A raise boring head which includes a plurality of rolling cutters distributed over the head and including circumferentially spaced gauge cutters. Each cutter has a rotatable part and a support shaft supporting the rotatable part with the ends of the support shafts carried in saddles fixed to the body of the raise boring head. Each end of each support shaft is formed to a rectangular shape and fits into a rectangular slot in the respective saddle and is secured therein as by bolts. The radially outer sides of the saddles for the gauge cutters are provided with hard wear resistant inserts to reduce the wear thereon.

1 Claim, 6 Drawing Figures
RAISE BORING HEAD AND ROLLING CUTTER ARRANGEMENT THEREFOR

The present invention relates to excavating equipment, and is particularly concerned with a reamer, or raise boring head, of substantial size and two rolling cutter arrangements therefor and support saddles for the rolling cutters.

A reamer, or raise boring head, of the type with which the present invention is concerned comprises a support structure of substantial size having a stem connected thereto and about the middle and projecting axially therefrom in a direction substantially perpendicular to the plane of the support structure.

The stem is adapted for connection to a drill string for being rotated thereby while being pulled in the direction of the axis of the stem. Supported on the support structure are rolling cutters in circumferentially and distributed relation with each rolling cutter comprising a rotatable outer part and a supporting cylindrical shaft which is detachably connected to a saddle mounted on the support structure.

The rolling cutters of an arrangement of the nature described are subjected to extreme abuse because the rolling cutters are required to reduce rock and the like and the rotary outer parts of the rolling cutters and the bearings thereof will, at times, have a high failure rate. It is, therefore, important to be able to change the cutters relatively easily while, at the same time, providing firm support therefor on the support structure of the reamer, or raise boring head.

A primary object of the present invention is the provision of an improved arrangement for supporting the rolling cutters on the support structure of a reamer, or raise boring head.

Another object is the provision of a supporting arrangement for the rolling cutters which permits rapid and easy replacement thereof.

Still another object of the present invention is the provision of wear resistant material on the outermost ends of the outermost supports for the rolling cutters to inhibit abrasion thereof while the reamer, or raise boring head, is in service.

These and other objects and advantages of the present invention will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a somewhat schematic view looking down on top of a raise boring head and showing the distribution on the head of the rolling cutters which engage the formation being reduced.

FIG. 2 is a side elevational view of one of the rolling cutters of FIG. 1, together with the supporting saddle therefor, and, more specifically, one of the gauge cutters.

FIG. 3 is an end view looking in at the cutter and saddle combination of FIG. 2 from the end that is presented radially outwardly when the cutter is mounted on the raise boring head.

FIG. 4 is an exploded perspective view showing the support shaft for a rolling cutter and the saddle in which the shaft is mounted.

FIG. 5 is a fragmentary perspective view showing an arrangement wherein a roll pin holds the shaft of the rolling cutter in the saddle at one end.

FIG. 6 is a fragmentary view drawn at enlarged scale and showing a wear resistant insert in one end of a saddle.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, a generally plate-like, or somewhat conical, support structure is provided having a central stem projecting axially therefrom in a direction perpendicular to the plane of the support structure and adapted for connection to a drill string for receiving thrust and rotating effort therefrom.

Mounted in distributed relation on the support structure are saddles which consist of spaced legs projecting upwardly from the support structure, with each leg having a substantially rectangular slot extending therein from the top. Each rolling cutter comprises a rotatable outer part and a central support shaft on which the outer part is journaled on the support shaft having end parts receivable in the slots in the legs.

Bolts extending diametrically through the ends of the support shaft are threadedly connected to the legs of the saddles and retain the rolling cutters on the saddles firmly, but in such a manner that the rolling cutters can easily be removed from the saddles.

DETAILED DESCRIPTION OF THE INVENTION:

FIG. 1 schematically illustrates a raise boring head which will be seen to consist of a plate-like support structure 10 having a stem 12 upstanding therefrom at about the center for connection to a drill string. Support structure 10 is perpendicular to the axis of stem 12 and carries in radially and circumferentially distributed relation a plurality of rolling cutters, each mounted in a support saddle that is fixed to the support structure.

The rolling cutters in FIG. 1 consist of a pair of innermost cutters 14, a set of cutters 16 positioned radially outwardly from cutters 14 and distributed angularly relative thereto, a further set of cutters 18 radially outwardly from cutters 16 and distributed angularly thereto, and outermost cutters 20 which are generally in alignment with cutters 14 and 16 and all of which are about the same radial distance from the axis of stem 12.

The cutters 20 are referred to as gauge cutters because they determine the diameter of the shaft which is formed when the cutter head is rotated while simultaneously being pulled in the direction of the stem 12, usually upwardly, against a formation to be removed.

One of the gauge cutters 20 is shown more in detail in FIGS. 2 and 3, wherein it will be seen to comprise a rotatable outer sleeve-like part 22, advantageously made wear resistant as by the provision of carbide inserts, (not shown), and having a central shaft 24 on which the outer part 22 is journaled as by antifriction bearings. Shaft 24 is mounted in a saddle 26 and is fixed therein for firm support of the part 22 of the rolling cutter.

As will be seen in FIG. 3, saddle 26 has legs 27 and 29 and on the side thereof which faces radially outwardly of the rolling cutter head, namely, on the radially outer side of the radially outer leg, is provided with cemented hard metal carbide inserts 28, cemented tungsten carbide, for example, which impart abrasion resistance to that end of the saddle which is most exposed to abrasion in use. Reference to FIG. 2 will show that the radially outer side of leg 27 is radially within the limits of the outer part 22 of the respective cutter and that the leg is inclined so as to diverge from the axis of stem 12 in the upward direction.
The construction of the saddle and shaft and the connections therebetween will be seen in FIG. 4. In FIG. 4, shaft 24 will be seen to have a generally squared end 30 at one end and a generally squared end 32 at the other end. By generally squared is meant that the shaft is shaped so as to have angularly related flat sides thereon.

Portion 30 is receivable in vertical slot 34 formed in leg 27 at one end of saddle 26 and portion 32 is receivable in slot 36 formed in leg 29 at the other end of the saddle. The slots 34 and 36 have flat side walls and a flat bottom wall and are of such a width as closely to receive between the side walls thereof the respective one of the portions 30, 32 thereby assisting in holding shaft 24 against rotation.

Leg 27 of saddle 26, beneath the bottom of slot 34, is formed with a hole 38 for receiving the barrel nut 40 formed with a transverse tapped hole 42 which registers with holes 44 in the saddle when the barrel nut is in place. Holes 44 also register with a hole 46 formed in portion 30 and through these holes extends cap screw 48 which threads into threaded hole 42 of barrel nut 40.

At the other end of the saddle, two holes 50 are provided in leg 29 for receiving the barrel nuts 52 and which barrel nuts 52 have threaded holes 54 to receive the cap screws 56 that are insertable through holes 58 in portion 32 and holes 60 in the saddle so that portion 32 of the shaft can also be fixedly clamped to respective leg of the saddle.

FIG. 4 will also show that the carbide inserts 28 are mounted in holes 62 provided therefor in the radially outwardly facing side of the leg at the radially outer end of saddle 26. These inserts are either pressed, cemented or brazed in the respective holes and advantageously protrude a short distance outwardly from the end of the saddle so as to be effective in preventing the end of the saddle from being abraded. FIG. 6 shows at about full scale a typical insert 28 as mounted in the saddle end.

The saddle arrangement illustrated in FIGS. 2, 3 and 4 is of merit in respect of rolling cutters because it is easy to change the rolling cutters without dismounting the saddle from support structure 10. The saddles can, thus, be welded to the support structure and remain in place thereon and the rolling cutters that are carried by the saddles can be removed and replaced as necessary as the rolling cutters become dull, or break, or in case the bearings fail therein, or for any other reason.

In all of the saddles except the saddles pertaining to innermost cutters 14, substantial space is available for reaching the cap screws which clamp the respective shafts in the saddles, but space is somewhat limited at the radially inner ends of the saddles pertaining to cutters 14 and, in this case, the end of the shaft pertaining to the cutters 14 which is nearest to stem 12 can be held in place as by the roll pin arrangement 64 shown in FIG. 5 which engages the top of the shaft end in the adjacent slot in the saddle.

The cutters at 14 have their axes substantially horizontal so that there is not as much loading of these cutters in a direction to impose stresses on the radially inner end of the shaft as in the case with the other cutters and the roll pin arrangement 64 of FIG. 5 has proved to be quite satisfactory for cutters in the position referred to.

In the drawings, each saddle has the legs at the ends integral with a base member, but the legs could, if desired, be welded individually to the support structure 10 of the raise boring head.

It will be noted, upon reference especially to FIGS. 2 and 4, that the radially outer ends of saddles 26 are formed so as to be convex outwardly. The convexity of the radially outer ends of the saddles of the outermost cutters is advantageously such that these surfaces are substantially concentric with the axis of stem 12. This configuration of the radially outermost sides of the saddles of at least the radially outer cutters permits these surfaces to be provided with the hard wear resistant inserts 28 which inhibit excessive wear of these outermost surface portions.

Modifications may be made within the scope of the appended claims.

What is claimed is:

1. In a rolling cutter; a rotatable outer part, a central support shaft rotatably supporting said outer part and having end portions projecting axially beyond the respective ends of said outer part, saddle means having generally parallel legs fixed relative to each other and spaced to receive said rotatable part therebetween, a slot extending into one end of each said leg part and each having spaced parallel side walls and a bottom wall perpendicular to the side walls, each end portion of said central support shaft being receivable into a respective slot and having flat parallel sides engaging the side walls of the slot and a flat bottom perpendicular to said sides and engaging the bottom wall of the respective slot, each said leg having at least one hole extending therethrough in a direction substantially parallel to said support shaft and spaced downwardly in the respective leg from said bottom wall of said slot, a barrel nut removable mounted in each hole, and a bolt for each barrel nut extending downwardly through the end portion of the support shaft which is disposed above the nut and downwardly through the portion of the respective leg disposed between the bottom wall of the slot and the said hole in which the barrel nut is mounted and threadedly engaging the barrel nut whereby each said end portion is fixed in the respective slot and clamped against the bottom wall thereof.