cam may not take hold and begin to revolve as promptly as it should. The keyboard rubber roll should be fairly soft and resilient, or the action of the keyboard cam will not be what it should be.

Fifteenth, the matrix, as it comes out of the magazine, may strike upon the assembler front partition or guide. These assembler front partitions or guides, which have been previously described, are rounded at their upper edge, where they register with the channels of the magazine, and are made as sharp as possible so as to give the matrix the greatest possible clearance. There are twenty-seven of these partitions, and it sometimes happens that the larger sizes of matrices will strike upon the rounded top of these partitions and either stop or hesitate so as to cause a transposition. If the matrix strikes upon the partition so that it stops, the trouble is easily remedied by bending the partition slightly with a pair of pliers. It is when the matrix strikes just enough to be hindered a little in its passage, but keeps on going, that the transposition occurs. This interference of the matrix with the partition is sometimes rather hard to detect. The entire number of matrices in the magazine channel should be

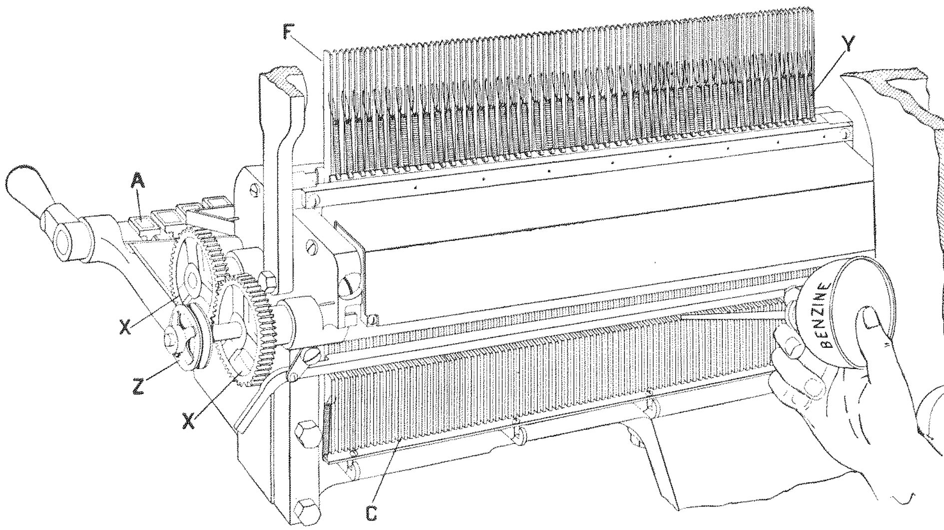


Fig. 26.—Rear view of the keyboard mechanism. *A*, keybutton; *C*, keyboard bar; *F*, keyreed; *X-X*, keyboard cam roll spur gears, which drive the keyboard rubber rolls; *Y*, keyreed spring; *Z*, keyboard cam pulley. This figure also shows the method of applying benzine to clean the keyboard bars.

run out by a touch upon the keyboard and the action closely watched. Sometimes it is necessary to take off the driving belt of the keyboard and turn the keyboard cam rolls by hand so that the action of the escapement is very slow. In this way it can be found out whether the matrix actually does strike upon the partition. This trouble is sometimes annoying because it is difficult to discover. The operator or machinist should not bend the partitions, however, until he is actually sure that the matrices are striking as above described.

Sixteenth, wear upon the escapement pawls. It occasionally happens in machines which have run for a long time that the shoulder on the escapement pawls shown in Fig. 7 wears so that the pawl projects too far into the channel of the magazine. More often it happens that the pawl pounding upon the magazine digs a hole into it, so that the pawl projects too far into the channel of the magazine. When a new pawl is substituted for an old one it may be found to be a little too long. In either case it may be necessary to file down the pawls with a fine file so that they are on a level with the bottom of the magazine channel when the pawl is in its lower position. In filing the pawls great care should be taken not to file either the bottom or the sides of the magazine channel. It is not impossible to spoil the whole magazine when one attempts to file the pawls without knowing how to use the file.

The matrix, on being released by the escapement, slides down over the "front" and falls upon the belt. The matrix is prevented from falling sideways by the "front" partitions. These partitions are fastened to the "front" at two points. At the top of the "front" a lug on the partition rests in a slot, and the lower part of the partition is fastened to the "front" by a screw that comes in from the back side of the assembler front. The lower end of these partitions is left loose and slightly curved, so as to direct the falling matrix upon the belt at an angle. There are about twenty-seven of these partitions. They are milled off to a sharp edge at the top, where the matrix comes from the magazine. The position of the upper part of these partitions is important. They are so placed as to be between two successive channels, sidewise, in the magazine.

The matrix, after falling upon the belt, is carried down by the belt and beneath a device called the assembler chute finger or, more commonly, the chute spring.

The foregoing description of the assembling mechanism of the Linotype has been made as applying to a single-magazine Linotype, such as the Model 1 or Model 5. After the two-letter attachment, as previously described, came into use, giving one hundred and eighty characters from the keyboard instead of ninety, it was found that the art required a still greater number of characters at the immediate command of the operator. This led to the multiple-magazine Linotype, which contains a number of magazines that can be operated from the same keyboard.

In the multiple-magazine Linotype, either the magazines must be raised and lowered, using a common assembler front and distributor, as in the Model 8, or more than one set of distributor screws have to be used to return the matrices to the magazines and some means of changing the point of action of the keyboard reeds, so as to operate on the different magazine escapements. This has been carried to its highest development in the Model 9 and Model 24 Linotypes, the escapement mechanism of which is illustrated in Fig. 23.

In the Models 1 and 5 the lower spring *V*, as shown in Fig. 14, may sometimes lose its strength so that it does not fully overcome the spring *W* on the escapement verge. All the springs in connection with the escapement and the keyreed should be examined to see that they have not been displaced, or lost their tension.

A very large number of chute springs of different forms have been contrived. The object of a chute spring is to direct the matrix downward and hold it close to the assembler rails so that it will strike upon the star wheel at the proper angle. It also retards slightly the heavy matrices so that they do not pound the matrices already in the assembler. The chute spring must be very flexible, so as to permit the passage of matrices of different thicknesses, giving them the proper direction and at the same time not checking their progress enough to cause transpositions. The correct action of this chute spring depends somewhat upon the operator and his individual practice.

The ideal operation of the keyboard requires an even touch with an exact interval of time between each action of the fingers upon the keybuttons. There are few operators, however, who finger the keyboard in this manner. There are certain combinations, such as "the," "that," "ough," "tion," etc., which come so often that the operator fingers the keyboard on these combinations of letters much more rapidly than his ordinary movement. It is this difference in the individuality of the operator that requires a slightly different adjustment of the chute spring to get the best results. Most operators learn their own methods of fingering and can adjust the chute spring to suit their own taste.

The matrix, after passing underneath the chute spring, strikes against the assembler star wheel, commonly known as the "star wheel." This is a small wheel about one inch in diameter, with four prongs, and is usually made of fiber. This wheel revolves at a rapid rate. The matrix is directed against this wheel in such a way that the lower part of the matrix strikes against the matrices already assembled and the revolving prongs of the star wheel throw up the upper end of the matrix into a vertical position, and then the friction of the prong pulls the matrix down upon the rails of the assembler, or assembling elevator. This action is so rapid that in the ordinary operation of the machine it cannot be followed by the eye. On the assembler stick are two small spring pawls, which give way, allowing the upper ears of the matrix to take a vertical position and pass into the stick, but which snap in and prevent the matrix from falling back upon the star wheel. With a chute spring properly adjusted, with a star wheel in proper relation to the rails, it is possible to put into the assembler stick as many as twelve to fifteen matrices per second. It is this action, from the light touch of the finger upon the keybutton to the action of the star wheel in putting the matrix in the stick, which makes the Linotype unrivaled in speed of composition.

### WHAT TO DO WHEN MATRICES FAIL TO DROP

When matrices fail to respond to the touch of the keybutton it may be due to one or more of several causes. When it is found that a matrix does not respond, all the matrices of that character should be removed from the channel. Then, first, see if the pawls are working properly.

Sometimes grit and dirt get into the bearings of the pawls and cause them to stick. The rear pawl normally should stand exactly level with the bottom of the magazine channel, and when the keybutton is pressed the front pawl should descend exactly to the level at the bottom of the channel, in order to allow the matrix ears to slide over it. If the pawl does not work, again press the keybutton and see if the keyrod is working. If that is not working, then examine the keyboard cam and see if it is acting. If the cam does not work it is probably due to the fact that the rubber roll has become glossy on the surface, in which case the roll should be taken from the machine and rubbed with sandpaper, so as to remove the gloss, and then washed in soap and water to remove any particles of rubber that may be adhering to the surface. If the roll is not washed these particles of rubber are liable to collect in the teeth of the cam and allow it to slide over the face of the roll. Sometimes, for lack of oil, the little bearing of the keyboard cam wears a hole in the yoke, or the bearing is worn. A new cam yoke should be put in. When the cam is put in order next examine the keyreed and see that it is straight and works freely in its slots, and without friction.

Next examine the spring that controls the verge and see if it is in proper working order. Examine the channel for dirt or other foreign substance and then run the matrices back in the channel and try the keybutton again. If the matrices do not respond, remove them again from the channel and examine them for defects.

They may be dirty or the ears may have become battered or twisted. If the edges of the ears are discolored and look as though they were covered with gum, rub them on a soft-pine board or a piece of dry leather until all dirt is removed. Next examine the ears to see if they are damaged in any way. If any are found battered or twisted, they must be taken out, straightened, and the battered edges removed with a fine file. In doing this work be very careful not to change the aligning point of the lug or you will have bad alignment. The matrices should then be returned to the channel and should work properly.

A high-speeded machine, in addition to speeded keyboard, will sometimes cause matrices to fail to drop, as the action of the escapement pawls is too rapid and catches the matrices before they pass completely over the pawl. It is also sometimes necessary to file sharp edges off the escapement pawls.

Do not allow the matrices to strike the upper edge of the lower assembler glass or brass plate in passing into the assembler or against the matrix guard at the top of the magazine. This batters the lugs, and the burrs so formed will cause the matrices to stick in the channels.

The keyboard cams should start instantly and turn easily when a touch of a key causes them to drop on the rubber roll. They should be cleaned and brushed at least twice a year, or oftener if necessary, so that they will revolve freely in their supporting yoke. In cleaning, the cam yoke should be removed, thoroughly cleansed of oil and dirt, and a small drop of oil applied to the pivots. Use clock oil only. Thick machine oil must not be used on these cams, and only a very small quantity of clock oil should be used, and this should be applied with the end of a fine broom-straw or toothpick. *Under no condition should oil be squirted into the keyboard from an oil can.*

Matrices falling to the floor should be picked up immediately. If kicked about or stepped on, hair lines will result, or the matrices be otherwise damaged.

The response of two or more letters at one touch of the keybutton, or "doubles" is almost invariably caused by the accumulation of dirt or rust under the banking bar or on the shoulder of the keybar slot at the point where the keyboard banks against the banking bar when a key is struck. This condition prevents the keybar returhing quickly to its normal position, and the keyboard cam continues to revolve until the connection is broken through vibration. The under side of the banking bar and the keyboard should be kept scrupulously clean by the careful use of gasoline or benzine applied with a small piece of cheesecloth on the end of a screwdriver, or, preferably, a thin piece of wood. This point is below the keyboard rubber rolls, hence no danger or injury to them can occur through the use of benzine or gasoline.

### ALIGNMENT OF MATRICES

The face alignment of the matrices is caused by the mold pressing against their vertical faces and pushing them back against the first elevator jaw; and the vertical alignment, by their lower ears or lugs rising against the under edge of the groove of the mold. The matrices are held in place by the first elevator, and, at the time of casting, the mold should move forward freely over the ears of the matrices without coming in contact with them. It is important, therefore, that the first elevator should descend fully to its place. If it does not, the advancing mold will come in contact with the lower ears of matrices and shear or cut away the upper edges of the ears.

Attention should be given to see that the vise automatic, shown in Figs. 42 and 43, is properly adjusted or set, so as to cause the machine to come to a stop in case the first elevator fails to come down to its proper position. After the mold has advanced over the ears, or lugs, of the matrices, the first elevator rises slightly, lifting the matrices and bringing the ears against the under side of the groove in the mold. It is this action that causes the vertical alignment. If the ears, or lugs, have been worn or cut away, the matrices will not align properly.

During the alignment and during the first justification, the matrices must be perfectly free, so that they may readjust themselves sidewise in the line. Hence the importance of preventing the mold from pressing

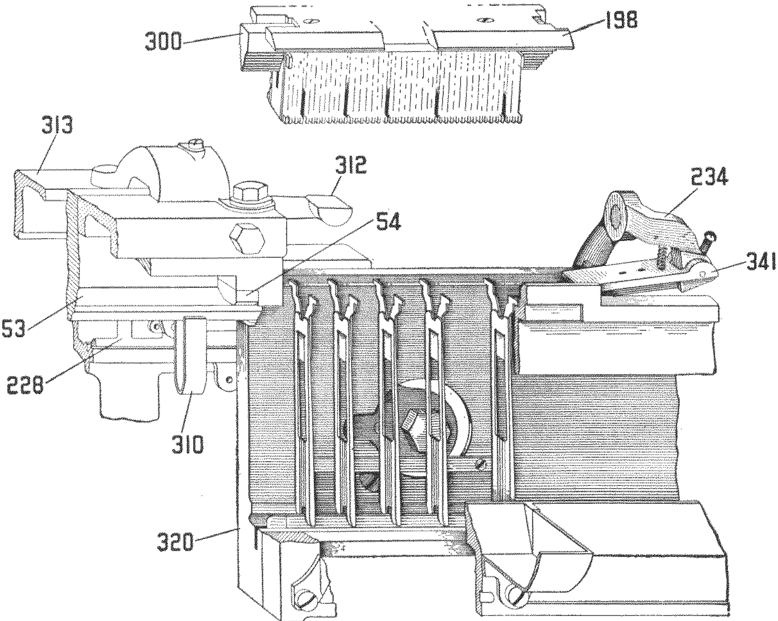


FIG. 27.—Another view showing the second-elevator bar with the matrices being carried upward by the second-elevator lever, leaving the spacebands below in the intermediate channel. The spacebands have no teeth to register with the second-elevator bar, and the ears of the wedges are wider than the ears of the matrices and register in a groove on the front side of the intermediate channel. This groove prevents the spacebands from rising when the second-elevator bar goes up.

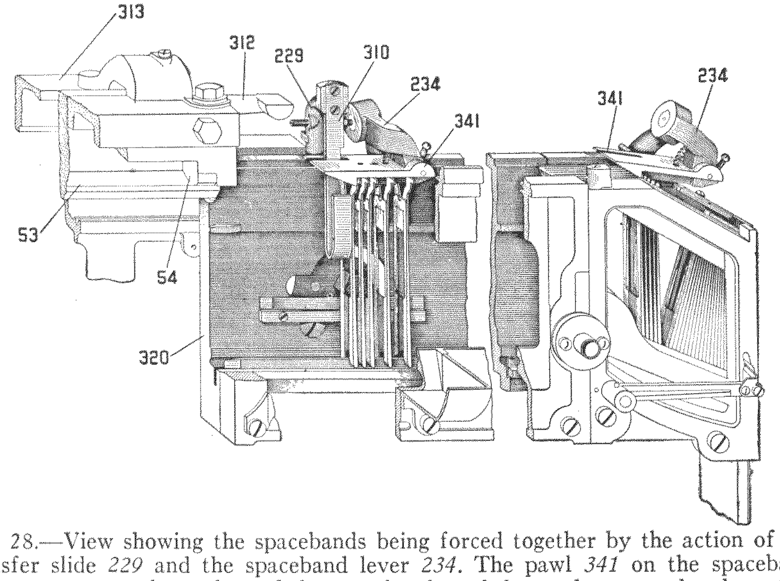


FIG. 28.—View showing the spacebands being forced together by the action of the transfer slide *229* and the spaceband lever *234*. The pawl *341* on the spaceband lever passes over the wedges of the spacebands and draws them over by the action of the lever *234* into the spaceband box, or the magazine for the spacebands.

against the matrices and spaces at its first movement forward. The mold should advance only to within ten thousandth of an inch of the vise jaw at the first movement. This distance can be obtained by an adjustment of the eccentric pin in the mold-slide cam lever.

## ASSEMBLING OF SPACEBANDS

The spacebands, being of an entirely different shape and weight, cannot be passed through the magazine as are the matrices (see Fig. 27, showing spacebands in intermediate channel, and the forcing together, by the action of transfer slide and spaceband lever in Fig. 28). Their shape and weight require a different holder, or magazine, for holding them, and they are delivered in an entirely different way. The spacebands are stored normally at a point directly above the assembler stick, at its right-hand end as the operator faces the machine. The escapement that releases the spacebands is of an entirely different character from that which releases the matrices, and is shown in Figs. 29 and 31. A blade with two prongs, very sharp at the top, passes between the suspending shoulders of the spaceband, and at the same time lifts the spaceband over the projecting shoulder, allowing the spaceband to drop through a tube, or channel, directly upon the star wheel. It will be noted that the spaceband descends vertically upon the star wheel, instead of striking it at an angle as do the matrices. The blade, already referred to, which delivers the spacebands, is operated by a keyboard cam similar to that which operates the matrix, through a link and lever passing in the rear of the key reeds. The trigger which releases the cam that operates the spaceband lever is connected to a bar passing the whole length of the keyboard and having at its left end a projection for the operation of the trigger. As the spaceband falls vertically a somewhat shorter distance than the matrix, and as it weighs considerably more than the matrix, the tendency of the spaceband is to arrive at the assembler stick upon the star wheel in advance of the last letter of a word touched by the operator before he operates the spaceband lever. The spaceband keyboard cam is usually larger than the ordinary keyboard cams, so that it will take a longer time in its revolution, and it will be noted that the delivery of the spaceband by its escapement is at the end of the keyboard cam action instead of at the beginning, as in the release of the matrix. The object of all this is to give the matrix that is released by the finger of the operator, just before he touches the spaceband key, an advantage in the matter of time, so that the matrix will arrive at the star wheel before the spaceband. The matter of timing the fall of the spaceband with the fall of the matrix is very important. Rapid and correct action of the Linotype in the matter of assembling depends upon the close and accurate timing between the matrices and spacebands, so that they will be delivered into the assembler stick in the order in which the keys are touched by the operator. Fig. 31 shows spaceband box, with adjusting screw, center bar and center bar bracket.

As a general proposition, transpositions, either of matrices or spacebands, are caused by the failure of the parts to act in perfect time. As described, this failure may be due to weakness of the springs, lack of oil, or presence of dirt or grease in various places. With all the chances for transpositions of matrices and spacebands previously enumerated, it would

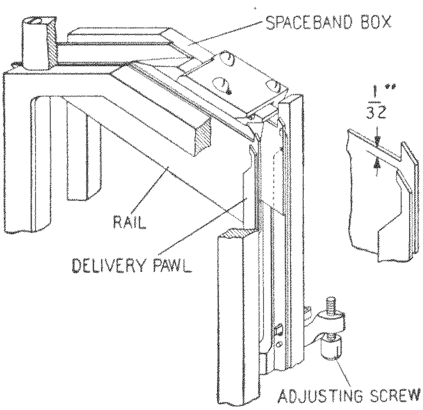


FIG. 29.—Diagram of the spaceband box and delivery pawls showing the proper position for these pawls to deliver a spaceband.

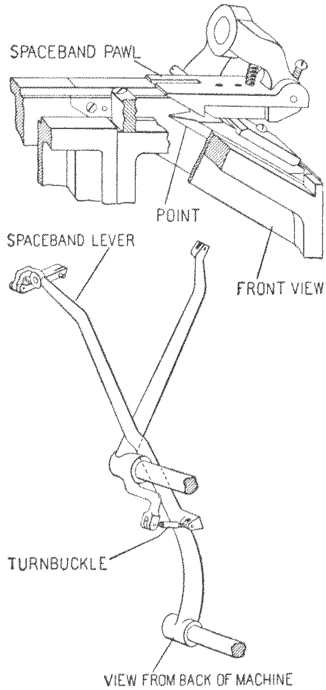


FIG. 30.—Spaceband lever and the elevator transfer lever as viewed from the back of the machine.

The view above shows the spaceband pawl at its extreme right-hand position from the front of the machine. At this position the spaceband pawl should have delivered the spacebands into their magazine.

seem as though it would be a very difficult matter to keep a machine in good condition for rapid operation. This is not the case. A little pains taken along the lines suggested will keep the machine in such condition that, no matter how fast the operator may touch the keys, the matrices and spacebands will fall in their appropriate places to make the composed line of matrices.

THE STAR WHEEL

The star wheel is driven by a belt from a pulley mounted on the intermediate bracket, as shown in Fig. 32. In the design used until recently there was a pair of spur-gear wheels, as shown in Fig. 32. On the spindle of one of these wheels at 7 there is mounted a small friction disk which is kept pressed against the disk that drives the star wheel. The object of this spring-pressed disk is to allow the star wheel to stop in case of a clog of the matrices as they are passing into the assembler. A small dog-clutch

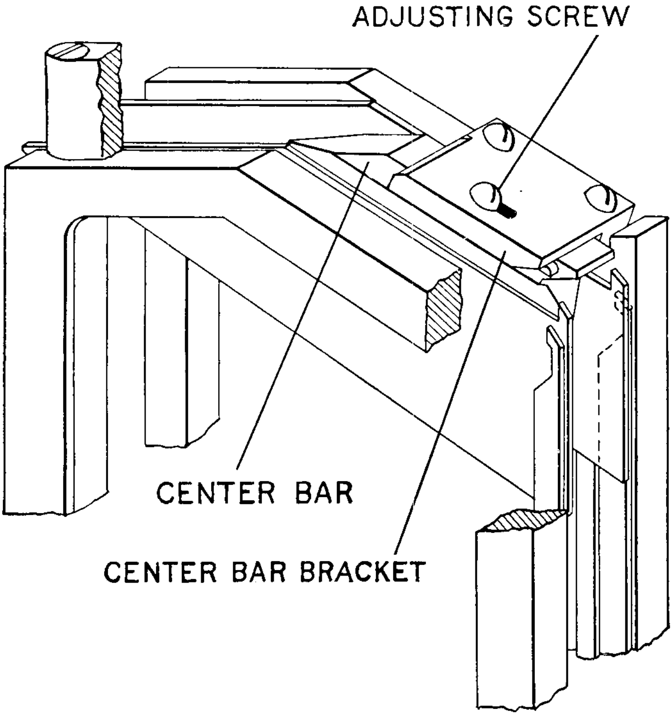


FIG. 31.—View of the spaceband box, showing the center bar and the center-bar bracket, and the screws for adjustment by which the center-bar bracket can be placed in exact position to receive the upper part of the spaceband and guide it downward to the point of storage.

operated by hand is shown in the figure, by which the spindle that drives the star wheel can be disconnected by the operator while he is clearing out the matrices in case of a clog as referred to. For some years past, instead of the flat belt driven by a pulley on the intermediate bracket, as described and illustrated, a round belt running over grooved pulleys is used, as shown in Fig. 32. There is a fast and a loose pulley in this device, and means for shifting the belt from one pulley to the other, thereby stopping and starting the star wheel.

ASSEMBLER ENTRANCE

The assembler entrance, sometimes called the "front," consists of a brass casting having slots cut in it at the top and screw bushings fastened in at proper intervals. These slots and screw bushings support the partitions or guides which are made with lugs which fit in the slots and the bushings. A wire is run through on the back side of these partitions to hold them in position.

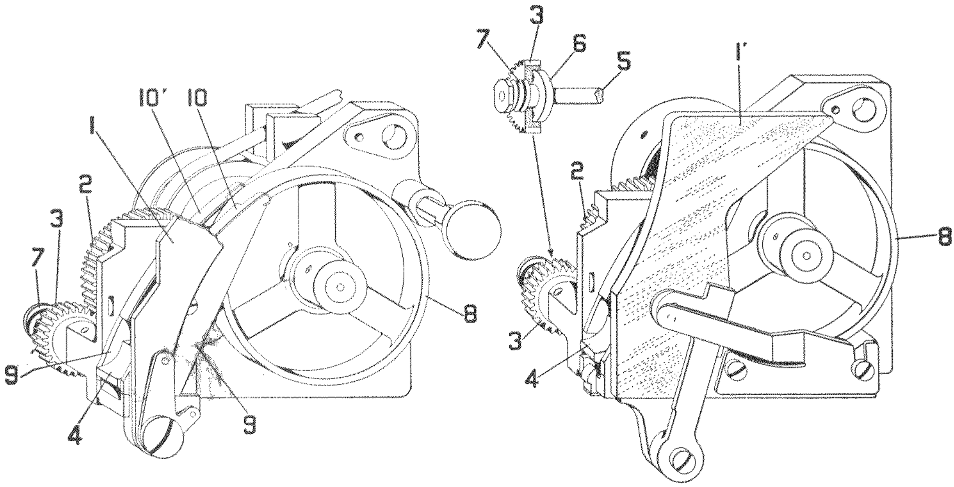


FIG. 32.—View showing the details of the assembler block. In this figure, *1* is the assembler cover which is shown broken away in the left-hand view; *2* is a gear connected by a belt to the intermediate shaft, which drives a smaller gear *3* at a high speed. The smaller gear *3* is mounted on a shaft, upon which shaft is mounted the star wheel *4*. Gear *3* is not fast upon the shaft *5*, but is held against a friction disk *6* by a spring *7*. The friction disk *6* is fastened upon the shaft *5*. If anything, such as a clog of the matrices, occurs which stops the action of the star wheel, the shaft *5* stops, while the spur gear *3* continues to revolve. The slipping action of the gear *3* against the friction disk *6* is to prevent the breakage or bending of the matrices in the case of a clog at the star wheel.

*8* is the large pulley over which the assembler belt runs. The assembler belt is not here shown. *9-9* are the assembler chute rails; *10-10* are spring rails which are fastened to the fixed rails *9-9*. These rails are of such shape as to direct the matrix directly upon the star wheel.

The lower edge of the magazine containing the matrices registers at the top of this assembler front, the magazine being set just a little higher than the front. The front is of such a shape that when the partitions are in place the matrices sliding out of the magazine will slide down the face of this assembler front between the partitions which prevent them from turning sidewise. Just below the assembler casting runs the assembler belt. Most of the matrices in falling strike upon this belt and are carried down to the assembler chute.

There is a cover, hinged at the top, which fits down over the partitions, and guides the matrix down upon the belt to assembler chute. This cover was formerly made of glass but owing to the difficulty of making the glass the right shape, and the breakage, it is now made of brass.

### ASSEMBLER CHUTE

At the lower part of the assembler front is mounted the assembler chute. This consists of a pair of rails mounted on a block. The upper side of these rails is covered by a pair of spring rails, so when the matrices come down over them they will strike a slightly yielding rail instead of a solid one. In the earlier forms of the machine there were no spring rails, but the rails were made out of fiber so as to avoid wear of the matrices. These rails wore out rapidly and new ones had to be substituted. All of the later machines, however, have the mechanism above described. The shape of the assembler chute and of the chute spring mounted just above it are such as to guide the matrices as they come from the belt down upon the star wheel and into the assembler stick.