

**March 3, 1959**

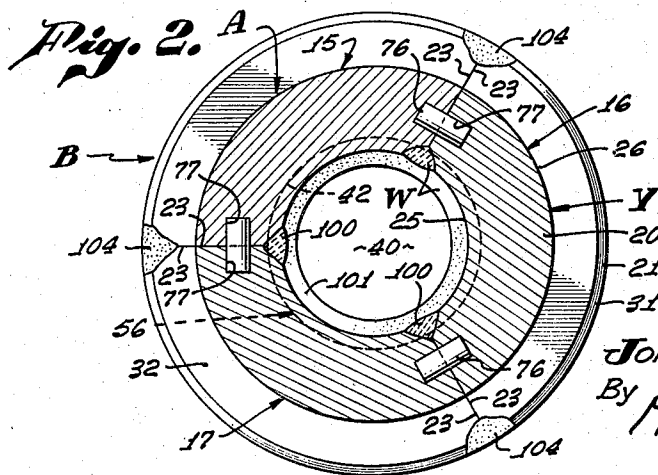
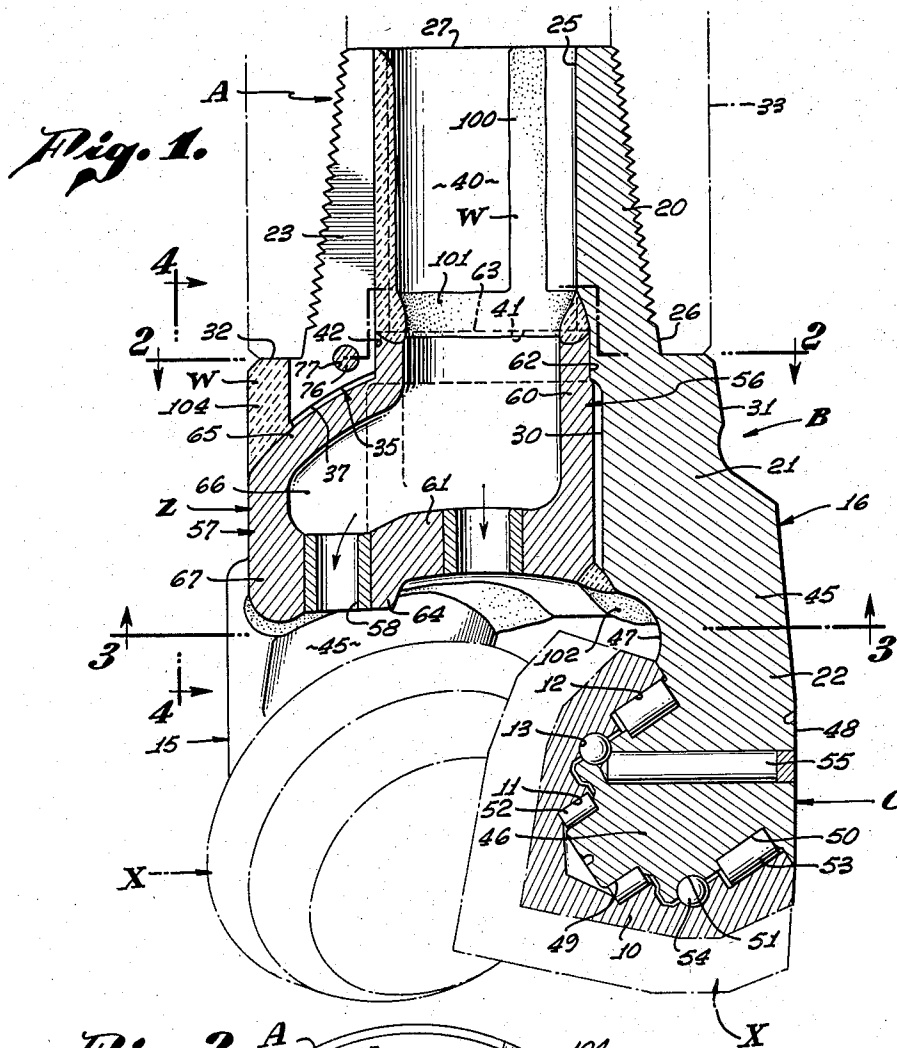
**J. S. GOODWIN**

**2,875,984**

WELL-DRILLING ROLLER BIT

Filed March 28, 1955

3 Sheets-Sheet 1



31  
INVENTOR  
JOHN S. GOODWIN,  
By Maxwell & Maxwell  
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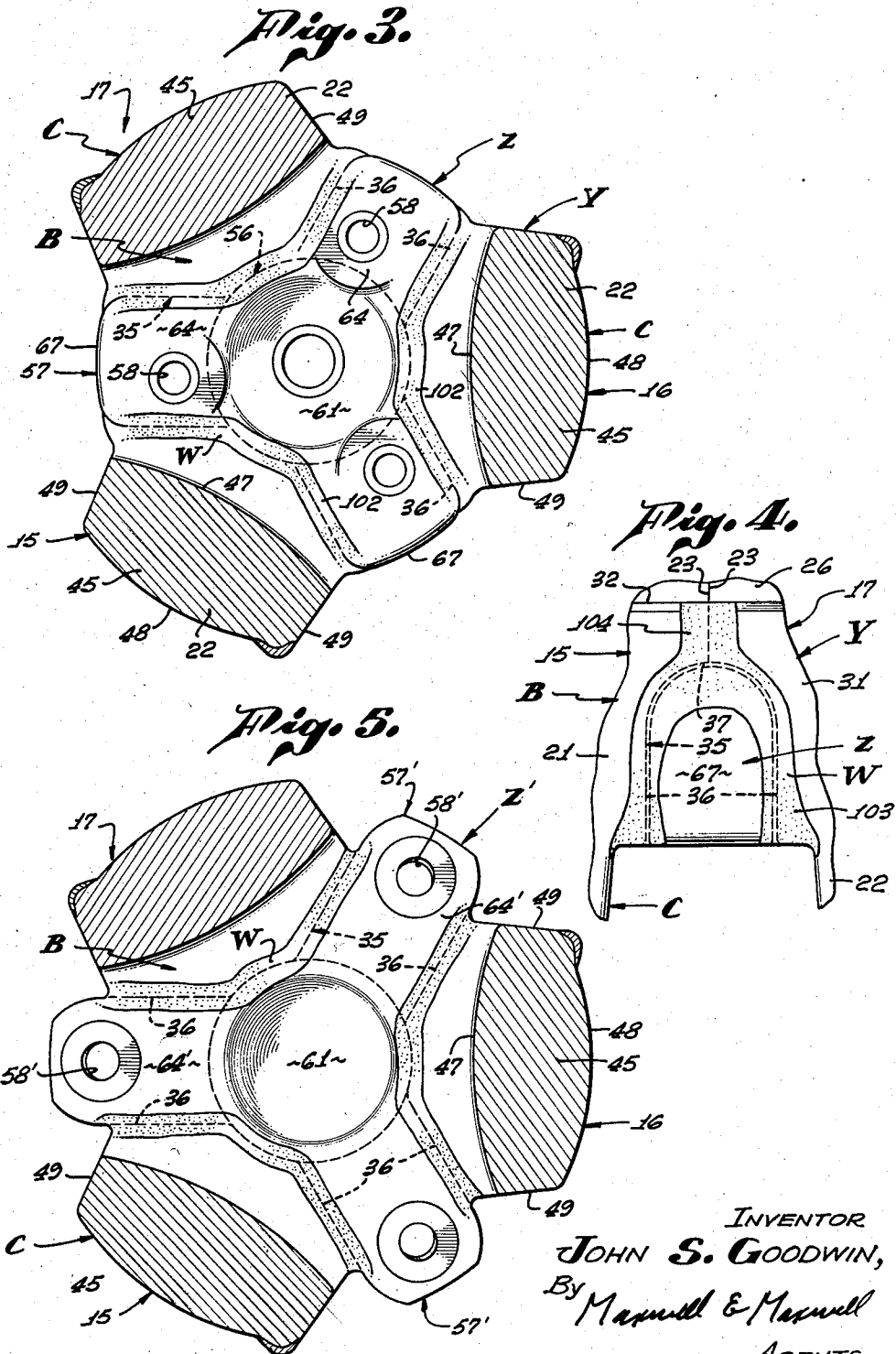
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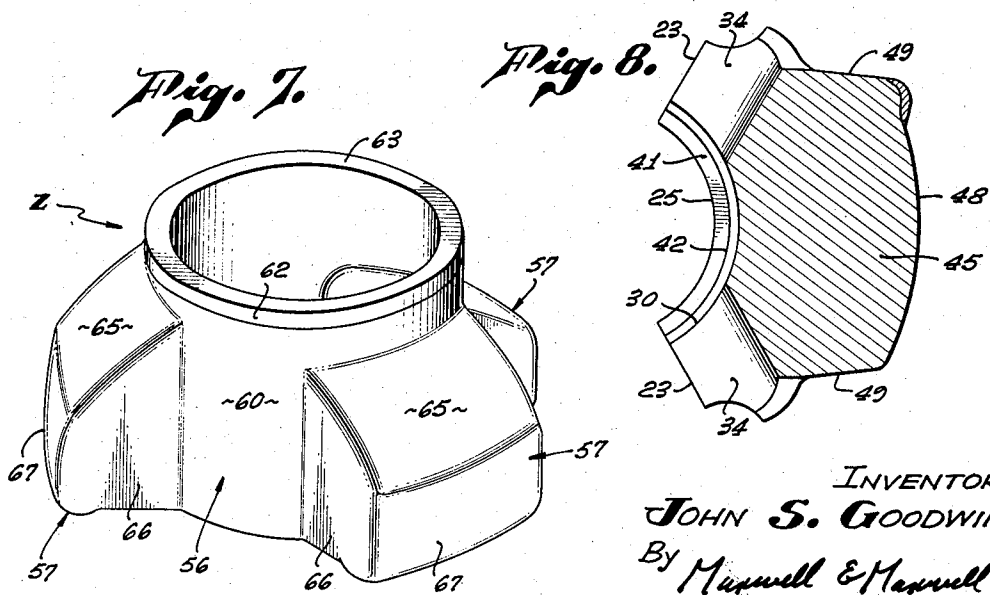
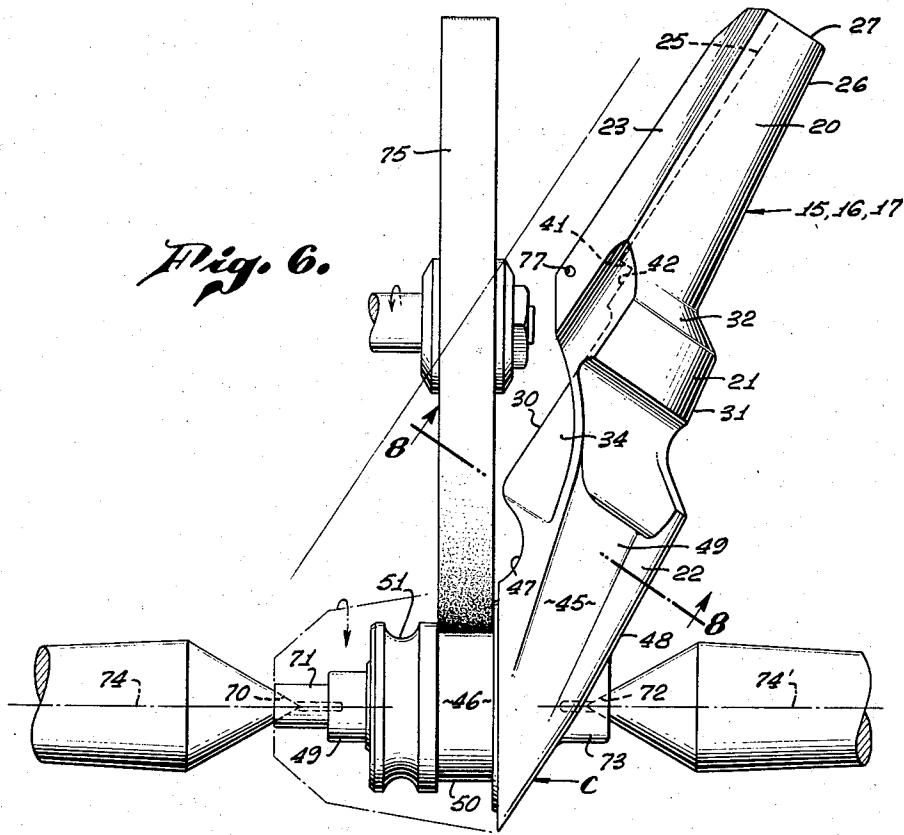
J. S. GOODWIN

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3 Sheets-Sheet 3



INVENTOR  
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## WELL-DRILLING ROLLER BIT

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Application March 28, 1955, Serial No. 496,963

11 Claims. (Cl. 255—313)

This invention has to do with a well-drilling roller bit and is concerned in particular with a new and highly useful construction therefor, it being a general object of this invention to provide an extremely simple, inexpensive and improved construction for the manufacture and production of well-drilling bits.

Well-drilling bits of the type under consideration are used extensively in the rotary method of drilling wells and are subjected to severe operating conditions. Therefore, the materials and methods employed in the manufacture of drilling bits are of high quality and standards resulting in a costly product. In spite of the fact that only the best material and workmanship is employed in the manufacture of such well tools, roller bits are, at best, short lived thus requiring a large number of bits in order to dig a well. Economy in manufacture is, therefore, an important factor.

Because of the severe working conditions encountered, roller bits are necessarily of rugged construction and are characteristically compact structures having a body with depending legs carrying roller cutters. The compactness of these structures results in machining and assembly difficulties requiring special tools and tedious steps in the process of manufacture and ordinarily resulting in high costs. For example, various parts must be turned and ground to meet production standards, and in bit constructions heretofore employed, access to the areas to be machined in said manners is materially restricted. With restricted access to said areas the machining and grinding processes become prolonged and costly.

An object of this invention is to provide a rugged and practical roller bit construction that is of simple, inexpensive, and improved construction.

An object of this invention is to provide a roller bit construction wherein areas to be machined are easily accessible. With the construction that I have provided, special machine tools are not required and ordinary high rate of production methods of machining are employed in the manufacture of the bit. That is, large rugged cutting bits, milling cutters, and grinding wheels may be employed in order to shape and form the elements of the bit.

Still another object of this invention is to provide a bit construction wherein accurate, inexpensive machining steps are employed resulting in easily and quickly made parts of accurate workmanship and high quality.

It is another object of this invention to provide a segmental body construction for a roller bit of the type referred to wherein the segments are identical and only a multiplicity of one part is required.

It is still another object of this invention to provide a segmental bit construction as above referred to which is adapted to receive various central fluid manifold elements for directing the fluid handled by the drilling string in the desired manner.

An object of this invention is to provide a segmental roller bit construction of the character referred to that is easily assembled and secured together by simple welded joints. With the construction that I have provided, only

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a minimum of welding is required to join the parts of the structure and to provide a fluid seal that confines flow of mud to the flow passage through the bit.

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

Fig. 1 is a detailed sectional view taken vertically through the drilling bit that I have provided. Fig. 2 is a sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a sectional view taken as indicated by line 3—3 on Fig. 1. Fig. 4 is a side view of a portion of the bit taken as indicated by line 4—4 on Fig. 1. Fig. 5 is a view similar to Fig. 3 showing a modified form of the bit construction that I have provided. Fig. 6 is a view of one of the segmental elements of the bit body that I have provided showing it in the process of manufacture. Fig. 7 is a perspective view of a typical manifold as provided in connection with the bit construction, and Fig. 8 is a sectional view through the segmental element of the bit taken as indicated by line 8—8 on Fig. 6.

The bit that I have provided, and as illustrated in the drawings, is preferably a roller bit having a plurality of roller cutters X. For example, there are three roller cutters X equally spaced circumferentially of the structure. In accordance with the invention, the bit is of fabricated construction and involves generally a segmental body Y and a fluid handling manifold Z. The cutters X, segments of the body Y and the manifold Z and separately formed parts are assembled and secured together by welding W. It will be understood that when there are three cutters X involved, there are three body segments that are assembled and then secured together by welding around the manifold Z. These parts, when assembled as shown throughout the drawings, form the bit of the present invention.

The cutters X may be alike and may be ordinary roller cutters of the type commonly employed in the art. The cutters are, generally speaking, frusto conical elements with rows of intermeshing circumferentially spaced teeth (not shown), the rows of teeth of the three cutters being lapped or meshed so that the teeth of one cutter fit into grooves between the teeth of the other cutter. The cutters X are rotatably carried by the body Y on equally spaced outwardly and upwardly inclined axes that intersect the central portion of the structure. In practice, the cutters may be offset from the vertical axis of the body Y to gain the most efficient cutting action. As shown, each cutter X is a cup-shaped element 10 with inner and outer bearing races 11, 12, and 13 provided to cooperate with the body Y as hereinafter described to rotatably mount and retain the cutters X on the body.

The body Y is a tubular part of segmental construction involving like segments 15, 16, and 17, which in practice, are preferably identical. Each of the segments involves, generally, an upper coupling section 20, an intermediate section 21 and a lower cutter section 22. Each segment and the section thereof is an arcuate semi-circular part forming a portion of the tubular body Y. That is, the body Y is formed of segments which have radially disposed side faces 23 that extend longitudinally of the body and abut each other to form a continuous outer wall or shell.

The coupling sections 20 of the segments 15, 16, and 17 are preferably identical so that a description of one serves as a description of the other. Section 20 is arcuate or semi-circular and has a concave inner wall 25 and a convex outer wall 26. The walls 25 and 26 are concentric, the wall 26 being upwardly and inwardly tapered and terminating in a flat end 27 in a plane normal to the central axis of the structure. The walls 25 and 26 extend

between the side faces 23 of the segment and when the segments 15, 16, and 17 are assembled the walls 25 and 26 form a continuous circular wall defining a pin A that is concentric with the axis of the bit and projects upwardly therefrom. The wall 26 is threaded and is adapted to be coupled with the lower end of a drill pipe or collar 33 to be rotated thereby.

The intermediate sections 21 of the segments 15, 16, and 17 are preferably identical so that a description of one serves as a description of the other. Section 21 is also arcuate or semi-circular and has a concave inner wall 30 and a convex outer wall 31. The wall 30 and 31 are concentric forming, in effect, continuations of the walls 25 and 26 of section 20 above described. The walls 30 and 31 extend between the side faces 23 of the segments, and when the segments are assembled the walls 30 and 31 form a continuous circular wall defining an intermediate body portion B that is concentric with the vertical axis of the bit and depends downwardly from the pin A. The wall 31 is somewhat larger in radius or diameter than the wall 26, there being a circumferentially axially disposed shoulder 32 that joins the walls and is faced upwardly to receive and form a stop for the lower end of the drill pipe or collar 33.

In accordance with the invention I have provided a recess 34 at each wall 23, and which recess is formed in the lower depending portion of the section 21. The recesses 34 are shaped so that when adjoining segments 15, 16, and 17 are brought together or assembled, a notch 35 is formed in the point of joinder between the segments. The notch 35 thus formed is provided to receive parts of the manifold Z hereinafter described, and as shown, the notches 35 are in the nature of lateral openings in the intermediate body portion B and are defined by sides 36 and a top 37. The top and sides are suitably shaped and continuously curved to fit the form of the manifold Z. In order to facilitate assembly of the manifold Z with the segments 15, 16, and 17, substantial clearance is provided between the top and sides of the notches 35, as clearly illustrated in Figs. 1 and 4 of the drawings.

As above pointed out, the body Y is tubular in form and, as shown, a bore 40 extends therethrough defined by the inner walls 25 and 30. The wall 30 is somewhat larger in radius or diameter than the wall 25 there being a circumferential axially disposed shoulder 41 joining the walls and faced downwardly to receive and form a stop for the manifold Z. The lower end of bore 40 receives the manifold Z with clearance and a counter bore or guide or seat 42 is preferably provided to guide and position the manifold as hereinafter described. The guide or seat 42 is located at the upper end of the body portion B where it joins the pin A.

The cutter carrying sections 22 of the segments 15, 16, and 17 are preferably identical so that a description of one serves as a description of the other. Section 22 is a simple elongate projection 45 provided with a trunnion 46 that carries a roller cutter X and forms a leg C of the bit that I have provided. The projection 45 is somewhat narrower circumferentially than the section 21 and is defined by inner and outer walls 47 and 48 and by sides 49. The walls 47 and 48 are continuations of the walls 30 and 31 while the sides 49 extend downwardly from the lower end of the intermediate section 21 at or near the sides 36 of the recesses 34 that form the notches 35.

The trunnion 46 is carried at the lower end of the projection 45 and projects downwardly and inwardly on an axis that intersects or is offset to intersect the central vertical axis of the structure. As shown, the trunnion 46 is a bearing element with inner and outer bearing races 49 and 50 and with a retainer race 51. A cutter X is rotatably and antifrictionally carried on the trunnion 46 with inner and outer rollers 52 and 53 operating between the races of the trunnion and cutter, and with balls

54 operating between the retainer races of the trunnion and cutter. It will be apparent how the balls 54 retain the cutter X on the trunnion 46 so that it is rotatable, there being a plug 55 secured in an opening in the trunnion to retain the balls in proper working position.

The manifold Z is a unitary element of the drilling bit that I have provided and is such that it may be varied as circumstances require in order to suitably handle the circulating fluid or mud which is delivered by the drilling string through the drill pipe and/or collar 33. The manifold Z not only serves to handle fluid, but acts primarily to close the lower end of the body section 20 and bore 30, and to tie and secure the segments 15, 16, and 17 together into the tubular body Y. The manifold Z involves generally a central flow tube 56, lateral extensions 57 and fluid handling openings or jets 58.

The central flow tube 56 is an elongate vertically disposed part with a cylindrical outer wall 60 open at the upper end and closed at the lower end by a bottom 61. The bottom 61 is substantially a flat horizontally disposed plate-like part. The tube 56 corresponds substantially with the diameter of the inner wall 30 of body section 21, preferably somewhat smaller in diameter in order to establish suitable clearance, and has a turned upper end portion 62 carried in the guide or seat 42, and an upper end face 63 in abutment with the shoulder 41. It will be apparent how the parts thus related are easily assembled and act to position themselves relative to each other.

In the form of the invention shown in Figs. 1 and 3 of the drawings, the extensions 57 are more or less minimum in size and lateral extent, there being three equally spaced extensions so that each extension occurs between adjacent cutters X. As shown, each extension 57 projects radially from the central tube 56 and involves a bottom 64 continuing from the bottom 61, a top 65 joined to and projecting laterally from the wall 60, side walls 66 joined to and projecting laterally from the wall 60, and an outer end wall 67 closing the extension. The extensions 57 conduct fluid laterally to the outer peripheral portion of the bit to be handled by the openings or jets 58 which are carried in the bottoms 64 at or near the outer periphery of the bit to direct fluid downwardly and onto the cutters X. As shown in Figs. 1 and 3 of the drawings, there may be a plurality of openings or jets 58, for example, one opening in each extension 57 and one or more openings in the bottom 61 of the manifold. The opening in the bottom may be on the central vertical axis of the bit to direct fluid onto the center portion of the cutters X. The openings or jets 58 may be provided with orifice bushings or inserts secured in place by brazing or the like in order to reduce erosion and wear.

In Fig. 5 of the drawings, I have illustrated a modified form of the invention wherein extensions 57' are provided which are elongated or extended in order to carry the openings or jets 58' outward of the cutters X so that fluid is directed downwardly and onto the bottom of the well bore, by passing the cutters X.

It is a feature of the present invention to provide a roller bit structure that is easily machined and assembled. I have illustrated, in Fig. 6 of the drawings, a typical segment of my roller bit construction in the process of being turned or ground. It is to be observed that the segment (15, 16, or 17) is a straight elongate part with the trunnion 46 angularly related thereto to project downwardly and away from said part. It is to be observed that the segment is of limited circular extent and is devoid of any parts designed to extend diametrically of the finished bit construction. In this latter respect, it is the manifold Z which is provided to extend diametrically of and to close the bore 40 and to tie the segments 15, 16, and 17 together.

With the segments 15, 16, and 17 formed as above described the bearing races 49 and 50 and retainer race 51 are completely accessible for machining, there being

no restriction whatsoever radially of the trunnion axis. A preferred method of machining is shown in the drawings which is accomplished by cutting a center drilled opening 70 in a projection 71 at the inner end of the trunnion 46 and a center drilled opening 72 in the exterior of the leg C or at the outer wall 48. As shown, a boss 73 is provided on the wall 48 to receive the center drill and opening. The projection 71 and boss 73 may be removed after the machining and grinding are completed. Thus the segment of the body Y may be machined on center 74 and 74' using cutting tools 75 of ample size and durability.

In order to assemble the bit that I have provided the roller cutters X are placed in operating position on the trunnions 46 whereupon the segments 15, 16, and 17 are brought together with the side faces 23 in abutment with each other and with the manifold Z in operating position. It will be apparent that the turned end portion 62 of the manifold aligns with the guides or seats 42 of the segments so that the segments are properly positioned. Suitable dowel pins 76 and/or dowel openings 77 may be provided in the faces 23 in order to facilitate positioning of the segments in different machines during the process of manufacturing. The dowels 77 position segments for drilling center holes 70 and 72 so that the segments are maintained at a given height for the various machining operations. The extensions 57 of the manifold Z project laterally of the flow tube 56 and are accommodated by the recesses 34 in the segments which form the notches 35.

In order to secure the parts together in the relationship above described, the welding W is applied in the manner clearly shown throughout the drawings. In practice, each vertical joint between the sections 20 of the segments are joined at the inner wall 25 by a seam weld 100, and the manifold Z is secured in position and joined to the segments 15, 16, and 17 by a continuous circular seam weld 101 that connects with the welding 100. Thus the segments are permanently joined and the flow of fluid is sealed and confined to flow through the bore 40.

In addition to the welding 100 and 101 the bottom of the manifold Z is secured to the lower portion of the section 21 by seams of welding 102 which in effect join the manifold Z to the upper ends of the legs C (see Fig. 3). As best shown in Fig. 4, the extensions 57 or 57' are secured to the intermediate body portion B by means of a seam weld 103 that joins the outer end portions of the extensions to the periphery of the body B. Further, the abutting faces 23 of the segments are secured together at the exterior of the body portion B by welding 104. It will be apparent that suitable chamfers and the like may be provided to receive the welding as circumstances require.

From the foregoing it will be apparent that I have provided an extremely simple and easily manufactured roller bit. The bit that I have provided is extremely compact and of durable rugged construction, and such as to facilitate the manufacture by means of substantially accurate and durable cutting tools and equipment. Further, each of the segments may be identical and easily forged or otherwise formed and shaped of the desired durable material, such as high quality steel, and each is then machined without excessive waste of materials. Since each segment is individually machined on centers, all of the bearing surfaces are perfectly round and true and concentric with each other, and the resulting finished segment is metallurgically sound with case hardened surfaces that are concentric and of uniform thickness.

Having described only typical preferred forms and applications 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 and fall within the scope of the following claims.

Having described my invention, I claim:

1. A well drilling roller bit including, an elongate segmental body with a coupling section, depending in-

intermediate body sections and cutter carrying sections, a longitudinal bore extending through the coupling and body sections, an angularly disposed trunnion carried at the terminal end portion of each cutter carrying section, the intermediate body sections being of limited circumferential extent and circumferentially spaced in order to gain unrestricted access radially of the trunnion of each individual cutter carrying section before assembly thereof, and a fluid handling manifold carried by the segmental body to close the said bore at the lower end of the intermediate section and having lateral extensions projecting radially between the circumferentially spaced intermediate body sections, said intermediate body sections being secured one to the other and to the manifold and extensions thereof.

2. A well drilling roller bit including, an elongate segmental body with a coupling section, depending intermediate body sections and cutter carrying sections, a longitudinal bore extending through the coupling and body sections, the intermediate body sections being of limited circumferential extent and circumferentially spaced, there being a turned seat concentric with the axis of the body and at the lower end of the said bore, and a fluid handling manifold at the lower end of the intermediate section of the body and comprising, a central flow tube with a turned portion engaged with the said seat and in communication with the said bore and having lateral extensions projecting radially between the circumferentially spaced intermediate body sections, said intermediate body sections being centered by the turned portion of the manifold and secured one to the other and to the manifold and extensions thereof by welding.

3. A well drilling roller bit including, an elongate segmental body with a coupling section, depending intermediate body sections and cutter carrying sections, a longitudinal bore extending through the body, there being a downwardly faced shoulder and a turned seat concentric with the axis of the body and at the lower end of said bore, and a fluid handling manifold at the lower end of the intermediate section of the body and comprising, a central flow tube with an upwardly disposed face engaging the said shoulder and with a turned portion engaged with said seat and in communication with said bore, and with lateral extensions with restricted openings therein forming jets directing fluid downwardly, said intermediate body sections being longitudinally positioned by the face on the manifold and centered by the turned portion of the manifold and secured one to the other and to the manifold by welding.

4. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the body when the segments are assembled, the intermediate body sections being of limited circumferential extent and circumferentially spaced, and a fluid handling manifold at the lower end of the intermediate section of the body and comprising, a central flow tube carried in and in communication with the bore, and with extensions lying between the depending circumferentially spaced intermediate body sections and projecting radially of the flow tube and with restricted openings therein forming jets directing fluid onto the bottom of the well, said body segments being secured one to the other and to the manifold and lateral extensions thereof by welding.

5. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the body when the segments are assembled, there being a downwardly faced shoulder and an arcu-

ately turned seat in each segment concentric with the axis of the body and at the lower end of the said bore, the intermediate body sections being of limited circumferential extent and circumferentially spaced, and a fluid handling manifold at the lower end of the intermediate section of the body and comprising, a central flow tube with an upwardly disposed face engaging the said shoulder and with a turned portion engaged with the said seats and in communication with the said bore, and having lateral extensions projecting radially between the circumferentially spaced intermediate body sections, each of said body segments being longitudinally positioned by the face on the manifold and centered by the turned portion of the manifold and secured one to the other and to the manifold and extensions thereof by welding.

6. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner well forming a bore through the coupling and intermediate sections when the segments are assembled, seams of welding at the coupling section and joining the segments along the inner wall of the coupling section, and a fluid handling manifold having a bottom extending diametrically of the tubular body at the lower end thereof and joined by welding to the body and sealing with the body and directing fluid received from said bore.

7. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the coupling and intermediate body sections when the segments are assembled, seams of welding at the coupling section and joining the segments along the inner wall of the coupling section, and a fluid handling manifold having a bottom extending diametrically of the tubular body at the lower end thereof and having a tubular part joined by a seam of welding to the said inner walls at the coupling section and sealing with the body and directing fluid received from said bore.

8. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the coupling and intermediate body sections when the segments are assembled, seams of welding extending longitudinally of the coupling section and joining the segments along the inner wall thereof, and a fluid handling manifold having a bottom extending diametrically of the tubular body at the lower end of the intermediate section and having a tubular part joined by a seam of welding to the said inner walls at the coupling section and sealing with the body and directing fluid received from said bore, there being seams of welding joining the manifold to the exterior of the intermediate section.

9. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the coupling and intermediate body sections when the segments are assembled, seams of welding extending longitudinally of the coupling section and joining the segments along the inner wall thereof, and a fluid handling manifold having a bottom extending diametrically of the tubular body at the lower end of the intermediate section and having a tubular part joined by a seam of welding to the said inner walls at the coupling section and sealing with the body and directing fluid received from said bore, there being continuous seams of welding joining the manifold to the exterior of the intermediate section adjacent the cutter carrying section.

10. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the coupling and intermediate body sections when the segments are assembled, seams of welding extending longitudinally of the coupling section and joining the segments along the inner wall thereof, and a fluid handling manifold having a bottom extending diametrically of the tubular body at the lower end of the intermediate section and having a tubular part joined by a continuous seam of welding to the said inner walls at the coupling section and sealing with the body and directing fluid received from said bore, there being continuous seams of welding at the exterior of the body and joining the manifold and body.

11. A well drilling roller bit including, an elongate tubular body made up of like longitudinally disposed segments each with a coupling section, an intermediate body section and a depending cutter carrying section, and each having an arcuate inner wall forming a bore through the coupling and intermediate body sections when the segments are assembled, seams of welding extending longitudinally of the coupling section and joining the segments along the inner wall thereof, and a fluid handling manifold having a bottom extending diametrically of the tubular body at the lower end of the intermediate section and having a tubular part joined by a seam of welding to the said inner walls at the coupling section and sealing with the body and directing fluid received from the bore, there being continuous seams of welding at the exterior of the body and joining the manifold and body and joining the manifold to the lower portion of the intermediate section at the cutter carrying sections.

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