

Jan. 2, 1934.

C. S. KNIGHT

1,942,145

PERFORATING DIE

Filed June 23, 1932

2 Sheets-Sheet 1

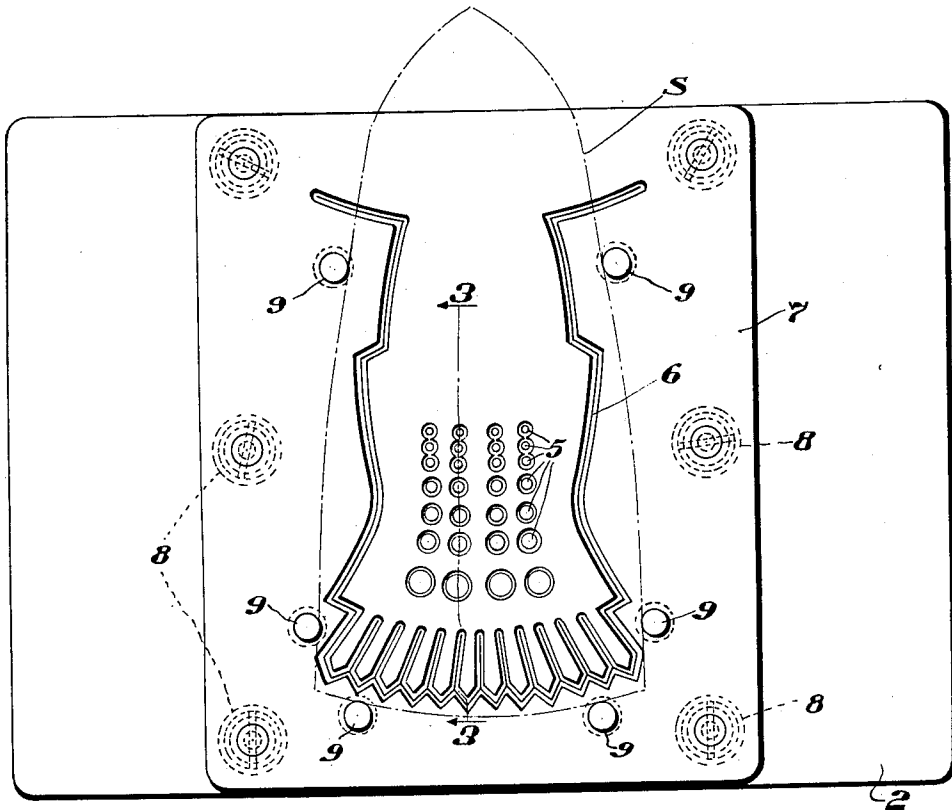


FIG. 1

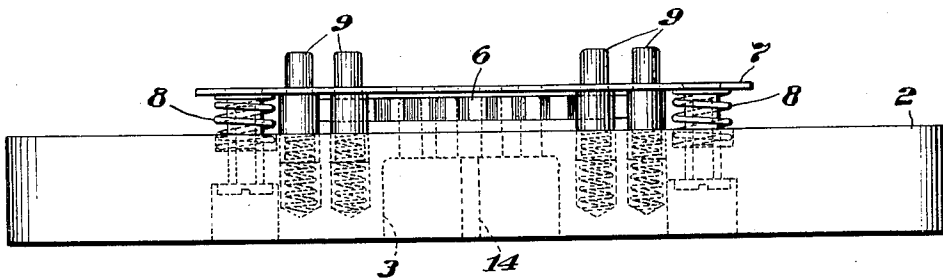


FIG. 2

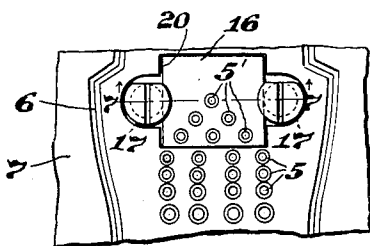


FIG. 6

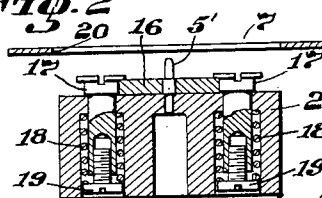


FIG. 7

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2 Sheets-Sheet 2

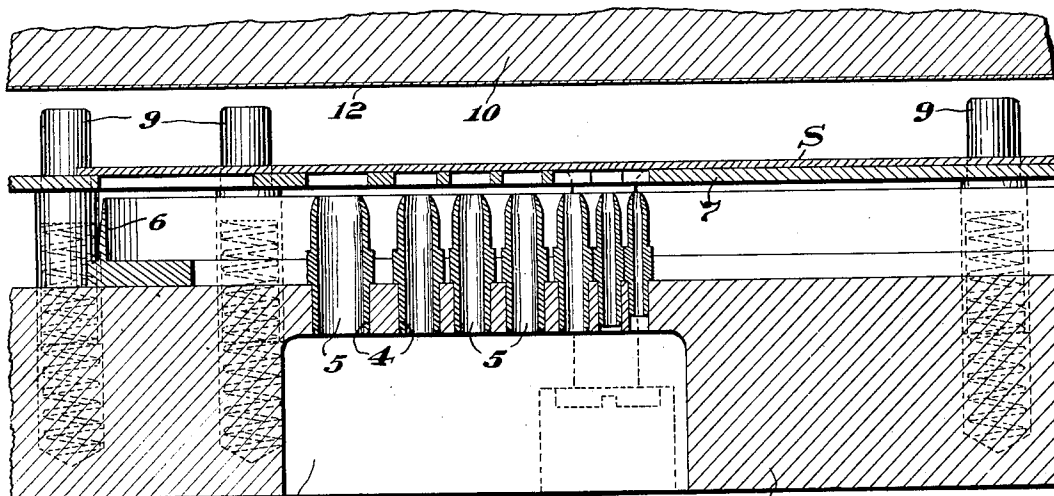


Fig. 3

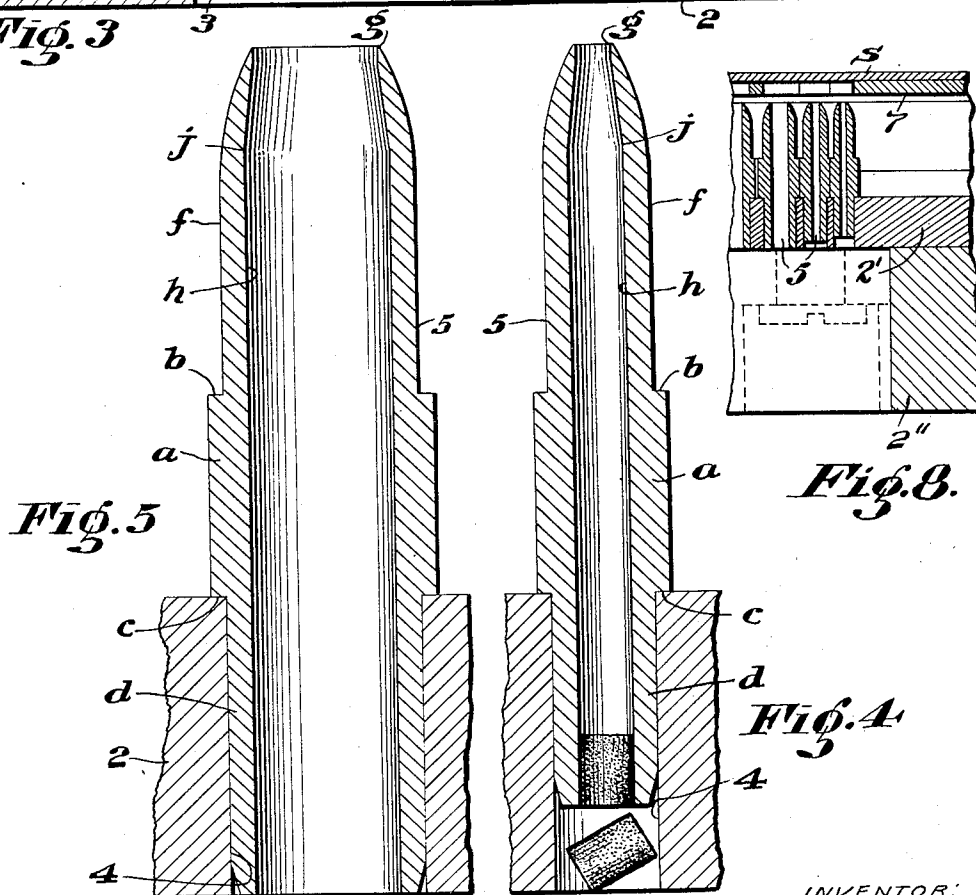


Fig. 5

Fig. 8.

Fig. 4

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UNITED STATES PATENT OFFICE

1,942,145

PERFORATING DIE

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Application June 23, 1932. Serial No. 618,847

10 Claims. (Cl. 164—93)

This invention relates to perforating dies of the type used chiefly, but not exclusively, in the shoe industry. Dies of this character are used very extensively for the purpose of ornamenting portions of a shoe upper and other parts made of leather or similar sheet materials.

It has been the usual practice heretofore to make the die plate for such a die in three pieces or sections; namely, a top plate or face plate, a back or base plate, and an intermediate hardened steel plate. The perforating tubes are manufactured to a high degree of exactness, usually in a precision lathe, and they are pressed into holes drilled accurately both as to size and position in the top plate above mentioned. The lower ends of these tubes rest upon the intermediate hardened plate. They are all of substantially the same height, a tolerance of not more than one or two thousandths of an inch ordinarily being permitted, and consequently, the upper ends of the tubes are maintained in substantially the same horizontal plane by virtue of the fact that they are all backed up by the hardened plate. They are supported partly by the latter plate and partly also by their pressed or driven fit in the holes of the face plate. Each tube has a central bore through which the small section or "pill" of leather which it cuts from the work is forced, and the hardened plate has holes of approximately the same, but usually very slightly larger, diameter than the bores of the tubes to permit these pills to pass through. For the same reason the base plate is cut out or recessed in line with the holes in the hardened plate so that the pills can drop freely through it.

It will be observed that a die of this construction requires a great deal of drilling, particularly if the pattern is of an intricate design, and that this drilling operation must be performed with an exceptionally high degree of accuracy. The manufacturing operations on such a die are further complicated by the fact that the bores of the smaller perforating tubes may have a diameter as small as fifteen thousandths of an inch, those in several of the smaller sizes ranging from this figure to sixty-five thousandths. Due to the manner in which these tubes are mounted it is necessary to use drills only slightly larger than said bores in making the holes through the intermediate plate. In addition, the holes drilled in the hardened plate must register very accurately with those in the face plate since any inaccuracy, particularly in the smaller sizes, is likely to cause the pills to jam where they pass from the perforating tubes into the holes in the intermediate

plate. In fact, this frequently occurs, both from the cause just mentioned and also due to other conditions, thus making it necessary to take the die apart, to remove the plugged tubes and replace them with new ones.

The present invention deals especially with the conditions above described. It aims to improve the construction of perforating dies with a view to simplifying the manufacturing operations, reducing the liability of errors in such operations, effecting economies in the expense of manufacture, facilitating the making of repairs, and generally improving and perfecting die constructions of this type. The invention involves both a novel die structure and also a novel perforating tube for use in such dies.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a plan view of a typical perforating die embodying features of this invention;

Fig. 2 is an edge view of the die shown in Fig. 1;

Fig. 3 is a vertical, sectional view approximately on the line 3—3, Fig. 1, but on a much larger scale than the latter figure;

Figs. 4 and 5 are vertical, sectional views of individual perforating tubes shown in Figs. 1 and 3, but on a much larger scale than in either of the latter figures;

Fig. 6 is a plan view of a portion of a die illustrating a modified construction embodying the invention;

Fig. 7 is a sectional view on the line 7—7, Fig. 6; and

Fig. 8 is a fragmentary sectional view of a construction similar to Fig. 3 but illustrating a modification.

Referring first to Figs. 1, 2 and 3, it will be observed that the die structure there shown includes a die plate 2 which preferably consists of a single integral piece of metal. This plate has a smooth flat top and one or more relatively large recesses 3 extending thereinto from the lower face of the plate. A series of holes 4 is drilled through the portion of the plate between the upper surface and the bottom of the recesses 3, these holes being designed to receive the perforating tubes 5. The number and arrangement of tubes used in any die necessarily will vary with the pattern or the design which the die is to make in the leather. The particular die

shown in Figs. 1, 2 and 3, for the purposes of explaining the invention, is intended to cut and perforate a fancy tongue for a sport shoe. This die, therefore, includes a knife 6 of the peculiar outline shown in Fig. 1 to cut the body portion of the tongue to the desired shape. The knife customarily is milled out of steel, as better shown in Fig. 3, and has an integral base which is secured to the die plate 2 by screws.

Cooperating with the perforating tubes 5 and the knife 6 is a stripper plate 7 which is supported by a series of springs 8, as in prior die constructions of this general type. The strip of stock or leather S rests on this plate and is located by spring pressed positioning pins 9 similar to those heretofore used in perforating dies.

These dies are intended particularly for use in such machines as that shown in Patent No. 1,448,751, these machines including a reciprocating head 10 with means for guiding a strip of relatively thick paper 12 under the head so that after the leather has been positioned and the head 10 descends, it forces the leather strip S down upon the cutting edges of the perforating tubes 5 and the knife 6, this movement continuing until all of the cutting instrumentalities have been forced through the leather and have cut very slightly into the paper strip 12. As the head rises the plate 7 is lifted by the springs 8 and carries the leather strip S upwardly with it, thus stripping it from the cutting devices, the stripper plate having holes through which these devices project when the plate is fully depressed.

An especially important feature of this invention resides in the construction and mounting of the perforating tubes 5. It will be seen from an inspection of Fig. 3 that in this die the tubes, instead of being mounted in a face plate and having their inner ends backed up by a hardened intermediate plate, are supported solely by shank portions of the tubes pressed or driven into the holes 4 in the die plate and by shoulders which rest on the upper surface of the die plate 2. Each tube has a cutting edge at its upper end and the distance between the shoulder on the tube and its cutting edge is made uniform in all of the tubes so that the cutting edges of the tubes are levelled or, in other words, are all maintained in the same horizontal plane, by the engagement of the shoulders of the tubes with the die plate.

The details of construction of the tubes will be readily understood from an inspection of Figs. 4 and 5, Fig. 4 showing one of the smaller tubes, while Fig. 5 shows an intermediate or larger size. Referring first to Fig. 4 it will be seen that the tube there shown comprises a body portion including an approximately cylindrical part or integral collar *a* provided with upper and lower shoulders *b* and *c*, the lower of these shoulders resting on the upper surface of the die plate 2, as above described. Projecting downwardly from this body portion is a substantially cylindrical smooth surfaced shank *d* which has a driven or pressed fit in the hole 4 in the die plate, the lower end of said shank being chamfered or bevelled slightly, as shown, to facilitate the driving or pressing operation. During this operation the upper shoulder *b* on the body *a* is useful in affording a firm bearing for the tool used to press the tube into the die plate. The body portion of the tube also includes an upright extension *f* which is of cylindrical form for the greater part of its length but tapers gradually near its upper end to a cutting edge *g*. The bore *h* of the tube is of a uniform diameter for, say, ten

or fifteen thousandths of an inch below the cutting edge *g* and then gradually widens to about the point *j* and remains of uniform diameter from the latter point to the bottom of the tube.

When the cutting edge of a tube of this construction is forced through the leather it makes a clean cut, taking a pill or plug of accurate dimensions out of the leather. The next succeeding cut forces the first pill further down the tube and into the portion of the tube which is wider and through which, therefore, the pill will move fairly freely. The clearance, however, is not sufficient to permit the pill to fall through the tube. For example, in one of the smaller tubes the bore at the cutting edge *g* may be twenty-six thousandths. At the point *j* it would widen out to thirty-three thousandths, and this dimension would be maintained throughout the rest of the tube. Typical dimensions for such a tube would be as follows:

Outside diameter of shank *d* and part *f*, sixty-one thousandths. Outside diameter of body portion *a* between the shoulders, seventy-nine thousandths. Vertical distance between shoulders, one-eighth of an inch, length of shank, three-sixteenths of an inch in the larger tubes and approximately one-eighth of an inch in the smaller tubes, the minimum length of said shank of the smallest tube being twice the outside diameter of the shank. Distance from upper shoulder *b* to cutting edge *g* two hundred eighteen thousandths. The vertical dimensions will be substantially the same for all sizes of tubes, but the horizontal dimensions obviously will vary with the tube size. These tubes must be made in a precision lathe because of the extreme accuracy required, the tolerances being very low indeed. After the manufacturing operations on them have been completed they are hardened. They are made in certain designated sizes and they may be said to be standard. The dies, however, are always special since they must be manufactured to the pattern or design which is to be cut in the sheet material operated upon.

While the shoulder *b* is not absolutely necessary, it is useful as a support against which the tool which forces the tube into the die plate can be abutted. Furthermore, it is desirable to avoid a long taper above the enlarged portion *a* of the body of the tube, particularly in the tubes of smaller sizes, since there is always some tendency where a taper is used and the tubes are placed close to each other, for the leather to wedge between adjacent tubes, thus tending to bend or break the tubes. This will be evident from an inspection of the relationship between the three right-hand tubes shown in Fig. 3. A further advantage of this construction is that it prevents the location of the tubes so close to each other as to weaken the leather excessively when it is perforated. In other words, the dimensions of the body portions of the tubes are made such that they determine the minimum spacing which experience has shown to be practical.

In milling out the large recesses or cavities 3 in the lower side of the die plate 2, it is desirable to reduce the thickness of the metal left between the bottom of this recess and the top of the plate to a dimension approximately equal to the maximum length of the tube shanks. In practice this probably would be in the neighborhood of three-sixteenths of an inch. Since this practice may result in weakening the die plate too greatly where the tubes are bunched closely together, it is desirable not to make these recesses too large

but to leave ribs or webs, such as that shown at 14, Fig. 2, to provide ample strength in the tube supporting portion of the die plate. The reduction of this part of the plate to a thickness substantially equal to the length of the tube shanks is of advantage, however, in maintaining the entire series of pills or plugs of leather in the tubes until they are discharged into the large recess 3. This arrangement, combined with the shape given to the bores of the tubes, avoids any danger of the pills becoming jammed and plugging the tubes in the manner above described. Due to the fact that the shanks of the small size tubes are somewhat shorter than those of the larger tubes, the lower ends of the former may be set back somewhat above the bottom surface of the recess 3, but even in this relationship the danger of plugging the tubes is much less than in prior constructions, due to the fact that after the pills leave the tubes they drop into a hole which has a minimum diameter equal to that of the outside diameter of the tube shanks and consequently, considerably larger than the bores of the tubes. It frequently occurs, however, that as a leather pill is discharged from a tube it will turn over in the hole in the die plate approximately as shown in Fig. 4. The pills are held under considerable compression while in the tubes, and they therefore tend to expand upon being discharged. In order to avoid any possibility of such a pill catching in one of the holes 4 in the die plate, it is preferable to make the distance between the lower ends of the tubes and the bottoms of the recesses less than twice the outside diameter of the tube shank, this relationship applying more especially to the very small tubes. Usually the diameter of the shanks of these very small tubes is less than the thickness of the leather which is being worked upon, and consequently, the pills are longer than the diameter of the tubes. This appears to be an important reason for the tipping of the pills in the holes after they have been discharged from the lower ends of the tubes. If, however, the proportions above described are maintained, then no more than two pills at the most can become lodged at a time in the holes below the ends of the tubes, and any resistance which they offer is not sufficient to produce a jam that will not clear itself.

In making a die plate of the character above described, the holes are drilled for the tubes 5, the recess or recesses are milled or otherwise cut in the back of the plate, the plate is hardened, the tubes are then inserted, and the other assembling operations are performed, as will be obvious to those skilled in this art. It will be evident, however, that the invention effects important economies in the manufacture of dies of this character, particularly because of simplifying the construction of the die plates and greatly reducing the drilling operations. Since the die plate is an integral structure, there is no danger of misaligning drilled holes with each other as in the prior constructions above described. Furthermore, the number of very small drills which must be used is reduced and the size of the drills required for even the smallest size of tubes heretofore used is increased so that the delay and expense occasioned by breaking drills is lessened. For example, in manufacturing prior dies used in the shoe trade, drills as small as thirty-five thousandths of an inch in diameter were required for certain of the perforating tubes. In dies made according to the present invention, however, the smallest drill required for the mounting of

tubes of the same size is fifty thousandths of an inch in diameter. While the perforating tubes made in accordance with this invention are somewhat more complicated than corresponding sizes of tubes of prior constructions, this fact is not of great practical importance for the reason that the tubes can be made very accurately in an automatic precision lathe so that the increase in expense for tubes is relatively slight. The saving in labor which follows from the use of this construction is far more important than the increase in expense for the tubes themselves. To state the matter somewhat differently, a large percentage of the work requiring great precision is transferred from the manufacture of the die plates to the manufacture of the tubes where it can be done by automatic machinery. It is taken out of the part of the die which is always special and transferred to those units which are standard.

The invention also facilitates the operation of repairing the dies since it is simply necessary to punch out a broken tube and replace it with a new one when such an operation is required, whereas in the old constructions such repairs required the disassembling of the die plate before a tube could be replaced. The present arrangement further avoids the necessity for positioning pins and screws heretofore required to hold the sections of the die plate together. This die construction, therefore, is superior both from the standpoint of the manufacturer and the user.

This construction also lends itself readily to those modifications of a perforating die which sometimes are required to adapt it to changes in design without necessitating the rebuilding of the die. For example, let it be assumed that the user of the die wishes to add more tubes at the upper end of the bunch of perforating tubes shown in Fig. 1 for the purpose of extending the perforations farther up the tongue, changing the contour of the perforated area, or for any other reason. Such a change can easily be made in the construction shown by mounting the desired number of tubes in a removable auxiliary die plate 16, Figs. 6 and 7, and releasably securing this plate to the main die plate 2, as by screws 17—17'. These tubes 5' carried by the plate 16 are made exactly like the tubes 5, but instead of being pressed into holes drilled accurately for them in the main die plate, the cylindrical portions *a* of the tubes 5' have a pressed or driven fit in the plate 16, while the shanks *d* of said tubes fit freely in holes drilled through the reduced portion of the die plate into the cavity 3, the cavity in this case being extended so as to underlie the entire area in which the tubes are positioned. The holes so drilled through the reduced part of the die plate are not as large as the cylindrical portions *a* of the tubes so that the shoulders *c* of the tubes 5' rest on the upper flat surface of the die plate, just as do the shoulders of the other tubes 5. Consequently, these additional or auxiliary tubes 5' are levelled in the same manner as the original group 5 of tubes. At the same time the shanks of these tubes 5' serve to position them and the auxiliary die plate 16 on the main die plate.

The screws 17 are held in place by strong coiled springs 18 which encircle said screws, the latter being drilled and tapped to receive additional screws 19—19 which back up the springs 18—18. Also, the heads of the screws 17—17 are cut off, or made flat at one side, as clearly shown in Fig. 6, so that by turning these screws until their flat

sides are parallel with and adjacent to the edges of the plate 16, the plate can be lifted out of position and removed from the die. In such a construction the stripper plate 7 usually would have a hole 20, Fig. 6, cut through it of sufficient size to permit the passage therethrough of the plate 16.

The die can thus be changed readily in the manner just described to permit the introduction of additional perforating tubes, when desired, and such changes involve only very slight modifications of the original die structure.

While I have herein shown and described a typical embodiment of my invention, it will be understood that this disclosure has been made rather by way of explanation than limitation, and that the invention may be embodied in other forms without departing from the spirit or scope thereof. For example, many of the advantages of this construction can be obtained by dividing the main die plate 2 along the horizontal plane substantially through the plane of the bottom of the recess 3 so that all of the drilling for the perforating tubes will be performed in the upper section of the die plate, the recess 3 lying entirely in the lower section. This construction is illustrated in Fig. 8, the two sections of the main die plate being indicated at 2' and 2'', respectively. Such a modification, however, is rarely of advantage. Also, while the die has been shown and described with the tubes in an upright position, since this is the position in which the die customarily is used, the reference to the top and bottom surfaces of the die plate and the upper and lower ends of the tubes in both the specification and in the claims has been made for the purposes of convenience and clearness and does not limit the parts to use in these positions.

Having thus described my invention, what I desire to claim as new is:

1. A perforating die comprising a die plate having a substantially flat top and one or more recesses extending thereinto from the lower face thereof thus providing a portion of reduced thickness between said top and the bottoms of said recesses, said die plate also having a series of holes extending through said reduced portion, a series of perforating tubes each having a shoulder resting on the top of said die plate and each provided with a reduced shank extending into one of said holes and having a pressed fit therewith, the lower end surfaces of said tubes being out of contact with the metal of said plate, and said die plate forming the sole supporting means for said tubes.

2. A perforating die comprising a die plate having a substantially flat top and one or more recesses extending thereinto from the lower face thereof thus providing a portion of reduced thickness between said top and the bottoms of said recesses, said die plate also having a series of holes extending through said reduced portion, a series of perforating tubes each having a shoulder resting on the top of said die plate and each provided with a reduced shank extending into one of said holes and having a pressed fit therewith, said die plate forming the sole supporting means for said tubes, each of said tubes also having a bore extending therethrough from its upper to its lower end and being provided with a cutting edge at its upper end, said bore being of smaller diameter at and immediately adjacent to said cutting edge than at other parts of the tube.

3. A perforating die according to preceding claim 2 in which the distance between the lower

ends of certain of said tubes and the bottoms of said recesses is less than twice the outside diameters of the respective tube shanks.

4. A perforating die comprising a die plate having a flat upper surface, a series of perforating tubes each having an approximately cylindrical shank driven rigidly into a hole in said plate, each of said tubes also having a shoulder resting upon the upper surface of said plate and being provided with a cutting edge at its upper end, the lower end surfaces of said tubes being out of contact with the metal of said plate, and the distances from the shoulders to the cutting edges of said tubes being substantially uniform.

5. A perforating die comprising a die plate having a flat upper surface, a series of perforating tubes each having an approximately cylindrical shank driven rigidly into a hole in said plate, each of said tubes also having a shoulder resting upon the upper surface of said plate, said shank having a length below said shoulder at least twice as great as the outside diameter of the shank, the lower end surfaces of said tubes being out of contact with the metal of said plate, and each tube being provided with a cutting edge at its upper end.

6. A cutting tube for perforating dies comprising a body provided with a shoulder and including an extension projecting upwardly above said shoulder and terminating at its upper end in a cutting edge, and an approximately cylindrical shank extending downwardly from said shoulder, said tube having a central bore extending therethrough from its upper to its lower end and of smaller diameter at and immediately adjacent to said cutting edge than at other parts of the tube.

7. A cutting tube for perforating dies comprising a body provided with a shoulder, an approximately cylindrical shank extending downwardly from said shoulder, said body having a portion above said shoulder which is tapered to a cutting edge, said tube having a central bore which widens for a short distance as it extends downwardly from said cutting edge and thereafter is maintained throughout the remainder of the length of the tube, at a larger diameter than that of said cutting edge.

8. A cutting tube for perforating dies, comprising a body including an approximately cylindrical portion provided with abrupt shoulders at its upper and lower ends, a smooth approximately cylindrical shank extending downwardly from the lower of said shoulders, said body having an approximately cylindrical extension projecting upwardly from the upper of said shoulders with a tapered end portion above the latter cylindrical portion terminating in a cutting edge, and a central bore extending through the tube and of smaller diameter at and immediately adjacent to said cutting edge than at other parts of the tube.

9. A perforating die comprising a main die plate, a series of perforating tubes each having a shank pressed tightly into a hole in said plate, each of said tubes also having a shoulder resting upon the upper surface of said plate and each being provided at its upper end with a cutting edge, an auxiliary die plate removably secured on the upper surface of said main die plate, one or more perforating tubes secured in said auxiliary die plate, each of the latter tubes having portions projecting below the bottom surface of said auxiliary die plate and extending into holes in said main die plate, and means for releasably

securing said auxiliary die plate to said main die plate.

10. A perforating die comprising a main die plate having a substantially flat top and one or more recesses extending thereinto from the lower face thereof thus providing a portion of reduced thickness between said top and the bottoms of said recesses, said die plate also having a series of holes extending through said reduced portion, a series of perforating tubes each having a shoulder resting on the top of said die plate and each provided with a reduced shank extending into one of said holes and having a pressed

fit therewith, said die plate forming the sole supporting means for said tubes, an auxiliary die plate positioned on said main die plate, one or more perforating tubes secured rigidly in said auxiliary die plate, each of the latter tubes having a shank portion extending below the lower surfaces of said auxiliary die plate and projecting loosely into holes formed in them, respectively, in said main die plate, the latter tubes having shoulders resting on said main die plate, and means for removably securing said auxiliary die plate to said main die plate.

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