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ROLLER CUTTER ORGANIZATION FOR EARTH BORING DRILLS

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Fig. 1.

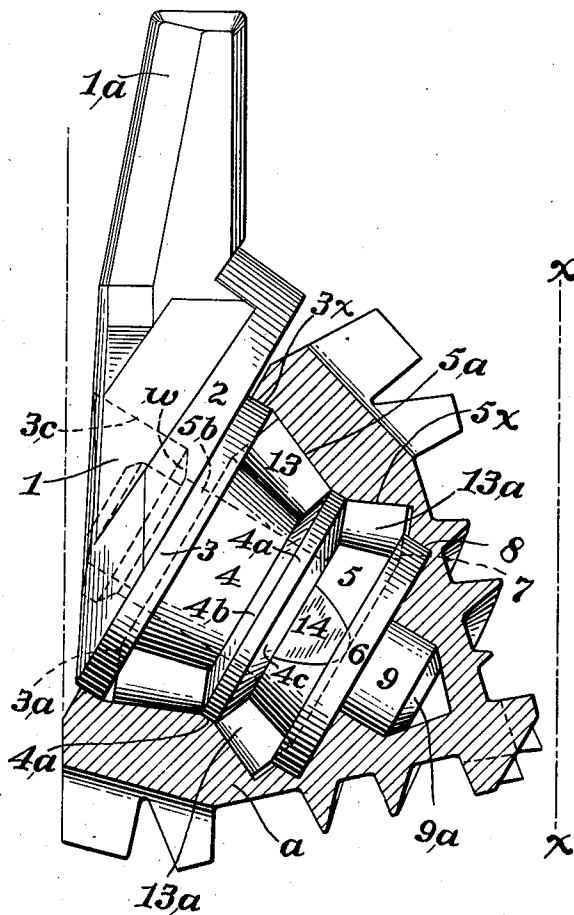


Fig. 2.

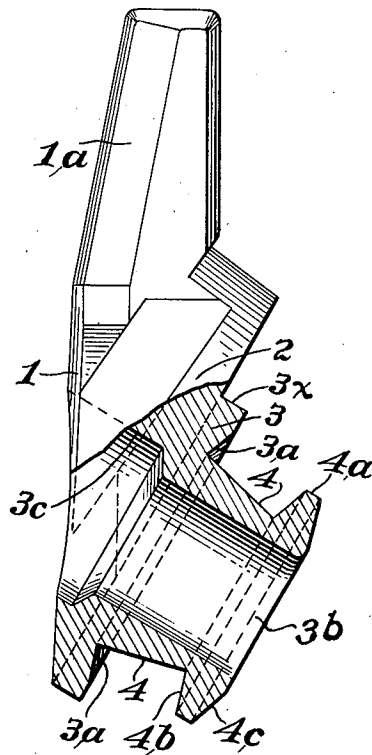


Fig. 3.

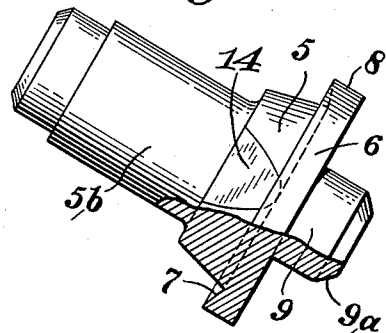
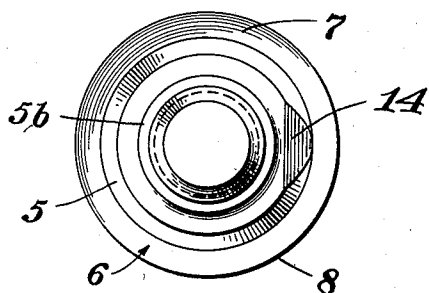


Fig. 4.



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UNITED STATES PATENT OFFICE

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ROLLER CUTTER ORGANIZATION FOR
EARTH BORING DRILLS

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11 Claims. (Cl. 255-71)

The invention concerns a roller cutter organization for earth boring drills having frusto-conical roller bearings in two sets, those of one set tapering towards the vertical axis of the drill, and taking on their peripheries end thrust of the roller cutter in a direction outwardly towards the support of the organization, and those of the other set taking on their peripheries end thrust of the roller cutter inwardly towards the vertical

axis of the drill. The terminal spindle portion is shown in Figs. 3 and 4 and is in one piece throughout. This is also true of the main spindle section and its support as shown in Fig. 2. The flange 4a above mentioned has a plain cylindrical friction bearing as will be hereinafter referred to.

The rotary cutter *a* is of frusto-conical form and has teeth on its periphery for performing the cutting actions upon the formation at the bottom of the bore hole. Between the base portion of the roller cutter and the raceway 4 of the main section of the spindle, roller bearings 13 are located to run upon the frusto-conical raceway 4 and upon a complementary raceway shown at 5a and forming the wall of the bore of the cutter near its open base end. The frusto-conical rollers 13 have their larger diameter end faces bearing on a face or shoulder 3a of the flange or cylindrical portion 3 of the main spindle section. This shoulder or face 3a is formed by undercutting the inner face of the flange or cylindrical portion 3 at an inclination as shown in Fig. 2 and in dotted lines in Fig. 1.

The smaller diameter ends of the frusto-conical roller bearings 13 bear with their faces upon the shoulder 4b of the flange 4a of the main section of the spindle. The raceway portion of the terminal section of the spindle receives roller bearings 13a of frusto-conical form, whose smaller ends face outwardly in respect to the vertical axis of the drill. These bearing rollers 13a find a raceway complementary to that shown at 5 of the spindle, said complementary raceway being indicated at 5x on the wall of the bore of the frusto-conical cutter at a point between the roller bearings 13 and the inner end of the organization. The roller bearings 13 which taper towards the vertical axis of the drill receive upon their peripheries end thrust of the roller cutter outwardly towards the spindle support, and the other set of frusto-conical roller bearings 13a receive upon their peripheries end thrust of the roller cutter in a direction inwardly towards the vertical axis of the drill. These roller bearings supplement each other in providing efficient roller bearing means for the roller cutter. The small diameter ends of the roller bearings 13a engage the inclined shoulder 4c of the terminal flange of the main section of the spindle, and at their larger end faces the roller bearings 13a find a bearing upon the inclined shoulder 7 at the undercut portion of the flange 6. The smaller diameter end faces of the frusto-conical roller bearings

10 The invention consists in the features and combination and arrangement of parts hereinafter described and particularly pointed out in the claims.

15 In the accompanying drawings

Figure 1 shows a vertical sectional view of the roller cutter, the spindle and its support, together with the roller bearings, being shown in side elevation.

20 Fig. 2 is a part sectional view and side elevation of the main section of the spindle and its support.

Fig. 3 is a side elevation of the terminal section of the spindle, partly in section.

Fig. 4 is an end view of the terminal section of the spindle, looking from left to right of Fig. 3.

In these drawings:

1 indicates generally the main spindle section and 1a the shank thereof, which latter is adapted to be seated in any suitable way in connection with the drill head, so that the spindle will be supported in a position inclining downwardly and inwardly towards the vertical axis of the drill, which is indicated by the dotted line *x-x* of Fig. 1. The main spindle section comprises a body 2 having a cylindrical portion 3 adjacent which is a frusto-conical raceway 4 which tapers towards the vertical axis of the drill. At the inner end of this raceway portion 4 the main section of the spindle terminates in a flange 4a, with presents shoulders on its opposite sides at 4b, 4c, which shoulders incline laterally and inwardly towards the axis of the spindle. This main section of the spindle has a bore 3b which receives the stem 5b of a terminal spindle section, the main body portion of which, indicated at 5, constitutes a frusto-conical raceway portion which tapers outwardly towards the spindle support, and hence in a direction away from the vertical axis of the drill.

Adjacent the larger diameter end of the frusto-conical raceway portion 5 there is an annular flange 6 which is under-cut to provide a lateral face 7, and on the inner face of the flange 6 a reduced diameter extension or pilot portion 9 is

13, 13a are shielded from end thrust of the roller cutter because these end faces are covered by the inclined shoulders of the flange 4a of the main section of the spindle.

5 A gateway 14 is provided on the surface of the raceway 5 by flattening said surface as shown. This flattened surface is in a plane parallel with the plane of the overlying portion of the raceway wall 5x of the roller cutter. The purpose of this gateway is to allow the assembly of the roller bearings 13a to take place by moving said roller bearings, larger end first, in a direction towards the vertical axis of the drill.

15 In assembling the parts the terminal raceway section is seated within the apex portion of the bore of the frusto-conical cutter, so as to bear upon the walls of the apex portion of the cutter, which are intended to receive said terminal spindle section. The roller bearings 13a are then introduced into place between the frusto-conical raceway surfaces 5 and 5x by moving said roller bearings in a direction towards the vertical axis of the drill, with their larger diameter ends foremost. After this assembly of the frusto-conical roller bearings 13a has taken place, the main spindle section with its frusto-conical roller bearings 13 is moved into place over the shank or stem 5b of the terminal section of the spindle, so that the end face or shoulder 4c of the flange 4a of the main section of the spindle will bear upon the smaller end face of the already assembled conical rollers 13a. This will bring the frusto-conical bearings 13 on the surface 4 against the complementary frusto-conical raceway surface 5a. It will also bring the surface of the flange or body 3 into frictional contact with the frictional surface 3x at the open end base bore of the frusto-conical cutter.

25 The parts having thus been assembled are secured in proper relative positions to each other by welding the stem 5b of the terminal section of the spindle to the support 2 of the main section of the spindle. For this purpose an enlarged cavity is formed at the outer end of the bore 3b of the main section of the spindle, this enlarged cavity being indicated generally at 3c, and a weld w may be effected between the outer end of the stem 5b and the wall of this enlarged cavity.

30 Besides bearing upon the roller bearings the roller cutter will find frictional bearings at a plurality of points between its bore wall and parts of the spindle assembly, namely, at 3x, at 4a, between the inner ends of the frusto-conical roller bearings, at 8 upon the surface of the flange 6, and upon the periphery of the pilot portion 9 of the terminal section of the spindle, and its bevelled edge 9a.

35 It will be noted that the roller bearings 13a after having been inserted into place through the gateway 14 will assume the position shown in Fig. 1, with their end faces bearing respectively upon the inclined shoulder 4c and the shoulder 7 formed by under-cutting the flange 6. They will, therefore, be in a position to roll upon the frusto-conical surface 5 and when they arrive at the gateway in their rolling actions will be prevented from dropping down into said passageway by the contact of their small end faces with the shoulder 4c.

40 In other words, the frusto-conical rollers in passing over the passageway 14 will be supported in their prescribed positions and will not tip or drop down by reason of the fact that the ends of said roller bearings will find support on the

shoulders mentioned above, namely 4c and 7.

The passageway 14 is left open, no gate member or closure being necessary to fill it.

45 These roller bearings may be said to float or be held in suspension over the passageway 14 without contacting with the bottom of said passage. They do not encounter any shoulder or edge projecting across their path. The flat surface of the passageway merges into the periphery of the raceway surface 5 at a low angle. The roller bearings 13a not only serve as such, but also as rotative locking means for holding the roller cutter on the spindle.

50 The drill has a plurality of rotary cutter units such as above described. The spindles of these units are in different vertical planes radial to the vertical axis of the drill. Two or three such units may be employed at the bottom of the drill, spaced apart 180° when two are used, and 120° when three are employed. The drill head carrying these units rotates clockwise about its vertical axis, that is to say, looking down upon the drill, while in the hole being bored the revolution of the drill would be clockwise. I place the gateway or "flat" 14 on the trailing side of the spindle, or the side which follows in the direction of revolution of the roller cutter unit about the vertical axis of the drill, and have indicated this location of the gateway in Figs. 1, 3, and 4. The thrust of the roller cutter towards the axis of the spindles, and consequently against the roller bearings, is heaviest on the leading side of the unit as compared to the trailing side, and hence by the present arrangement I locate the flat gateway on the spindle where the roller bearings will take thrust to a minimum degree so that the capacity or freedom of the roller bearings to float over this gateway, or flat portion of the raceway, will be enhanced.

55 The tooth structure of the frusto-conical roller cutter forms no part of the present invention this subject matter having been divided out and made the subject of a divisional application executed Jan. 13, 1938, Serial Number 189,020, filed Feb. 5, 1938.

I claim:

1. A roller cutter assembly for earth boring drills comprising a toothed roller cutter of frusto-conical form having a bore opening through its base, a spindle in main and terminal sections, said terminal section having a frusto-conical raceway tapering outwardly away from the vertical axis of the drill, frusto-conical roller bearings, said raceway having a gateway for the introduction of frusto-conical roller bearings, large diameter end first, said main spindle section having a frusto-conical raceway tapering towards the vertical axis of the drill and frusto-conical bearing rollers on said last mentioned raceway taking on their peripheries end thrust of the cutter outwardly towards the spindle support, and shoulders on said main spindle section affording bearing surfaces for the small diameter ends of both sets of roller bearings and for the large diameter ends of the said roller bearings on the main spindle section, a shoulder on the terminal spindle section for the large diameter ends of the other set of frusto-conical roller bearings, said last-mentioned roller bearings taking on their peripheries end thrust of the roller cutter inwardly towards the vertical axis of the drill, and means for holding the main and terminal spindle sections together, substantially as described.

2. A roller cutter assembly according to claim

1 in which the terminal spindle section has a reduced diameter projection at its free end extending into a reduced diameter bore within the apex portion of the cutter, substantially as described.

3. A roller cutter assembly for earth boring drills comprising a frusto-conical roller cutter, a spindle having a free end enclosed by the cutter, a support for the spindle at the outer end thereof, a set of frusto-conical roller bearings located between the base portion of the roller cutter and the spindle and tapered towards the vertical axis of the drill, a second set of frusto-conical roller bearings located between the apex portion of the roller cutter and the spindle, and tapered towards the spindle support, an annular flange on the spindle between the small diameter ends of the two sets of frusto-conical roller bearings, said flange having oppositely inclined side shoulders upon which the small diameter end faces of both sets of rollers bear, the said roller bearings within the base portion of the roller cutter taking upon their peripheries end thrust of the roller cutter outwardly towards the spindle support and the second set of frusto-conical roller bearings taking upon their peripheries end thrust of the roller cutter inwardly towards the vertical axis of the drill, a flange on the spindle against which the larger diameter ends of the second set of frusto-conical roller bearings bear, and lock the frusto-conical roller cutter rotatively on the spindle, substantially as described.

4. A roller cutter assembly according to claim 3 in which the spindle has friction bearing surfaces for the roller cutter adjacent the larger diameter ends of each set of frusto-conical roller bearings.

5. A spindle for a roller cutter of an earth boring drill having a main section with a support therefor at its outer end, an annular shoulder adjacent the support, a frusto-conical raceway adjacent said shoulder, an annular flange at the smaller diameter end of said frusto-conical raceway, having oppositely inclined side shoulders, a separately formed terminal section secured to the main section having a frusto-conical raceway tapered outwardly towards the support with its small diameter end adjacent the inner inclined shoulder of the flange on the main spindle section, a gateway in the surface of the last mentioned raceway for the introduction of frusto-conical bearing rollers, in a direction towards the vertical axis of the drill, and with their larger diameter ends first, and a flange on the larger diameter portion of the terminal spindle section presenting a side shoulder facing outwardly towards the support, substantially as described.

6. A frusto-conical roller cutter for earth boring drills having a bore open at its base and closed at its apex, said bore having a frusto-conical raceway wall within the base portion of the cutter tapering towards the apex of the cutter, a second frusto-conical raceway wall within the apex portion of the cutter tapering towards the open base portion of the said cutter, said cutter having an annular friction surface within its bore at its base, an annular friction surface between the adjacent smaller diameter ends of its oppositely tapered frusto-conical portions,

and an annular friction surface adjacent the larger diameter end of its second frusto-conical raceway wall.

7. A frusto-conical roller cutter for earth boring drills having a bore open at its base and closed at its apex, said bore having a frusto-conical raceway wall within the base portion of the cutter tapering towards the apex of the cutter, a second frusto-conical raceway wall within the apex portion of the cutter tapering towards the open base portion of the said cutter, said cutter having an annular friction surface within its bore at its base, an annular friction surface between the adjacent smaller diameter ends of its oppositely tapered frusto-conical portions, and an annular friction surface adjacent the larger diameter end of its second frusto-conical raceway wall, the terminal bore within the apex end of the cutter being of smallest diameter, substantially as described.

8. A spindle according to claim 5 in which the terminal spindle section has a stem extending through a bore of the main spindle section and secured to the support.

9. A roller cutter assembly for earth boring drills comprising a toothed roller cutter of frusto-conical form having a bore opening through its base, a spindle having a frusto-conical raceway surface tapering in a direction away from the apex end of the roller cutter and having a passageway in said raceway surface, roller bearings tapered to fit the said raceway surface of the spindle and insertable into place between said spindle raceway surface and a complementary frusto-conical raceway surface of the roller cutter along said passageway with the larger diameter end first, and annular walls on the spindle contacting the end faces of said frusto-conical roller bearings and controlling the same to pass in normal position over said passageway, said gateway being located on the trailing side of the spindle in respect to the direction of travel of the spindle about the vertical axis of the drill.

10. A roller cutter and spindle assembly for earth boring drills according to claim 9 in which the gateway consists of a substantially flat area in the frusto-conical raceway surface of the spindle in a plane at a steeper inclination to the axis of the spindle than said raceway surface, substantially as described.

11. A spindle for a roller cutter of an earth boring drill having a support at one end extending upwardly therefrom for attachment to the drill head to hold the spindle in a prescribed relation in its travel about the vertical axis of the drill with the roller cutter unit mounted thereon, said spindle having a main section to which said support is connected and having a terminal section formed separately from and attached to the main section, said terminal section having a frusto-conical raceway tapering towards the support, with a gateway in said surface for the insertion of frusto-conical roller bearings, large end first, in a direction towards the larger diameter end of said frusto-conical raceway, said gateway being on the trailing side of the spindle in respect to the direction of travel of said spindle about the vertical axis of the drill, substantially as described.