July 16, 1940. L. L. THOMPSON 2,207,766

ROTARY DRILL BIT

Filed March 7, 1938

Fig. 1

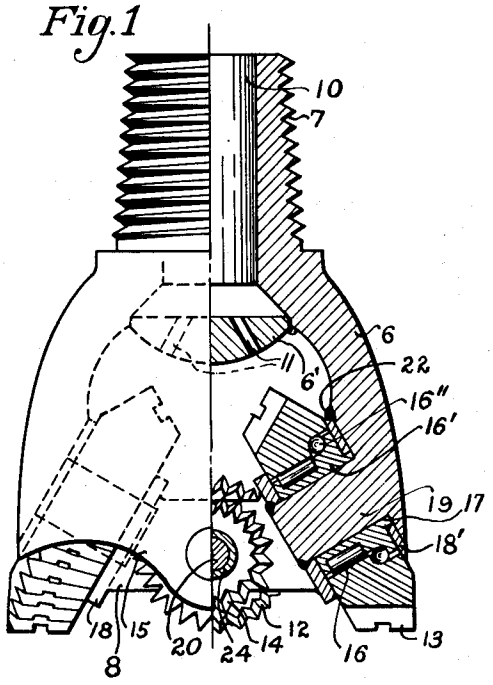


Fig. 2

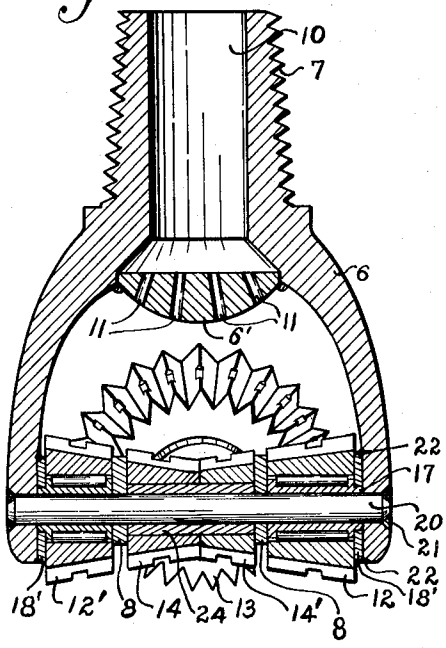


Fig. 4

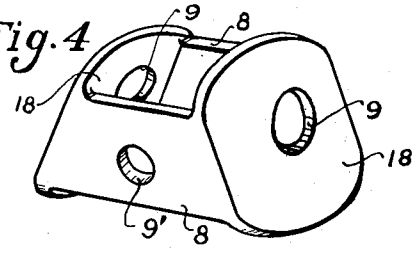


Fig. 3

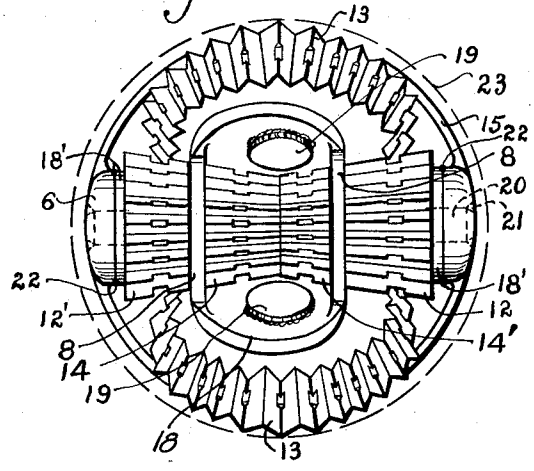


Fig. 5

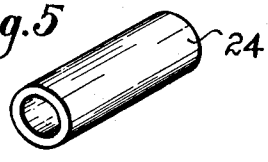
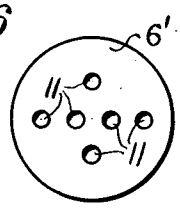


Fig. 6



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2,207,766

ROTARY DRILL BIT

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Application March 7, 1938, Serial No. 194,491

14 Claims. (Cl. 255—71)

This invention relates to improvements in bits for rotary well drills, and more particularly to the type employing rotatable toothed cutters.

Heretofore bits of the rotatable cutter type have been so constructed that undue strain was placed on the bearings and shaft. Some attempts have been made to brace the center of the usual transverse center shaft, but difficulty has been encountered inasmuch as at the particular point where the brace is disposed, a portion of the earth formation is left undisturbed by the cutter and in most instances this forms a core which acts as a bearing and prevents the cutters from readily acting upon the earth formation.

The principal object of this invention is to provide in a bit of the rotatable cutter type for action of the cutters upon the entire surface of the bottom of the well, without leaving an undisturbed portion of earth formation.

This object is accomplished in a preferred embodiment of this invention by providing a dual brace for the transverse cutter shaft with cutters of unequal lengths disposed upon said cutter shaft and with cutters disposed between said dual braces. The provision of rotatable cutters of unequal length on a transverse shaft provides for opposed cutters following different paths.

Another object of this invention is to provide for easy assembly and ready disassembly of the bit when repairs are necessary.

While the drawing illustrates a preferred embodiment of the invention, it is to be understood that in adapting same to meet specific needs and requirements, the design may be varied and changes made in minor details of construction, within the scope of the invention as claimed without departing from the spirit thereof.

In the accompanying drawing,

Fig. 1 is a side elevation of the drill bit with a quarter section removed to show the details of construction;

Fig. 2 is a vertical section taken at right angles to Fig. 1;

Fig. 3 is a bottom plan view of the drill bit;

Fig. 4 is a perspective view of a dual brace member detached;

Fig. 5 is a perspective view of the cutter bushing interposed between the dual brace members detached; and

Fig. 6 is a top plan view of a fluid diffusion plate removed from the drill bit.

With more particular reference to the drawing, the numeral 6 represents the drill bit body preferably of unitary construction which has an externally threaded portion 7 provided at the upper end thereof to interfit with the regulation tool joint of a rotary drill stem for securing the drill bit thereto.

The lower portion of the body of the bit is substantially of bell-shape having a depending annular skirt 15 that encloses the upper portions of the cutters housed therein.

As shown in Fig. 1, stub shafts 19 are rigidly secured, preferably integrally, with opposite sides of the body 6, and have cutters 13 journaled thereon upon roller bearings 16 housed between an inner race 16' and the inner face of each rotary cutter 13. The confining space for the roller bearings 16 is relatively small providing substantially a close bearing fit within the inner bore of the cutter (with a clearance of only .005''), so that foreign matter such as sand and rock cuttings are excluded from the roller bearings, but there is sufficient clearance to permit water or other liquid to enter around the bearings, thereby preventing heating and wear. The cage 16' has an inwardly projecting locking shoulder 17 thereon, to interlock with a bearing thrust plate 18', which is welded to the body 6 at the point 22 to prevent turning relative thereto and causing wear on the stub shaft 19.

A ball thrust bearing 16'' is disposed in each cutter 13 and sustains the end thrust. In this manner both radial and thrust loads are sustained by anti-friction bearings.

Mounted on the inner ends of the opposing stub shafts 19 is a dual brace member, generally of annular form, provided with sides 8 and ends 18, integrally united together, as shown in Fig. 4. The ends 18 are mounted on the inner ends of the stub shafts 19 to which they are welded, the stub shafts being received in holes 9 in said ends.

Holes 9' in the sides 8 receive and support a transverse shaft 20 which extends across between opposite sides of the skirt 15 of the body 6. The shaft 20 is rigidly secured to the skirt portion 15 at 21, as by welding.

Mounted on the shaft 20 in longitudinal relation are cutters 12 and 12' at opposite ends of said shaft and cutters 14 and 14' adjacent the middle of the shaft. Each of these cutters is frustro-conical in shape and provided with peripheral cutting teeth, the cutters 14 and 14' being turned in facing relation with their smaller ends abutting, while the cutters 12 and 12' also face one another with their smaller ends inward.

The cutters 14 and 14' are journaled on a bushing 24 mounted on the shaft with a rela-

tively tight fit so that it has little tendency to turn. Inasmuch as the cutters 14 and 14' are on opposite sides of the center of the bit, they will revolve in opposite directions and by mounting them on the bushing 24, this minimizes wear on the cutters, the bushing and the shaft. The cutters 12 and 12' are journaled on roller bearings 16 mounted and operated similar to the roller bearings 16 described above with respect to the cutters 13. Thrust plates 18' are used at the outer ends of the cutters 12 and 12' and are also secured as by welding at the points 22 to hold said thrust plates and the inner roller bearing cage against rotation on the shaft 20.

The oblique cutting edges of the cutters 12, 12' and 14, 14' cause these to cut a hole with a tapering bottom which converges upwardly to the center. The cutters of each pair are of different lengths, the cutters 12 and 14 being of greater lengths, respectively than the cutters 12' and 14'. The cutter 12 is of sufficient length to cut both the width of the cutter 12' plus the thickness of the side bar 8, while the cutters 14 and 14' are of lengths respectively to extend from the corresponding side 8 to the center of the bit. On a half revolution, the cutter 14 will cut out any core that may be left by the side 8 between the cutters 12 and 14' on the previous half revolution of the bit. In this way, the cutters 12, 12' and 14, 14' cut out the formation from the center of the hole outwardly to the inner side of the body 6, while the cutters 13 having their cutting edges horizontal, cut paths externally of the diameter of the portion covered by the cutters 12 and 12' to points externally of the body 6. In this way, the rotary bit acts on the earth formation over the entire surface of the bottom of the hole by the successive action of the respective cutters in turn, leaving a smooth clean wall in the hole as designated generally by the numeral 23 in Fig. 3. This hole 23 will be sufficiently large relative to the body 6 to permit free circulation of liquid between the outside of the skirt 15 and the bore of the hole.

When the cutters and the dual brace 8, 18 are assembled in the body 6, the thrust plates 18' are welded to the body at the points 22 to prevent these thrust plates and the bearing cage from turning and causing wear on the shafts 19 and 20. The close fitting of the rollers 16 with the inner bores of the cutters prevents their getting out of alignment. The welds at 21 and 22 are of such nature that they may be cut loose readily with a torch or chisel, so as to facilitate ready removal of the shaft 20 and its cutters, the dual brace 8, 18, and the cutters 13 and their bearing assemblies for the purpose of repair or replacement of any of these parts that may be desirable. The thrust plates 18' prevent wear on the body and may be removed readily when they become worn and new thrust plates inserted. The ends 18 of the brace unit form thrust plates at the inner sides of the cutters 13, these ends 18 being welded or otherwise rigidly secured to the inner ends of the stub shafts 19 in such manner that they may be readily removed with a chisel or cutting torch without injury to the body permitting the insertion of new cutters when necessary. The sides 8 of this unit serve as end thrust plates between the cutters 12 and 14', and 12' and 14, respectively. The removal of these parts readily in the manner described permits the replacement of the several parts whenever desired, allowing the body 6 to be used repeatedly because the only points of wear will be on the thrust plates, the bearings and the cutters.

The body 6 has an axial opening 10 through the shank 7 for the circulation of liquid, such as water, therethrough, and a plug 6' is secured in the body 6 at the inner end of said opening, the plug being provided with oblique diffusing openings 11 therethrough for directing the liquid streams against the respective cutters 12—14', as shown in Figs. 1 and 2. This liquid is circulated through the drill stem by high pressure pumps and due to the openings 11 discharging directly against the faces of the cutters, the dirt is continuously washed therefrom.

A bit of this construction permits faster drilling because of its effective cutting over the entire surface of the bottom of the hole for each revolution of the bit.

I claim:

1. A rotary drill bit comprising a body having laterally spaced portions, a shaft extending transversely between said portions and connected therewith, a plurality of supports for said shaft spaced lengthwise thereof, and conical cutters mounted on the shaft between the supports and between the respective supports and the lateral portions of the body.

2. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, a plurality of supports carried by said body and connected with an intermediate portion of said shaft and spaced apart lengthwise thereof, and frustro-conical cutters mounted on the shaft between the supports and between the respective supports and the sides of the recess.

3. A rotary drill bit comprising a body having laterally spaced portions, a shaft extending between said portions and supported thereby, a plurality of supports carried by the body and connected with intermediate portions of the shaft spaced apart lengthwise thereof, and frustro-conical cutters mounted on the shaft between the supports and between the respective supports and the spaced portions.

4. A rotary drill bit adapted to turn about an axis, comprising a body having laterally spaced portions, a shaft extending between said portions and supported thereby, a plurality of supports carried by the body and connected with intermediate portions of the shaft at points spaced laterally from the axis of the body, and frustro-conical cutters mounted on the shaft between the supports with the inner ends thereof approximately at the axis of the bit.

5. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, a frame having opposite ends secured to the body and supported thereby and having spaced sides supporting an intermediate portion of the shaft, and cutters mounted on the shaft.

6. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, a dual cross-brace having opposite ends secured to the body and supported thereby and having spaced sides through which the shaft extends supporting an intermediate portion thereof, and cutters mounted on said shaft.

7. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft

extending transversely between opposite sides of said recess and supported thereby, a dual cross-brace having opposite ends secured to the body and supported thereby and having spaced sides through which the shaft extends supporting an intermediate portion thereof, and cutters mounted on said shaft between the spaced sides of said cross-brace and between said sides and the adjacent sides of the recess.

8. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, said body having stub shaft projecting into said recess, a dual cross-brace having opposite ends supported by said stub shafts and having spaced sides through which the shaft extends supporting an intermediate portion of said shaft, and cutters mounted on said shaft.

9. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, said body having stub shafts projecting into said recess, a dual cross-brace having opposite ends supported by said stub shafts and having spaced sides through which the shaft extends supporting an intermediate portion of said shaft, cutters mounted on said shaft between the spaced sides and between said sides and the adjacent sides of the recess, and cutters journaled on the stub shafts.

10. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, a dual cross-brace having opposite ends secured to the body and supported thereby and having spaced sides through which the shaft extends supporting an intermediate portion thereof, and cutters mounted on said shaft between the spaced sides of said cross-brace and between said sides and the adjacent sides of the recess, said dual cross-brace having the sides laterally offset relative to the axis of the body with the cutters arranged to cut overlapping paths substantially throughout the entire width of the body.

11. A rotary drill bit comprising a body having a recess in the lower portion thereof, a shaft extending transversely between opposite sides of said recess and supported thereby, frustro-conical cutters mounted on said shaft, a spacer between said cutters at each opposite side of the axis of the body, said spacers being eccentric of the body and the cutters being of different lengths arranged to cut kerfs substantially throughout the width of the body.

12. A rotary drill bit comprising a body having a surrounding wall with an enlarged hollow recess therein, and cutters journaled in said recess on different transverse axes at angles to each other, said wall having the lower edge portion thereof forming a skirt extending continuously about the upper portions of the cutters with said upper portions of the cutters in the hollow recess, and said body having means for supplying fluid to the upper portion of the hollow recess.

13. A rotary drill bit comprising a body having a plurality of cutters connected therewith, shaft means on which said cutters are journaled, a roller bearing within at least one of said cutters journaling the same, an end thrust plate removably mounted on the shaft means at the inner side of said cutter and having a removable weld holding the same on the shaft means, and a ball bearing assembly forming an end thrust bearing for said cutters.

14. A rotary drill bit comprising a body having a surrounding wall with an enlarged hollow recess therein, and cutters journaled in said recess on different transverse axes at angles to each other, said wall having the lower edge portion thereof circular concentric with the body and forming a skirt extending continuously about the upper portions of the cutters with said upper portions of the cutters in the hollow recess, and said body having means for directing fluid to the upper portion of the hollow recess.

LONNIE L. THOMPSON.