Feb. 13, 1940. R. W. MAXWELL 2,190,365

CUTTER AND BEARING ASSEMBLY

Filed Jan. 24, 1938

FIG. 1.

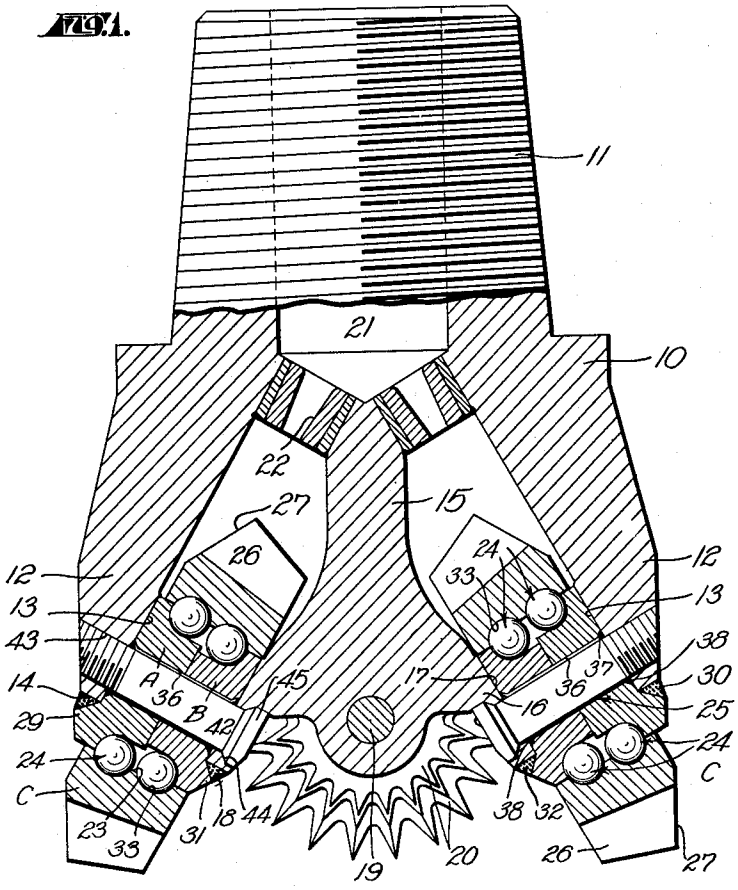


FIG. 2.

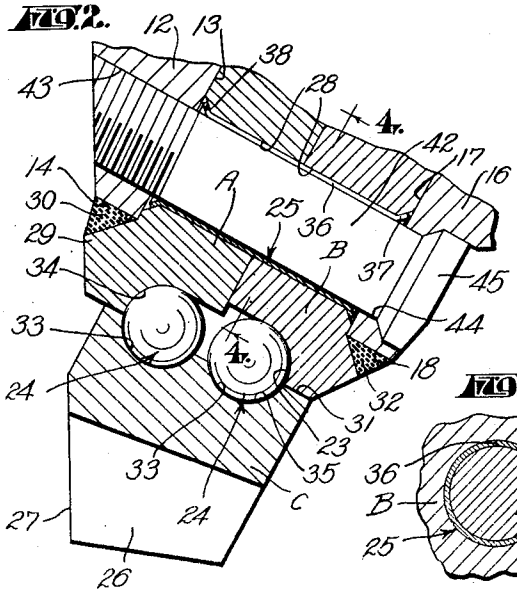


FIG. 3.

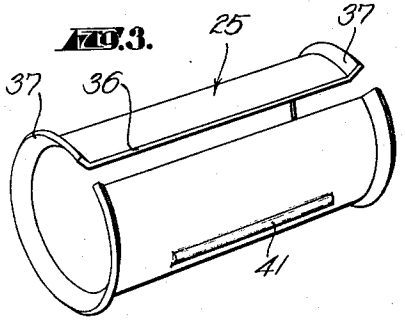


FIG. 4r.

Inventor
ROBERT W. MAXWELL
By
His Attorney

Patented Feb. 13, 1940 2,190,365

UNITED STATES PATENT OFFICE

2,190,365

CUTTER AND BEARING ASSEMBLY

Robert W. Maxwell, Los Angeles, Calif., assignor to Globe Oil Tools Company, Los Nietos, Calif., a corporation of California

Application January 24, 1938, Serial No. 186,641

4 Claims. (Cl. 308—193)

This invention relates to well drilling tools and relates more particularly to a roller cutter for a drilling tool and bearing means for the cutter.

A general object of this invention is to provide a simple, practical and dependable roller cutter and bearing assembly that is easy and convenient to handle.

Another object of this invention is to provide a roller cutter and bearing assembly that may be handled, transported and installed on the tool as a unit.

Another object of this invention is to provide a cutter and anti-friction bearing assembly embodying a simple, inexpensive retaining member that may be inserted in the pin receiving openings of the bearing elements at the place of manufacture to hold the bearing elements against separation and movement, so that the assembly may be conveniently handled as a unit and quickly installed on the bit or drilling tool.

A further object of this invention is to provide a cutter and bearing assembly of the character mentioned in which the retaining member holds the bearing elements against relative turning so that the elements may be more readily secured or welded to the bit body in their proper positions.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawing, in which:

Fig. 1 is a vertical detailed sectional view of a rock bit illustrating two cutter and bearing assemblies of the character provided by the invention. Fig. 2 is an enlarged fragmentary vertical detailed sectional view of one of the cutter and bearing assemblies of the bit and adjacent parts of the bit body. Fig. 3 is an enlarged perspective view of the retaining member of one of the assemblies, and Fig. 4 is a fragmentary transverse detailed sectional view taken as indicated by line 4—4 on Fig. 2.

The present invention may be embodied in cutter and bearing assemblies for use on well drilling tools of various characters. In the following detailed disclosure I will describe a typical form of the invention incorporated in a rock bit for use in the rotary method of well drilling. It is to be understood that the invention is not to be construed as limited or restricted to the form or application of the invention about to be described, but is to be taken as including any features or modifications that may fall within the scope of the claims.

The rock bit illustrated in the drawing comprises a body 10 provided at its upper end with a tapered screw threaded pin 11 for facilitating the connection of the bit with the drilling string. Two diametrically opposite downwardly and outwardly projecting legs 12 are provided on the lower end of the body 10. The legs 12 have downwardly and outwardly inclined bearing surfaces 13 on their inner sides and the lower ends 14 of the legs 12 are preferably flat and at substantially right angles to the surfaces 13. A substantially central web 15 projects from the lower end of the body 10 in spaced relation to the legs 12. The web 15 has downwardly and outwardly inclined wings 16 whose outer surfaces 17 are finished and parallel with the surfaces 13. The lower ends 18 of the wings 16 are preferably flat and at right angles to the surfaces 17. The web 15 carries a shaft or pin 19 for supporting the inner roller cutters 20. The outer roller cutters C, embodied in the assemblies of the invention to be hereinafter described, are arranged between the legs 12 and the wings 16. A fluid passage 21 enters the body 10 from the upper end of its pin 11 and discharge ports 22 communicate with the lower end of the passage 21 and direct the circulation fluid downwardly against the cutters of the bit. The assemblies of the outer cutters C and their bearing means are identical and I will proceed with a detailed description of one assembly, it being understood that such description is equally applicable to the other assembly.

The improved cutter and bearing assembly of the present invention comprises a cutter C having a central longitudinal opening 23, a plurality of bushing or bearing elements A and B in the cutter opening 23, balls 24 rotatably supporting the cutter C on the bearing elements A and B and a retaining member 25 for holding the bearing elements A and B against separation and relative movement.

The cutter C is in the nature of a roller cutter and in the particular embodiment of the invention illustrated is generally frusto-conical in shape. The opposite ends of the cutter C are flat and parallel and the periphery of the cutter is provided with suitable cutting teeth 26. The outer corners 27 of the teeth 26 are preferably beveled off.

The bearing elements A and B are arranged in the opening 23 of the cutter C and are adapted to be attached to and supported on the body 10 of the bit. In the particular form of the invention illustrated in the drawing there are two bearing elements A and B, the element A being

located in the outer portion of the cutter opening 23 and the element B being arranged in the inner portion of the opening 23. The elements A and B are spool like parts and have central longitudinal openings 28 and flat parallel opposite ends. The two elements A and B are arranged in end to end relation with their inner ends in abutment. The outer end of the bearing element A is adapted to cooperate with the bearing surface 13 of a body leg 12, while the outer end of the element B is adapted to cooperate with the surface 17 of a wing 16. A lug 29 is provided on the outer end of the bearing element A to project below the lower end 14 of the adjacent leg 12 to be secured thereto by welding 30. The welding 30 aids in securing the bearing element A to the body leg 12 and prevents rotation of the bearing element during operation of the bit. A lug 31 is provided on the outer side of the bearing element B to project at or below the lower end 18 of the adjacent wing 16 and is secured to the lower end of the wing by welding 32. The welding 32 aids in securing the bearing element B to the wing 16 and prevents turning of the bearing element during operation of the tool.

The balls 24 are provided to rotatably support the roller cutter C on the bearing elements A and B. There are two axially spaced ball grooves or races 33 provided in the wall of the cutter opening 23. The periphery of the bearing element A is provided with a ball race 34 opposing one of the races 33 and the periphery of the bearing element B has an annular ball race 35 opposing the other race 33. The balls 24 are arranged in the sets or pairs of opposing races 33 and 34 and 33 and 35 to support the cutter C for free rotation.

The race 34 faces axially toward the adjacent wing 16 as well as outwardly, and the race 35 faces axially toward the adjacent leg 12, as well as outwardly. The races 33 in the cutter opening 23 are of substantial depth so that the balls 24 cooperating with the deep races 33 and the diagonal or pitched races 34 and 35 are operable to transmit the axial thrusts as well as the radial thrusts that are imposed on the cutter C, that is, the balls 24 in the set of races 33 and 34 are adapted to take the outward end thrusts as well as the radial thrusts, while the balls 24 in the set of races 33 and 35 are adapted to take the inward end thrusts as well as the radial thrusts. It will be observed that the balls 24 cooperating with the pairs of races 33 and 34 and 33 and 35 formed and related as described above, prevent displacement of the cutter C from the assembly of the elements A and B. The cutter C is supported solely or entirely by the series of balls 24 and does not bear on the adjacent leg 12 or the adjacent wing 16.

The retaining member 25 is an important feature of the invention. The member 25 serves to hold the bearing elements A and B against separation prior to the mounting of the cutter and bearing assembly on the bit so that the said assembly may be conveniently handled, transported and installed as a unit. The member 25 also serves to hold the bearing elements A and B against relative turning so that the arrangement of either the element A or the element B with its lug 29 or 31 in position for welding to the leg 12 or the wing 16, as the case may be, automatically positions the other element A or B in the right position for welding.

The member 25 is a simple inexpensive part formed of steel or other material having the desired flexibility and resiliency. The member 25 is arranged in the aligned longitudinal openings 28 of the bearing elements A and B and is of sufficient length to have its opposite ends at or adjacent the outer ends of the elements. The member 25 is tubular and preferably has a thin wall to be flexible and to occupy a minimum of space in the openings 28. The retaining member 25 is provided with a longitudinal split or slit 36 extending from one end to the other. The slit 36 renders the member 25 contractible and expansible. The opposite end portions of the member 25 are flared to have holding cooperation with the bearing elements A and B. An inclined and outwardly projecting annular flange 37 is provided on each end of the member 25. The flanges 37 are preferably identical and integral parts of the member 25.

The bearing elements A and B are shaped to receive or cooperate with the flanges 37 of the member 25. Annular depressions or sockets 38 are provided in the outer ends of the members A and B at the mouths of their openings 28. The walls of the sockets 38 slope inwardly toward the center of the cutter and bearing assemblies to conform to and properly receive the flanges 37. The sockets 38 and the flanges 37 are related so that the flanges may be entirely received in the sockets so that the outer margins of the flanges are at or within the planes of the outer ends of the elements A and B. The member 25 is proportioned so that its flanges 37 cooperate with the walls of the sockets 38 to retain the members A and B with their inner ends in abutment.

It is believed that it will be apparent how the flanges 37 cooperating with the sockets 38 retain or hold the members A and B in the positions just mentioned. In assembling the member 25 in the aligned openings 28 of the bearing elements A and B it is necessary to contract the split member so that the flange 37 on its entering end may pass through the openings. In practice the member 25 may be readily contracted to have the portions bordering its split 36 lap one over the other. This lapping of the portions bordering the slit 36 materially reduces the diameter of the member 25 so that the flange 37 on its entering end readily passes through the openings 28. When the flange 37 on the advancing or entering end of the member 25 reaches its socket 38 the member 25 is free to expand through its resiliency and returns to a condition where its edges bordering the slit 36 are in cooperation or adjacent relation as illustrated in Fig. 4 of the drawing. The resiliency of the member 25 brings and holds the flanges 37 in effective cooperation with the walls of the sockets 38. In introducing the member 25 in the openings 28 of the elements A and B a flange 37 may be arranged in a socket 38 and the member may be forced inwardly so that the cooperation of the flange with the sloping wall of the socket compresses or contracts the member to the condition described above.

In accordance with the invention the bearing elements A and B and the member 25 have cooperating parts which prevent relative turning between the bearing elements. In the preferred structure illustrated in the drawing a longitudinal groove 40 is cut in the wall of the opening 28 of each member A and B. This key way or groove 40 may extend between the opposing ends of the bearing elements A and B. The retaining member 28 is shaped or bent to have a longitudinally extending rib or key 41 on its periphery for cooperating with the grooves 40. The key 41 may extend between the flanges 37 or may have

it ends spaced inwardly from the flanges as illustrated in Fig. 3. When the member 25 is inserted in the openings 28 as described above, the member 25 is turned or the elements A and B are turned with respect to the member so that the grooves 40 receive the key 41. In practice the key 41 may snap into the grooves 40 when the member 25 expands to the condition illustrated in Figs. 1, 2 and 4 of the drawing. The rotative positions of the lugs 29 and 31 of the elements A and B, respectively, are preferably related to the grooves 40 and they key 41 so that the slit 36 is in the upper portions of the openings 28, considering the assembly to be in position on the bit.

A supporting pin 42 is provided to secure or mount the assembly of the cutter C and its bearing on the bit. The leg 12 and the wing 16 are provided with aligned downwardly and inwardly inclined openings 43 and 44, respectively. The pin 42 is passed outwardly through the opening 44 and the retaining member 25 and its outer portion is threaded in the opening 43. A head 45 is provided on the inner end of the pin 42 to bear outwardly against the wing 16. The pin 42 extending through the retaining member 25 dependably supports the cutter and bearing assembly on the bit.

In assembling the cutter C and its bearing, a series of balls 24 is first arranged in a race 33 and a bearing element A or B is then introduced into the cutter opening 23 to have its race 34 or 35 cooperate with the balls. A series of balls 24 is then arranged in the other race 33 and the remaining bearing element A or B is inserted in the cutter opening 23 to have its race 34 or 35 cooperate with the balls 24. The retaining member 25 is then contracted and inserted in the openings 28 as described above. The member 25 is assembled in the position where its flanges 37 cooperate with the sockets 38 and where its key 41 is received in the groove 40. The flanges 37 cooperating with the sockets 38 dependably prevent endwise separation of the bearing elements A and B and the balls 24 cooperating with the opposing pairs of races 33 and 34 and 32 and 35 prevent separation of the cutter C from the bearing elements. Thus the cutter C and its bearing parts are held in assembled relation to constitute a readily handled and transported unit.

When the bearing and cutter unit is to be assembled on the bit it is passed upwardly between a wing 16 and a leg 12 and the lugs 29 and 31 are brought to positions where they oppose the lower ends 14 and 18 of the leg and wing, respectively. In this connection it is to be understood that the key 41 cooperating with the grooves 40 prevents relative turning of the bearing elements A and B so that the two lugs 29 and 31 may be simultaneously brought to the desired position and both remain in place during the welding of the lugs to the leg and wing. When the cutter C and its bearing has been positioned between the lug 12 and the wing 16 the pin 42 is passed through the opening 44 and the member 25 and is threaded in the opening 43. The lug 29 may then be secured to the end 14 of the leg 12 by the welding 30 and the lug 31 may be similarly secured to the lower end 18 of the wing 16 by the welding 32.

The retaining member 25 does not in any way interfere with the positioning of the cutter and bearing assembly on the bit. The slit 36 in the member 25 is provided in the upper portions of the openings 28 as described above, so that the slit portions of the member 25 are not subjected to the heavy forces transmitted between the pin 42 and the bearing elements A and B. When the pin 42 is removed to permit the removal and replacement of the cutter C and the bearing assembly the retaining member 25 remains in holding engagement with the bearing elements A and B so that the cutter and its bearing parts are removed as a single unit.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. An assembly of the character described comprising a roller having an opening, tubular bearing elements in the opening, anti-friction parts rotatably supporting the roller on the bearing elements and transmitting end thrusts between the roller and the bearing elements, a tubular retaining member to be arranged in the bearing elements and having laterally projecting end parts to cooperate with the ends of the bearing elements to hold the elements against axial separation, said retaining member being flexible and split longitudinally from one end to the other whereby it may be contracted for ready insertion in the bearing elements, and key and groove connections between the member and the bearing elements preventing relative turning between the elements.

2. Bearing means for a rotatable roller comprising two tubular bearing elements arranged in end to end relation and having tapered sockets in their outer ends and peripheral ball grooves, balls cooperating with the grooves and the roller to rotatably support the roller, a tubular member for arrangement through the elements, and flaring preformed flanges on the opposite ends of the member engaging in said sockets to hold the bearing elements against longitudinal separation, the member being longitudinally split from one end to the other whereby it may be contracted through the engagement of one of said flanges with one of said tapered sockets to have the parts of its flanges at the split in overlapping relation whereby the member may be readily introduced into the bearing elements.

3. An assembly to be mounted between spaced supporting parts comprising a roller having an opening, tubular bearing elements in the opening of the roller, balls rotatably supporting the roller on said elements and transmitting end thrusts between the roller and said elements, lugs at the outer ends of the elements to be secured to said parts, a split flexible tubular member arranged in the said elements and having preformed end flanges engaging the ends of the elements to hold the elements against axial separation whereby the assembly may be arranged between said parts as a unit, and key connections between the member and the elements preventing relative turning of the said elements whereby the lugs are maintained in the correct relationship to be simultaneously positioned at the lower ends of said parts for attachment thereto.

4. An assembly to be mounted between spaced supporting parts comprising a roller having an opening, tubular bearing elements in the opening of the roller, balls rotatably supporting the

roller on said elements and transmitting end thrusts between the roller and said elements, lugs at the outer ends of the elements to be secured to said parts, a split flexible tubular member arranged in the said elements and having preformed end flanges engaging the ends of the elements to hold the elements against axial separation whereby the assembly may be arranged between said parts as a unit, there being longitudinal grooves in the interiors of the elements, and a key on the member cooperating with the grooves to hold the elements against relative turning so that the lugs may be simultaneously located for attachment to the said supporting parts, the grooves and lugs being related so that the split of the tubular member is at the upper side of the member when the lugs are attached to the lower ends of said parts.

ROBERT W. MAXWELL.