June 24, 1947. G. O. CONNER 2,422,775

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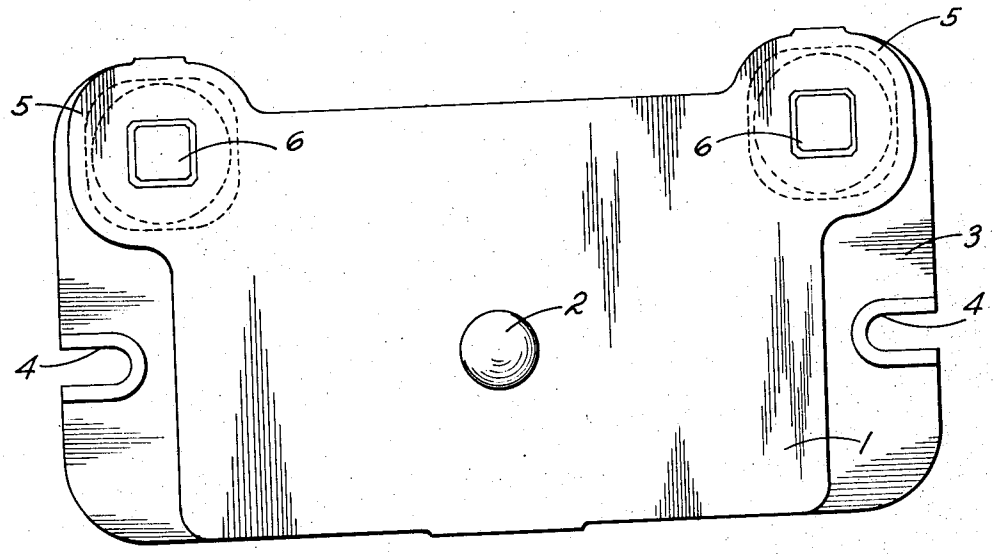



Fig. 1

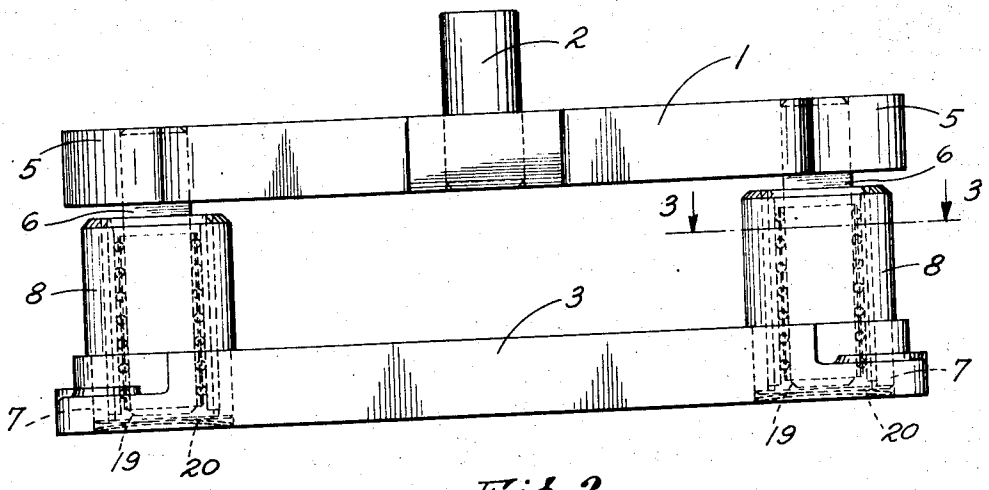



Fig. 2

INVENTOR.
GUY O. CONNER

BY J. D. Douglass

ATTORNEY

June 24, 1947. G. O. CONNER 2,422,775

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Filed June 2, 1945 5 Sheets-Sheet 2

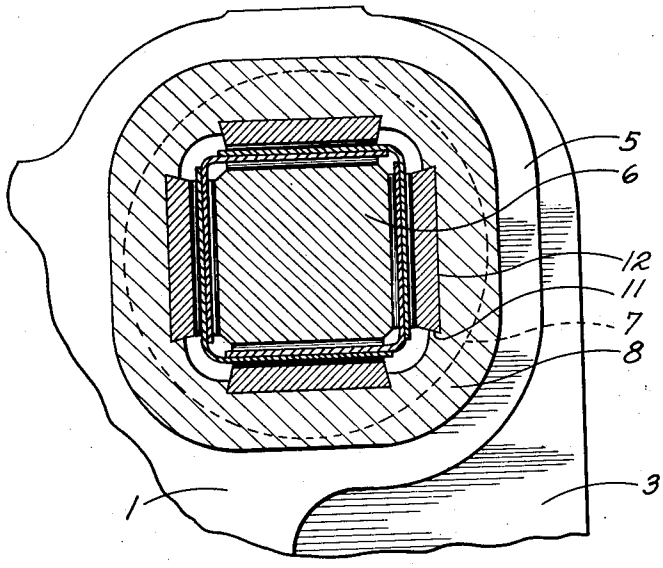



Fig. 3

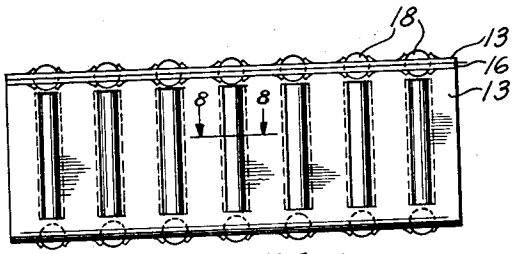



Fig. 4

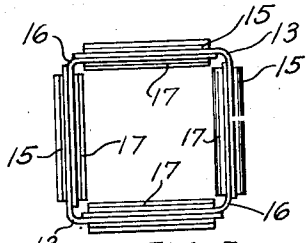



Fig. 5

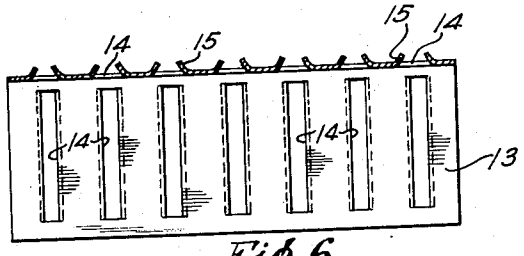



Fig. 6

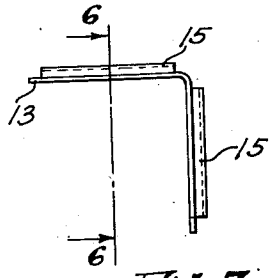



Fig. 7

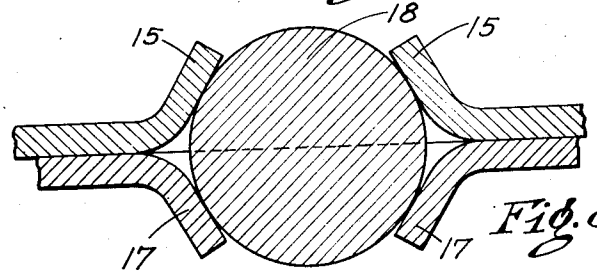



Fig. 8

INVENTOR.
GUY O. CONNER

BY

J. D. Douglas
ATTORNEY

June 24, 1947. G. O. CONNER 2,422,775

DIE SET

Filed June 2, 1945 5 Sheets-Sheet 3

Fig. 9

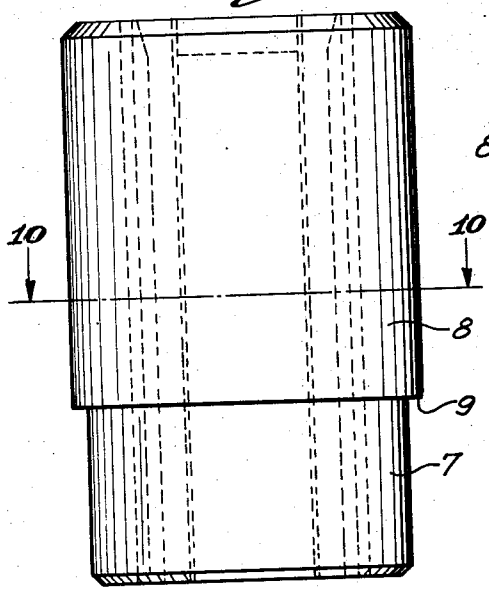
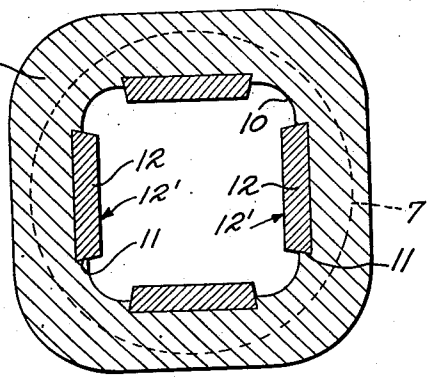



Fig. 10



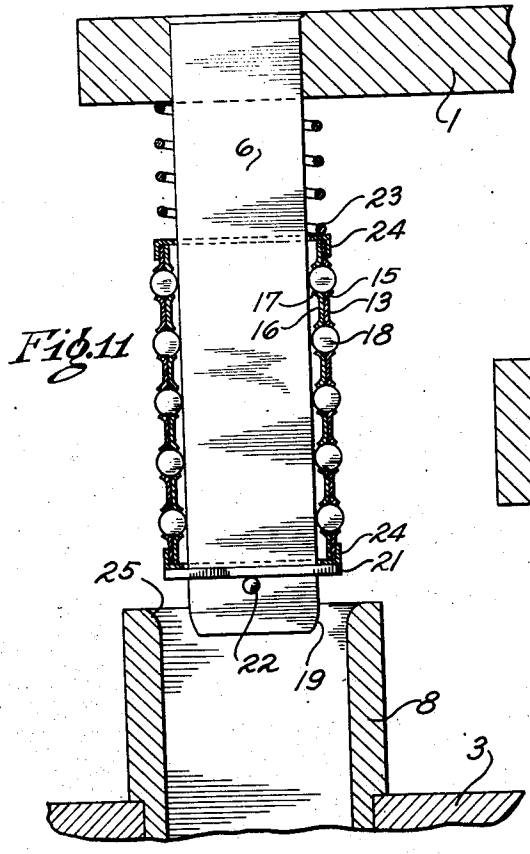




Fig. 11

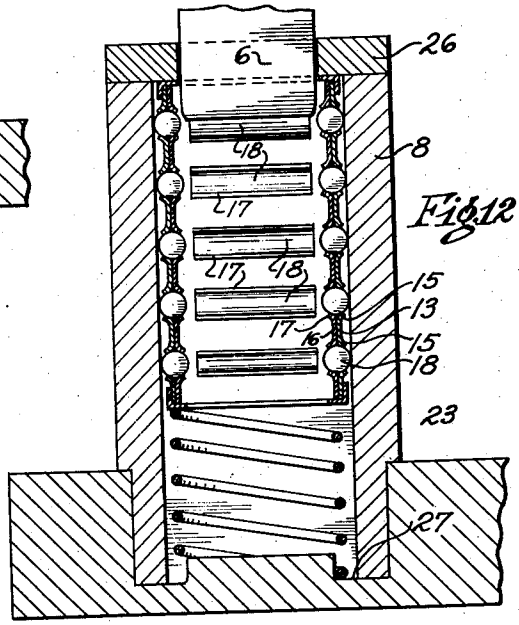



Fig. 12

INVENTOR.
GUY O. CONNER

BY

J. D. Douglas

ATTORNEY

June 24, 1947. G. O. CONNER 2,422,775

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Filed June 2, 1945 5 Sheets-Sheet 4

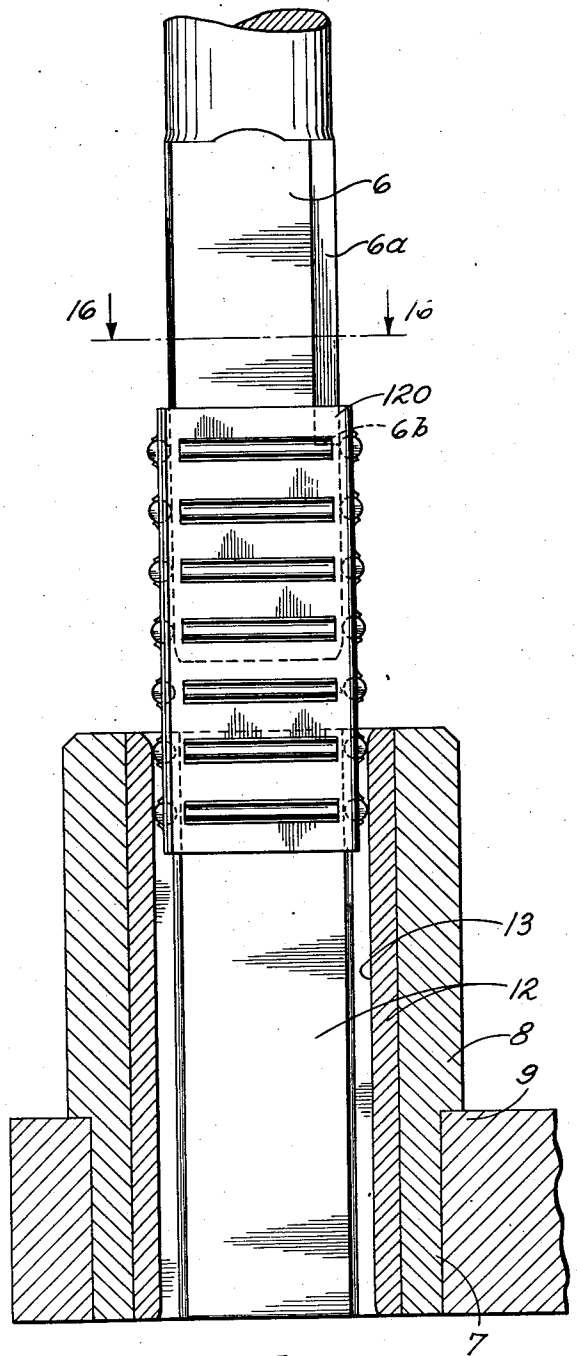



Fig. 13

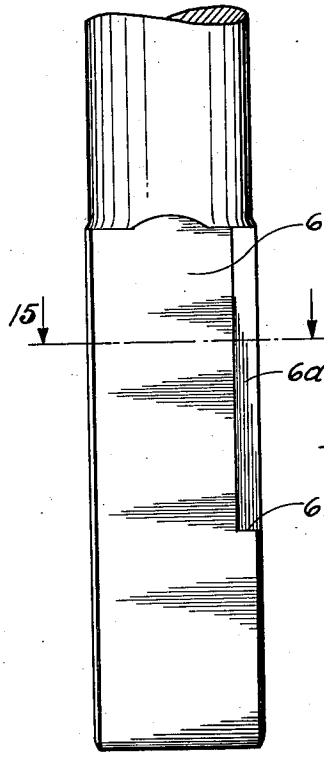



Fig. 14

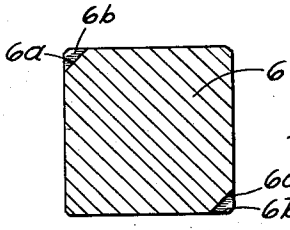



Fig. 15

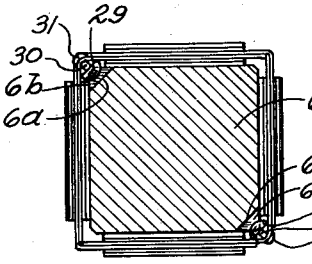



Fig. 16

INVENTOR.
GUY O. CONNER

BY

J. D. Douglass

ATTORNEY

June 24, 1947. G. O. CONNER 2,422,775

DIE SET

Filed June 2, 1945 5 Sheets-Sheet 5

Fig. 17

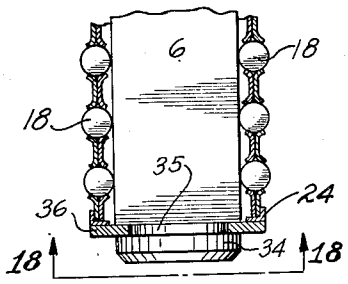



Fig. 18

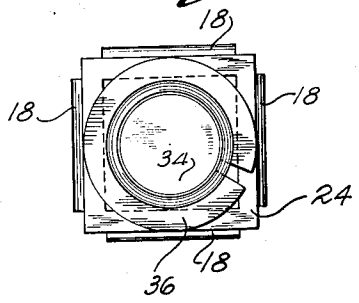



Fig. 19

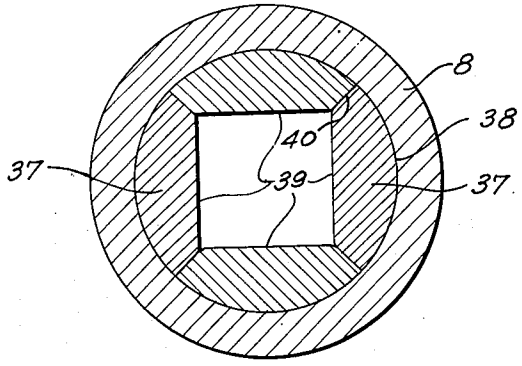
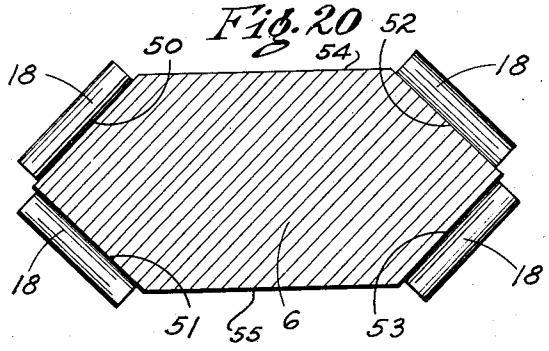



Fig. 20




INVENTOR.
GUY O. CONNER

BY

J. W. Newgass

ATTORNEY

Patented June 24, 1947

2,422,775

# UNITED STATES PATENT OFFICE

2,422,775

## DIE SET

Guy O. Conner, East Cleveland, Ohio

Application June 2, 1945, Serial No. 597,321

31 Claims. (Cl. 164—118)

1

This invention relates to improvements in forming machines and more particularly to improvements in apparatus for maintaining alignment between the moving parts of forming machines, such as dies which may be carried thereby. It is a continuation in part of my copending application S. N. 519,284.

The invention about to be described will be described specifically in connection with its use on die sets of the type such as are used to carry dies in punch presses. It is to be understood, however, that the invention is not to be limited to the specific application disclosed, but may be used in many types of forming machines other than punch presses.

As is well known to those versed in the art, a punch press usually comprises a traveling head which is reciprocable toward and away from a bolster, the head being usually guided in its travel by ways disposed on the side of press. Inasmuch as the heads are relatively large and heavy, a certain amount of clearance must be provided between the head and the ways in order to eliminate friction. In course of time, these ways also become worn and result in a looseness of fit that has a detrimental effect on the work that is being formed by the machine. Hence, it has become customary to employ a separate device for maintaining proper alignment of the dies, which device, commonly known as a die set, is adapted to support the dies, it in turn being secured to the head and bolster of the press.

The die set, as commonly constructed, comprises a pair of heavy plates adapted to be secured, respectively, to the head and bolster of the press. One of these plates has rigidly mounted thereon a pair of pins called "leader" pins, and these pins are reciprocable in bushings called "leader pin guides" carried by the other plate. The dies or forming means are mounted on the opposing surfaces of the two plates. The leader pins and bushings have a relatively close fit and are supposed to maintain the desired alignment between the dies. This alignment depends largely, if not entirely, upon the amount of clearance between the leader pins and their cooperating bushings.

It will appear, therefore, that it is desirable to reduce this clearance as much as possible in order to maintain the best alignment of the dies. There are, however, limitations as to the minimum amount of clearance that can be used, for if the leader pins and bushings are too tight, there will be an excess of friction during operation which will cause them to get hot and

2

"freeze," making the device completely inoperative. In the course of time, the leader pins and bushings wear, and the alignment, then, is no better than if the dies were placed directly on the head and bolster. It is not practical in most instances to replace these pins and bushings, therefore, the entire die set is replaced. The element of friction plays an important part in machines that are operated at high speeds, particularly in machines of the type disclosed in my copending application, Serial No. 497,792. In this type of machine the parts corresponding to the heads and bolster both move. The speed at which they move is so great that the pins and bushings have been known to get hot and freeze in a relatively short period.

It is desirable to maintain accurate alignment between the dies in forming machines because it not only increases the die life but admits the making of a better product. This is particularly true where the thickness of the stock is decreased. With thin stock it becomes not only desirable, but necessary, to maintain more accurate alignment between the dies, otherwise the edges of the material will not have the proper shape. There eventually comes a time, when extremely thin stock is being formed, that ordinary die sets cannot be used.

By applying my present invention to a die set the possibility of misalignment of the dies is greatly reduced. This results in a material increase in die life; the ability to operate the machine at higher speeds because of the reduction in the frictional losses; and the ability to operate on much thinner stock with ordinary forming machines.

Another advantage of the invention, which will become more apparent as the description proceeds, resides in the decrease in "bench" time necessary for the workman to set up the dies. Heretofore, when ordinary die sets were used, because it was necessary for the leader pins and guides to have a relatively close fit to prevent lateral movement of the dies relative to each other, it was extremely difficult to assemble and take apart the die sets. Obviously, this difficulty increased with the tightness of fit of the leader pins and guides, and in some instances it was necessary to use jacks and bars to get the die set apart. This not only took time, but sometimes caused the pins to be bent, resulting in the ruination of the dies. By my present invention the dies may be quickly and easily disassembled by hand and without the use of jacks or bars

and still the alignment possible is more perfect than could be attained with ordinary die sets.

Still other advantages of the invention, and the invention itself, will become more apparent from the following description of an embodiment thereof, which description is illustrated by the accompanying drawings and forms a part of this specification.

In the drawings:

Fig. 1 is a plan view of a complete die set embodying my invention;

Fig. 2 is an elevational view thereof with certain hidden parts shown in dotted lines;

Fig. 3 is a horizontal sectional view taken from a plane indicated by the line 3—3 of Fig. 2 and looking in the direction of the arrows;

Fig. 4 is an elevational view of a bearing assembly as used in my invention;

Fig. 5 is an end view thereof;

Fig. 6 is a sectional view of one of the bearing retainer elements taken on the line 6—6 of Fig. 7 and looking in the direction of the arrows;

Fig. 7 is an end view of one of the bearing retainer elements removed from assembly of Fig. 4;

Fig. 8 is an enlarged fragmentary view showing the manner in which a bearing is held in the bearing retainer element;

Fig. 9 is an elevational view of one of the leader pin bushings removed from the plate;

Fig. 10 is a horizontal section taken in the line 10—10 of Fig. 9 and looking in the direction of the arrows;

Fig. 11 is a fragmentary section taken through a die set, with the leader pin shown in elevation, and illustrating a modified form of my invention;

Fig. 12 is a similar view of another form of my invention;

Fig. 13 is an elevational view of a modified form of a leader pin removed from the plate, and a bearing assembly showing the bearing assembly partially entered into the bushing, the leader pin bushing and plate being shown in section;

Fig. 14 is an elevational view of a leader pin removed from the plate;

Fig. 15 is a section taken on the line 15—15 of Fig. 14;

Fig. 16 is a section taken on the line 16—16 of Fig. 13.

Fig. 17 is a fragmentary view of the end of a leader pin such as is shown in Fig. 11, illustrating another modification of my invention;

Fig. 18 is a view taken from a plane indicated by the line 18—18 of Fig. 17 and looking in the direction of the arrows;

Fig. 19 is a section similar to that of Fig. 10 illustrating a modified form of leader pin guide useful in my invention; and

Fig. 20 is a view through a modified form of leader pin and showing one manner in which the bearing may cooperate therewith.

In carrying out my invention, I preferably provide means to maintain alignment between members, which are movable toward and/or away from each other, in the form of guide means carried by one member and cooperable with guide means carried by the other member and with means interposed between the guide means to decrease the frictional resistance and control the relative lateral movement therebetween. The guide means are preferably provided with bearing surfaces and the anti-friction means is preferably in the form of roller bearings disposed therebetween. The space between the guiding means



may be such that the bearings have a relatively close fit therein limiting the amount of lateral movement. In the preferred form, the space between the guiding elements is such that the bearing elements are held therebetween under pressure. This pressure may vary between relatively wide limits from a point where the pressure is very light to that where it is quite heavy. In some instances, it may be desirable that the bearings be unloaded, that is, they may be small enough that there is a slight clearance between the bearings and the walls.

Referring now to the drawings, throughout which like parts are designated by like reference characters, and more particularly to Figures 1 and 2 which depict a die set embodying my invention. The die set illustrated includes a flat upper plate 1, which is provided with a post 2, that is set into the plate in the conventional manner and extends upward from the top of the plate. The top plate is adapted to be secured, by means of the post 2, to the traveling head or ram of a press, not shown, in a manner well known to those versed in the art.

The bottom plate 3 is similar in formation to the upper plate, except that it is somewhat wider, as indicated, and is provided with U shaped notches 4 by means of which it may be bolted to the press bed or bolster not shown.

The upper plate is formed with a pair of ears 5 disposed at the corners on one side, in each of which is secured a leader pin 6, that extends downwardly toward the lower plate. The leader pins are of square cross section and may be secured in the upper plate by a press fit or in any other desired manner so long as they extend normal to the under face of the top plate.

Cooperating with the leader pins on the top plate, are guides, sometimes called bushings, that are carried by the lower plate. Figures 9 and 10 are elevational and cross sectional views, respectively, of a preferred form of guide. Each guide comprises a lower portion 7 which may be cylindrical in cross section, and an upper portion 8 which may be substantially square in cross section, the junction of the two parts providing a shoulder 9. The guide is secured in the lower plate coaxial with the leader pin by a press fit in a manner similar to the leader pins. The shoulder 9 rests on the top surface of the lower plate and lends stability to the guide after being assembled in the plate.

The leader pin guide is provided with a vertically extending bore 10 which may be substantially square in cross section (Fig. 10). The cross sectional area of the bore 10 is larger than the cross section of the leader pin and the walls of the bore are each provided with a channel 11, the side walls of which are slanting and in which are secured hardened steel plates 12, the plates forming a dovetail connection with the channels. The plates preferably are secured in the channels by a press fit and may be shorter than the guides. After insertion the material of the guides at the upper and lower ends of the plates 12 may be staked, thus securely holding the plates in place. The faces 12' of the plates may be hardened and ground prior to insertion. Likewise the faces of the leader pins are hardened and ground.

The leader pins are sufficiently smaller in cross section than the distance between opposite plates 12 that there is a space between the walls of the leader pins and the plates 12 in which are disposed bearings. The bearings are of such a size that they span the space between the leader

pins and the plates 12. Preferably they should be of such a size that they prevent lateral movement between the leader pin and guide. This condition is sometimes known as loading, and the amount of loading may vary, depending upon the type of service for which the die set is designed. For light work the loading may be relatively light, that is the bearings are snug between the walls, but the pressure on them is not very great. For heavy work the bearings may be heavily loaded where the pressure upon the bearing is considerably greater than in the case of light loading. In some instances, as previously stated, there may be no loading, in which event the bearings would fit loosely in the space between the walls.

The bearings in this case are of the roller type and are held in their proper position between the walls by cages as shown in Figures 3 to 8 inclusive.

The bearings retainer may be fabricated in various manners, one manner being shown in Figures 4 to 8 inclusive. In this case, the cage is constructed of angle plates as shown in Figures 6 and 7. Each outer element comprises an angle plate 13, the sides of which are generally rectangular and extend at right angles to each other. The faces of each element are provided with openings 14 which are formed by striking the material outward to provide tongues 15. Two such elements are provided for each retainer. Matching with these elements are two inner elements, indicated at 16, Fig. 5, which are substantially the same as the outer elements except that the tongues 17 are struck inward. The four elements are secured together, as can best be seen in Fig. 5, with the outer elements, each forming two adjacent sides of a square and with the apex of the angles formed by the plates opposite to each other, and with the inner elements overlapping the opposite outer elements and with the apex of the angles formed by the inner elements being opposite to each other. In this manner the four elements form a square cage. The openings in each element align with those of the element which they overlap and the bearings 18, which may be cylindrical, are retained within the openings by the tongues 15 and 17, as can best be seen in Fig. 8.

As previously stated, the retainer with the bearings carried thereby is disposed in the space between the leader pin and the guide plates 12 of the guide. This is shown most clearly in Figures 2 and-3. In operation, when the upper plate, as viewed in Figure 2, is moved upward, the leader pins are withdrawn from the guides, the bearings 18 rolling on the face of the leader pins and the plates 12.

Likewise the bearings roll between the two opposed faces upon the downward travel, and because of the pressure or loading of the bearings between the faces, the leader pin is prevented from moving laterally relative to the guide, but the parts may move more freely longitudinally relative to each other.

The ends of the leader pins may have beveled edges as indicated at 19 to permit them to enter into the bearing assembly more readily.

As shown in Fig. 2, the end 7 of the guide does not extend to the bottom of the opening in the base but stops short thereof, and the opening closed by a welch plug 20. This prevents foreign matter from entering the lower end of the opening and also assists in maintaining a lubricant for the bearings in the bore of the bushing.



At this point, it is desirable to point out that although throughout these drawings I have shown flat plane faces on the leader pin and guide between which the bearings are engaged, this is not to be construed as a limitation on my invention as it will be very apparent to those skilled in the art to use faces of other types. For instance, it would be quite within the purview of my invention to construct the faces so that they are arcuate in cross section or a longitudinal segment of a cylinder. If the faces were convex in cross section, then the bearings would be of concave cross section to match the opposed convex faces. If the faces of the pins and guides were concave in cross section, then the bearings would be convex in cross section to match the faces. In either event, the operation would be substantially the same.

Furthermore, although I have shown and described the bearings as being cylindrical, it will be apparent that ball bearings may be used and highly successful results obtained. The balls could be placed in rows or staggered as is clearly shown in my copending application S. N. 519,284.

These leader pins could be of elliptical cross section if desired, in which event the bearings could be disposed opposite the major and minor axes of the ellipse, the walls of the guide could also be similarly curved, and the walls of the bearings would be incurvate.

The device shown in Figures 1 and 2 is more particularly adapted for operation where the movement of the plates is such that the leader pin is not necessarily completely withdrawn from the guide. When the operation is such that the leader pins are completely withdrawn from the guides, means may be provided to hold the bearing assembly on the leader pin or in the guide in a position such that upon the entry of the leader pin into the guide, the bearing will be positioned for proper engagement therebetween. Such means is disclosed in Fig. 11. In this case, the retainer is prevented from dropping off of the leader pin by a ring 21 which engages the bottom edge of the retainer and which is held in place by a pin 22 which may be a cotter pin. Means may be provided for holding the bearing assembly in proper position on the leader pin prior to entry of the pin into the guide. In this case, a helical spring 23 is disposed about the leader pin with its upper end in engagement with the under side of the top plate and with its lower end engaging the top of the retainer. The ends of the retainer are provided with members 24 of angular cross section which are seated on and embrace the ends of the retainer to provide a thrust surface for the spring 23 and the ring 21.

In the operation of the apparatus just described, the leader pin may be completely withdrawn from the retainer. The ring 21 prevents the bearing from dropping off of the pin upon such withdrawal and the spring 23 holds the bearing in its proper place on the lower end of the leader pin prior to entry of the pin into the guide. When the leader pin and bearing enter the guide, the upper end of which is curved at 25 to permit ready admittance, the bearing enters with the leader pin until it engages the walls of the guide after which the bearings roll between the walls, upward relative to the leader pin and downward relative to the guide, compressing the spring 23. In this manner, the leader pin and guide with the rolling bearings therebetween maintain alignment of the parts during and prior to the forming operation.

Fig. 12 illustrates a modified form of the apparatus similar to that of Fig. 11 but wherein the bearing assembly is retained within the leader pin guide. In this case, the guide 8 may be somewhat longer than that of the preceding figures and the upper end is closed by a ring 26 which may be secured to the guide in any suitable manner. The bearing retainer assembly may be the same as that in Fig. 11, and a helical spring 23 is disposed between the lower plate which supports the guide. As shown in the drawings, the opening for the guide in this case does not extend through the plate but is provided with the bottom wall 27 that has a circular groove 28 in which the spring is seated. A preferred construction would be to close the bottom opening by a separate plug upon which the spring could rest; or the spring could rest on a shoulder provided by a ring inserted in the bottom of the opening.

In the operation of the foregoing structure, the leader pin may be completely withdrawn from engagement with the guide and bearing on the upward travel of the device. The spring 23 then holds the retainer in an upward position with the end of the retainer engaging the member 26. In this event, when the bearing elements are ready to be engaged by the leader pin upon entering the guide on its downward travel, the pin, after entering into the bushing, engages with the bearings which roll downward at one-half the speed of the pin in a manner similar to that already described.

Figs. 13 to 16, inclusive, illustrate a preferred form of structure similar to that of Figs. 11 and 12. The leader pin 6 is shown removed from the top plate, and is similar in formation to that previously described except that the diagonally opposite corners at 6*a* are removed extending from the upper end of the pin to a point at 6*b* spaced from the lower end of the pin. The lower end of the pin retains its square formation. The guide may be the same as shown in Figs. 2, 9 and 10.

The bearing assembly may be exactly the same as described in Figs. 3 to 8. In this instance, however, stop members are provided which prevent the bearing assembly from falling off of the leader pin when it is withdrawn from the guide. Each of the stop members may comprise a head 29 disposed on the inside opposite corners of the bearing cage, having a stem 30 which extends through the wall of the cage and is headed over at 31 on the outside, as can best be seen in Fig. 16. These stop members are secured in place after the bearing assembly is placed in the leader pin. The heads 29 extend into the space where the corners 6*a* are removed allowing the bearing to slide freely thereon. The heads, however, engage the shoulder 6*b* after the bearing assembly has moved downward on the post a predetermined distance, preventing the assembly from falling off of the leader pin when it is withdrawn from the guide, this position being best shown in Fig. 13. It will also be noted that this has an advantage over the structure shown in Figs. 11 and 12, in that the bearing assembly enters the guide ahead of the leader pin. Since the bearing assembly only travels half as far as the leader pin, this permits a wider range of movement of the leader pin in and out of the guide.

Obviously, the stop member 29 can assume other forms. It could be in the form of a screw having a projecting end that extends into the space left at 6*a*; it could be formed by a projection on the cage itself which could be bent over to extend into the space or it could be formed by upsetting the cage to cause it to project inward and thus serve as a stop. In any event, the function would be the same.



In this embodiment, I also contemplate the use of a spring as shown in Fig. 11. This may be desirable to prevent the bearing assembly from traveling upward due to inertia when the leader pin and bearing are completely removed from the guide. It also helps to properly position the bearing assembly during high speed operation.

In Figs. 17 and 18, I have illustrated another modified form of the invention as disclosed in Fig. 11. In this embodiment, the end 34 of the leader pin is cylindrical; a groove 35 separates the end from the body 6 and the bearing assembly is held on the leader pin by a split spring ring 36 which is disposed in the groove 35.

Fig. 19 illustrates a modified form of leader pin guide, the section being taken from the same plane as that of Fig. 10. In this case, the exterior and interior of the guide may be cylindrical, although obviously the exterior could be square if desired. The desired bearing surfaces in this instance are provided by four elongated segments 37, the exterior surface of each being curved at 38 to allow a close fit with the cylindrical interior wall of the guide. The inner face 39 of each is ground flat to provide a bearing surface which operates the same as that illustrated in Figure 10. The longitudinal edges are provided with oblique faces at 40, the size of the segments being such that the faces 40 of adjacent segments meet when assembled in the guide.

It will be seen that in this embodiment the construction is such that no difficult broaching operations are necessary. All the surfaces may be ground and thus formed to provide a close tight fit. The segments may be installed by pressing them into the guide after which the wall of the guide may be staked to hold the segments in place.

Although I have referred to the leader pins in their preferred forms as being square in cross section, it is within the purview of my invention to provide leader pins of different shaped cross section. For instance, they could be provided with three flat sides in the form of a triangle, or they could be in the form of a polygon. Neither is it necessary that all sides be the same length, the only desideratum being that the bearings have a conformation similar to the space between the leader pin and guide. If the bearing surfaces are flat, the bearings should be cylindrical, except, of course, in the case where ball bearings are used.

In Figure 20, I have shown a form which is also depicted in my copending application, wherein the leader pin has six sides and has bearings in engagement with only four of the six sides. In this case, the sides 50—51 form a V and are opposite to the sides 52—53. The bearings may be omitted from the sides 54—55 if desired.

It should also be borne in mind that the bearing retainer may take forms other than that illustrated. For instance, the walls may be solid and the bearings held in place by staking over the walls adjacent the opening.

The number of leader pins and their cooperating guides may also be varied. In the drawings, I have shown the invention as having the conventional number of leader pins and guides. It will be apparent, however, that this number may be varied and that my invention particularly makes it possible to construct a die set having only one leader pin, in which event the polygonal

construction lends itself readily to preserving radial as well as vertical alignment.

It will thus be seen that I have provided an improved die set that is easy to operate and which results in a material savings of the workman's "bench time." The construction is such that the dies are maintained in very accurate alignment which enables articles to be formed with a high degree of accuracy. It also appears that because it is possible to maintain a proper alignment, that the cutting or forming edges of the dies do not tend to mutilate each other even when the clearance space is small as it need be when operating on extremely thin stock. This, therefore, results in a material increase in die life. Furthermore, the die sets themselves, because of the character of my invention, are capable of extraordinary long life; operate easier and, therefore, result in a saving of power not possible with ordinary dies. Because of the ease with which the die set parts may be taken apart and put together, it is not necessary to use jacks or bars and the leader pins are thus less apt to be thrown out of alignment.

It will also be understood that the invention is applicable to other places than the leader pins and guide; for instance, it may be desirable to apply the same to the traveling head itself. This is particularly true when the invention is used in connection with the heads of my high speed forming machine of my copending application, Serial No. 497,792, although it is not limited in its application to this particular form of machine.

Having thus described my invention, I am aware that numerous and extensive departures may be made therefrom, without departing from the spirit or scope of the invention as defined in the appended claims.

I claim:

1. An apparatus of the class described, comprising die parts supporting members adapted for movement toward and from each other, guide means for maintaining alignment of said members during their movement including one or more posts carried by one of said members and one or more sockets carried by the other member, said posts and sockets being of polygonal cross section and anti-friction members disposed between said post and socket walls to provide a loaded rolling engagement therewith.

2. A die set comprising members adapted for movement toward and from each other, means to guide said members in their movement comprising one or more polygonal leader pins rigidly connected to one of the members and complementary guides for receiving and holding said leader pins against lateral movement rigidly connected to the other member.

3. An apparatus of the class described comprising spaced members movable toward and from each other, means to maintain predetermined alignment between said members comprising guide means carried by one member and movable in spaced relation to guide means carried by the other member, and roller bearing elements interposed between the guide means under loaded conditions to decrease friction and control relative lateral movement therebetween in all directions.

4. Means for maintaining in alignment cooperating die means relatively reciprocable toward and away from each other and adapted to operate on work disposed therebetween comprising guide means respectively rigidly connected with said die means, said guide means having opposed spaced apart planar guiding surfaces extending parallel to the direction of relative reciprocation of said die means, which surfaces reciprocate in parallel paths alongside each other upon relative reciprocation of said die means, and means interposed between said surfaces resisting relative movement of said guide means in all directions transversely of the direction of relative reciprocation of said die means.

5. Means for maintaining in alignment cooperating die means relatively reciprocable toward and away from each other and adapted to operate on work disposed therebetween comprising guide means respectively rigidly connected with said die means, said guide means having opposed spaced apart planar guiding surfaces extending parallel to the direction of relative reciprocation of said die means, which surfaces reciprocate in parallel paths alongside each other upon relative reciprocation of said die means, and anti-friction bearing means interposed between said surfaces under loaded condition and movable relatively to each of said surfaces resisting relative movement of said guide means in all directions transversely of the direction of relative reciprocation of said die means.

6. An apparatus of the class described, comprising die parts supporting members adapted for movement toward and from each other, guide means for maintaining alignment of said members during their movement including one or more projections of polygonal cross section rigidly carried by one of said members and complementary guides rigidly carried by the other member, said projections and guides having cooperating bearing surfaces and anti-friction members disposed between said surfaces to hold said guide means against lateral movement.

7. A die set comprising plates adapted for attachment to a forming machine and to carry die parts thereon, leader pins carried by one plate and extending toward the other, leader pin guides on the other plate for cooperative engagement with the leader pins and means interposed between the guides and pins for holding said pins and guides and the die set parts in predetermined alignment with each other said leader pins being polygonal in cross section.

8. In combination with a die set having a first plate adapted for attachment to the traveling head of a press and a second plate adapted for attachment to the bolster of a press, means to guide said plates in their movement toward and from each other comprising leader pins carried by one plate and extending toward the other and formed with flat plane faces on their sides extending longitudinally thereof, leader pin guides carried by the other plate adapted to receive and guide said leader pins.

9. In combination with a die set having a first member adapted for attachment to the traveling head of a press and a second member adapted for attachment to the bolster of a press, means to guide said members in their movement toward and from each other comprising leader pins carried by one member and extending toward the other and formed with planar faces on their sides extending longitudinally thereof, leader pin guides carried by the other member adapted to receive and guide said leader pins each of said guides being provided with planar faces disposed opposite the faces on said leader pins and bearing elements interposed between said opposed faces.

10. In combination with a die set having a first plate adapted for attachment to the traveling head of a press and a second plate adapted for attachment to the bolster of a press, means to guide said plates in their movement toward and from each other comprising leader pins carried by one plate and extending toward the other and formed with planar faces on their sides extending longitudinally thereof, leader pin guides carried by the other plate adapted to receive and guide said leader pins, each of said guides being provided with planar faces disposed opposite the faces on each of said leader pins and bearing elements interposed between said opposed faces under loaded conditions.

11. A die set comprising plates adapted to be secured in a press or forming machine, guide means for holding said plates in alignment with each other comprising at least one leader pin carried by one of said plates and extending toward the other, said leader pin being polygonal in cross section and provided with bearing engaging faces on its sides, a leader pin guide carried by the other plate and extending toward said plate carrying the leader pin and being formed with a longitudinally extending openings of polygonal cross section, the walls of which provide bearing surfaces that extend in spaced opposed relation to the bearing surfaces of said leader pins and bearing elements disposed in the spaces between the bearing faces of the leader pin and guide under pressure.

12. An apparatus of the class described comprising a pair of members movable toward and away from each other, guide means for guiding said members in their movement and preventing relatively lateral movement therebetween comprising posts extending from one of said members and hollow guides carried by the other member coaxial with said posts, each of said posts having flat faces extending longitudinally thereof and each of said guides having corresponding flat faces extending opposite to and in spaced relation to the faces of said posts, and roller bearing elements disposed between said faces, the space between said faces being sufficiently large to receive said bearings but small enough to cause said bearings, when between the faces, to be under loaded conditions.

13. A die set comprising a first plate for attachment to the head of a press, a second plate for attachment to the bolster of a press, means for guiding said plates in their movement toward and from each other comprising leader pins carried by one plate and extending toward the other, said leader pins being of square cross section and having bearing faces on their sides, guides carried by the other plate and extending toward the first mentioned plate and having bearing faces therein extending opposite to said faces on the leader pins in spaced relation thereto, bearing elements for each leader pin and guide disposed between said faces and each including a cage, roller bearings carried by the cage and adapted for engagement with said walls, said bearings being disposed between said walls under loaded condition.

14. A die set comprising plates adapted to be moved toward and from each other and to support die parts thereon, guide means for guiding said plates in their movement and maintaining alignment therebetween comprising leader pins carried by one plate and extending toward the other, guide means on the other plate for cooperation with the leader pins and each comprising a housing, removable bearing plates disposed in said housing and bearing means disposed between the leader pins and bearing plates under loaded condition.



15. A die set comprising a pair of spaced parallel plates adapted to be moved toward and from each other and to carry die parts thereon, means for guiding and maintaining alignment between said plates comprising at least one leader pin rigidly carried by one plate and extending toward the other, said pin being polygonal in cross section and the sides constituting planar bearing faces, at least one guide rigidly carried by the other plate and extending toward the plate carrying the leader pin, said guide comprising a housing formed with a longitudinally extending opening into which the leader pin may extend, bearing engaging members carried by the housing and having longitudinally extending planar bearing faces disposed opposite to and spaced from the bearing faces on said leader pins, a bearing element interposed between the opposed bearing faces including a retainer shaped to conform to the leader pin, roller bearing elements carried by said retainer in spaced relation to each other, said roller bearings being sufficiently large to bridge the space between said bearing faces and exert pressure therebetween to rigidly maintain the post and guides and the plates in predetermined lateral alignment and to permit free movement of the plates toward and from each other.

16. A die set comprising a pair of plates adapted to be secured in a forming machine and to be moved toward and from each other, at least one leader pin carried by one plate and extending toward the other, said pin being of polygonal cross section and the sides thereof comprising bearing engaging faces, at least one guide rigidly carried by the other plate and extending toward the first plate and comprising a housing of polygonal cross section the interior of the housing having the walls formed to provide ways, bearing plates disposed in said ways and provided with bearing engaging surfaces disposed in spaced parallel relation to the bearing surfaces on said leader pin, bearing means interposed between said bearing engaging faces and including a bearing retainer cage surrounding the leader pin and spaced therefrom, roller bearing elements carried by the cage in spaced vertical relation between each opposing set of bearing engaging faces, said bearings being disposed between said bearing faces under loaded conditions and exerting predetermined pressure therebetween to hold the guide and post and hence the plates in rigid lateral alignment with each other.

17. A die set comprising spaced parallel die supporting plates adapted to be moved toward and away from each other, leader pins carried by one plate and extending toward the other, leader pin guides carried by the other plate and extending toward the first plate, said guides being disposed in alignment with the leader pins and having a bore in which the leader pin may travel, a bearing assembly carried by the leader pin and adapted upon the leader pin entering the guide to be interposed between the leader pin and guide and having bearing elements engaging the surface of the leader pin and the guide and exerting pressure therebetween to hold the same against lateral movement relative to each other.

18. An apparatus of the class described comprising members disposed in parallel relation to each other and movable toward and from each other adapted to carry cooperating die parts,

guide means for said members comprising one or more leader pins carried by one of the members and extending toward the other, said leader pins having flat side surfaces extending longitudinally thereof, one or more guides carried by the other member and extending toward the first member, each of said guides having a bore provided with flat surfaces disposed opposite to and in spaced relation to the flat surfaces on the leader pin and extending longitudinally of the guide, means for holding the guides and leader pins in predetermined lateral alignment with each other comprising a bearing unit including a bearing cage and bearing elements supported thereby, lock means to hold said cage on said leader pin upon the removal from the guide.

19. A die set comprising a pair of plates disposed in parallel relation to each other and movable toward and from each other adapted to carry cooperating die parts, guide means for said plates comprising one or more leader pins carried by one of the plates and extending toward the other, said leader pins having flat side surfaces extending longitudinally thereof, one or more guides carried by the other plate and extending toward the first plate, said guide having a bore provided with flat surfaces disposed opposite to and in spaced relation to the flat surfaces on the leader pin and extending longitudinally of the guide, means for holding the guides and leader pins in predetermined lateral alignment with each other comprising a bearing unit including a bearing cage and bearing elements supported thereby, lock means to hold said cage on said leader pin upon the removal from the guide and spring means for holding said bearing unit in proper position for engagement with said guide when the leader pin is beyond the confines of the guide.

20. A die set including members adapted for attachment to a forming machine and to be moved toward and from each other, guide means for said members to hold them against lateral movement relative to each other comprising one or more leader pins carried by one member and extending toward the other and one or more leader pin guides carried by the other member and extending toward the first member, each of said leader pins being of polygonal cross section and the sides formed to provide planar bearing surfaces, said guides each being hollow and having planar bearing surfaces disposed opposite to and in spaced relation to the faces on said pins, bearing means adapted to be disposed in the space between the bearing faces on the pins and guides when the pins are telescoped in the guides upon movement of the plates toward each other and comprising a cage, roller bearings carried by the cage and locking means to hold said bearing means on the leader pin upon removal thereof from the guide and spring means disposed around the leader pin between the plate and bearing retainer to hold the bearing means toward the end of the leader pin when out of the guide.

21. A die set comprising a pair of plates adapted to carry die parts and movable toward and away from each other, guide means for holding said plates against lateral movement relative to each other and guiding said plates in their movement toward and from each other comprising leader pins carried by one plate and extending toward the other plate, leader pin guides carried by the other plate and extending toward the first plate, bearing means adapted to be interposed between the guides and pins when the pins are telescoped within the guides and spring means for said bearing means to hold said bearing means in predetermined position prior to entry of the pin into the guide to properly position said bearing means between the guide and pin upon entry of the pin into the guide.

22. A die set comprising plates adapted to be secured to the head and bed of a forming machine and movable toward and from each other, means to hold said plates against lateral movement relative to each other and to guide said plates in their movement toward each other comprising leader pins rigidly carried by the upper plate each of said leader pins being of polygonal cross-section, the sides thereof forming planar bearing surfaces, a bearing assembly carried by each leader pin and having roller bearings disposed in spaced vertical relation to each other, the end of said leader pin being cylindrical and an annular channel formed between the square and round portions thereof, a lock ring disposed in said channel and holding said bearing assembly against accidental removal from said pin, and spring means disposed around said leader pin having its upper end in engagement with said plate and the lower end engaging said bearing assembly to hold it against said lock ring, guide means carried by said lower plate coaxial with said leader pins and provided with bearing engaging surfaces adapted for engagement with said bearings, said bearing elements and leader pin adapted to enter said guides upon movement of the plates toward each other and said roller bearings engaging the pins and guides with pressure.

23. An apparatus of the class described comprising a pair of members movable toward and from each other and adapted to carry forming dies, guide means for guiding said members therebetween comprising posts rigidly carried by one member and extending toward the other member, guides carried by said other member and extending toward the first member, said guides being coaxial with said posts and sufficiently larger than the posts to provide a space between the post and guide when the post is telescoped within the guide, and bearing means for said posts and guides each including a bearing retainer and bearings carried thereby disposed on said posts and cooperating means on the post and bearing means to hold said bearing means against accidental removal from the post when the post is removed from the guide and to permit said bearings to extend beyond the end of the post prior to entry of the post into the guide.

24. Means for maintaining in alignment cooperating die means relatively reciprocable toward and away from each other and adapted to operate on work disposed therebetween comprising guide means respectively rigidly connected with said die means, said guide means having opposed spaced apart planar guiding surfaces extending in the direction of relative reciprocation of said die means, which surfaces reciprocate in spaced paths alongside each other upon relative reciprocation of said die means, and anti-friction bearing means interposed between said surfaces and movable relatively to each of said surfaces resisting relative movement of said guide means in all directions transversely of the direction of relative reciprocation of said die means.

25. A die set comprising a pair of plates disposed in spaced relation to each other and movable toward and from each other adapted to carry cooperating die parts, guide means for said plates comprising one or more leader pins carried

by one of the plates and extending toward the other, said leader pins having flat side surfaces extending longitudinally thereof, one or more guides carried by the other plate and extending toward the first plate, said guide having a bore provided with flat surfaces disposed opposite to and in spaced relation to the flat surfaces on the leader pin and extending longitudinally of the guide, means for holding the guides and leader pins in predetermined lateral alignment with each other comprising a bearing unit including a bearing cage and bearing elements supported thereby, means to hold said cage in said guide upon the removal of the leader pin from the guide and spring means for holding said bearing unit in proper position for engagement with said leader pin upon its re-entering the guide.

26. A die set including members adapted to be moved toward and from each other, guide means for said members to hold them against lateral movement relative to each other comprising one or more leader pins carried by one member and extending toward the other and one or more leader pin guides carried by the other member and extending toward the first member, each of said leader pins being of polygonal cross section and the sides formed to provide bearing surfaces, said guides each having bearing surfaces disposed opposite to and in spaced relation to the faces on said pins, bearing means adapted to be disposed in the space between the bearing faces on the pins and guides when the pins are telescoped in the guides upon movement of the plates toward each other and comprising a cage, bearings carried by the cage and means to hold said bearing means upon the leader pin upon removal thereof from the guide comprising a projection on the cage, said leader pin being formed with a boss engageable with said projection to hold said cage on said leader pin, said cage being movable to extend beyond the leader pin when the leader pin is out of the guide.

27. An apparatus of the class described, comprising die parts supporting members adapted for movement toward and from each other, guide means for maintaining alignment of said members during their movement including one or more posts carried by one of said members and one or more sockets carried by the other member, each of said posts and sockets being formed with a plurality of longitudinally extending bearing engaging faces and anti-friction members disposed between said bearing faces in a loaded rolling engagement therewith.

28. Means for maintaining in alignment cooperating die means relatively reciprocable toward and away from each other and adapted to operate on work disposed therebetween comprising a guide means respectively rigidly connected with said die means, said guide means having a plurality of opposed spaced apart guiding surfaces extending parallel to the direction of relative reciprocation of said die means, which surfaces reciprocate in parallel paths alongside each other upon relative reciprocation of said die means, and means interposed between said surfaces resisting relative movement of said guide means in all directions transversely of the direction of relative reciprocation of said die means.



29. An apparatus of the class described comprising a pair of members movable toward and away from each other, guide means for guiding said members in their movement and preventing relatively lateral movement therebetween comprising posts extending from one of said members and guides carried by the other member adapted to surround said posts, each of said posts having plane faces extending longitudinally thereof and each of said guides comprising a housing and means disposed within said housing to provide plane bearing engaging faces extending opposite to and in spaced relation to the faces of said posts, bearing elements disposed between said faces.

30. A die set comprising plates adapted to be moved toward and from each other and to support die parts thereon, guide means for guiding said plates in their movement and maintaining alignment therebetween comprising leader pins carried by one plate and extending toward the other, guides means on the other plate for cooperation with the leader pins and each comprising a housing, said housing being formed with a cylindrical interior surface and a plurality of segmental plates disposed in said housing, said plates having oblique meeting edges in engagement with each other and a cylindrical surface in engagement with the housing and formed to provide bearing engaging surfaces and bearing means interposed between said plates and said leader pins.

31. An apparatus of the class described comprising members disposed in spaced relation from each other and adapted to be moved toward and from each other, means to maintain a predetermined alignment between said members during their movement comprising cooperating elements on said members extending in overlapping spaced relation to each other and roller bearings interposed between said members to control relative lateral movement therebetween transversely in all directions.

GUY O. CONNER.


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