

Sept. 1, 1931.

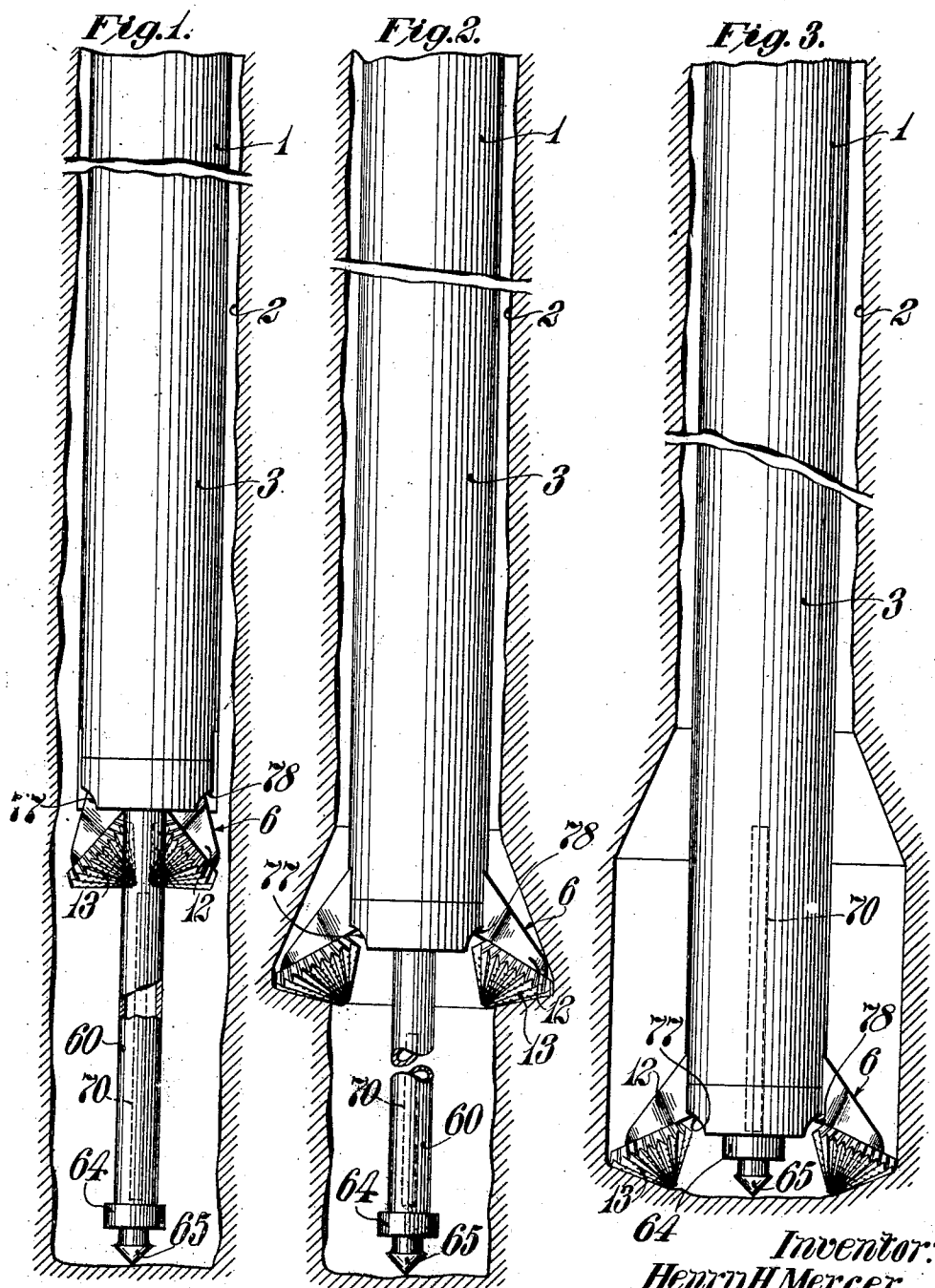
H. H. MERCER

1,821,473

BORING TOOL

Filed Oct. 26, 1925

3 Sheets-Sheet 1



Inventor:
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by *V. J. S. S. S.*
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Sept. 1, 1931.

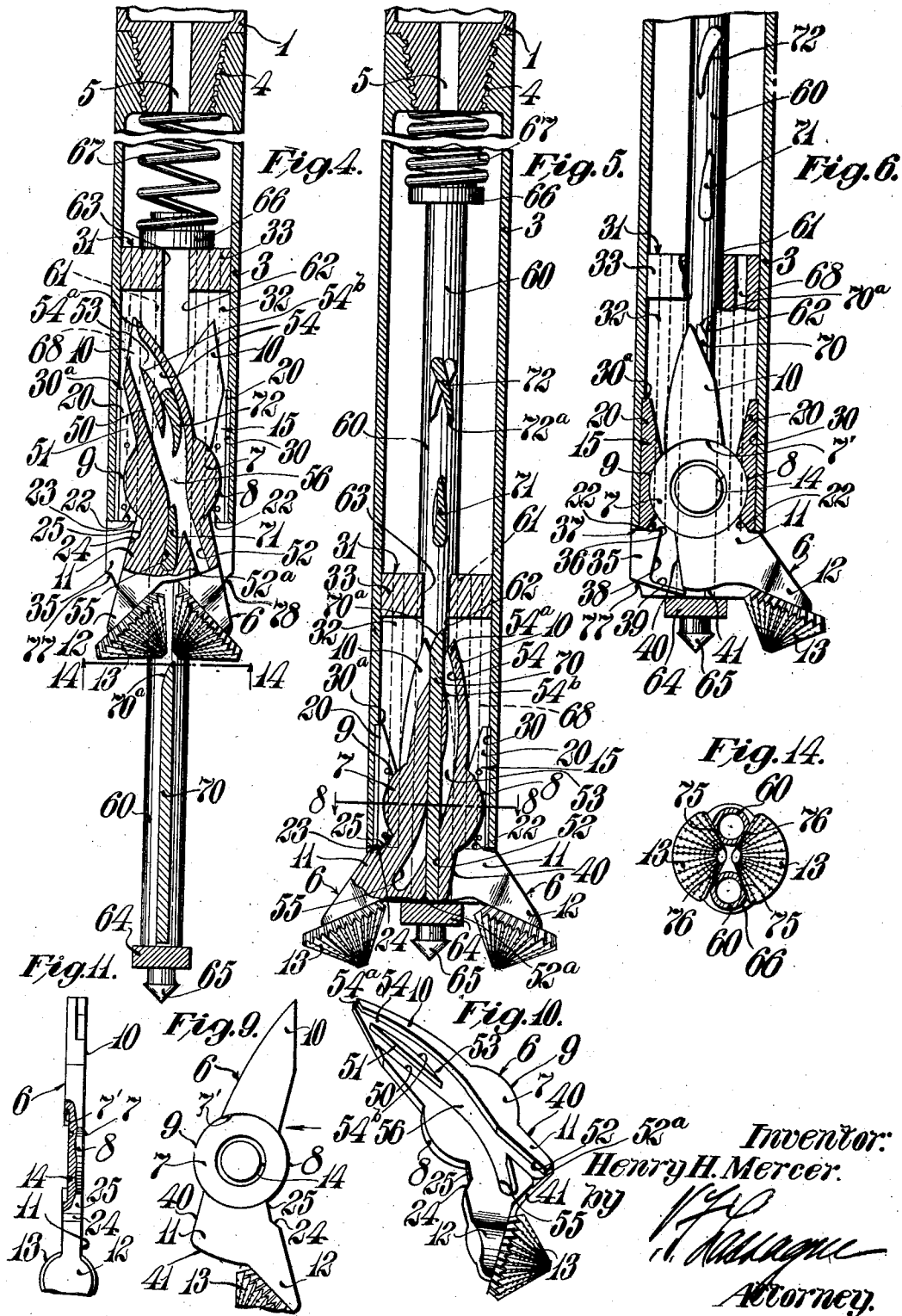
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3 Sheets-Sheet 2



Inventor:
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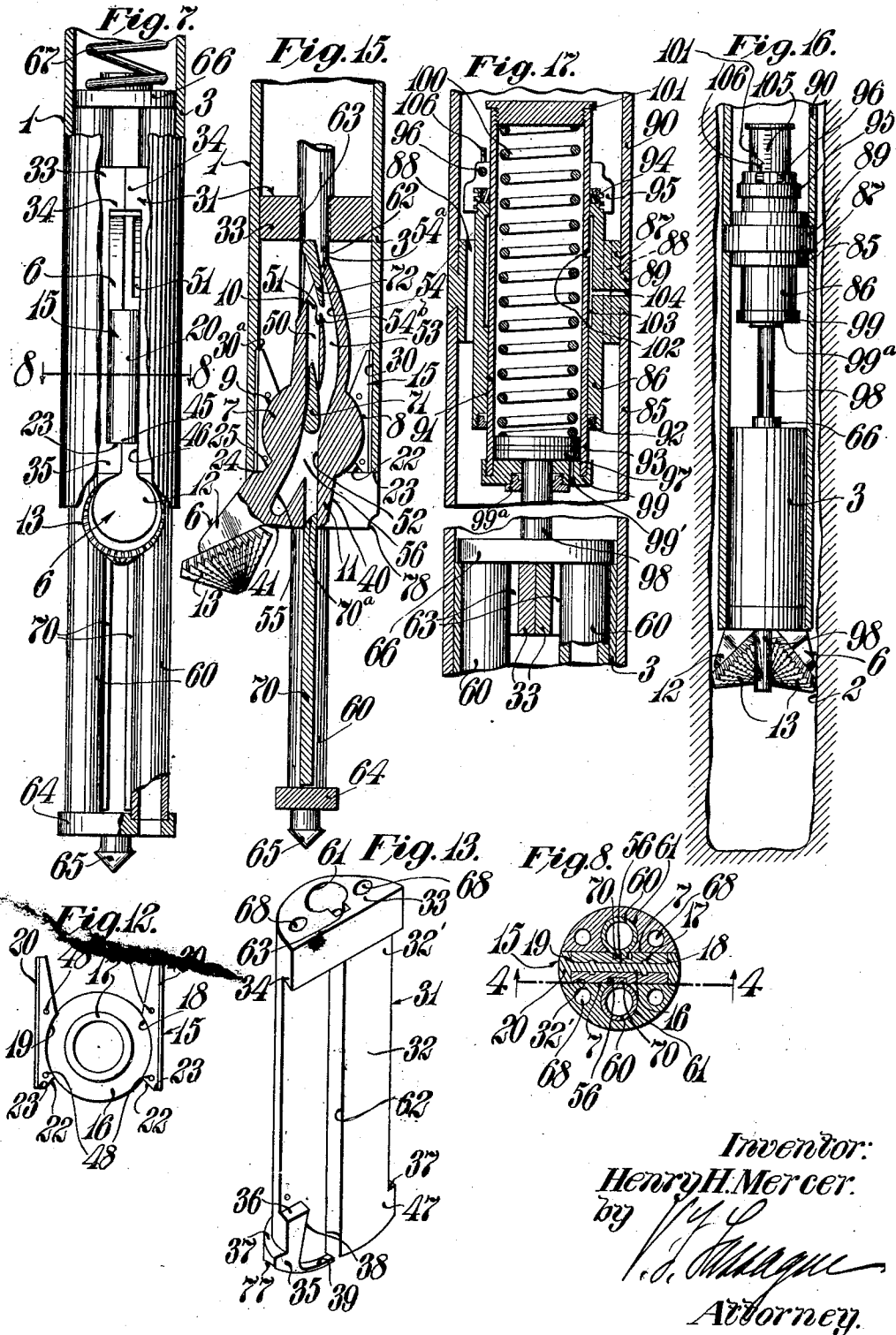
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BORING TOOL

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3 Sheets-Sheet 3



Inventor:
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UNITED STATES PATENT OFFICE

HENRY H. MERCER, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN
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BORING TOOL

Application filed October 26, 1925. Serial No. 65,019.

While this invention relates generally to improvements in boring tools, it is directed more particularly to expanding reamers.

In boring holes for certain kinds of work such as to receive explosives, it is desirable that the bottom portion of the hole be enlarged, thereby to provide a substantial sized pocket for receiving the explosives. While my invention is particularly applicable to enlarging the lower portion of the hole for the purpose above described, it will of course be understood that the same might be used for any purpose desired.

It is an object of my invention to provide improved means for materially enlarging the hole and particularly improved means for effecting operation of the expansion mechanism employed when the same has reached a predetermined distance from the hole bottom. In one specific aspect of the invention the above result is accomplished by providing a pair of outwardly moving arms carrying a well known type of conical shaped rotating cutter and having cam mechanism for insuring outward movement of the arms with subsequent locking thereof. This cam mechanism is generally operable by an exterior force such as a member abutting the bottom of the hole and another member movable relative thereto, relative movement therebetween causing the cam mechanism to operate. A further object is to provide a structure whereby certain parts may be made identical such for instance as the reamer carrying arms, means for retaining the same in operative relation to a supporting casing, and cams for actuating said arms. Another form of means for actuating the cutter carrying arms and one which is not dependent upon a member engaging the bottom, comprises a fluid actuated cylinder adapted to effect relative movement between the cam member and the member carrying the arms, this latter type of mechanism also permitting the utilization of actuating fluid for hole cleansing purposes.

In the accompanying drawings I have shown for purposes of illustration two forms which my invention may assume in practice.

In these drawings,—

Fig. 1 is a side elevational view with the reamer arms contracted.

Fig. 2 is a side elevational view with the reamer arms expanded.

Fig. 3 is a side elevational view with the reamer arms expanded and fed downwardly through its maximum depth.

Figs. 4 and 5 are vertical sectional views taken substantially on line 4—4 of Fig. 8, showing the reamer arms contracted and expanded, respectively.

Fig. 6 is a vertical sectional view with the parts in position, as indicated in Fig. 5, but with the left hand reamer arm removed to facilitate illustration.

Fig. 7 is a side elevational view similar to Fig. 1, but turned through 90° and parts of which are broken away to show details of construction.

Fig. 8 is a transverse sectional view taken substantially on line 8—8 of Figs. 5 and 7.

Fig. 9 is an elevational view of the inner side of one of the reamer carrying arms.

Fig. 10 is a perspective view of the reamer carrying arm looked at from its outer side.

Fig. 11 is a fragmentary side elevational view of the reamer arm looked at from the direction of the arrow in Fig. 9 and partly broken away in section to show details of construction.

Fig. 12 is a side elevational view of the journal support for the reamer carrying arms.

Fig. 13 is a perspective view of one of the duplicate retaining sides for the reamer carrying arms and journal support.

Fig. 14 is a transverse sectional view on line 14—14 of Fig. 4.

Fig. 15 is a diagrammatic view of the cam actuating mechanism in a position intermediate that shown in Figs. 4 and 5, parts being omitted to facilitate illustration.

Fig. 16 is a side elevational view of a modified form of reamer arm expansion actuating means.

Fig. 17 is a partial vertical sectional view of the modified form of actuating means.

In the illustrative embodiment of my invention shown in Figs. 1 to 15, I have pro-

vided a pipe 1 extending from the ground surface down into a hole 2 which has been initially bored by suitable drilling apparatus. Attached to the lower end of the pipe 1 is my improved expanding reamer which comprises
 5 a casing 3 having its upper end threadedly connected as at 4, preferably by a tapered male and female joint, to the pipe 1. The pipe 1 also has an air conducting passage 5 leading to the cylinder 3.

10 The reamer and expansion means therefor comprise substantially four mechanisms certain of which of course include a plurality of elements and some of these elements are duplicates. The four mechanisms are, the duplicate reamer carrying arms, a journal support for permitting said duplicate arms to be
 15 suitably journaled, duplicate retaining walls for holding the arms and journal support in operative relation, and duplicate cam mechanism adapted to engage suitable grooves formed in the outer surfaces of the reamer arms. The arms, journal support therefor, and duplicate retaining walls when assembled, form a substantially cylindrical outer
 20 surface and are insertible within the lower end of the cylinder 3.

Referring more specifically to the above mentioned mechanisms the reamer arms, generally indicated 6 and being identical in construction, comprise a hub portion 7 having
 30 convex cylindrical surfaces 8 and 9 (see Figs. 9, 10 and 11). Projecting upwardly and downwardly from the hub 7 are flat cam engaging portions 10 and 11. These portions are flush with one side of the hub 7 while the opposite sides are offset thereby forming a recess 7'. A boss 12 extends laterally from the portion 11 and is adapted to support rotatably a usual conical shaped reamer cutter
 40 13. The manner of supporting the cutters 13 in the bosses 12 is also well known. As shown, formed on the inner side of each of the hubs 7 is an annular groove 14. To support the two arms in their journaled relation a thrust journal support generally indicated
 45 15 is provided (see Fig. 12) and comprises a central cylindrical portion 16 having aligned annular flanges or thrust rings 17 on opposite sides thereof as clearly shown in Fig. 8. These flanges are receivable in each of the grooves 14 while the convex surfaces 8 and 9 of each of the arms will engage the concave cylindrical surfaces 18 and 19 of vertically
 50 extending lateral supporting arms 20 which also extend laterally of the opposite sides of the portion 16. Short horizontal surfaces 23 formed on the lower end of the arms 20 engage, when the reamer arms are in their expanded position, surfaces 24, while the surfaces 22 engage surfaces 25 formed on the
 55 reamer arms.

When the reamer arms and journal support are in their operative relation, in effect they
 60 will form what might be termed an arm unit

with the bosses 12 extending in opposite directions as indicated in Figs. 2, 5 and others. As shown in Fig. 8 the two hubs 7 and the journal support 15 when in their operative relation are narrow. To support this unit and to receive the upward thrust thereof the lower end of the casing 3 has a counterbore 30 to receive slidably the arms 20 of the journal support and forming a shoulder 30^a with which the upper surfaces of the arms engage, the depth of this counterbore being equal to the length of the arms 20.

To hold positively this arm unit in fixed relation to the casing 3 there are, in this instance, provided a pair of duplicate retaining wall forming members generally indicated
 80 31. These two wall forming members when placed together and assembled with the arm unit form what might be termed a supporting unit. Referring to Fig. 13 only one of these walls will be described in view of the duplicate character of the two. A semi-cylindrical body portion 32 has an upper head 33 which forms a semi-circle whose radius of curvature is equal to the inner diameter of the casing 3, thereby causing a portion 34 of the head 33 to overhang the surface 32' of the body. The distance of this overhang is equal to one-half the thickness of the arm unit. Formed in one lower corner of the body 32 is an arm stop 35 and it has a portion 36 projecting outwardly from the body portion 32 a distance also equal to one-half the thickness of the arm unit. A radial flange 37 projects a distance equal substantially to the thickness of the wall of the cylinder 3 adjacent the counter bore. The portion 35 extends downwardly to form surfaces 38 and 39, these being adapted to engage surfaces 40 and 41 formed on the portion 11 of the arms 6 when the latter are in retracted position. The annular flange 37 terminates at a point flush with the inner side of the body portion 32 at a point diametrically opposite to the member 35. Thus when the two duplicate retaining walls 31 are placed together, there will be a portion 35 at diametrically opposite points. There will also be formed between the two halves a slot equal to the thickness of the arm unit. The arm unit when disposed between the retaining walls will have the lower surfaces 23 of the thrust journal support 15 resting upon the portions 36. It will be noted from Fig. 8 that the width of the arms 20 is equal to the width of the groove formed between the surfaces 32' of the two retaining members so that the surfaces 23 will overhang each of the supporting surfaces 36 a distance equal to one-half the thickness of the groove and as shown at 45 in Fig. 7. Thus the arms 20 of the journal support also constitute spacing members for the lower end of the walls 31. Due to the half thickness of the members 35 a slot 46 is formed between each of the members 35 and the op-
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posing portion 47 of the walls 31. With the arms 20 resting upon the surfaces 36 and the reamer arms projecting in opposite directions through the slots 46, it will be seen that when the reamer arms are collapsed the surfaces 40 and 41 of the right hand reamer arm will engage the surfaces 38 and 39 on the left hand side of the body member 31, this relation being more readily seen from consideration of Fig. 9, Fig. 13 and Fig. 6. The same relation exists between the left hand reamer arm and the right hand stop 35. The arm unit may, if desired, be held in operative relation to the retaining walls 31 as by suitable dowel pins 48 (see Fig. 12), although any other suitable means might be employed. The supporting unit comprising the retaining wall assembled with the arm unit may now be inserted within the lower end of the cylinder 3 and forced upwardly therein until the flanges 37 engage the lower end of the casing. Upward movement of the journal support 15 is limited by engagement with the shoulder formed by the annular counterbore in the lower end of the casing 3. The retaining walls may be prevented from rotating relative to the casing by any suitable means such as set screws or the like.

As it is desired not to expand the reamer arms until the same have reached a predetermined position in the hole 2, improved cam actuating mechanism is provided; and in the preferred form this mechanism includes an abutment member which upon engagement with the bottom of the hole holds the cam mechanism against further longitudinal movement, while the casing 3 continues to descend. An additional function is that of holding the reamer arms expanded while the same descend with the casing 3. The casing 3 is rotated during this operation so as to effect a cutting action. The mechanism for expanding the reamers comprises essentially three means; namely, a pair of parallel rods adapted to abut the bottom of the hole, a series of cams disposed on the inner sides of each rod, and a series of cam receiving grooves formed in the outer surfaces of the reamer arms 6. The cam receiving grooves in the arms 6 comprise a straight groove 50 having portions 51 and 52 in the arm portions 10 and 11, respectively. Traversing the groove 50 is a curved groove 53 having portions 54 and 55 in the portions 10 and 11, respectively, these grooves intersecting to form a common grooved portion 56. From Fig. 8 it will be seen that these grooves face outwardly and are adjacent the surfaces 32' of the retaining walls 31. Due to the duplicate character of the two arms the grooves on the two arms, when assembled, will be relatively reversed.

To actuate these arms two parallel hollow abutment rods 60 are slidably mounted in openings 61 which extend entirely through

each of the retaining walls 31. The opening 61 slightly overlaps the surface 32' thereby forming a vertical slot 62. This overlap is not, however, sufficient to cut through the overhanging portion 34 so that in order to take care of cams which are mounted on the rod 60 a vertical slot 63 is formed in the portion 34. The rods are joined at their lower end by a transverse member 64 having a central abutment point 65, while the upper end of the rods are joined by a member 66 between which and the pipe 1 is disposed a spring 67. The rods 60 and the joining members 64 and 66 are hollow so that air flowing through the passages 5 can be discharged adjacent the bottom of the hole to blow the cuttings therefrom. To discharge a blast of air adjacent the cutters a series of openings 68 extend longitudinally and entirely through each of the retaining walls 31. Mounted on each of the inner surfaces of the rods 60 which are duplicates are three cams comprising an elongated locking cam 70 and a pair of arm swinging cams 71 and 72, the cams 71 and 72 being tapered at their adjacent ends in order that they may easily operate and cooperate with the grooves 50 and 53. Due to Figs. 4 and 5 being taken on line 4—4 of Fig. 8 the cams on the rod 60 which is disposed on the upper side of the horizontal center line of Fig. 8 are shown in full, while the cams on the other rod 60 are shown in section without any apparent support being shown in Figs. 4 and 5. This is done for the sake of clearness and understanding of the operation of the device. In order that the reamer arms may be contracted as much as possible, notches 75 and 76 are formed in the rods 60 to receive the cutters 13 when in the position shown in Fig. 14 and in order to allow swinging of the cutters the lower portions of the retaining walls 31 are cut away as at 77 and 78. It will also be noted that the cutter supporting portion 12 of each of the arms is offset laterally from the lower base portion 11 thereof, this being clearly shown in Fig. 7. The reason that the arms are each offset on opposite sides from the center line of the casing, and in order to bring the cutters back to the center the offset feature is resorted to.

In the operation, the reamer device with its reamer arms is collapsed as shown in Figs. 1 and 4 and inserted in the hole 2 until the member 65 abuts the hole bottom whereupon the rods 60 will be held against vertical movement while the casing 3 is fed downwardly by any suitable mechanism at the ground surface. During the downward movement of the casing 3 the cam receiving slots 50 and 53 will move relative to the cams 71 and 72. During this relative movement from the position shown in Fig. 4 the following action takes place. The cam 72 disposed in the groove portion 54 forces its re-

spective reamer arm outwardly and when the cam 71 is disposed within the common groove 56 the cam 72 will have pivoted the reamer arm sufficiently on the journal support 15 so that the cam 71 will pass into the grooved portion 51 instead of into the grooved portion 54, this being permitted due to the tapered end of the cam 71. This position is shown in Fig. 15. At this particular instant the groove cut away surface 52^a of the grooved portion 52 will have just engaged the curved surface 70^a of the cam 70. Continued relative movement will cause further pivotal outward movement of the reamer arms and when the cam 72 emerges from its grooved portion 54, the cam 71 will be fully disposed within the grooved portion 51 while the grooved portion 52 will have received a considerable portion of the straight cam 70. Continued relative movement will therefore effect no further outward movement of the reamer arms and the latter will be held in fixed relation not only by the locking cam 70, but also by engagement of the surfaces 22 and 23 of the journal support 15 by the surfaces 25 and 24 of the reamer arms. When the desired amount of reaming has been accomplished the stem 1 is removed upwardly from the hole by any suitable means at the ground surface, but the spring 67 will hold the rods 60 down. The result is that the reverse cam action is obtained so as to contract the reamer arms. This reverse cam action is as follows. The cam 70 has relative movement to the slot 50 until the surface 70^a is disposed adjacent the common grooved portion 56 at which period the cam 71 enters the grooved portion 51 and upon continuous relative movement the cam 70 will just about be withdrawing from the grooved portion 52 when the cam 72 is just entering the grooved portion 54. The cam 72 can enter the grooved portion 54 for the reason that its tapered end extends laterally of the cam 71 and the grooved portion 54 terminates so as to provide a cut away surface 54^a. This permits the surface 54^b to engage the surface 72^a of the cam 72. The result is the cam 72 is safely started within the grooved portion 54. Upon continued relative movement the cam 72 will engage the surface 54^b and accordingly due to the inclination of the cam 72 will pivotally inwardly move the reamer arms about the journal support 15. The reamer arms will continue to move inwardly so that by the time the cam 71 is within the common grooved portion 56 the lower end of the cam 71 will easily move into the grooved portion 55 where it will come to rest by engagement with the end of said grooved portion. The collapsed reamer may then be removed through the small portion of the hole 2, leaving merely a large reamed pocket at the bottom. It will also be noted that pressure fluid flows from the pipe 1 through the

casing 2 and between the moving parts of the reamer during operation thereof thus rendering the device self-cleaning and preventing wear of these parts by any foreign substance.

It is the purpose of my modification as shown in Figs. 16 and 17 to actuate the rods 60 without abutting the bottom of the hole and to also provide means whereby varying degrees of reamer expansion may be had thereby to effect different sized reamed holes. To accomplish this I have mounted the casing 3 within and hold the same in fixed relation to a casing 85. The principal distinction between the modification and the preferred form is to provide mechanism for actuating the rods 60 from their upper end. This mechanism comprises a support 86 having a radial flange 87 provided with ports 88 and a dove-tailed annular flange 89, the inclined surfaces of which are engaged by the tapered ends of the casing 85 and of a drill stem 90. The flange 87 and casing 85 and 90 are held in fixed relation by any suitable and well known means. The support 86 is provided with a cylindrical bore 91 carrying at one end a packing 92 which engages the periphery of a cylinder 93. The upper end of the support 86 also carries a packing 94 engaging the upper end of the cylinder 93 while a split collar 95 has threaded engagement with the upper end of the support 86 and is adapted to be clamped to the cylinder 93 as by a bolt 96. A piston 97 has a piston rod 98 extending through a cylinder head 99 and attached to the transverse member 66 which holds the rods 60 in their fixed relation. The port 99 provides communication between the cylinder 93 and the casing 85. A spring 100 is disposed between the piston 97 and the upper cylinder head 101. A port 102 has communication with an annular elongated recess 103 the latter venting to the atmosphere as through a radial port 104. To limit the degree of reamer expansion the cylinder 93 is longitudinally adjustably mounted in the bore 91 the adjustments being effected by loosening the bolt 96 and moving the cylinder 93 downwardly or upwardly to bring the desired one of a series of marked graduations 105 into alinement with the top of a pin 106 carried by the collar 95. It will of course be clear that any fixed surface could be used to gage the position of the marked graduations, although a pin is preferable for the reason that grease or other matter might accumulate on the fixed surface.

In the operation of this form of my invention the casing 85 and 90 will be inserted within the hole 2 without any air pressure in said casing. Accordingly the spring 100 will force the piston 97 to the position shown in Fig. 17 with consequent positioning of the rods 60 at the lower limit of their travel. By

analogy with Figs. 1 and 7 it will be seen that at the same time contraction of the reamer arms takes place. The entire mechanism below the piston rod 98 is identical to that shown in the preferred form of device. When the reamers have reached the predetermined point from which the reaming action will commence, air pressure admitted to the casing 90 and passing through the ports 88 and 99' will force the piston 97 upwardly against the spring 100 thereby carrying the rods 60 upward. This results in expanding the reamer arms in a manner similar to that described in connection with the preferred form. (See Figs. 2, 3, 4 and 5.) Upward movement of the piston 97 is limited by the engagement or abutting of the upper surface of the transverse member 66 with the lower surface of an adjustable member 99^a threadedly secured within the bottom of the cylinder head member 99. Downward movement of the piston 97 is limited by the engagement of the lower surface of the transverse member 66 with the upper surfaces of the heads 33 formed on the wall forming members 31. Thus to obtain different degrees of reamer expansion, that is when holes of different diameters are desired to be reamed, the cylinder 93 need only to be vertically moved to vary the distance between the lower surface of the member 99^a and the upper surfaces of the heads 33. The reamer may have its maximum expansion when the cylinder 93 is clamped in the position shown in Fig. 16, the cylinder 93 being shown in its extreme upward position. If, however, the cylinder 93 is moved downwardly the piston 97 and head 99 will be supported so that the amount of piston travel will be reduced by the amount of said separation. During this separation the rod 60 cannot be forced downwardly by the spring 100 for it is assumed that in the position shown in Fig. 17 the rods already have their maximum downward movement and accordingly the reamers are in their contracted position as shown in Fig. 16. It will also be noted that the graduations marked on the cylinder 93 may be so determined that the distance between each graduation may cause inch variations in the diameter of the reamed hole, although other graduations may obviously be used. It will also be evident that the elongated annular recess 103 in the member 86 permits the venting of the bore of the cylinder 93 above the piston 97 irrespective of the adjusted position of the cylinder relative to the member 86. Advantages other than those pointed out will be clearly apparent to those skilled in the art.

While I have in this application specifically described two forms which my invention may assume in practice, it will be understood that these forms of the same are shown for purposes of illustration and that the invention may be modified and embodied in var-

ious other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. An earth cutting tool comprising a cutter carrying arm having a plurality of cam receiving grooves, means for supporting the same to allow radial movement thereof, and actuating means therefor including a plurality of cams adapted to cooperate with said plurality of grooves, one of said cams serving to effect initial outward movement of said arm and another to effect final outward movement. 70
2. An earth cutting tool comprising a cutter carrying arm having a straight groove and a curved groove, means for supporting said arm for radial movement, and arm actuating means including cam mechanism receivable in said grooves. 80
3. An earth cutting tool comprising a cutter carrying arm having intersecting grooves, means for supporting said arm for radial movement, and arm actuating means including cam mechanism receivable in said grooves. 85
4. An earth cutting tool comprising a cutter carrying arm having intersecting grooves, means for supporting said arms for radial movement, and arm actuating means including cam mechanism cooperating with said grooves to cause said radial movement, and cam mechanism also adapted to cooperate with one of said grooves to lock said arm in an outward position. 90
5. An earth cutting tool comprising a cutter carrying arm having angularly disposed grooved portions, means for supporting said arm for radial movement, and arm actuating means including cams angularly disposed with respect to each other and adapted to cooperate with said grooved portions. 95
6. An earth cutter comprising a cutter carrying arm having straight and curved grooved portions, means for supporting said arm to allow radial movement thereof, and arm actuating means including cam mechanism receivable in said grooved portions. 100
7. An earth cutter comprising a cutter carrying arm having straight and curved grooved portions, means for supporting said arm to allow radial movement thereof, and arm actuating means including cam mechanism adapted to cooperate with said curved portion to cause radial movement of said arm and to cooperate with said straight portion to lock the same in position. 105
8. An earth cutter comprising a cutter carrying arm having a cam receiving groove, means for supporting said arm to allow radial movement, and arm actuating means including a plurality of separate cams successively receivable in said groove. 110
9. An earth cutting tool comprising a cutter carrying arm having a cam receiving groove, means for supporting said arm for 115

radial movement, and arm actuating means including a plurality of spaced cams adapted to be simultaneously receivable in said groove.

5 10. An earth cutting tool comprising a cutter carrying arm, means for supporting the same, and arm actuating mechanism including a plurality of cams, certain of which are adapted to effect radial arm movement, and
10 certain of which are adapted to lock said arm in position after radial movement.

11. An earth cutting tool comprising a cutter carrying arm, means for supporting the same for radial movement, and actuating means therefor including a plurality of spaced cams having certain portions thereof in alinement and a portion extending laterally from said alined portions.

12. An earth cutting tool comprising a casing, a pair of cutter carrying arms, and means for pivotally supporting the same including a journal interposed between and having sliding engagement with the inner sides of said arms, and means for supporting said journal support by said casing.

13. An earth cutting tool comprising a casing, a pair of radially movable cutter carrying arms, and means for pivotally supporting the same including a journal support interposed between and having sliding engagement with the inner sides of said arms and having supporting portions adapted to be removably secured to said casing.

14. An earth cutting tool comprising a pair of cutter carrying arms, a journal support interposed between and having sliding engagement with the inner sides of said arms, and arm actuating mechanism disposed on the outer side of said arms.

15. A reaming device comprising a pivoted tool carrying arm provided with an imperforate hub and supporting means therefor comprising projections journaled in said hub.

16. An earth cutting tool comprising a casing, a cutter carrying arm, and means for supporting the same in said casing including a removable journal support, a plurality of retaining walls, and means for supporting said journal support by said walls which are receivable in said casing.

17. An earth cutting tool comprising a casing, a pair of cutter carrying arms, means for supporting said arms by said casing including a journal support disposed between and common to said arms, and a plurality of retaining walls having means forming a slot therebetween within which said journal support is receivable, said retaining walls and journal support being disposable within said casing.

18. An earth cutting tool comprising a casing, a pair of cutter carrying arms, means for supporting said arms by said casing including a journal support disposed between and common to said arms, and a plurality of re-

taining walls having means forming a slot therebetween within which said journal support is receivable, said retaining walls and journal support being disposable within said casing, and actuating means for said arms including rods movable longitudinally relative to said casing and carrying cams adapted to cooperate with said arms.

19. An earth cutting tool comprising a casing, a plurality of cutter carrying arms, means for supporting the same including a plurality of retaining walls disposed in said casing having means forming a slot within which said arms are receivable and having a longitudinal opening, and arm actuating means including a rod extending through said retaining wall opening, and cam mechanism carried by said rod and adapted to cooperate with an arm.

20. An earth cutting tool comprising a casing, a pair of identical cutter carrying arms each having a hub portion provided with outer cylindrical bearing surfaces, and means associated with said casing cooperating with said bearing surfaces to support said arms.

21. An earth cutting tool comprising a casing, a pair of identical arms each having a hub portion provided with outer cylindrical bearing surfaces, and a journal support carried by said casing disposed between said arms and having cylindrical surfaces cooperating with said bearing surfaces.

22. An earth cutting tool comprising a pair of cutter carrying arms, and means for supporting the same including means presenting cooperating annular grooved and flanged portions, certain of which are associated with said arms.

23. An earth cutting tool comprising a casing, a plurality of cutter carrying arms, means for pivotally supporting the same by the lower portion of said casing, actuating means therefor including a plurality of rods disposed within said casing and extending from below said pivotal support to an upper portion of said casing, and means disposed at the upper end of said casing for effecting relative movement between said rods and casing thereby to cause radial movement of said arms.

24. An earth cutting tool adapted for reaming a hole comprising a casing, a pair of cutter carrying arms, means for supporting the same at the lower end of said casing, and actuating means therefor including a pair of rods disposed on the outside of said arms, and means for effecting relative movement between said rods and casing including actuating means disposed at the upper end thereof, said rod and arms having cooperating cam and grooved members, said rods adapted to be actuated to open said cutter carrying arms by engagement with the bottom of the hole.

25. An earth cutting tool comprising a casing, a cutter carrying arm, means for supporting the same by said casing including retaining wall means having a slot and head and a longitudinally extending opening, means for supporting said arm within said slot, and actuating means for said arm including a member movable through said longitudinal opening and having a movable abutment member adapted to engage said head.

26. An earth cutting tool comprising a casing, a cutter carrying arm, means for supporting the same by said casing including retaining wall means having a slot and head and a longitudinally extending opening, means for supporting said arm within said slot, actuating means for said arm including a member movable through said longitudinal opening and having a movable abutment member adapted to engage said head, and means engageable with said abutment member for effecting relative movement between said member and casing.

27. As an article of manufacture, a retaining wall comprising a member having a body portion and an overhanging spacing portion at one end, and an opening extending longitudinally through said body portion and overlapping the surface of the same and presenting a slot in said surface.

28. As an article of manufacture, a retaining wall comprising a member having a body portion and an overhanging spacing portion at one end, an opening extending longitudinally through said body portion and overlapping the surface of the same and presenting a slot in said surface, and means disposed at a lower portion of said body member presenting abutment surfaces.

29. As an article of manufacture, a retaining wall comprising a member having a body portion and an overhanging spacing portion at one end, an opening extending longitudinally through said body portion and overlapping the surface of the same and presenting a slot in said surface, and means disposed at the lower portion of said member presenting a laterally extending supporting lug.

30. As an article of manufacture, a retaining wall, a plurality of which are adapted to form a unit and comprising a body member having an overhanging hub portion, and a lug disposed at the lower end of said body member to form a suitable journal support.

31. As an article of manufacture, a journal support comprising a member presenting bearing surfaces on opposite sides thereof, annular flanges projecting from said surfaces, and substantially parallel arms extending from opposite edges of said surfaces.

32. As an article of manufacture, a cutter carrying arm comprising a cutter supporting

portion, a portion having cam receiving grooves formed only in the side thereof, and a supporting hub portion disposed between the ends of said arm.

33. As an article of manufacture, a cutter carrying arm comprising a cutter supporting portion, a portion having cam receiving grooves formed only in the side thereof, and means presenting an annular supporting surface on the side of said arm opposite said cam grooves.

34. As an article of manufacture, a tool carrying arm comprising a tool supporting portion, a hub portion adapted to engage supporting means for said arm, and cam receiving grooves formed in the side of said arm and passing through said hub portion.

35. An earth cutting tool comprising expansible cutter carrying arms, supporting means therefor, means for actuating said arms including a hollow member adapted to cause movement of said arms upon abutting a hole bottom, and means whereby cleansing fluid may be discharged through said hollow member, said hollow member being movable bodily relative to said arms and said supporting means.

36. An earth cutting tool comprising a pair of reamer cutter carrying arms having portions mounted in overlapping relation, and cam mechanism for actuating one of said arms cooperating with the overlapping portion of said arm and disposed wholly on the side of said arm farthest away from the other arm, and similar cam mechanism for actuating said other arm.

37. An earth cutting tool comprising a casing, a pair of reamer cutter carrying arms pivotally mounted in said casing with their journal portions in overlapping relation, and cam mechanism for actuating one of said arms cooperating with the journal portion of said arm and disposed wholly on the side of said arm farthest away from the other arm, and similar cam mechanism for actuating said other arm.

38. An earth cutting tool comprising a casing having a circular wall, a plurality of cutter carrying arms having relatively wide flat portions for supporting the same, and means for mounting said arms in said casing and guiding the same for transverse movement relative to said casing during opening and closing of said cutter carrying arms, said means comprising a plurality of removable members presenting a space therebetween and having parallel walls for receiving and enclosing said flat portions of said arms, said members being disposed within the circular wall of said casing, and means for preventing axial displacement therefrom.

In testimony whereof I affix my signature.

HENRY H. MERCER.

CERTIFICATE OF CORRECTION.

Patent No. 1,821,473.

Granted September 1, 1931, to

HENRY H. MERCER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 24, for the misspelled word "cuter" read cutter, and line 33, for "centain" read certain; page 6, line 22, claim 12, after the word "journal" insert the word support; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of April, A. D. 1932.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.

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