July 7, 1936. C. E. REED 2,047,113

EARTH BORING APPARATUS

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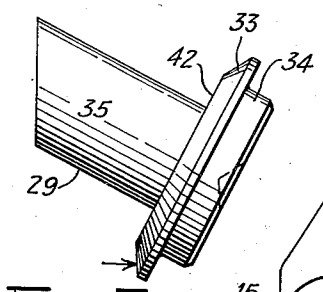


Fig. 7

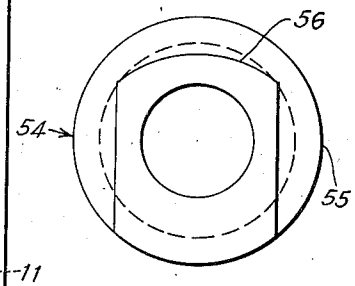


Fig. 8

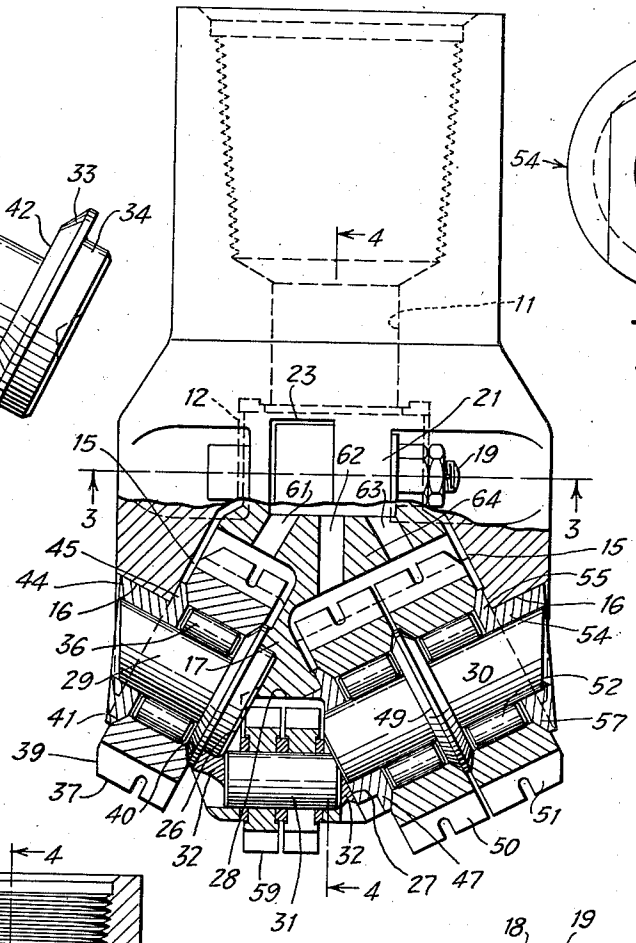


Fig. 1

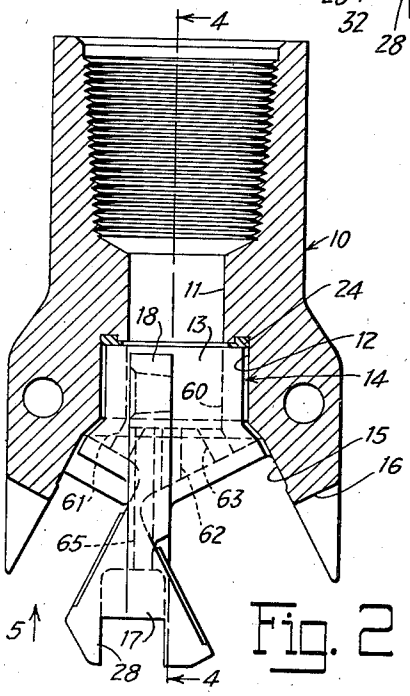


Fig. 2

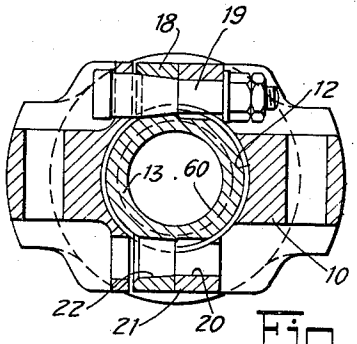


Fig. 3

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Fig. 10.

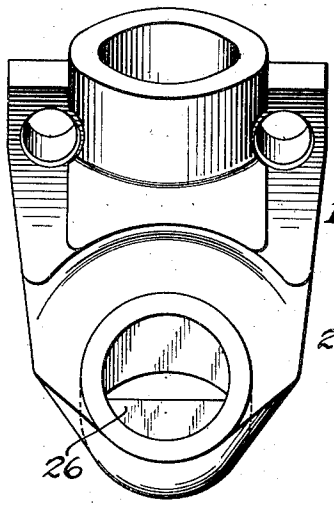


Fig. 9.

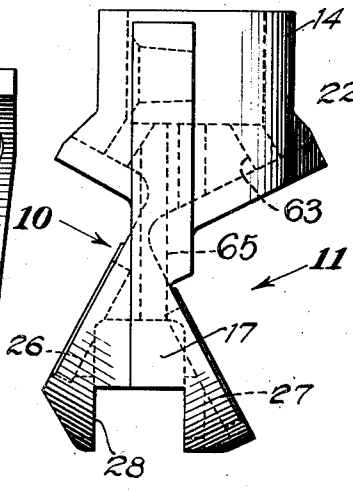


Fig. 11.

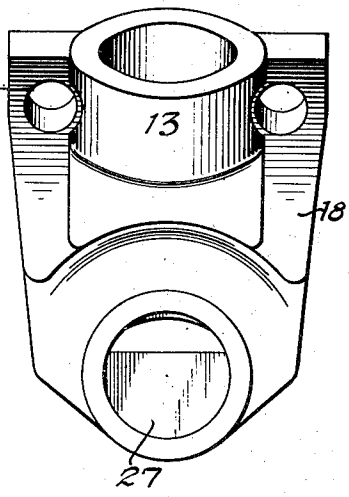
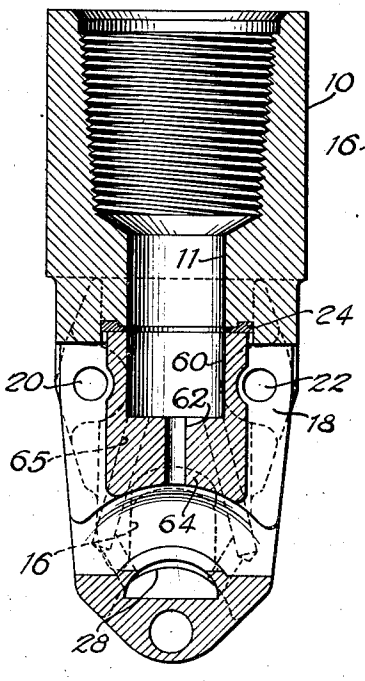


Fig. 4.



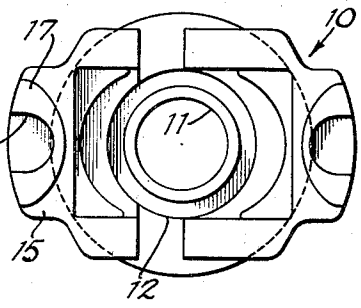


Fig. 5.

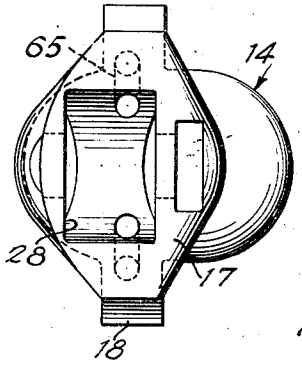


Fig. 6.

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EARTH BORING APPARATUS

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Application December 10, 1932, Serial No. 646,628

25 Claims. (Cl. 255—71)

This invention relates to earth boring drill bits and more particularly to bits embodying roller cutters.

An object of the invention is to increase the efficiency and prolong the life of a roller bit by counteracting operating forces and thrusts tending to produce excessive wear and breakage. Another object is to insure smoother rolling of a cutter on its spindle by overcoming the tendency of the cutter to rock slightly out of line with the axis of the spindle and thereby to bind itself. A further object is to segregate thrusts between two cutters mounted on the same spindle, in order that an external force acting on one will not be transmitted to the other. A still further object of the invention is to provide a support for the spindles which is reinforced at the points where breakage is most likely to occur, without decreasing the space available for the cutters.

A feature of the invention is an improved arrangement for distributing flushing fluid to the cutters.

In accordance with the above and other objects, the invention comprises a cutter spindle having an integral flange separating the cutters, which flange prevents the transmission of force from one cutter to the other. It is contemplated that the roller cutter spindles will be mounted upon a carrier member, removable from the bit head together with the spindles and cutters as a unit. The outside ends of the spindles are supported by bearing bushings mounted in notches in the bit head and having flanges projecting below the lowermost end of the bit head, the projecting ends of the flanges being of sufficient thickness and strength to resist the reaction of the adjacent cutters.

Referring now to the drawings, Fig. 1 shows a complete unit, partly in side elevation and partly in section;

Fig. 2 shows the bit head in section and the carrier member in elevation looking in the same direction as Fig. 1;

Fig. 3 shows the bit head and carrier member in section, looking in the direction of the arrows 3—3 of Fig. 1;

Fig. 4 is a sectional view along the line 4—4 (Figs. 1 and 2) showing the bit head and carrier member;

Fig. 5 is a bottom view of the bit head;

Fig. 6 is a bottom view of the carrier member;

Fig. 7 is a detail view of one of the spindles;

Fig. 8 is a detail view of the bearing bushings looking in the direction of the arrow 8 (Fig. 1);

Fig. 9 is an elevation of the carrier member; and—

Figs. 10 and 11 are views of the carrier member looking in the direction of the arrows 10 and 11 respectively of Fig. 9.

Referring to Figs. 1 to 5, the bit head is shown at 10 having an internally threaded upper end for attachment to the drill pipe. It has a central bore 11 for the downward passage of flushing fluid. It has a recess 12 in its lower end of substantially cylindrical form to receive the upper cylindrical end 13 of the carrier member 14 of the roller cutter unit. Below the cylindrical portion of the recess 12 the recess flares outwardly and downwardly, the inclined walls of this flaring recess being indicated at 15. The depending walls 15 have downwardly opening notches or bearing seats 16 at their lower ends. The recess defined by the walls 15 is open laterally of the bit head, it being understood that the lower part of the bit head is oblong in cross-section, the length being indicated in Fig. 1 and the width of this lower part being indicated in Fig. 4. It will be noted also that the notches 16 in the depending end walls 15 are in line with each other or, in other words, their centers lie in the same vertical plane passing through the axis of the bit head from end to end thereof.

The carrier member 14 comprises, besides the cylindrical portion 13 above mentioned, a body 17 connected with the said cylindrical portion by arms, lugs, or wings 18 extending up therefrom on each side. The roller cutter unit is held to the bit head by tapered bolts 19 passing through openings 20 in projections 21 of the bit head on their lateral faces and through openings 22 in the projections 18 of the carrier member, which projections, when the parts are assembled, lie alongside the parts 21 of the bit head (see Fig. 3). The upper ends of the projections or arms 18 of the cutter unit do not bear upon the shoulders 23 on the bit head at the upper ends of the parts 21. The upthrust is taken by the bolts 19 and the bit head. Upthrust is also taken by the central cylindrical portion 13 of the roller cutter unit which, as shown in Fig. 2, at its upper end bears upon the ring 24 seated in the bit head. The body portion 17 of the carrier 14 is generally of triangular form in vertical cross-section, as seen in Figs. 2 and 9, and is provided with suitable sockets 26, 27 and a recess 28 for receiving and supporting the cutter spindles 29, 30 and 31 respectively. The spindles are arranged in such relation as to form substantially an inverted arch-shaped structure. The three spindles may be welded to each other and to the carrier member, the welding being indicated at 32 (Fig. 1).

The spindle 29 (Figs. 1 and 7) is provided with a flange 33 which abuts the body 17 around the edge of the socket 26, and with a cylindrical extension 34 which is received by said socket. The flange 33, extension 34 and bearing portion 35 of the spindle are preferably integral, but it will be understood that they may be formed of separate parts rigidly united to each other, if desired.

Surrounding the spindle 29 are roller bearings 36 upon which is mounted a roller cutter 37.

The cutter 37 is provided on its peripheral surface with cutting teeth, the outer edges 39 of which are bevelled. The inside diameter of the cutter is bevelled at the edges 40 and 41 to cooperate with their associated bearing surfaces to resist the lateral and vertical thrusts imposed upon the cutter. Cooperating with the edge 40 on the cutter is the bevelled part of the surface on the flange 33. It should be noted that the lowermost part of flange 33 engages the cutter edge 40 over a limited area in substantially a vertical plane, the area of engagement being approximately at the same level as the point where the edge 39 engages the side of the bore hole. As a result of the arrangement just described, the radial pressure of the bore hole against the cutter is transmitted to the flange 33 in the direction of the arrow (Fig. 7) which is at right angles to the adjacent surface of the flange. Consequently the flange on the bearing member resists the radial thrusts which might otherwise rock the cutter 27 with respect to the axis of the spindle, thereby causing the cutter to become held against rotation. The flange 33 on the spindle 29 is provided further with a radial surface 42 which engages the ends of the rollers 37.

The bevelled edge 41 of the cutter 37 cooperates with suitable means for taking thrusts in a vertical direction. Such means comprises a bearing bushing 44 seated in notch 16 of the bit head and removably secured to the latter as by a press fit. As shown in Fig. 4, the notch 16 is of non-circular shape, and the bearing bushing is of corresponding shape to prevent rotation of the latter. The bearing bushing 44 has a flange 45 engaging the inclined wall 15 in the bit head. The flange 45 has a bevelled surface and a radial surface similar to flange 33 previously described, and the bevelled surface of the former engages the cooperating surface 41 of the cutter 37 to prevent the cutter from rocking about its spindle when an upward force is exerted on the cutter.

The spindle 30 is supported at its inner end by the wear bushing 47, which is welded to the spindles 30 and 31 and to the carrier member 14. The wear bushing is provided with a flange having a radial and a bevelled surface similar to the flange on the bearing bushing 44. Intermediate its length, spindle 30 is provided with a flange 49 which is preferably integral with the spindle. The flange 49 acts as a separator between two roller cutters 50 and 51 and has two radial faces separating the roller bearings 52. The peripheries of the radial faces are bevelled to take up radial and vertical thrusts as in the case of the bevelled surfaces on the flange 33 and bushing 44 respectively. In addition, flange 49 segregates the thrusts on the cutters 50 and 51 whereby any force exerted on one cutter is prevented from being transmitted to the other cutter, as was frequently the case with prior constructions in which two roller cutters were mounted on the same shaft. The flange 49, moreover, results in maintaining the gauge of the hole longer, the smoother running of the cutters and the elimination of slippage of the cutting edge, due to the independent rotation of the two cutters.

The outer end of spindle 30 is supported in a bearing bushing 54 (Figs. 1 and 8) having a flange 55 engaging the inclined wall 15, and a stem 56 snugly engaging and received within the notch 16 of the bit head. This flange, like the corresponding flange on the bearing bushing 44, is provided with a radial and a bevelled surface. The lowermost portion 57 on the flange 55 preferably projects below the lower end of the notch 16. This end portion receives the upward thrusts from the roller cutter 51 and it is therefore important that the end portion be of sufficient thickness to prevent it from shearing or being deformed by the upward pressure. In the illustrative embodiment of the invention, the portion 57 is made at least as thick as the remainder of the flange 55 and, as will be seen in Fig. 8, is reinforced by the stem 56.

Supplementing the cutters 37, 50 and 51 are the roller cutters 59 mounted on the spindle 31 in the recess 32 and cooperating with the other cutters to cut the entire area of the bottom of the bore hole.

The present invention also comprises an arrangement for conducting flushing fluid from the drill stem to each of the roller cutters. The cylindrical part 13 of the roller cutter unit has a central bore 60 for the flushing fluid which is distributed through suitable openings 61, 62 and 63 through the bottom wall 64 of the cylindrical portion of the carrier. Each of the openings 61, 62 and 63 in the wall 64 terminates above one of the cutters mounted upon the spindles 29, 30. In addition to these openings, passages 65 (Figs. 2, 4 and 6) are provided in the carrier body 17 and lead from the central bore 60 to the recess 28 at the bottom of the projection 17, for flushing the cutters 59.

In view of the above description, it is not necessary to explain in further detail how the bit operates or to point out the order in which the parts are assembled or disassembled. The cutters are arranged on axes in the same vertical plane and are adapted to cut the entire area of the bottom of the bore hole. When the cutters become worn, it is contemplated that the cutters, spindles and carrier member will be removed from the bit head and replaced as a unit. To detach the roller cutter unit the bolts 19 are first removed and the unit is then removed axially from the bit head.

While the invention as described comprises several novel features which cooperate with each other, each of the features is not necessary in order that the others be operative. For example, the bearing bushings 44 and 54 might be used in connection with some of the present arrangements of cutters and spindles which do not embody the carrier member 14. Furthermore, other modifications may be made within the spirit of the present invention and of the appended claims.

The illustrative embodiment of the invention incorporates certain features claimed in applicant's copending applications. The carrier member 14, its means of attachment to the bit head, and its arrangement for supporting the inner ends of upwardly diverging spindles and for supporting a cutter within a recess in the carrier member, are claimed broadly in application Serial No. 593,650, filed February 17, 1932. They are also claimed, more specifically, in application Serial No. 608,295, filed April 29, 1932, which relates to a structure of this character in which the outer ends of the upwardly diverging spindles are received within downwardly open notches in the bit head.

What is claimed is:

1. A roller bit comprising a bit head having a depending wall, defined by an inclined inside face meeting a vertical outside face, with a recess therein, a removable wear member in the recess and surrounding an end portion of a roller cutter

spindle and providing the bearing therefor, said member having a thrust receiving surface protecting the inclined wall of the bit, and a portion of said member projecting beyond the lower end of the said wall and downwardly, said member having a bore, said projecting portion of said member being of substantial thickness below the bore.

2. A removable bearing for a roller boring drill, said bearing having a bore, said bearing, in vertical section, being of triangular shape with a segmental flange extending outwardly in a plane at right angles to the axis of the bore in the said bearing, the said bearing having parallel surfaces and a bearing surface between the parallel surfaces, one end of each parallel surface extending to the periphery of the segmental flange.

3. In a roller bit a plurality of roller cutters mounted upon a single spindle having a common axis inclined to the bit axis, a flange on said spindle maintaining two adjacent cutters out of contact with each other, said flange being integral with the spindle whereby to prevent stresses from being transmitted directly from one cutter to another.

4. In a roller cutter assembly for a rotary drill bit, a spindle having a flange intermediate the ends of the spindle, said flange having a bevelled surface for receiving thrusts directed towards the axis of the bit, and the said flange also having a surface at right angles to the axis of the spindle, said surface receiving end thrusts, one spindle end beveled at an acute angle to its axis.

5. The combination of a spindle, a roller cutter, and a removable bearing member, said spindle having, adjacent one end, an integral flange and an end portion projecting beyond the flange for insertion in a supporting means, said flange having at each side thereof a bearing surface at right angles to the axis of the spindle, and outwardly from one of said side surfaces another bearing surface inclined to the axis of the spindle, and at the other end of the spindle a removable bearing member having bearing surfaces corresponding to the bearing surfaces of the said flange, the removable bearing member having a bore receiving the end of the spindle, and a non-concentric exterior face on the removable bearing member, the removable bearing member and the spindle end therein being beveled at an acute angle.

6. A spindle having an integral flange, each side of which flange has a bearing surface at right angles to the axis of the spindle, and another bearing surface inclined to the axis of the spindle, the spindle being adapted to receive a roller cutter at each side of said flange and one end of said spindle beveled at an acute angle.

7. The combination of a spindle having an integral flange, a roller cutter on the spindle at each side of the said flange, one end of the spindle being beveled at an acute angle, a removable bearing member thereon of general triangular shape, viewed in section vertical through the spindle axis, the other end of the spindle having a removable wear member, and means securing said removable members to the spindle.

8. According to claim 7, said flange, removable bearing member and removable wear member having surfaces at right angles to the spindle axis receiving end thrusts, and outwardly from the said surface on each member an additional surface, inclined to the spindle axis, receiving operating thrusts of the roller cutter.

9. In a roller drill, a bit head and a roller cutter and spindle assembly for insertion into or removal from its operating position in said head, said assembly comprising a spindle having a flange and having a stud projecting from one side of said flange, the latter having a bearing face extending outwardly from the stud, the other side of the flange comprising a radial surface surrounded by a tapered surface, a removable bearing member on the spindle, one side of said bearing member comprising a radial surface surrounded by a tapered surface, roller cutter means on said spindle between the bearing member and flange and having bearing engagement with the tapered surfaces, said removable bearing member having flat sides adapted to fit the bit head to prevent rotation of the bearing member and having an end beveled at an acute angle to the spindle axis, the tapered surface on the bearing member engaging the cutter means below the spindle and below the bit head and taking operating thrusts from the cutter means.

10. In a roller bit, a bit head, a carrier, and side cutters in planes converging in the bit head, spindles for said cutters, the outer ends of said spindles each supported by a member seated in a notch or recess of the bit head, said member having a tapered end thrust receiving surface projecting within the plane bounding the side of the side cutter, said spindles carrying tapered end thrust receiving surfaces projecting within the plane bounding the other side of said side cutters, studs projecting beyond said surfaces and supported in sockets formed in the carrier, each stud being integral with its associated thrust receiving surface.

11. In combination with a roller bit head having a recess in an inclined wall, said recess having parallel walls and an arched ceiling and opening downwardly, a spindle having an end projecting into a removable wear member fitting the parallel walls and ceiling of said recess, said member also bearing on the inclined wall of the bit head and having a portion of substantial thickness extending below the inclined wall, said portion supporting operating loads on a roller cutter, and a bearing surface on said member projecting within the plane bounding the side of a roller cutter.

12. A roller cutter assembly comprising a bit head having a recess defined by an inclined wall, said wall having a slot extending therethrough, and a removable bearing member fitted to said slot and surrounding an end portion of a roller spindle and providing the bearing therefor, said member providing a bearing support below the inclined wall, said member having segmental flanges seated on the inclined wall laterally of the slot.

13. In earth boring apparatus, a bit head having a recess at its lower end for mounting rotary cutters therein, one end of the recess being defined by an inclined face diverging downwardly from the bit axis and converging at its lower end with a side face of the bit head to provide a downwardly tapering side wall, the lower end of the wall being cut completely through from face to face to provide a slot open at its lower end, a removable bearing member supported within said slot and surrounding an end portion of a roller cutter spindle and providing the bearing therefor, said bearing member comprising a shank portion fitting said slot and a flange engaging the inclined face around the edge of the slot.

14. In earth boring apparatus, a bit head having a recess at its lower end for mounting rotary cutters therein, one end of the recess being de-

fined by an inclined face diverging downwardly from the bit axis and converging at its lower end with a side face of the bit head to provide a downwardly tapering side wall, the lower end of the wall being cut completely through from face to face to provide a slot open at its lower end, a removable bearing member supported within said slot and surrounding an end portion of a roller cutter spindle and providing the bearing therefor, said bearing member comprising a shank portion fitting said slot and a flange engaging the inclined face around the edge of the slot, said flange projecting below the lowermost edge of the wall to provide support for a cutter below said wall.

15. In an earth boring drill, a roller cutter assembly comprising a bit head having parallel and ceiling bearing surfaces in notches opening downwardly and having bearing surfaces on walls defining a roller cutter recess in the lower end of said head, thrust sustaining members seated in said notches having segmental flanges seated on said bearing surfaces, roller cutters and spindles therefor, the outer ends of the spindles being supported and surrounded by said members, the axes of said spindles inclining downwardly and inwardly towards the axis of said head, and a removable spindle supporting means forming substantially the keystone of an inverted arch construction when in place between the inner ends of said spindles.

16. In an earth boring drill, a bit head having at its lower end a recess defined by diverging walls, the lower ends of which are provided with notches forming parallel and ceiling bearing surfaces, a roller-cutter unit comprising spindles converging downwardly, the outer ends of the spindles being supported by thrust members seated in the respective notches and engaging the parallel and ceiling bearing surfaces, and the inner ends of the spindles being supported by a wedge-shaped member, said wedge-shaped member and spindles forming substantially an inverted arch construction, the interfitting parts of the notches and thrust members being so constructed and arranged to permit seating and unseating of the members by movement thereof in a direction parallel to the bit axis.

17. In an earth boring drill, a bit head having a depending inclined wall terminating in a notch, said notch being shaped to provide parallel bearing surfaces and an inclined ceiling bearing surface, a roller cutter unit comprising an end thrust receiving member adapted to seat in said notch and to bear on said wall and ceiling bearing surface, spindles for roller cutters and a wedge-shaped member between the spindles, the unit forming substantially an inverted arch construction when assembled together, said spindles being adapted to support said wedge-shaped member against upward thrusts.

18. In an earth boring drill, roller cutter and spindle units having end thrust sustaining means surrounding end portions of the spindles, a bit head having inclined walls providing bearing surfaces and having downwardly opening notches in said walls, each notch being shaped to provide parallel bearing surfaces and a ceiling bearing surface, a wedge-shaped member between the inner ends of the spindles and supporting the spindles, and means drawing the wedge and seating the end thrust sustaining means on said bearing surfaces and in the notches, said spindles being adapted to support said wedge-shaped member against upward thrusts.

19. In an earth boring drill, a bit head having a depending inclined wall terminating in a notch extending through said wall, a member having a bearing surface seating on an arched ceiling and contacting parallel sides in said notch and also having a flange, one side of said flange bearing on a wall of the bit head when the member is seated in the notch, and the other side of the flange adapted to take end thrusts of a roller cutter, the said member having a bore receiving the end of a spindle.

20. In an earth boring drill, a bit head having at its lower end a recess for receiving a roller cutter unit, one wall of the recess being inclined downwardly towards a side wall of the bit head, the lower end of the bit head being provided with a notch extending completely therethrough from the recess to said side wall, said notch providing parallel and ceiling bearing surfaces, a bearing member seated within said notch and supported by said parallel and ceiling bearing surfaces, and a spindle supported by said bearing member.

21. In a roller boring drill, a bearing member having a body portion with parallel sides connected by a curved bearing surface, said body portion having a bore receiving an end of a spindle, a segmental flange on said member at one end of the body portion, one side face of said flange being adapted to bear on a supporting wall of the drill and the other face of said flange having a surface lying in a plane at right angles to the axis of the spindle, said surface being adapted to receive end thrusts of a roller cutter.

22. In a roller boring drill having a supporting wall, a bearing member having a body portion and a flange, said body portion having a bore receiving and surrounding a spindle extending inwardly of the drill from said flange, one side of the flange adapted to bear on the supporting wall of the drill, and the other side of the flange having a surface lying in a plane at right angles to the spindle axis, said body portion having an end surface inclined to the flange.

23. In a roller cutter boring drill, in combination, roller bearings and frictional bearing areas on a spindle, the frictional bearing areas being annular and extending outwardly from the roller bearings, said frictional bearing areas each constituting a frustum of a cone, the axis of which cone coincides with the axis of said spindle.

24. A roller cutter boring drill according to claim 23 which includes a sleeve type bearing on one end of a roller cutter spindle, said bearing and spindle having end thrust receiving surfaces that are positioned within a plane bounding the side of a roller cutter when assembled therewith.

25. In a roller boring drill, a spindle having a flange, a bearing member sleeved on the spindle and spaced from the flange, roller bearings on the spindle confined between parallel radial surfaces on the flange and bearing member respectively, frusto-conical surfaces on the flange and bearing member respectively, said frusto-conical surfaces having apices between the bearing member and flange and coincident with the spindle axis, and a roller cutter mounted on roller bearings and having complementary surfaces bearing frictionally on said frusto-conical surfaces.

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