Oct. 15, 1946. R. W. ANDREASSON 2,409,525

DRILLING DEVICE

Original Filed Sept. 30, 1943 3 Sheets-Sheet 1

Fig. 1.

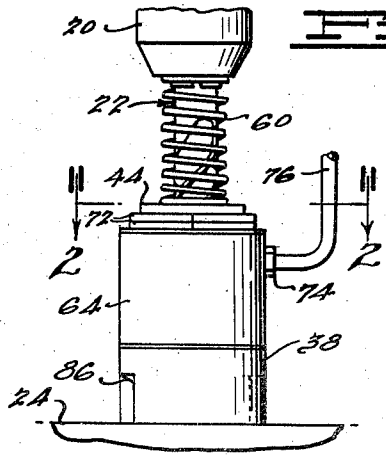


Fig. 2.

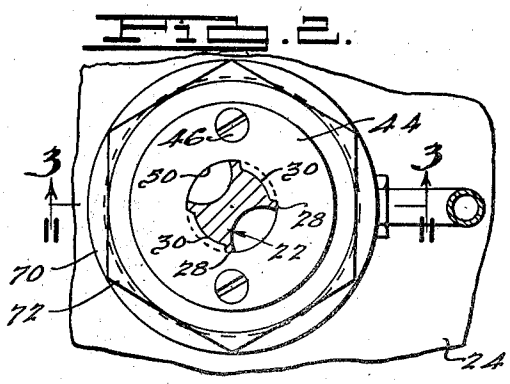
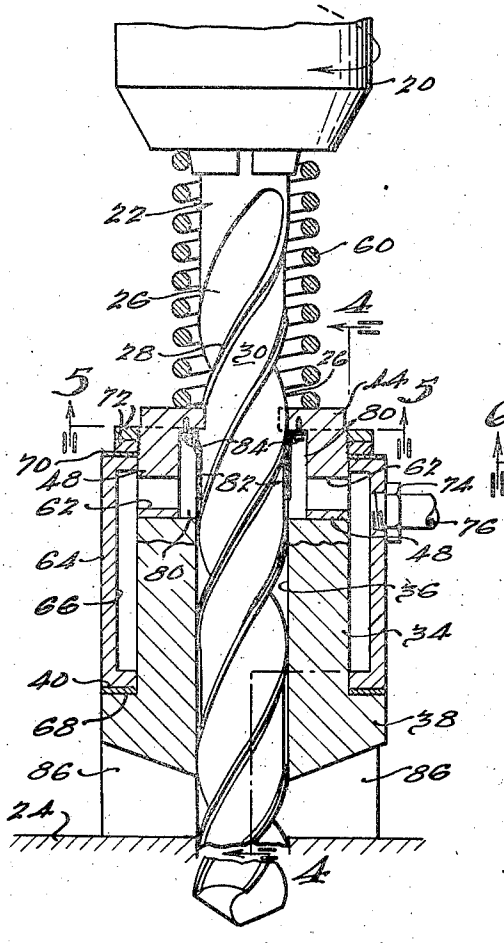


Fig. 3.



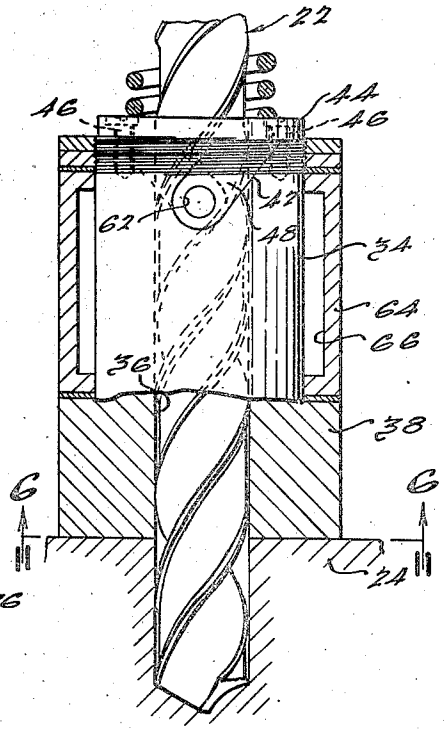


Fig. 4.

INVENTOR.
Rudolf W. Andreasson.
BY
Harness, Dickey & Pierce.
ATTORNEYS.

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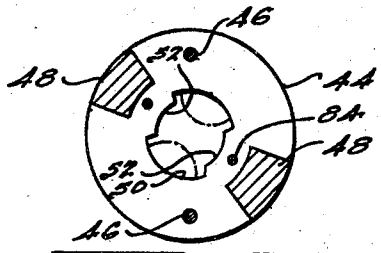
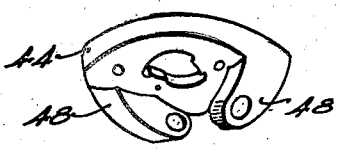


FIG. 5.



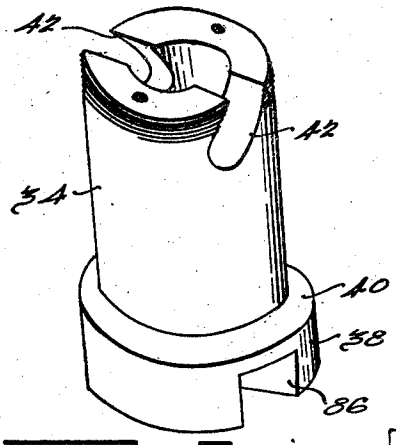


FIG. 7.

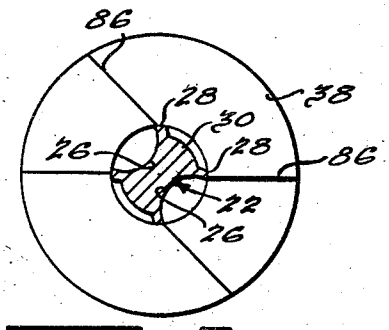


FIG. 6.

FIG. 8.

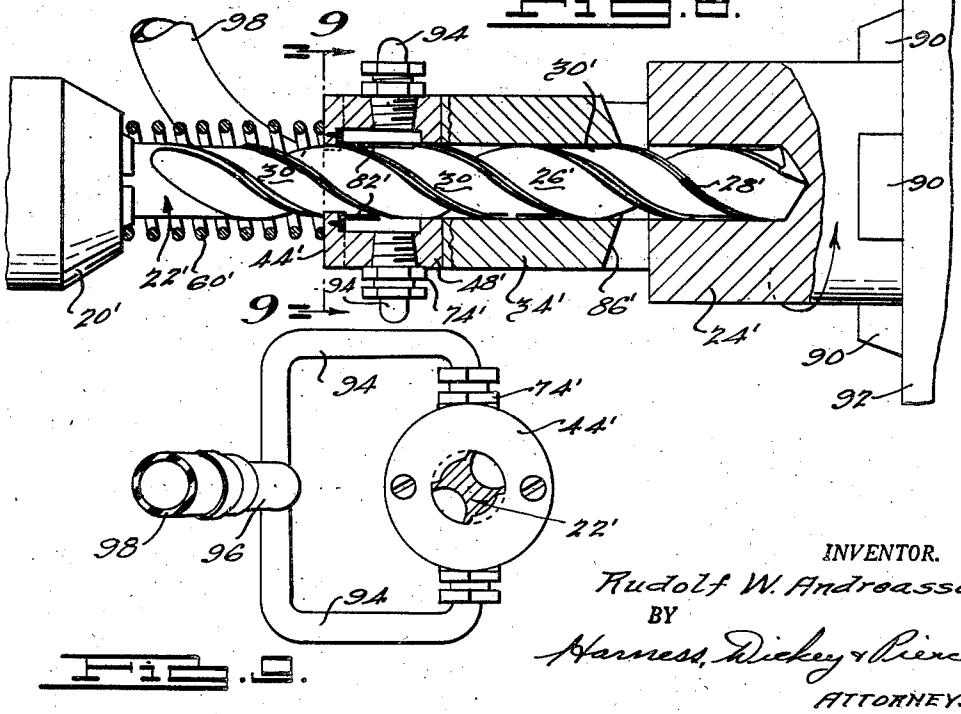


FIG. 9.

INVENTOR.
Rudolf W. Andreasson.
BY
Harness, Dickey & Pierce
ATTORNEYS.

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DRILLING DEVICE

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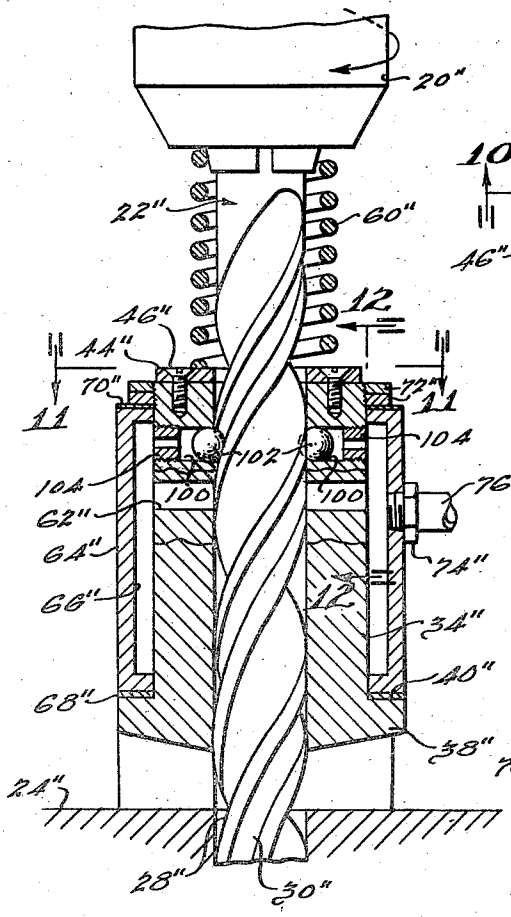
Fig. 10.



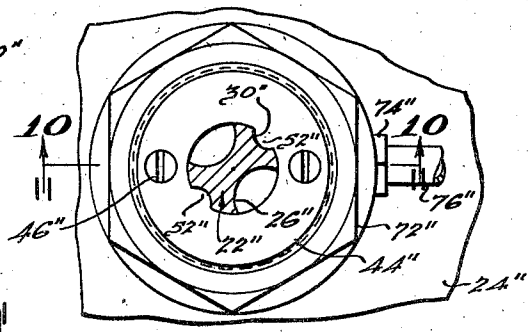


Fig. 11.

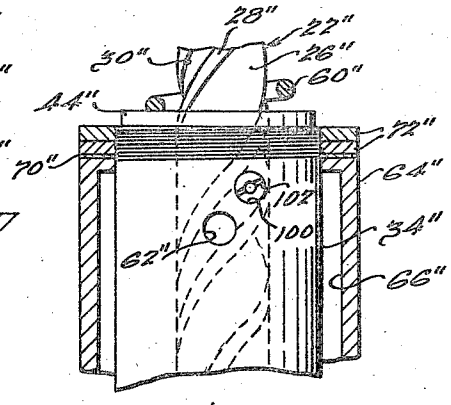


Fig. 12.

INVENTOR.
Rudolf W. Andreasson.
BY
Harness, Dickey & Pierce
ATTORNEYS.

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2,409,525

UNITED STATES PATENT OFFICE

2,409,525

DRILLING DEVICE

Rudolf W. Andreasson, Franklin, Mich.

Continuation of application Serial No. 504,351, September 30, 1943. This application September 27, 1944, Serial No. 556,008

19 Claims. (Cl. 77—68)

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This invention relates to drilling devices and particularly to devices employed in connection with drills enabling the effects of oil hole drills to be obtained without actually having passages within the drills for the passage of oil or the like, and is a continuation of my application for Letters Patent of the United States for improvement in Drilling device, filed September 30, 1943 and now abandoned, Serial No. 504,351.

Objects of the invention include the provision of means adapted for use in a conventional type of twist drill whereby to enable the flow of a fluid to be directed to the point of the drill during a drilling operation without the necessity of providing passages for the flow of such fluid within the body of the drill itself; the provision of a device of the character described by means of which the same effects may be obtained as in conventional oil hole drills on drills of a size too small to be capable of being formed as oil hole drills; the provision of a device of the character described enabling greater amounts of fluid to be directed to the point of the drill than is possible with conventional oil hole drills; the provision of a device for use in connection with twist drills or the like in which the lands are relieved only between the opposite side edges thereof, and not at the side edges, including a device provided with a bore for reception of the drill, the device being formed to close the relief in the lands of the drill at one end thereof, and having means for introducing fluid to the relief of the lands, whereby the fluid is caused to flow along the relief toward the point of the drill to that end of the device more adjacent the point of the drill; the provision of a device of the type described which is adapted to be pressed against the face of the work whereby the fluid flowing through the relief in the lands of the drill is prevented from escaping from the lands at the surface of the work and is caused to continue down the relief of the lands to the point of the drill during a drilling operation; the provision of a device of the type described including a part adapted to rotate with the drill associated therewith and a second part rotatable relative thereto providing means through which fluid may be introduced to the bore of the device; and the provision of a device of the character described by the use of which the effects of an oil hole drill may be obtained by an ordinary drill and by means of which production operations requiring the use of oil hole drills may be carried out at a material reduction in the cost of the drilling operation.

Other objects include the provision of a method

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of drilling a hole in a piece of work including the steps of flowing a coolant along the drill being employed toward the point thereof between the walls of the hole being and the surface of the lands of the drill, and discharging such coolant from the hole by flowing it through the flutes of the drill away from the point of the drill; and the provision of a method as above described in which the coolant flowing toward the point of the drill between the lands of the drill and the walls of the hole is under pressure.

The above being among the objects of the present invention the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate suitable embodiments of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a fragmentary, side elevational view illustrating a device of the present invention applied to a drill mounted in a drill press and operating upon a piece of work;

Fig. 2 is an enlarged transverse sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical, partially broken, partially sectioned view taken axially of the drill as on the line 3—3 of Fig. 2;

Fig. 4 is a partially broken, partially sectioned view taken on the line 4—4 of Fig. 3;

Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 3 and illustrating with greater clarity the construction of the upper member of the device shown in the preceding view;

Fig. 6 is a transverse sectional view taken on the line 6—6 of Fig. 4 and showing a bottom end view of the device shown in the preceding figures;

Fig. 7 is a perspective view of the main body portion of the device and its associated cap member in exploded relation;

Fig. 8 is a partially broken, partially sectioned view somewhat similar to Fig. 3, showing a modified form of the device of the present invention applicable to non-rotating drills;

Fig. 9 is a transverse sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is a view similar to Fig. 3 showing a further modified form of construction, it being a partially broken, partially sectioned view taken on the line 10—10 of Fig. 11;

Fig. 11 is a transverse sectional view taken on

the line 11—11 of Fig. 10, and illustrating the construction of the device in plan view; and,

Fig. 12 is a partially broken, partially sectioned view taken on the line 12—12 of Fig. 10.

In drilling deep holes in metal it is conventional practice to employ twist drills of the oil hole type, that is twist drills which have two or more passages running through the length thereof which open onto the point of the drill and through which oil, cutting compound or other suitable liquid may be forced not only to cool the point of the drill but particularly to carry the chips removed from the work by the drill up the flute of the drills and out of the bore being drilled. The provision of these oil holes in twist drills is an expensive operation with the result that oil hole drills cost considerably more than ordinary or so-called solid twist drills. The present invention enables the effect of oil hole drills to be obtained with ordinary or solid drills and, particularly where a large number of pieces are to be bored in an operation which would ordinarily require oil hole drills, enables the operation to be performed with ordinary drills thereby effecting a material saving in the cost of the operation. Included in the advantages of the present invention are the features that it enables a greater flow of liquid to be delivered to the point of the drill than is possible in conventional designs of oil hole drills and it is applicable to drills of a size too small to be conventionally formed as oil hole drills. Furthermore, by the practice of the present invention the coolant flowing toward the point of the drill, as well as that flowing away from the point, is in contact with the walls of the hole being drilled and substantially surrounds the drill with a body of coolant at all times, thus not only cooling the drill itself but also preventing the work from becoming unduly heated, permitting drilling operations to be materially speeded up and resulting in longer life to the drill.

While the lands of most of the conventional twist drills are each relieved from a point immediately rearwardly of the leading edge thereof, in a direction opposite to the direction of rotation, through and including the trailing edge of the land, there is a type of conventional twist drill produced in which the relief of the lands is terminated short of both the leading and trailing edges thereof. It is this last type of twist drill that the present invention is applicable to inasmuch as the relief thus provides a passage between the leading and trailing edges of each land which is utilized as a fluid passage in accordance with the present invention.

In accordance with the present invention a device provided with a bore closely fitting the drill is provided and the drill is projected therethrough. At its upper end, or the end thereof more remote from the point of the drill projected therethrough, the device is provided with means which cooperate with the drill, and preferably with the walls of the reliefs in the lands thereof to cause the device or the main body portion thereof to turn with the drill. At the same time it is provided with means at its upper end which cooperates with the reliefs to prevent the flow of fluid upwardly or toward the shank of the drill. The device is provided with a flat lower face, at least in angular alignment with the lands of the drill, and is preferably provided with spring means for constantly urging such face against the surface of the work being drilled. Fluid is introduced through the device under pressure into the space provided by the reliefs in the lands and such fluid, being prevented from flowing toward the shank of the drill, is caused to flow along the reliefs and between the reliefs and the bore of the device to the surface of the work, and from the surface of the work it continues down the reliefs of the lands and between the bottoms of the reliefs and the bore of the hole being drilled until it is discharged from the point of the drill, the liquid then returning up the drill through the usual flutes and carrying chips with it away from the point of the drill.

Where the drill rotates in operation, then the main body portion of the device necessarily rotates with the drill and in such case in order to introduce fluid to the space between the bore of the device and the reliefs of the lands, a sleeve is rotatably mounted on the body of the device to provide a chamber in open communication with the reliefs of the lands within the main body portion, and a fluid connection is provided for the sleeve so as to enable fluid under pressure to be introduced to the space between the sleeve and the main body portion of the device.

Referring now to the accompanying drawings and particularly to the embodiment illustrated in Figs. 1 to 7, inclusive, it is assumed in this particular case that the device is adapted for use in connection with a conventional drill press as, for instance, one provided with a rotating chuck 20 in which the shank of the drill, indicated generally at 22, is gripped in a conventional manner for rotation therewith. The chuck 20 is, of course, assumed to be conventionally mounted and rotated. The drill press is, of course, provided with the usual table or the like (not shown) upon which a piece of work such as 24 is supported for operation thereon by the drill 22.

The drill 22, as brought out in the several figures, is of the conventional twist drill type last above referred to. While it could have any desired number of flutes it is shown as of the conventional two flute type, that is, it is provided with a pair of flutes 26 arranged in diametrically opposed relationship and arranged in helical conformation about the axis of the drill 22. The lands indicated generally at 28 between the flutes 26 are radially relieved as at 30 between the opposite edges thereof, as perhaps best brought out in Figs. 2 and 6, leaving the lands of full radial dimension at both the leading and trailing edges thereof. It will be understood that this is a conventional construction for twist drills although the bulk of the twist drills carry the relief corresponding to the relief 30 clear across the trailing edge of the land. For the purposes of the present invention, however, the type of relief shown is necessary although the unrelieved portion of the land along the trailing edge thereof may be relieved a very small amount as, for instance, one to three thousandths in drills up to one inch in diameter without materially affecting the results obtained by the use of the present invention. It is also preferable, to enhance the effects of the present invention, to make the reliefs 30 in the lands 28 of greater depth than perhaps ordinarily provided. In other words for a drill in the neighborhood of one inch in diameter the depth of the relief 30 may be 0.020" or more as this has the effect of increasing the cross-sectional area of the oil passage in accordance with the present invention. It is to be noted, however, that no oil holes as conventionally understood are provided in the drill 22.

While the device of the present invention may

follow various forms and be constructed in a different manner to obtain the result desired, in the particular form thereof shown in the drawings by way of illustration it comprises a cylindrical main body portion 34 provided with a bore 36 extending axially therethrough and of such size as to relatively closely but slidably and axially reciprocably receive the drill 22 therein. In the construction illustrated in Figs. 1 to 7, inclusive, the lower end of the main body portion 34 is radially enlarged as at 38 so as to provide an annular radial shoulder 40 adjacent the lower end of the main body portion 34.

The main body portion 34 must be secured in nonrotatable relation to the drill 22 and this is accomplished by providing projections in the bore 36 of the body portion 34 arranged in interlocking and preferably complementary relation to the reliefs 30 or to the flutes 26, or to both, depending upon other features of construction. For instance, where means as hereinafter described are provided for ejecting the chips from the drill at the lower end of the main body 34 the projections may completely fill the flutes. However, for the purpose of illustration, in the particular embodiment shown, these projections are shown engaging the reliefs 30 only. It will also be appreciated that the projections mentioned may be located anywhere in the length of the body 34 as long as they do not obstruct the flow of liquid along the reliefs 30 toward the point of the drill or obstruct the escape of such liquid from the flutes 26 of the drill and from the main body 34. For the purpose of simplicity in construction they are shown at the upper end of the main body 34 in the construction shown in Figs. 1 to 7, inclusive.

As perhaps best brought out in Fig. 7 a pair of diametrically opposed slots 42 are formed in the upper portion of the main body 34, the slots 42 opening on the upper end face of the main body 34 and extending helically about the axis of the main body portion 34 on the same or substantially the same spiral as the flutes 26 of the drill 22. A cap member 44, of substantially the same diameter as the main body 34 is secured to the upper end face of the main body 34 by means of screws 46 and the cap member 44 has rigidly fixed thereto and preferably formed integrally therewith a pair of ears 48 which are complementary in size, shape and contour to the recesses 42 and are adapted to be received therein and completely fill at least the radially outer sides of the recesses 42.

As best brought out in Figs. 2 and 5 the cap 44 has a central opening 50 therein. The opening 50 is of generally circular conformation and its circular portion of the same diameter as the bore 36 and concentric therewith, but at diametrically opposite sides thereof it is provided with a radially inward extension or projection 52. While in the broader aspects of the present invention the projections 52 may cooperate with either the flutes 26 or the reliefs 30 to lock the main body portion 34 to the drill for equal rotation therewith, in the form shown the projections 52 are each complementary in shape to the cross-sectional configuration of the reliefs 30 in the lands 28 of the drill 22. The drill 22 may thus be introduced or projected through the cap 44 with the projections 52 being relatively closely but slidably received within the reliefs 30 of the lands 28 of the drill. The projections 52 thus serve to lock the cap 44 and, therefore, the main body portion 34 to the drill for equal rotation therewith and at the same time they form abutments which block the reliefs 30 in the plane of the cap member 44. It will be observed that while the projections 52 block the relief 30 there is no obstruction to the flutes 26 themselves in the form of construction shown.

It will be appreciated from the above description that if oil or other liquid is now introduced through the main body portion 34 into the relief 30 of the drill 22 within the length of the main body portion it will be substantially prevented from flowing towards the shank of the drill up the relief 30 because the projection 52 will block the flow in that direction, and cannot flow directly into the flutes 26 because the edge portions of the lands 28 bounding the opposite sides of the reliefs 30 substantially prevents escape of the liquid circumferentially of the drill because of the contact of the lands 28 with the walls of the bore 36. The only path of flow remaining for such liquid will, therefore, be between the reliefs 30 and the walls of the bore 36 toward the tip of the drill. Likewise it will be appreciated that if the lower face of the main body portion 34, that is the lower end face of the enlargement 38 is pressed or otherwise sealed against the surface of the work 24 which is being drilled, such liquid cannot escape from the lands at the point of contact of the main body with the work and consequently must continue to flow down the reliefs 30 to the tip of the drill before it can escape circumferentially of the drill to the flutes 26 thereof, upon which it may flow upwardly until it is free to escape from such flutes. In this manner the effect of an oil hole drill is obtained without any oil holes in a drill and this feature constitutes the gist of the present invention.

As a matter of fact it has been found that although it is desirable that the lower end of the main body 34 be pressed into contact, and preferably sealing contact, with the work, or to get an equivalent effect, it is not necessary in all cases. Even when the lower end of the main body 34 is spaced as much as one-quarter of an inch from the face of the work in which a hole is being drilled the stream of liquid discharged from the reliefs 30 at the bottom face of the main body 34 is found to cling to the reliefs 30 in the drill and continue to flow with force along the reliefs 30 between the drill and the work, thus resulting in satisfactory, although not as desirable, operation.

In order to urge the lower face of the main body 34 into contact with the work 24 any suitable means may be employed that is extensible in character so as to permit relative longitudinal movement between the drill 22 and the device as the drill is fed downwardly into the work. Perhaps the simplest and most efficient means of this character comprises a coil spring such as 60 arranged in surrounding relationship with respect to the drill 22 and maintained under compression between the cover 44 and the chuck 20.

In the particular construction shown in Figs. 1 to 7, inclusive, in order to prevent a flow of fluid to the recesses 30, holes 62 are drilled in a radial direction through the ears 48 in line, of course, with the reliefs 30 in the lands 28 and of no greater width than the reliefs 30. Where the work and not the drill rotates, then a connection may be made directly with the holes 62, as will hereinafter be more fully brought out in connection with the construction shown in Figs. 8 and 9, but where the drill rotates as assumed in the construction illustrated in Figs. 1 to 7, inclu-

sive, then other means must be provided. Such means comprises a collar 64 which is radially relieved internally thereof between its opposite ends as at 66. The unrelieved end portions of the collar 64 relatively closely but rotatably receive the main body portion 34 therein and the lower end of the sleeve 64 abuts the shoulder 40, preferably with the inter-position of a suitable sealing washer 68 between it and the shoulder 40 as shown. A similar washer 70 is placed over the upper end of the collar 64 and a pair of nuts 72 are threaded upon the upper threaded end of the main body 34. The nuts 72 are drawn down until a water-tight seal is established between them and the corresponding end of the collar 64 and between the shoulder 40 and the corresponding end of the collar 64. A suitable connection such as 74 is then extended through the collar 64 into the relief 66 therein and is connected by a tube such as 76 with a suitable source of liquid under pressure. The collar 64, of course, being rotatable relative to the main body 34 permits liquid to be constantly fed to the relief 66 within the collar 64 and flow from such relief through the openings 62 to the relief 30 of the drill 22 for the purpose above described.

It may be desirable to take precautions to prevent possible leakage of the liquid employed from between the cooperating surfaces of the projections 52 and the walls of the reliefs 30 toward the shank of the drill, and is particularly desirable where the projections 52 cooperate with the flutes 26, instead of the reliefs 30, to cause the device to rotate with the drill. In such case in order to seal the device against the escape of liquid at this point suitable sealing means may be employed between the main body and the walls of the reliefs 30. One form of such means which is particularly adaptable to devices to the larger sizes of drills is illustrated in Figs. 1 to 7, inclusive. In the structure there shown the ears 48 are of less radial dimension than the walls of the main body 34 so as to provide a pocket such as 80 between the radially inner surface of each ear 48 and the periphery of the drill. A strip of leather or other flexible material 82 is positioned within each pocket 80 with the upper end thereof sealed and fixed to the cover 44 as by means of screws 84 or the like, the lower ends of the pieces 82 being free. The pieces 82 directed toward the point of the drill at the same spiral as the reliefs 30 in the lands 28 and centrally thereof so as to lie therein. With such construction when liquid under pressure is introduced through the tubes 76 the liquid in flowing into the pockets 80 exerts a pressure against the pieces 82 which forces them into sealing relation with respect to the walls of the corresponding reliefs 30, thereby to provide the effect desired.

In the construction thus far described it will be appreciated that in order for the chips to be discharged from the bore being drilled and from the device it will be necessary for them to travel up the flutes 26 to the top of the device and escape from between the coils of the spring 60. This would ordinarily not be satisfactory and in order to avoid it, it is preferable to slot the lower face of the enlarged portion 38 of the main body portion 34 as indicated at 86. The slots 86 are, of course, angularly aligned with the flutes 26 so that as soon as the chips have reached the surface of the work they may be discharged directly out of the flutes with the liquid flowing up the flutes without the necessity of flowing through the length of the device itself. The slots 86 are, of course, of no greater angular extent than the flutes 26.

The slots 86 act more than to simply permit the chips to escape from the flutes of the drill and the body 34 when the device is used on a rotating drill. In such case the slots, in conjunction with the body 34, serve in the nature of a centrifugal pump and actually produce a pulling effect on the chips and liquid in the flutes, thus aiding in the circulation of the liquid coolant and serving to more effectively eject the chips from the bore being drilled.

The device of the present invention and as above described is possible of an additional use, whether the coolant circulation feature is employed or not. In this respect it will be appreciated that it is conventional practice to employ drill jigs in the production drilling of many parts. In such case the work is clamped in a fixture or jig which is provided with so-called "drill bushings" which serve to locate the drill with respect to the work. These drill bushings are simply hardened one-piece steel bushings anchored in the drill jig and each has a bore of a size to closely but rotatably receive a drill of the required diameter therein. Particularly where a long drill is being used, the drill is quite liable to bend or bow under the force of the drilling operation. In such case an excessive amount of friction develops between the drill and the bushing which fosters early destruction of both. The device of the present invention may be used to advantage in such cases.

To use the device of the present invention as a drill bushing, the outer sleeve 64 is simply set into the jig the same as a conventional drill bushing. The drill fits the bore of the main body 34 which is free to rotate in the sleeve 64. The only relative movement between the drill and the body 34 is a slow axial movement in such case and the wear from rotation is taken between the body 34 and sleeve 64 which may be equipped with rolling anti-friction bearings between them under such circumstances. In such case liquid may be caused to flow through the device and down the drill as above described, or not, as may be considered desirable under any particular condition of operation.

As previously mentioned where a device of the character described is employed in connection with a stationary drill and a rotatable piece of work, as for instance where a drill is mounted in the tail stock of a lathe and the work is mounted in the chuck of a lathe, then the rotatable sleeve 64 may be eliminated if desired and the liquid connection made directly with the main body portion of the device. Such a construction is illustrated in Figs. 8 and 9 wherein similar parts are illustrated by the same numerals as employed to designate the parts in the first described construction but with the numerals bearing a prime mark.

Referring to Figs. 8 and 9 it is assumed in this case that the drill 22' is mounted in a chuck 20' which in turn is mounted in the tail stock (not shown) of a lathe in a conventional manner and is, therefore, held against rotation. The work 24' in this case is assumed to be gripped in the jaws 90 of a lathe chuck 92 and, therefore, adapted to rotate with the chuck 92. The main body 34' of the device may be substantially identical to that of the first described construction except that the enlargement 38 may be eliminated and its upper end is not required to be threaded. The cap 44' may be identical to the cap previously described except that the ears 48'

thereof are tapped directly for reception of the liquid connection 74'. The same sealing means 82' may be employed. Otherwise the construction may be assumed to be identical with the first described construction and operate in the same manner.

In the case of the construction shown in Figs. 8 and 9 the connections 74' are connected together by a loop 94 of tubing having a central branch 96 to which a flexible hose or tube 98 may be connected for the purpose of supplying liquid under pressure to the device for feeding to the reliefs 30' of the drill 22' in the same general manner as described in connection with the previous construction.

It will be appreciated, of course, that with the construction illustrated in Figs. 8 and 9 there will be a limited amount of rotational movement of the device on the drill 22', this being true because of the fact that as the device travels relatively along the drill as the drill bores into a piece of work it will naturally follow the twist of the drill in moving toward the shank thereof. The amount of turning in this respect will usually be so small, however, that the flexible tube 98 will permit it without necessitating a split sleeve such as the sleeve 64 employed in the first described construction.

It will be appreciated that where it is desired to provide a device constructed in accordance with the present invention for relatively small drills it would be relatively difficult to provide a seal of the character of the seal 82' previously described in connection with the first described construction, and in such case a modified form of drill and seal as brought out in Figs. 10 to 12, inclusive, may be employed to obtain the same effect. Because of the similarity of the parts in the construction shown in Figs. 10 to 12, inclusive, to those shown in the preceding views, equivalent parts are designated by the same numerals except that such numerals bear a double prime mark, their construction and operation being assumed to be identical unless otherwise referred to.

Referring to Figs. 10 to 12, inclusive, it will be noted that the main body portion 34'' is substantially the same as the construction first described except that its upper end is not provided with slots of the character of the slots 42 in the first described construction, its upper end being free of such slots in this case. A cap member 44'' of substantially the same character as in the first described construction is employed except that in this case it is not provided with any ears such as the ears 48 in the first described construction. Furthermore, in view of the fact that the drill 22'' in this case is provided with reliefs 30'' in the lands 28'' thereof of cross-sectional conformation corresponding to a segment of a circle, as best brought out in Fig. 11, the cooperating projections 52'', corresponding to the projections 52 of the first described construction, are modified for complementary engagement of this modified form of relief as shown. A slip sleeve 64'' is provided on the main body portion 34'' and is secured in place in substantially the same manner as in the first described construction. In this case in view of the fact that the cover member 44'' is devoid of ears, the main body portion 34'' is provided directly with passages 62'' for conveying the liquid under pressure from the interior of the sleeve 64'' to the reliefs 30'' of the drill 22''.

In order to provide a seal to prevent the escape of liquid upwardly along the reliefs 30'' toward the shank of the drill in the construction illustrated in Figs. 10 to 12, inclusive, and instead of employing leather or other members such as the members 82 in the constructions first described, the following means is provided. As indicated in Fig. 10 above the holes or passages 62'', but aligned therewith along the spiral of the drill, a pair of diametrically opposite passages 100 are provided in the main body portion 34'' which open onto the corresponding relief 30'' and open into the relieved interior portion 66'' of the sleeve 64''. In each passage 100 is relatively closely but slidably received a ball 102, the inner ends of the passages 100 being slightly restricted to prevent complete projection of the balls 102 inwardly through the inner ends of the openings 100 but permitting the balls 102 to project therethrough to a sufficient extent as to fully seat the balls 102 in the reliefs 30''. The balls 102 are of the same radius as the radii of the reliefs 30'' so that in seating in the reliefs 30'' the balls 102 completely block the reliefs 30'' to the leakage of fluid upwardly therealong toward the shank of the drill. An axially apertured plug 104 is threaded into the radially outer end of each of the openings 100 so as to prevent the balls 102 from becoming inadvertently displaced from their approximate operative positions.

With this last described construction it will be appreciated that when liquid under pressure is introduced through the tube 76'' and connection 74'' into the interior of the sleeve 64'' such liquid will not only flow through the openings 62'' to the reliefs 30'' of the drill 22'', but liquid under pressure will flow through the apertured plugs 104 into the openings 100 and, acting against the corresponding balls 102, will force the balls 102 radially inwardly against the bottom of the corresponding reliefs 30''. In view of the fact that the reliefs 30'' may be accurately ground to size and, of course, the balls 102 may be made accurately to size, the pressure of the liquid in forcing the balls 102 into the reliefs 30'' will maintain them in liquid sealing relation with respect to the reliefs 30'' thus to obtain the desired result.

It will be appreciated that the construction illustrated in Figs. 10 to 12, inclusive, is particularly adaptable for use on devices of the present invention adapted for application to relatively small sized drills where it would be difficult or impossible to use the type of seal described in connection with the first two constructions shown, and by its use drills of a size heretofore considered entirely too small to form as oil hole drills may be readily used as oil hole drills as will be appreciated. This feature of the invention makes it particularly valuable inasmuch as there are many instances where an oil hole drill of relatively small size is extremely desirable but up to the present time has been commercially impractical to manufacture. It is not to be understood from the above statement that the application of the construction illustrated in Figs. 10 to 12, inclusive, is adaptable only to relatively small sized drills as obviously it is also applicable to larger sizes as well.

Having thus described my invention, what I claim by Letters Patent is:

1. In combination with a drill having longitudinally extending flutes and lands and in which the lands are each provided with a central relief opening onto the peripheral surface thereof and are substantially unrelieved along their opposite edges, a member having a bore in which said opposite edges of said lands of said drill are closely but slidably received, and means cooperating be-

tween said member and said drill maintaining said member against relative free rotation with respect to said drill, said member having fluid passages therein opening onto said reliefs, and the unrelieved portions of said lands in engagement with the walls of said bore serving to seal said passages from direct flow to said flutes.

2. In combination with a drill have longitudinally extending flutes and lands and in which the lands are each provided with a central relief opening onto the peripheral surface thereof and are substantially unrelieved along their opposite edges, a member having a bore in which said opposite edges of said lands of said drill are closely but slidably received, means cooperating between said member and said drill to prevent free rotation of said member with respect to said drill, and means cooperating between said member and said drill to seal said relief against the escape of fluid under pressure along said relief toward the shank of said drill, said member having passages therein opening onto said relief and sealed from said flutes by the unrelieved portions of said lands cooperating with the walls of said bore.

3. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief and are substantially unrelieved along their opposite edges, a member having a bore in which said opposite edges of said lands of said drill are closely but slidably received, means cooperating between said member and said drill maintaining said member against relative free rotation with respect to said drill, said member having fluid passages therein opening onto said reliefs, said passages being sealed from said flutes at all times by the unrelieved portions of said lands in engagement with the walls of said bore, and means rotatable with respect to said member operatively connected therewith and provided with an opening therein for the delivery of liquid to said passages.

4. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief and are substantially unrelieved along their opposite edges, a member having a cylindrical bore in which said drill is closely but slidably received, means cooperating between said member and said drill maintaining said member against relative free rotation with respect to said drill, said member having fluid passages therein opening onto said reliefs, said passages being sealed from said flutes by the unrelieved portions of said lands in engagement with the walls of said bore, and a sleeve rotatably surrounding said main body portion forming a space between it and said main body portion in open communication with said passages, said sleeve having an opening therein for the introduction of fluid under pressure to said space.

5. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief opening onto the peripheral surface thereof and are substantially unrelieved along their opposite edges, a member having a bore in which said opposite edges of said lands of said drill are closely but slidably received, means cooperating between said member and said drill operable to prevent free rotation of said member on said drill and seal said relief against the escape of material amounts of liquid toward the shank of said drill, and one end of said member being formed for substantially flat engagement, over the angular extent of said reliefs, with the surface of a piece of work whereby to provide a seal between said member and the work acting to prevent the escape of liquid from said reliefs at the surface of such work during movement of said drill into such work.

6. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief and are substantially unrelieved along their opposite edges, a member having a cylindrical bore in which said drill is closely but slidably received, means cooperating between said member and said drill operable to prevent free rotation of said member on said drill and seal said relief against the escape of material amounts of liquid toward the shank of said drill, one end of said member being formed for substantial sealing engagement with the surface of a piece of work and being provided with grooves extending from said bore to the radially exterior face thereof and communicating only with the flutes of said drill within said bore.

7. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief opening onto the peripheral surface thereof and are substantially unrelieved along their opposite edges, a member having a cylindrical bore in which said drill is closely but slidably received, means cooperating between said member and said drill maintaining said member against relative free rotation with respect to said drill, said member having fluid passages therein opening onto said reliefs, said passages being sealed from said flutes by the unrelieved portions of said lands in engagement wtih the walls of said bore, and means constantly urging said member toward the point of said drill for engagement with work being drilled thereby.

8. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief and are substantially unrelieved along their opposite edges, a member having a cylindrical bore in which said drill is closely but slidably received, means stationary with respect to said member providing portions projecting radially inwardly of said bore in interfitting engagement with said drill to provide a driving engagement therebetween, additional means carried by said body forming a seal between said body and the walls of said reliefs, said body having openings therethrough communicating the exterior of said body with the bore thereof in line with said reliefs between said sealing means and the point of said drill.

9. In combination with a twist drill having spirally arranged flutes and lands and in which the lands are each provided with a central relief and are substantially unrelieved along their opposite edges, a member having a cylindrical bore in which said drill is closely but slidably received, means stationary with respect to said member providing portions projecting radially inwardly with respect to said bore and into driving engagement with respect to said drill, sealing means located axially inwardly of said member movable under fluid pressure into sealing relation with respect to the walls of said reliefs, and said member having passages therein for the flow of fluid under pressure from the exterior surface thereof to said bore in line with said reliefs only and to said sealing means.

10. In a device of the type described, in com-

bination, a member having a cylindrical bore therethrough, a twist drill having spirally arranged flutes and lands and in which the lands are provided with a central relief and are substantially unrelieved along its opposite edges closely slidably received within said bore, said member having openings therein opening onto a limited angular extent of said bore, means comprising radially inwardly projecting portions carried by said member and drivingly interfitting said drill for maintaining said passages opening onto said bore in line with said reliefs and to the exclusion of said flutes, means cooperating between said member and the walls of the reliefs within said member sealing said reliefs against the escape of liquid toward the shank end of said drill, and means for introducing liquid under pressure to said passages.

11. In a device of the character described, in combination, a member having a central cylindrical bore therein, portions projecting radially inwardly of said bore carried by said member and formed for interfitting engagement with the surfaces of a relief between the opposite edges of the lands of a twist drill receivable in said bore, and said member having passages therein opening onto said bore in alignment with said portions on the same spiral as the spiral of a drill to be received in said bore.

12. A device of the character described comprising, in combination, a main body having a cylindrical bore therethrough, portions fixed with respect to said main body projecting radially inwardly of the walls of said bore, and said main body having passages therein opening onto said bore over a limited angular extent thereof and arranged in predetermined alignment with said portions angularly of said bore, and sealing means carried by said main body and adapted to be operated by fluid pressure applied to said passages projectable into said bore in the same alignment with said portions as said passages.

13. A device of the character described comprising, in combination, a body member having a cylindrical bore therethrough, a member secured to said body member and provided with portions projecting radially inwardly of said bore, said body having passages therein each opening onto said bore over a limited angular extent thereof and in predetermined relation angularly of said bore with respect to said projecting portions, and the opposite end of said main body having radially directed grooves therein misaligned with said passages and serving as means for permitting the discharge of chips from said bore.

14. In a device of the character described, in combination, a body member having an axial cylindrical opening therethrough, one end of said body member being provided with slots disposed helically with respect to the axis of said bore, a member secured to said end of said body member, ears fixed with respect to said last mentioned member complementary in size, shape and contour to said slots and removably received therein, said last mentioned member having a bore aligned with said bore in said body member and provided with portions projecting radially inwardly with respect to the walls of said bore of said body member, one of said members having openings leading therethrough to said bore of said body member between the opposite ends thereof aligned on the helix of said slots with said inwardly projecting portions, and the opposite end of said main body member having generally radially directed slots therein of limited angular extent misaligned with said inwardly projecting portions and said passages on the spiral of the first-mentioned slot.

15. In a device of the character described, in combination, a body member having an axial cylindrical opening therethrough, one end of said body member being provided with slots disposed helically with respect to the axis of said bore, a member secured to said end of said body member, ears fixed with respect to said last-mentioned member complementary in size, shape and contour to said slots and removably received therein, said last-mentioned member having a bore aligned with said bore in said body member and provided with portions projecting radially inwardly with respect to the walls of said bore of said body member, said ears having openings leading therethrough to said bore of said body member between the opposite ends thereof aligned on the helix of said slots with said inwardly projecting portions, and the opposite end of said main body member having generally radially directed slots therein of limited angular extent misaligned with said inwardly projecting portions and said passages on the spiral of the first-mentioned slot.

16. In a device of the character described, in combination, a body member having an axial cylindrical opening therethrough, one end of said body member being provided with slots disposed helically with respect to the axis of said bore, a member secured to said end of said body member, ears fixed with respect to said last-mentioned member complementary in size, shape and contour to said slots and removably received therein, said last-mentioned member having a bore aligned with said bore in said body member and provided with portions projecting radially inwardly with respect to the walls of said bore of said body member, one of said members having openings leading therethrough to said bore of said body member between the opposite ends thereof aligned on the helix of said slots with said inwardly projecting portions, pressure operated sealing means secured to said last-mentioned member on the radially inner side of each of said ears, and the opposite end of said main body member having generally radially directed slots therein of limited angular extent misaligned with said inwardly projecting portions and said passages on the spiral of the first-mentioned slot.

17. In a device of the character described, in combination, a main body member having a central cylindrical bore therethrough, means fixed with respect to said main body member including portions projecting radially inwardly of the walls of said bore over a limited angular extent thereof, said member having a pair of axially spaced openings therethrough opening onto said bore in predetermined relationship angularly of said bore with respect to each of said inwardly projecting portions, means for applying fluid under pressure to said opening, and a ball in each of said openings axially more adjacent to said inwardly projecting portions and partially projectable into said bore from said openings.

18. A device of the character described comprising, in combination, a body member having a cylindrical bore therethrough, a member secured to said body member and provided with portions projecting radially inwardly of said bore, said body having passages therein each opening onto said bore over a limited angular extent thereof and in predetermined spiral relation with said

projecting portions, the opposite end of said main body having radially directed grooves therein spirally misaligned with said passages, and a sleeve rotatably surrounding said main body portion forming a space between it and said main body portion in open communication with said passages, said sleeve having an opening therein for the introduction of fluid under pressure to said space.

19. In combination, a drill comprising a body having a point at one end thereof and having a flute and a land extending longitudinally of said

body from said point, said land being provided in its peripheral surface and between its opposite edges with a relief open to said peripheral surface along the length thereof, and means mounted upon and rotatable with said drill for supplying a coolant thereto, said means including a passage adapted to receive coolant under pressure and arranged so that it delivers the coolant only to said relief in said land for flow toward said point, said flute serving as an escape passage for said coolant from a hole being drilled by said drill.

RUDOLF W. ANDREASSON.