May 5, 1959 R. W. SARTOR 2,885,185

ROCK BIT

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Fig. 3

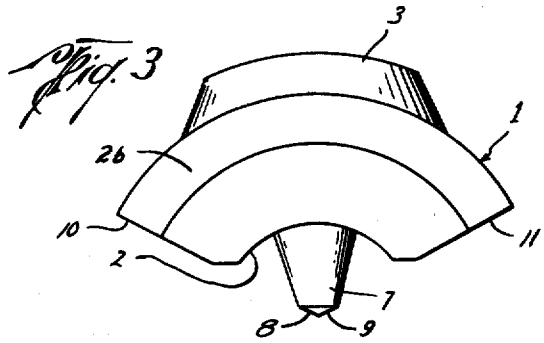


Fig. 1

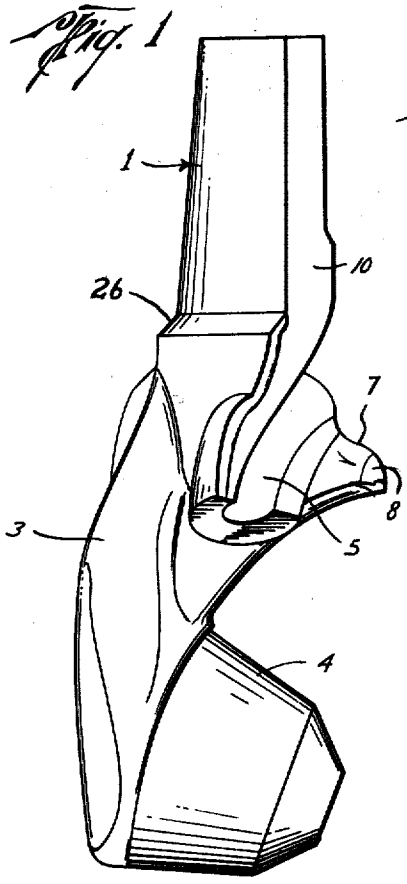
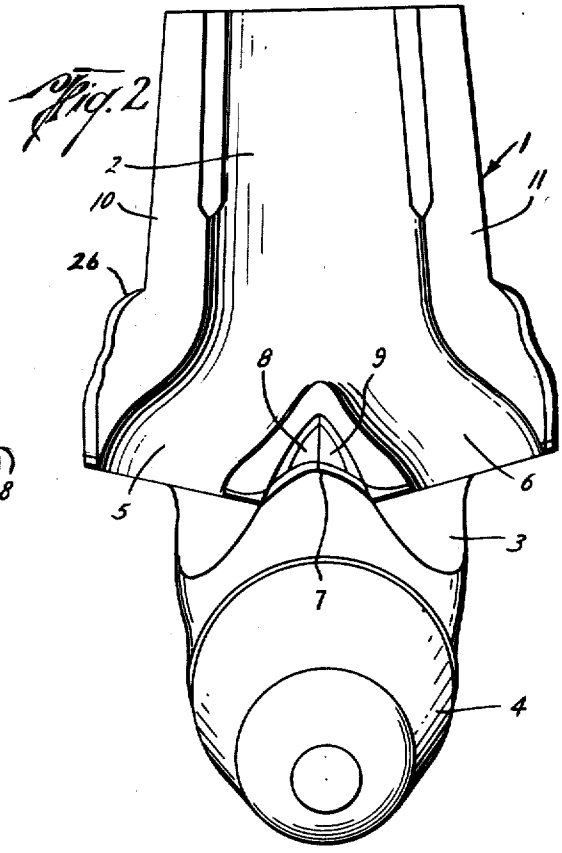


Fig. 2



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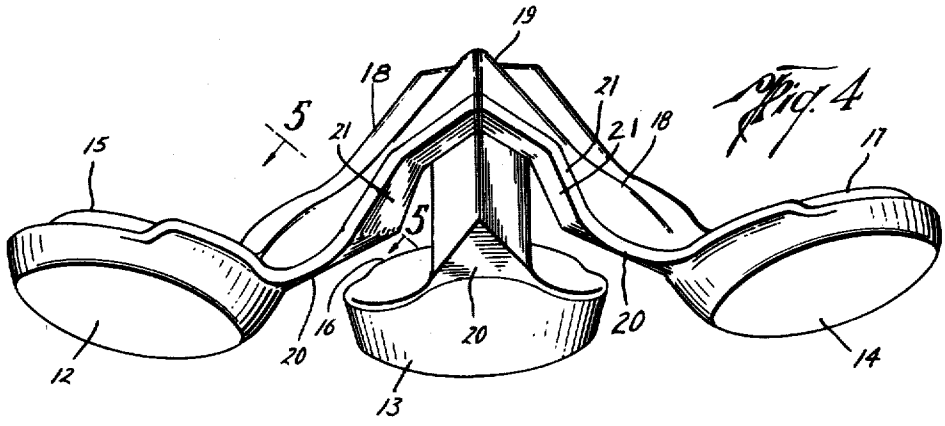


Fig. 4



Fig. 5

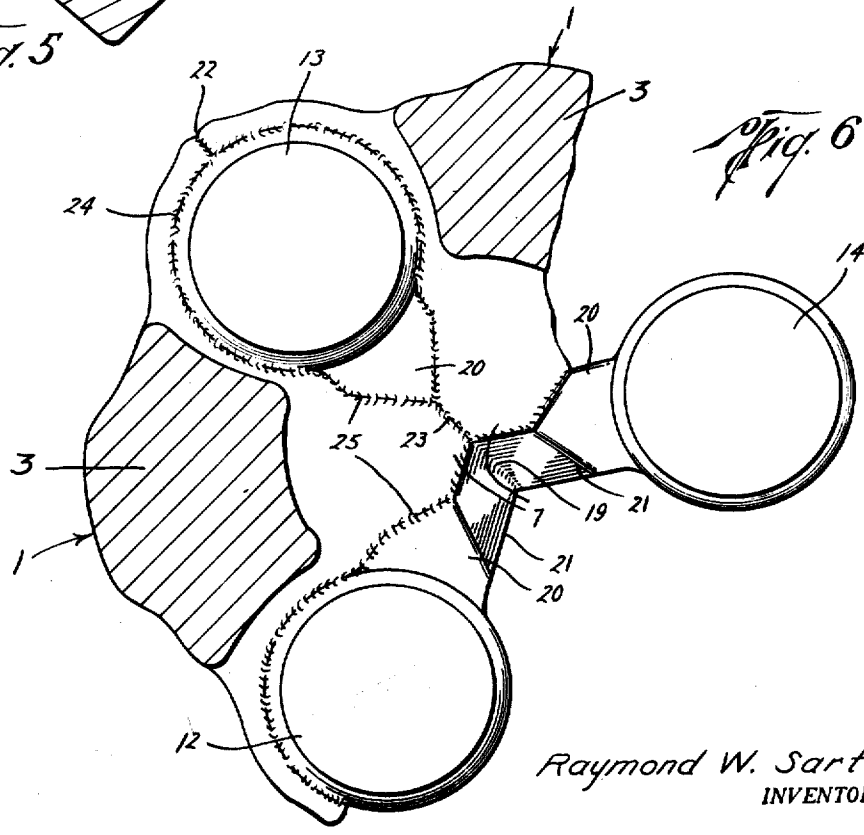


Fig. 6

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Fig. 9

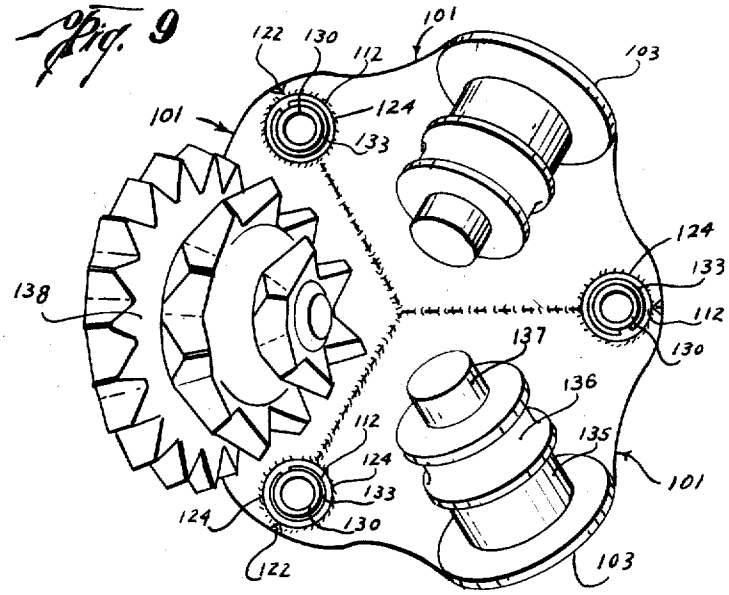
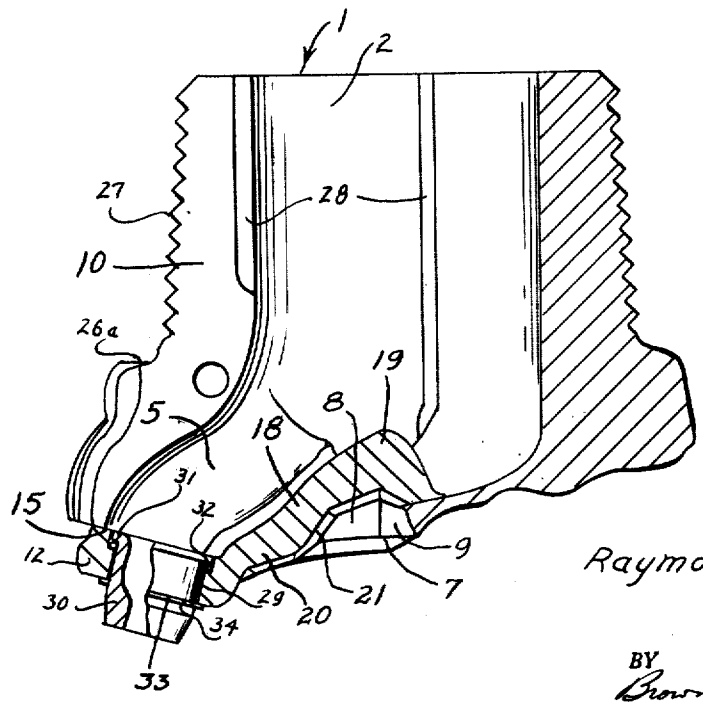


Fig. 7



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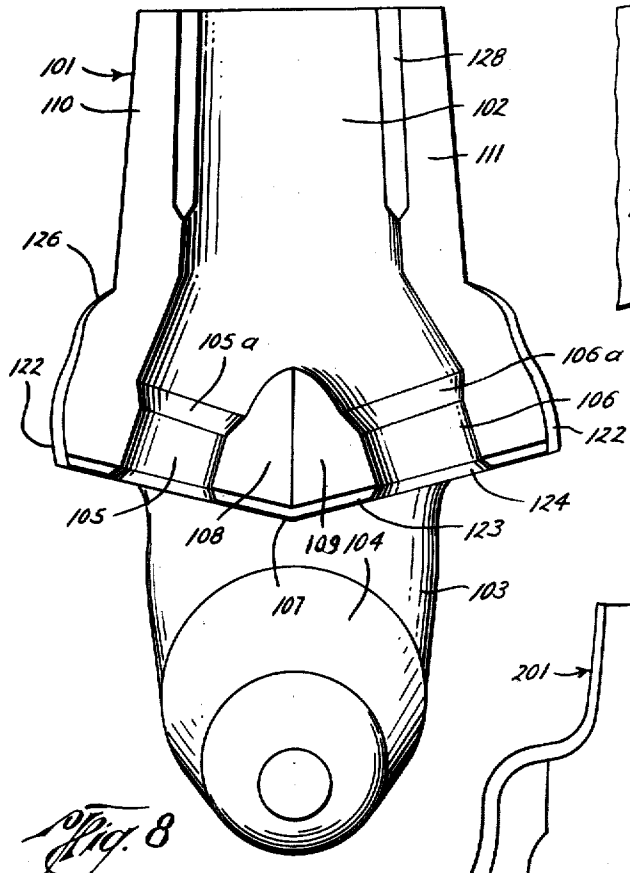


Fig. 8

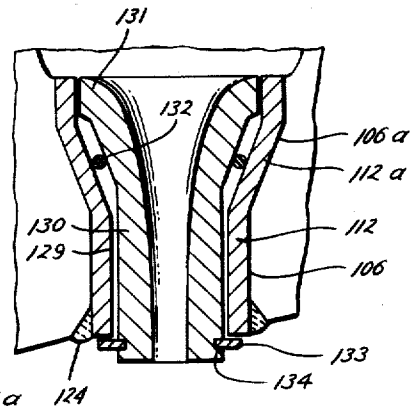


Fig. 10

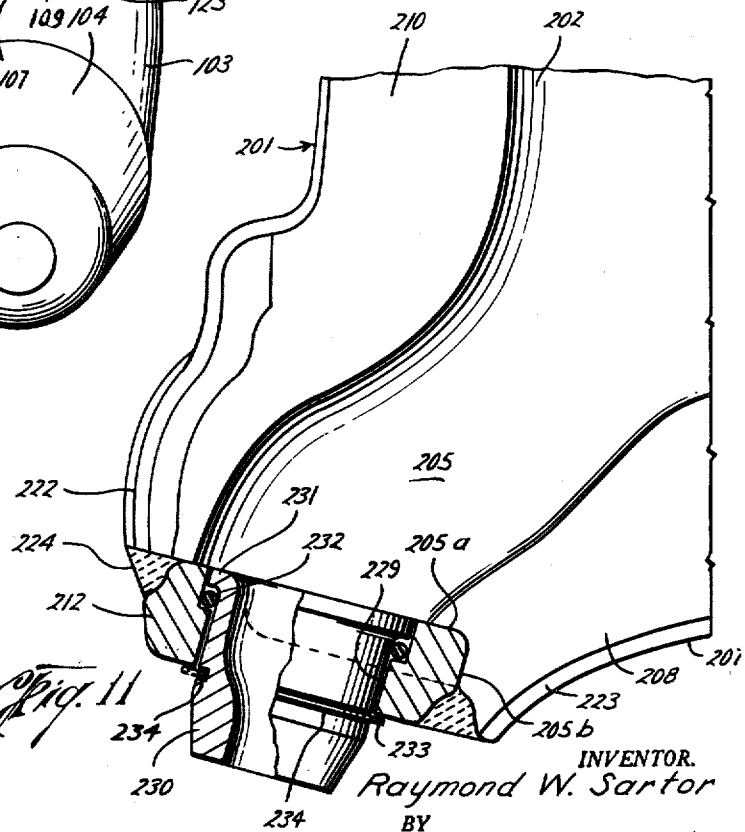


Fig. 11

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2,885,185

ROCK BIT

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Application September 13, 1956, Serial No. 609,564

3 Claims. (Cl. 255—313)

This invention relates in general to earth boring drill bits and has particular reference to a drill bit of the character used in drilling through hard formations and customarily known as rock bits. It has for its general object the provision of such a bit which will be durable and economical in construction and which will provide for the jetting of drilling fluid directly against the formation at the bottom of the hole being drilled.

Drill bits have heretofore been constructed of bodies made in segmental parts welded together along longitudinal parting lines with each segmental part provided with a downwardly and inwardly extending spindle providing a bearing for a rotating cutter generally conical in shape. These cutters are adapted to roll on the bottom of the hole during the drilling operation and are provided with teeth for breaking up the formation and providing the drilling action. The upper portions of the segmental body parts are so formed that when joined together they provide a hollow upper end which is customarily threaded to receive the lower end of a drill stem by which the bit is rotated and through which drilling fluid is pumped in the course of drilling. Openings are provided in the lower end of the hollow portion of the bit body to direct the drilling fluid against the cutters or against the bottom of the hole, as desired.

In drilling certain formations it is desirable that the drilling fluid be directed between the cutters in a strong jet to impinge directly on the bottom of the hole. In conventional bits employing three cone-shaped cutters in which the bodies of the bits are formed of segmental parts as above described, it has been found that if these segmental parts are so constructed that the drilling fluid jet openings are bisected by the parting lines between the segments, the resulting structure is not only difficult to assemble and fabricate but is subject to failures due to weakness in the welded joints between the segments. In order to avoid this situation, it has been proposed that the segments making the bodies of such bits be so constructed that the bearing spindles on the respective segments will be located closer to one longitudinal edge of the segment than to the other so that the drilling fluid openings may be located midway between the longitudinal planes passing through the bearing spindles and yet so that each drilling fluid opening may be located entirely in one segment. Such an asymmetric segment is more difficult to forge and machine than symmetrical segments.

It is therefore an object of this invention to provide a bit of the general character heretofore described but in which symmetrical segments may be employed in the construction of bits of the jet type in which the drilling fluid is jetted directly against the bottom of the hole being drilled, but in which the inherent weaknesses formerly encountered in making bits of this type with symmetrical segments are eliminated.

It is a further object of this invention to provide such a bit which may be assembled with substantially the same facility as bits of the more conventional type employing symmerical segments in which the drilling fluid is directed onto the cutters.

It is another object of this invention to provide a bit of the general character above described in which hardened nozzle inserts may be securely yet replaceably mounted, and so that they will not be lost through loss or damage to some securing means such as a snap ring.

A still further object is to provide a structure in which such hardened nozzle inserts may be put in place from inside the bit head and removed in the same fashion and provided with external stop projections engageable with the interior of the bit head so that the pressure of drilling fluid in operation will tend to more firmly seat the nozzle inserts within the bit head.

Another object of this invention is to provide in a bit of the character described a symmetrical segment construction in which provision is made for jet nozzles for jetting downward along the line bisecting the angle between bearing spindles but in which the jet opening will be completely surrounded by an integral annular metal part uninterrupted by a welded seam or parting line.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein is set forth, by way of illustration and example, one embodiment of the invention.

In the drawings:

Fig. 1 is a side elevation of a symmetrical bit body segment constructed in accordance with this invention.

Fig. 2 is an elevation of the same segment looking in a direction parallel to a longitudinal plane bisecting the segment.

Fig. 3 is a top plan view of the segment illustrated in Figs. 1 and 2.

Fig. 4 is a side elevation of an integral assembly of the parts in which the drilling fluid jet openings are to be provided in the finished bit.

Fig. 5 is a cross-sectional view taken along the line 5—5 of Fig. 4.

Fig. 6 is a bottom plan view, partly in section, showing the welded parting lines between the segments and surrounding the parts in which the jet openings are to be formed, parts of this figure being broken away for the purpose of illustrating the relation of the assembly of Fig. 4 to the bit segments.

Fig. 7 is a view in longitudinal cross-section through the bit illustrated in Fig. 6 along a central plane passing through the parting line between two of the segments, showing the jet nozzle structure in cross-section.

Fig. 8 is a view similar to Fig. 2 but showing a slightly modified form of body segment.

Fig. 9 is a bottom plan view of a bit made up of segments of the character shown in Fig. 8 with two of the cutters removed in order to afford a better view of the bottom of the bit head and of the nozzle construction.

Fig. 10 is an enlarged longitudinal cross-section of a modified form of jet nozzle construction adapted for use with the body segment illustrated in Fig. 8.

Fig. 11 is a view similar to the lower left-hand portion of Fig. 7, showing a modification.

Referring now more in detail to the drawings, the bit body is made up of a plurality of substantially identical symmetrical segments welded together. The segments shown in Figs. 1–3 each constitute one-third of a complete bit head and hence extend over 120° so that three of them may be joined together to provide a complete bit head. Each of these segments is comprised of an upper portion 1 having a tapered exterior surface adapted when the bit head is complete to be threaded on the outside so as to be joined to the lower end of the drill stem.

Each of these segments also has a concave portion 2 within its upper portion so that when the three segments are joined together, they will provide a hollow upper end within the bit body. This hollow upper end is adapted to receive drilling fluid pumped down through the drill stem in the course of drilling.

At its lower end each of the segments is provided with a downwardly extending portion 3 which may be termed a cutter leg or a cutter arm and on the lower end of this leg 3 is a downwardly and inwardly projecting bearing part 4 intended to be machined before the segments are joined together so as to provide bearing races substantially as shown in Fig. 9, later to be described.

Adjacent its lower end the concavity 2 is divided into two parts 5 and 6 separated from each other by a central projection or lug 7 which extends to the center of curvature of the segment or to the location of the axis of the finished bit. This lug or projection 7 has two lateral faces 8 and 9, respectively, which are in the same planes with the edge surfaces 10 and 11, respectively, of the segment so that when three segments of this character are fitted together, they will abut each other along the faces 8, 9, 10 and 11. As above explained, the concavity 2 represents one-third of a circular opening whose center will be along the axis of the completed bit. However, the branches 5 and 6 of this concavity are substantially semicircular so that when the three segments are assembled and are secured together, there will be three branches extending from the central hollow upper portion of the bit down along the three respective parting lines between segments, and each of these branches, like the main passageway in the upper part of the bit, will be circular in cross-section or substantially so.

In order to avoid the objections heretofore recited as being inherent in those bits in which the flow passageway for drilling fluid is formed by complementary grooves in the adjacent parting faces of the segments making up the bit head, provision is made in this bit for the branches 5 and 6 to be somewhat larger than it is necessary for them to be in the completed bit, and a separate integral nozzle-carrying member in the form of a pad is welded into each of these openings. Three such pads are illustrated at 12, 13 and 14, respectively, in Figs. 4 and 6. In this particular instance, provision is made for holding these pads in their proper relation to each other and in their proper relation to the assembled segments of the bit head during assembly so as to facilitate the assembly of the bit head. Each of these pads has a small projection on its upper surface, as indicated by the numerals 15, 16 and 17, respectively, which is adapted to engage against and close the lower end of the corresponding branch opening 5 or 6. In order to hold the pads in such position with respect to the branch drilling fluid openings during assembly, they are joined together with arms 18 meeting and integrally joined together at a common central point 19. Each arm has a part 20 extending inwardly from the corresponding pad and adapted to form a part of the bottom surface of the bit. From the inner end of the part 20 is an upwardly and inwardly extending part 21 adapted to extend upwardly along the upper and inner surface of the meeting projections 7 to the position 19 where all of these arms meet above the meeting projections 7. Thus not only are the pads each positioned with respect to the opening in the main bit head with which it is to cooperate, but the pads are positioned with respect to each other by the arms which join them together and are positioned with respect to the bit head as a whole by the interlocking of these arms around and above the meeting projections 7.

The details of mounting of the cutters being no part of this invention, it will be unnecessary to describe the same except to state that the appropriate bearing surfaces are machined on the projections 4 prior to assembly of the segments with respect to each other to form the complete bit head, and the cutters are mounted on the segments in approved conventional manner just before the segments are joined together.

The segments and the nozzle-receiving pad assembly shown in Fig. 4 are then assembled with respect to each other as shown in Fig. 6. The segments are welded together along the outer surface of the bit head, as shown at 22, and along the bottom surfaces of the projections 7, as shown at 23. The pads 12, 13 and 14 are welded in place by welding around the peripheries of the pads where they are in proximity to the adjacent bottoms of the segments as shown at 24 and along the meeting surfaces of the parts 20 of the arms 18 and the projections 7, as shown at 25. It will be seen that the welds 22, 23, 24 and 25 will provide a complete closure of the surfaces between the segments and the pads over the bottom of the bit head. It is understood that the welds 22 along the outer surface of the bit head will be continued upwardly and inwardly to the inner extremity of the shoulder 26 on the exterior of the bit head. This weld may be continued all the way up to the top of the bit head if desired but preferably the welding between the segments in the upper portion of the bit head is along the interior so that the threads may be formed on the exterior of this portion of the bit head without encountering the varying degrees of hardness in the metal which would be present if the welding were on the exterior and without weakening the welded joints.

Referring to Fig. 7, it will be seen that when the shoulder 26 is machined as shown at 26*a* and the threads 27 are formed on the upper outer portion of the bit head, a tool joint threaded onto the upper portion of the bit head may be of such proportion as to have its lower end abut and engage the shoulder 26*a* with a substantially sealing engagement. Thus, even though the welds 28 along the inner extremities of the parting surfaces between the segments are not joined to the welds 22 along the outer extremities of the parting surfaces, when the lower tool joint of a drill stem is engaged with the bit in the manner indicated, fluid pumped down through such drill stem will not be permitted to leak between these two sets of welds.

In order to provide for the mounting of nozzles of hard material and of such size and conformation as will direct the streams of drilling fluid in strong jets against the bottom of the hole being drilled, each of the pads 12, 13 and 14 is drilled with an opening of an appropriate size to receive such hardened nozzle. The pads being thus drilled, as shown at 29 in Fig. 7, then form annular integral nozzle-receiving members joined by welding to both of the adjacent segments of the bit head. This does not leave a weakened section as is the case in bits in which there is no such annular member incorporated nor does it leave the welded seams subject to leakage next to the nozzles or to erosion in the action of the drilling fluid. Instead, it provides a smooth continuous walled, accurately formed opening for receiving the nozzle element 30 and provides a reinforcement for the welding along the parting line which actually provides a slightly stronger joint than would a single continuous weld unbroken by any fluid passageway.

At the same time, the branches of the drilling fluid passageway down through the bit provide room for the insertion of the nozzle elements 30 down through the interior of the bit and into engagement with the drilled openings in the pads 12, 13 and 14. The nozzle elements provided by this invention are of a character having a portion adapted to fit the drilled openings 29 in the pads and having at their upper inner ends outwarding extending flanges or stop parts 31 adapted to engage the inner surfaces of the pads 12, 13 and 14 to provide stops against further downward movement of the nozzle members. Also appropriately positioned between the nozzle 30 and the adjacent wall of the opening 29 is a suitable sealing element such as the O-ring 32 illustrated, which

provides a seal to prevent the drilling fluid from flowing between the nozzle element **30** and the interior of the drilled hole **29** in the pad.

The nozzle elements **30**, thus mounted, are held in place against accidental upward displacement by means of snap rings **33** or other suitable similar fastenings, these rings being shown in engagement with suitable grooves **34** in the nozzle members just below the lower surfaces of the respective pads.

Referring now to the form illustrated in Figs. 8, 9 and **10**, it will be seen that the segment **101** is similar to that in the form already described in that it has a hollow portion **102** in its interior and in that it extends throughout substantially 120° so that three such segments will form a complete bit body. Likewise, in fashion substantially the same as that in the form previously discussed, this segment has a downwardly extending cutter leg **103** carrying a cutter spindle portion **104**.

However, this form provides openings **105** and **106** which are somewhat different from the corresponding openings provided in the previously described segment in that the openings **105** and **106** are formed substantially cylindrical except for a flaring taper as shown at **105***a* and **106***a* at their inner upper ends. Furthermore, the central projection **107** occupies substantially the entire space between the openings **105** and **106** instead of only a small central portion of such opening as in the previously described form. Furthermore, the entire surfaces **108** and **109** of the projection **107** engage with corresponding surfaces on the next adjacent segments so that a substantially greater surface contact between segments adjacent their centers is provided. These segments have outer contact surfaces along their outer walls as shown at **110** and **111**, which are substantially comparable to the surfaces **10** and **11** of the segments previously described.

It will now appear that the reason for the differences in the openings **105** and **106** from the openings **5** and **6** of the previously described form lies in the nature of the annular member which receives the nozzle insert. In the form shown in Figs. 8, 9 and 10, this annular member is in the form of a tube **112** with a cylindrical portion adjacent its lower end fitting the cylindrical portion of the opening **105** or **106**, as the case might be, and with a flaring portion closer to its upper end as shown at **112***a* adapted to fit within and rest against the tapered portion **105***a* or **106***a*, as the case may be. Each of these annular members **112** is separate from the others there being no connection provided as in the case of the members **12**, **13** and **14** previously described. However, after the segments have been welded together with these annular members in place, or simultaneously with such welding, these annular members are also welded in place. The welding along the outside of the bit head between the segments at **122** corresponds with the welding at **22** in the previously described form, and the projections **107** are welded together along the grooved lines at **123** in substantially the same fashion that the projections **7** are welded together in the previously described form. The annular member **112** is welded into place by welding around it at its lower end shown at **124**. The outer weld **122** terminates in a shoulder **126** in substantially the same fashion as that previously described and the upper ends of the segments may be welded together along their inner surfaces as indicated at **128**. It is to be understood that the numerals **122**, **123**, **124**, **126** and **128** in Fig. 8 indicate the bevelled corners prepared for receiving the welds of the numbers corresponding to those shown in this figure, while these numbers in Fig. 9 indicate the corresponding positions with the welds already completed.

Each of the annular members **112** also has a cylindrical bore therethrough at **129** with an upwardly facing flaring shoulder above this bore. Each such annular member is thus adapted to receive a nozzle insert **130** having an outwardly turned flange **131** adjacent its upper end, the parts bearing such relationship that when the nozzle insert **130** is in place within the annular member **112** it will be positioned at the limit of its downward movement by engagement between these parts, and a sealing member in the form of an O-ring **132** or the like may be employed between the abutting portions of the nozzle insert and the tubular member so as to provide a seal between these parts.

The annular members are shown having substantially squared lower ends so as to form abutments to receive split rings in the form of springs annular except for a split at one side, which are adapted to be sprung into place in grooves **134** in the exterior of the nozzle inserts **130** just below the lower ends of the tubular members **112**.

Thus it will be seen that the nozzle insert **130** may be passed into the completed bit head from above with the O-ring **132** or other sealing member in place about the nozzle insert just below the shoulder **131**. This assembly is then passed down through the hollow upper pin section of the bit head and into the corresponding tubular member **112** and seated therein in the position indicated in Fig. 10. Then the snap ring **133** may be snapped into the groove **134** about the lower end of the nozzle insert and the nozzle insert will have been secured in place. As in the case of the nozzle inserts **30**, pressure of drilling fluid from within the bit head will only tend to seat the nozzle insert more firmly and seal it more securely within the annular member which carries it. The split ring **133**, like the split ring **33**, merely serves the purpose of preventing accidental upward displacement of the nozzle insert.

The form just described provides every advantage of the form illustrated in Figs. 1 to 7, inclusive, except that the annular members **112** are separate from each other and hence must be put in place individually. However, they are easier and less expensive to make than the more complicated assembly illustrated in Fig. 4 and in the completed bit will serve the same purpose as the pads **12**, **13** and **14**.

In Fig. 11 there is illustrated a still further modification in which a pad **212**, similar in form to the pads **12**, **13** and **14**, is employed to provide the annular member. In this form, the segments are very similar to the segments illustrated in Figs. 1 to 7, inclusive, and have mating surfaces **210** along their outer walls comparing substantially with the surfaces **10** in the previously described form. Likewise, mating surfaces **208** are provided on the projections **207** centrally of the bit head, but these surfaces, like the surfaces **108** of Fig. 8, extend from the openings **205** inwardly to the center of the bit body. With the exceptions indicated, the bit head of the form shown in Fig. 11 is made up of segments very similar to those shown in Figs. 1 to 7, inclusive. Each of these segments **201** has a central opening **202** which connects with the branch openings of which only one designated by the numeral **205** is illustrated.

At the lower ends of the branch openings, along their inner walls closest to the center of the bit, they are provided with downwardly facing shoulders **205***a* and with downwardly extending flanges with walls **205***b* surrounding the opening **205**. There is thus provided a positioning receptacle for the pad **212**. This pad is preferably placed in position to be welded after the bit segments have been assembled but before they are welded together. They may then be welded together along the grooves **222** and **223** and at the same time the pads may be welded in place as illustrated at **224** by a weld extending completely around each pad.

Each pad is drilled with a hole **229** which is substantially cylindrical and of a size to receive the substantially cylindrical mid-portion of the nozzle insert **230**. This nozzle insert **230** has an outwardly turned flange **231** at its upper inner end and a sealing ring such as an

O-ring 232 is adapted to surround this nozzle insert just below the flange 231. Then when the nozzle insert 230 is passed into the bit after the parts have been welded together as above described, it can be positioned within the opening 229 with the seal ring 232 gripped between the flange 231 and the upwardly facing shoulder provided within the opening through the pad 212. This will serve to limit the downward movement of the nozzle insert and excessive pressure of drilling fluid within the bit head will only cause the nozzle insert to be seated more firmly within its annular member and to be more securely sealed therein. This nozzle insert may be secured in place as in the previous forms by means of a split spring ring 233 placed in a groove 234 in the external surface of the nozzle insert at a position which will be just below the lower surface of the annular member 212 when the nozzle insert is firmly seated therein.

From the foregoing it will be appreciated that a means has been provided for carrying out and accomplishing all of the objects and advantages of this invention in a facile and highly practical fashion.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. In a drill bit, a body comprising a plurality of segments integrally joined together and recessed so that they provide the body with a hollow upper end, at least one of said segments having a cutter leg extending downwardly therefrom with a downwardly and inwardly extending cutter bearing spindle on said leg and a rolling cutter on said bearing spindle, each of said segments being symmetrical about a vertical plane containing the longitudinal axis of the body and bisecting the angle between the mating faces of such segment, complementary grooves in the mating faces of two of said segments forming, when said segments are secured together, a downwardly directed fluid passageway between said hollow upper end and the exterior of the body, a continuous annular nozzle-receiving member surrounding said passageway in the form of a tube extending at least partly through said passageway and welded about its entire outer periphery to said two segments about said passageway adjacent the lower face of the segments so that said segments can be forged or cast in symmetrical shapes and yet, when assembled, the nozzle-receiving member can be welded thereto to provide a bridge therebetween free from interior seams through which fluid might leak, and a nozzle detachably secured and sealed in the opening through the annular member.

2. In a drill bit, a body comprising a plurality of segments integrally joined together and recessed so that they provide a body with a hollow upper end, at least one of said segments having a cutter leg extending downwardly therefrom with a downwardly and inwardly extending cutter bearing spindle on said leg and a rolling cutter on said bearing spindle, each of said segments being symmetrical about a vertical plane containing the longitudinal axis of the body and bisecting the angle between the mating faces of such segment, complementary grooves in the mating faces of two of said segments forming, when said segments are secured together, a downwardly directed fluid passageway between said hollow upper end and the exterior of the body, a continuous annular nozzle-receiving member in the form of a tube extending part way through said passageway and welded about its entire outer periphery to the segments adjacent the lower faces of said segments so that said segments can be forged or cast in symmetrical shapes and yet, when assembled, the nozzle-receiving member can be welded thereto to provide a bridge therebetween free from interior seams through which fluid might leak, said tube having a laterally extending part within the body to limit downward movement of the annular member in the passageway, and a nozzle detachably secured and sealed in the opening through the tubular member.

3. In a drill bit, a body comprising a plurality of segments integrally joined together and recessed so that they provide the body with a hollow upper end, at least one of said segments having a cutter leg extending downwardly therefrom with a downwardly and inwardly extending cutter bearing spindle on said leg and a rolling cutter on said bearing spindle, each of said segments being symmetrical about a vertical plane containing the longitudinal axis of the body and bisecting the angle between the mating faces of such segment, complementary grooves in the mating faces of two of said segments forming, when said segments are secured together, a downwardly directed fluid passageway between said hollow upper end and the exterior of the body, and a continuous annular nozzle-receiving member surrounding said passageway in the form of a tube extending at least partly through said passageway and welded about its entire outer periphery to said two segments about said passageway adjacent the lower face of the segments so that said segments can be forged or cast in symmetrical shapes and yet, when assembled, the nozzle-receiving member can be welded thereto to provide a bridge therebetween free from interior seams through which fluid might leak.

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