July 16, 1957 A. W. KAMMERER, JR 2,799,477

EXPANSIBLE DRILL BITS

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Fig. 1.

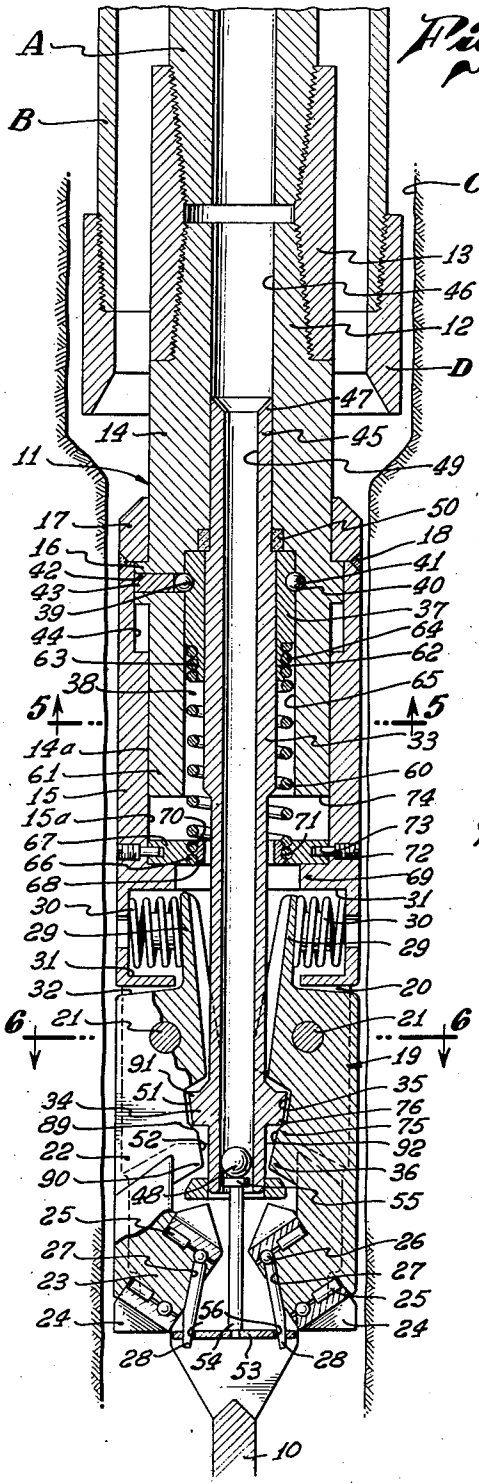
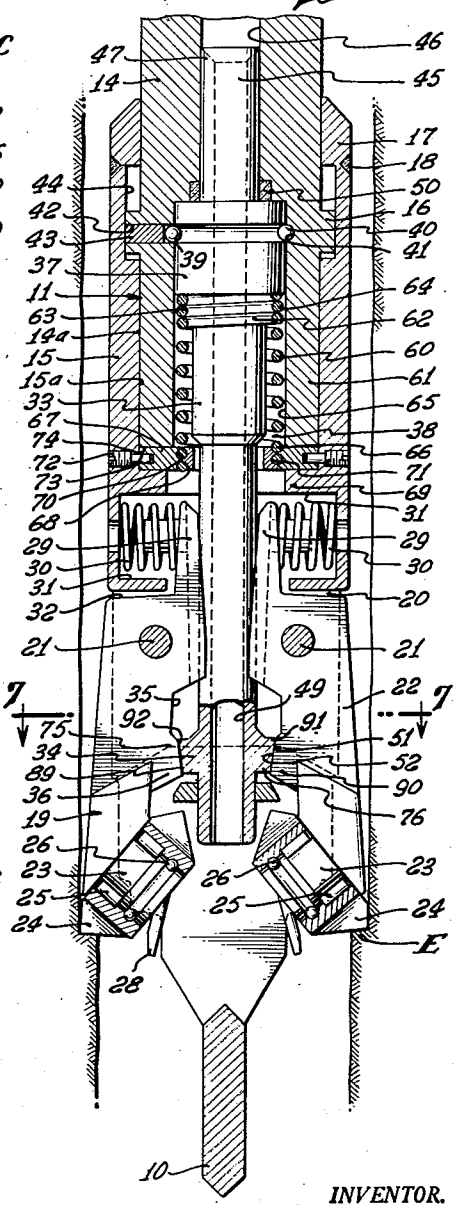


Fig. 2.



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Fig. 3.

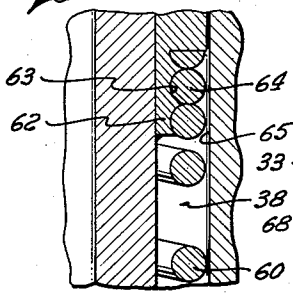


Fig. 4.

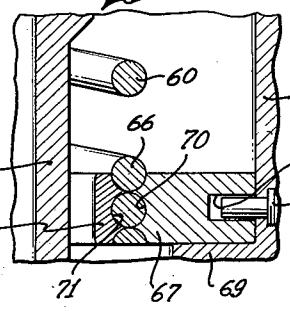


Fig. 8.

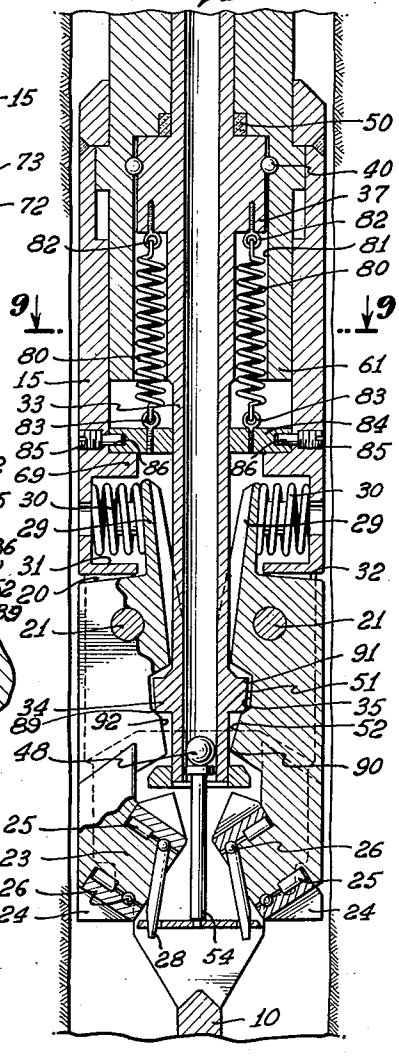


Fig. 5.

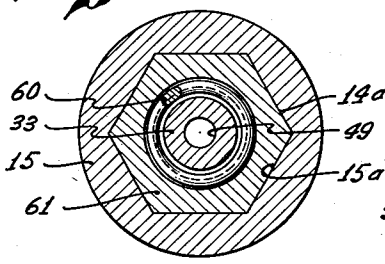


Fig. 10.

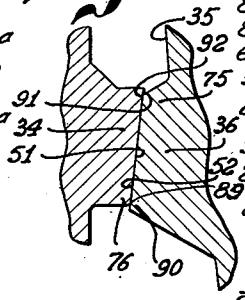


Fig. 6.

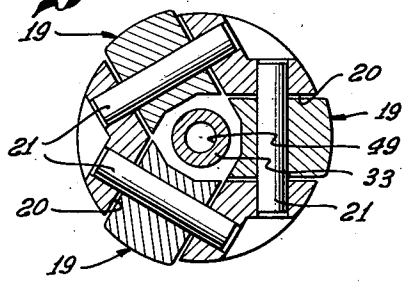


Fig. 9.

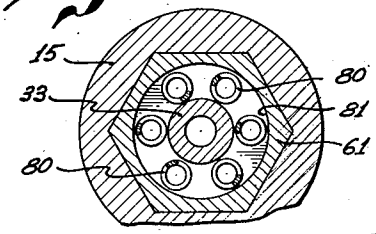
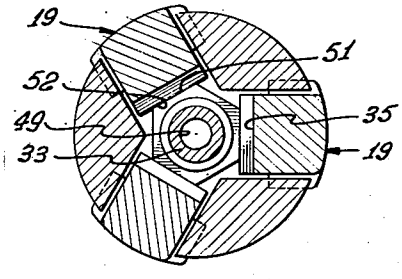


Fig. 7.



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United States Patent Office

2,799,477

Patented July 16, 1957

2,799,477

EXPANSIBLE DRILL BITS

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Application September 21, 1953, Serial No. 381,325

8 Claims. (Cl. 255—76)

The present invention relates to drill bits, and more particularly to rotary bits of the expansible type for drilling or reaming bore holes below well casing, or other well conduits, the diameter of the holes being greater than the inside diameter of the casing through which the bits are capable of passing.

Expansible drill bits are known in which the cutters are expanded laterally outward and locked in such expanded position through the medium of a mandrel telescopically arranged in the body of the drill bit. Usually, the mandrel moves down relative to the body to lock the cutters in an outward position. When the mandrel moves up relative to the body, the cutters are released and can be moved inwardly toward retracted position.

There are disadvantages to bits of the above type heretofore produced. A downward force must be maintained on the mandrel to hold it in its locked position for the purpose of securing the cutters in their expanded position. Elimination of this downward force, which may occur as a result of the cutters no longer engaging a formation shoulder, allows the body and cutter to move or drop down with respect to the mandrel, thereby, in effect, producing relative elevation of the mandrel in the body and shifting the mandrel to an unlocked position that could allow the cutters to retract, at least partially. It then becomes necessary to reshift the mandrel down in the body to again lock the cutters in their fully expanded position, but before this occurs, a length of undergauged hole might be drilled.

Accordingly, it is an object of the present invention to provide an expansible type of drill bit in which the cutters are locked in their fully expanded position, despite the relieving of the cutters of drilling weight, such as occurs when the cutters are elevated above the formation shoulder on which they have been operating, or the cutters enter a cavity, or the like, in the bore hole.

Another object of the invention is to provide an expansible type of drill bit embodying a locking mandrel telescoped in the bit body, in which the mandrel is maintained in its locking position in the body to hold the cutters in their outward expanded condition, despite the absence of drilling weight on the cutters.

In well bore drill bits of the expansible type referred to above, the telescoping of the mandrel in the bit body places a locking member behind the cutter device to hold the latter outwardly in its fully expanded condition. The cutter device and locking member are bearing upon each other, which can produce wear between the parts and the formation of a ridge or shoulder on the parts that might prevent subsequent retraction of the locking member from the cutter device. Should this occur, difficulty is encountered in shifting the locking member to a releasing position that will enable the cutter device to retract.

It is, therefore, still a further object of the invention to so relate the locking member and cutter device to each other that wear between the parts cannot prevent retraction of the locking member from the cutter device.

Another object of the invention is to facilitate retraction of the locking member of an expansible drill bit from the cutter device.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section through one embodiment of the invention disposed in a well bore, with its cutters and other parts in their initially retracted positions;

Fig. 2 is a longitudinal section, similar to Fig. 1, disclosing the cutters locked in their fully expanded position;

Fig. 3 is an enlarged fragmentary longitudinal section of a portion of the device;

Fig. 4 is an enlarged fragmentary longitudinal section of another portion of the device;

Fig. 5 is a cross-section taken along the line 5—5 on Fig. 1;

Fig. 6 is a cross-section taken along the line 6—6 on Fig. 1;

Fig. 7 is a cross-section taken along the line 7—7 on Fig. 2;

Fig. 8 is a longitudinal section, corresponding to Fig. 1, of another embodiment of the invention;

Fig. 9 is a cross-section taken along the line 9—9 on Fig. 8;

Fig. 10 is an enlarged fragmentary longitudinal section of the locking portion of the device in the locked position shown in Fig. 2.

The expansible drill bit disclosed in the drawings is specifically of the kind shown in the patent to Archer W. Kammerer, Patent No. 2,545,036, to which attention is invited. The rotary drill bit is attached to a string of drill pipe A, by means of which it is lowered through a well casing B in a well bore C to a point below the casing shoe D at which the diameter of the bore hole is to be enlarged. The drill bit may have a pilot bit 10 at its lower end for centering the tool in a hole that may have already been drilled, or for drilling the central portion of a new hole in the absence of pre-existing hole. The main portion of the bit is capable of enlarging the bore hole by producing and operating upon a formation shoulder E, as hereinafter described.

The upper end of the bit consists of a driving mandrel 11 whose upper pin 12 is threadedly connected to a sub 13 forming the lower end of the drill pipe string A. This mandrel includes an upper Kelly or drill stem member 14 slidably splined to the main body 15 of the bit. The exterior 14*a* of the kelly is hexagonally shaped, being telescopically received in a companion hexagonal socket 15*a* formed in the body 15. The mandrel 11 has a limited range of longitudinal movement within the body, its upward movement being limited by engagement of an external shoulder 16 on its Kelly portion 14 with a retainer ring 17 at the upper end of the body, which may be secured to the latter by the use of welding material 18.

The body 15 has a plurality of expansible parts mounted on it comprising cutter supporting members 19 pivotally mounted in body slots 20 on hinge pins 21 suitably welded to the body. Each cutter supporting member 19 consists of a depending leg 22 having a bearing supporting pin 23 inclined inwardly and downwardly and on which a roller side cutter 24 is rotatably mounted. Anti-friction roller and ball bearing elements 25, 26 are preferably placed between each cutter 24 and bearing pin 23, the roller bearing 25 transmitting radial thrusts and

the ball bearings 26 both radial and axial thrusts. The ball bearings 26 also retain each cutter 24 on a pin 23, being inserted and placed in a passage 27 of the bearing support, which is then closed by a plug 28 welded to the pin. The plug or pin 28 depends from the passage 27 and is used to hold the cutters 24 in retracted position, as explained below.

Each cutter supporting member 19 also includes an upwardly extending arm 29 against which an elastic expander 30 bears. This expander, in the form of a compressed coil spring, is received within a retainer pocket 31 in the body and exerts its force against the arm 29, tending to swing it inwardly and thus urge the cutters 24, on the other side of the fulcrum pin 21, in an outward direction. The extent of this outward movement is limited by engagement of suitable stop shoulders 32 on opposite sides of each cutter supporting member 19 with cooperable stop portions (not shown) of the body.

After the cutters 24 have been expanded outwardly by the expander springs 30 to a maximum extent, they can be locked in this position by a tubular member 33 of the mandrel, which is piloted in the kelly 14. This member is provided with a lock portion 34 movable from an upper position in transverse alignment with inner supporting member recesses 35, that allow retraction of the cutters 24, to a lower position opposite lugs 36 formed on and projecting inwardly from the cutter supporting legs 22, which prevent retraction of the cutters.

The tubular member 33 is connected in swivel fashion to the kelly 14 to permit slight relative arcuate or rotary movement therebetween. However, the kelly 14 and tubular member 33 are coupled together for longitudinal movement in both directions. This is accomplished by providing an anti-friction thrust bearing between the kelly and a boss or shoulder 37 fixed on the tubular member 33. The boss is received within a lower socket 38 in the kelly and has a toroidal raceway 39 on its exterior around which a plurality of bearing balls 40 can ride. These balls are also received in an opposed toroidal raceway 41 in the kelly.

The balls 40 are insertable into the raceways 39, 41 through a passage 42 extending through the external shoulder 16 on the kelly 14 communicating with its internal race 41. After the balls have thus been disposed in position, the hole 42 is closed by a suitable plug 43, which is prevented from moving outwardly of the kelly by the inner wall 44 of the surrounding body 15.

The tubular member 33 has an upper portion 45 extending into the central bore 46 of the kelly 14, with the upper terminus 47 of the member 45 flaring upwardly and outwardly to guide a ball 48, or a corresponding element, into the central passage 49 of the tubular member. Fluid pumped down the drill pipe string A will flow through the Kelly pin 12 and into the central passage 49. It is prevented from flowing around the exterior of the tubular member 33 by a suitable packing 50 disposed between the upper portion 45 of the tubular member and the kelly 14 adjacent the upper end of the tubular member boss 37.

The arrangement between the tubular member 33 and kelly 14 is such that both downward and upward movement is transmitted between the kelly 14 and tubular member 33 from one raceway 39 or 41, through the ball bearing elements 42, to the other raceway 41 or 39. In this manner, the kelly and tubular member are caused to move jointly in both longitudinal directions, but they are free to partake of relative movement therebetween to allow proper alignment and engagement between the faces 51 on the lock portion 34 and the companion faces 52 on the lugs 36.

When the mandrel 11 and its tubular member 33 are disposed in an upward position relative to the body 15, to place its lock portion 34 opposite the cutter supporting recesses 35, the cutters 24 and their supporting members 19 may be retained in their inward retracted position against the force exerted by the springs 30. The holding device for accomplishing this purpose includes a holding member 53 secured to the lower end of a central rod 54 whose upper end projects into the tubular member passage 49. A head 55 is secured to the upper end of the rod 54, having substantial clearance in the passage 49, to allow fluid to pass upwardly into the central passage 49 and into the drill string A. The holding member 53 has spaced holes 56 in its outer portions for receiving the lower ends of the ball bearing plugs 28.

When the holding device is disposed over the plugs 28 (Fig. 1), the cutter supporting members 19 are prevented from expanding under the influence of the springs 30, thereby holding the cutters 24 in retracted position. Release of the holding member 53 from the plugs occurs as a result of fluid pressure acting downwardly on the ball 48, which can rest on the head 55, the ball having substantially the same diameter as the passage diameter, to allow fluid pressure to be built up thereabove.

When fluid pressure is applied to the fluid in the drill pipe A and the mandrel passage 49, it can shift the ball 48, rod 54 and holding member 53 downwardly, to free the latter from the plugs 28 and thereby allow the springs 30 to move the arms 29 inwardly and the cutters 24 outwardly. The drill pipe A and drill bit are rotated, the springs 30 urging the cutters outwardly until they are in their fully expanded position and have produced a formation shoulder E in the wall of the well bore C. Thereafter, downward movement of the mandrel 11 within the body 15 will place the lock portion 34 of the tubular member 33 behind the supporting member lugs 36 to positively hold the cutters 24 in their outward position.

The mandrel 11 will be disposed in its downward position within the body 15, to secure the lock portion 34 behind the lugs 36, so long as downward drilling weight is being imposed on the tool, with the cutters 24 resting upon the formation shoulder E. In the present instance, it is desired to insure the retention of the lock portion behind the cutter supporting member lugs after the cutters have been expanded fully outwardly, despite the elevation of the drill pipe A and the mandrel 11 in the well bore, or in the event drilling weight is no longer being imposed on the cutters 24 for some other reason, as the entry of the tool into a cavity in the well bore C. However, despite the fact that it is desired to hold the lock portion 34 behind the lugs 36, in prior tools, elevation of the mandrel 11 within the body 15 will take place, elevating the lock portion 34 in alignment with the supporting member recesses 35 and allowing the cutters 24 to retract.

As disclosed in Figs. 1 to 7, inclusive, the foregoing purposes are achievable through use of a spring device. Thus, a tension spring 60 encompasses the tubular member 33, the spring extending upwardly within the Kelly socket 38, the latter having a skirt or sleeve 61 depending by a substantial extent below the boss or shoulder 37 of the tubular member 33. The upper end of this tension spring is secured to the boss or retainer sleeve 37, that may be suitably welded to the tubular member 33 for purposes of assembly of the apparatus, the retainer sleeve 37, in effect, constituting a part of the tubular member 33 and mandrel 11. The boss or shoulder containing the raceway 39 for the balls 40 is actually formed in the retaining sleeve 37. The lower portion 62 of the retaining sleeve is reduced in external diameter, being provided with an external groove 63 formed as a thread corresponding to the pitch of the upper spring turns 64 when collapsed against one another. The upper turns 64 of the tension spring are threaded onto the external threads 63 of the retainer sleeve 37, such turns of the spring being incapable of removal from the retainer sleeve since their outer surfaces are closely adjacent the inner wall 65 of the socket 38. That is to say, the spring turns 64 cannot move laterally outward a sufficient extent, before engaging the inner wall 65 of the socket, to bring

them out of engagement with the external threads 63 formed on the retainer sleeve 37.

The lower end of the spring 60 is anchored to the body by means of a retainer device. Thus, the lower turns 66 of the spring are collapsed adjacent one another, being received within and between an outer ring 67 and an inner ring 68, the outer ring resting on a body shoulder 69. The outer ring 67 has an internal thread-like groove 70 formed therein corresponding to the pitch of the spring turns 66, whereas the inner ring 68 has a similar external threaded groove 71 formed therein corresponding to the lower spring turns 66. The outer ring 67 is prevented from moving longitudinally of the body 15, being secured to the latter by one or more retainer pins or screws 72 threaded through the wall of the body, with their inner ends disposed within a peripheral ring groove 73. It is evident that the tension of the spring 60 on the outer ring 67 is incapable of moving the latter longitudinally, since it is secured to the body by the retainer pins 72, whereas the spring 60 cannot move inwardly of the outer ring 67 and out of the threaded grooves 70, 71 because of the holding action of the inner ring 68. Accordingly, the lower end of the spring 60 is securely attached to the main body 15 of the drill bit.

When the cutters 24 are held in their retracted position by the holding member 53, the lower end 74 of the Kelly skirt or sleeve 61 is disposed a substantial distance above the outer ring 67, the tubular member 33 being in an elevated position with its lock portion 34 disposed opposite the supporting leg recesses 35. At this time, the tension spring 60, which can exert a substantial force tending to move the body 15 relatively in an upward direction along the mandrel 11, is incapable of accomplishing this purpose, since the upper portions 75 of the lugs 36 engage the lower portions 76 of the lock member 34 on the mandrel, the holding member 53 retaining the lugs 36 in their inward position. However, once the holding member 53 has been released and the springs 30 have urged the cutter supporting members 19 and the cutters 24 outwardly to their fully expanded position, the spring 60 is operative to, in effect, lift the body 15, the cutter supporting members 19, and the cutters 24 upwardly along the mandrel 11, to dispose the lugs 36 fully opposite the lock portion 34 of the tubular member 33. Such upward elevating movement is limited by the engagement of the lower end 74 of the skirt or sleeve 61 with the outer spring retaining ring 67. Such engagement definitely locates the lock portion 34 of the tubular member longitudinally along the lugs 36 of the supporting member legs 22.

The spring 60 will retain the parts in the position just described, despite the imposition of drilling weight on the tool, or the lack of any drilling weight on the tool.

The drill bit is disposed in the condition shown in Fig. 1, in which the holding member 53 is connected to the cutter plugs 28, the mandrel 11 being in its upward position with respect to the body 15. The tension spring 60, which can exert a substantial force, is ineffective at this time, since the lock portion 34 of the mandrel 11 engages the upper portions 75 of the lugs 36. The tool is attached to the drill pipe A and is lowered through the well casing B. During such lowering action, the fluid in the well bore can pass upwardly into the drill pipe A by flowing around the rod head 55 and through the tool passages 49, 46. At this time, the ball 48 may occupy some upper position above the upper end 47 of the tubular mandrel 33. When it is desired to commence the hole enlarging operation below the casing shoe D, the pump pressure is applied to the fluid in the drill pipe, which pumps the ball 48 down into the tubular member passage 49 until it engages the rod head 55. When sufficient pressure is applied, the ball 48 will force the head 55 and rod 54 downwardly, to remove the holding member 53 from the plugs 28, whereupon the coil springs 30 are effective to commence moving the supporting

member arms 29 inwardly and the legs 22 and cutters 24 in an outward direction. The drill pipe A is rotated, the cutters 24 digging into the wall of the hole C until the cutters have been expanded to their maximum outward condition, to form the transverse shoulder E in the well bore. When the cutters 24 have been expanded outwardly to almost their full extent, the upper portions 75 of the lugs are no longer engaging the lower ends 76 of the lock portion 34 of the mandrel 11, so that the tension spring 60 is then effective to shift the mandrel 11 in a downward direction relative to the body 15. In fact, it may be effective to shift the body 15, supporting members 19 and cutters 24 in an upward direction. However, the tension spring 60 is instrumental in producing the relative downward telescoping action of the mandrel 11 in the body 15 even though downward drilling weight may not as yet have been imposed on the drill pipe A, to dispose the lock portion 34 fully behind the lugs 36 of the supporting members 19. The spring 60 is effective to shift the mandrel 11 downwardly with respect to the body 15 to the extent determined by engagement of the lower end 74 of the skirt or thrust sleeve 61 with the outer spring retaining ring 67.

Down weight may now be imposed on the drill pipe A and the mandrel 11 of the tool, this weight being transmitted through the outer ring 67 to the body shoulder 69, and from the body 15 of the tool to the cutters 24. Rotation of the drill pipe is continued, to cause the hole to be enlarged by reason of the cutters 24 rolling around the formation shoulder E. During this time, the down weight, by itself, is sufficient to hold the lock portion 34 of the mandrel 11 behind the lugs 36, so as to insure the retention of the cutters 24 in their full outward expanded position. In the event the drill pipe A is elevated, to raise the cutters 24 above the shoulder E, the tension spring 60 exerts sufficient force to also elevate the body 15 with the mandrel 11, retaining the outer ring 67 against the bottom 74 of the mandrel skirt or sleeve 61. Accordingly, the lock portion 34 of the mandrel is still held completely behind the lugs 36 of the supporting members 19, so that the cutters 24 are retained in their outward expanded position. Accordingly, if the drill pipe A is again lowered and the cutters 24 brought into engagement with the formation shoulder, assurance is had that the cutters are still fully expanded and that they will drill a full size hole.

The foregoing condition could also be presented if the tool were to be lowered into a cavity (not shown) in the well bore C. Such action would eliminate the drilling weight on the cutters 24, but the tension spring 60 would still be effective to hold the body 15 to its fullest extent in an upward position along the mandrel 11, with the ring 67 remaining in engagement with the lower end 74 of the skirt or sleeve 61. Accordingly, the cutters 24 would remain locked in an outward expanded position and could not retract, even partially, which could occur if the body 15 of the tool were allowed to drop down with respect to the mandrel 11. Such dropping action could obviously occur if the tension spring 60 were omitted.

In the event it is desired to remove the tool from the well bore, the drill pipe A is elevated, the cutters 24 remaining in their outward expanded position so long as they are disposed in the enlarged diameter portion of the well bore. Should they move into an upper restricted diameter portion, or into engagement with the casing shoe D, the further elevation of the cutters 24 would be prevented. However, an upward pull taken on the drill pipe A then elevates the mandrel 11 within the body 15 against the tension force of the spring 60, since the body cannot move upwardly at this time. Accordingly, the lock portion 34 is moved up above the lugs 36 and opposite the recesses 35, allowing the wall of the restricted diameter well bore or the casing shoe D to act upon the outer surfaces of the supporting members 19 and

shift the supporting members inwardly against the force of the expanding springs **30**. The supporting members **19** and cutters **24** can then be pulled completely within the well casing B and will remain in this retracted position, the outer surfaces of the supporting members **19** merely riding along the wall of the well casing. During this time, the spring **60** is ineffective to shift the lock portion **34** relatively downward, since the wall of the well casing B is holding the cutter supporting members **19** inwardly and the lower ends **76** of the lock portion can do nothing more than bear against the upper ends **75** of the lugs **36**. The tool can be elevated by means of the drill pipe A in the well casing B until it is completely withdrawn from the well bore at the top of the hole.

In the form of invention shown in Figs. 8 and 9, the same action can occur as in the other embodiment described above. However, in place of a single tension spring, a plurality of smaller diameter springs **80** is disposed in the annular space **81** between the Kelly skirt or sleeve **61** and the tubular member **33**. The upper ends of the springs **80** are connected to screw eyes **82** threaded into the boss or shoulder **37** of the tubular member **33**. The lower ends of the springs **80** are also attached to screw eyes **83** threaded into a retainer ring or washer **84** secured to the body **15** by retainer screws or pins **85** threaded into the wall of the body and extending into a peripheral groove **86** in the washer, this washer resting upon the shoulder **69** in the body **15**.

The plurality of coil springs **80** can be used to provide a greater tensile force than the single spring **60** disclosed in the other embodiment of the invention, although the single spring is more than adequate to exert the required force to hold the lock portion **34** of the mandrel fully behind the cutter supporting member lugs **36**. In all respects, the embodiment of the invention shown in Figs. 8 and 9 operate in the same manner as the other form of the invention.

In both forms of the invention, it is desired to facilitate the retraction of the mandrel **11** to its upward position within the body **15** whenever the tool is to be withdrawn from the well bore. During the operation of the tool in the well bore, with the cutters **24** in their fully expanded position, there is a certain amount of vibration or impacting of the cutter lugs **36** against the lock portion **34** of the mandrel. Such lugs may form a slight indentation in the lock portion **34** of the mandrel, or the lock portion of the mandrel may form a slight indentation in the lugs **36**. If the lower ends **89** of the lock portion faces of the mandrel were to extend below the lower portion **90** of the lugs, a lower shoulder or ridge may be formed in the outer faces **51** of the lock portion, and this lower ridge could then engage the lower ends **90** of the lugs, to preclude the elevation of the mandrel **11** with respect to the cutter lugs **36**, preventing their disposition in the releasing position, that will allow the cutters **24** to retract.

A similar condition would also occur if the upper ends **91** of the lock portion faces **51** were disposed below the upper ends **92** of the lug faces **52**. The impacting action between these parts would then cause the lock portion to indent the inner faces **52** of the lugs, forming a slight inward projection or shoulder in a lug that would catch on the upper ends **91** of the lock portion **34** and preclude elevation of the latter along the lugs to a releasing position.

The foregoing inability to elevate the mandrel to a releasing position is overcome in the present instance by so relating the lock portion faces **51** to the lug faces **52** that the lower ends **89** of the lock portion faces, when the mandrel **11** is fully telescoped downwardly within the body **15**, do not extend below the lower ends **90** of the lug faces. Similarly, the upper ends **91** of the lock portion faces **51** do not extend below the upper ends **92** of the lug faces **52**. Accordingly, during the impacting action between the lock portion **34** and the lugs **36**, any ridge or shoulder would be formed by the lower ends **89** of the lock portion **34** on the lugs **36**, this lower shoulder being disposed below the lower ends **89** of the lock portion, and thereby being incapable of preventing elevation of the latter with respect to the lugs. Similarly, the upper ends **92** of the lugs **36** could, at best, merely form an upper indentation or a shoulder in the upper ends of the lock portion **34** of the mandrel, but this shoulder would be above the upper ends **92** of the lugs **36** and could not preclude elevation of the lock portion **34** with respect to the lugs **36**.

To further facilitate withdrawal of the lock portion **34** from its locking position behind the lugs **36**, the outer surfaces **51** of the lock portion that engage the lugs are tapered slightly in a downward and inward direction with respect to the axis of the tool. These surfaces engage companion surfaces **52** that are similarly inclined on the lugs when the cutter supporting members **19** and cutters **24** are in their full outward expanded position. The extent of the taper is relatively slight, for example, being of the order of about five degrees to the axis of the tool. Such slight taper facilitates the upward elevation and withdrawal of the lock portion **34** out of engagement with the lugs **36**, but, at the same time, the angle is insufficient to cause any reactive force of the formation upon the cutters **24** to act upon the lock portion **34** and tend to elevate the mandrel **11** within the body **15**. The reactive force transmitted between the lugs **36** and the lock portion **34** is still practically entirely normal to the axis of the tool.

The inventor claims:

1. A rotary well drilling bit, including a main body, cutter means pivotally mounted on said body for expansion laterally outward of said body, means for expanding and holding said cutter means laterally outward, said expanding and holding means including a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel being movable relatively downward of said body to hold said cutter means laterally outward, and means disposed at least partially within said mandrel at the region where said mandrel is slidably splined to said body and operatively engaging said body and mandrel to urge said mandrel relatively downward in said body to maintain said mandrel in said position wherein it holds said cutter means laterally outward.

2. A rotary well drilling bit, including a main body, cutter means pivotally mounted on said body for expansion laterally outward of said body, means for expanding and holding said cutter means laterally outward, said expanding and holding means including a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel being movable relatively downward of said body to hold said cutter means laterally outward, and spring means disposed at least partially within said mandrel at the region where said mandrel is slidably splined to said body and engaging said mandrel and body to urge said mandrel relatively downward of said body to maintain said mandrel in said position wherein it holds said cutter means laterally outward.

3. A rotary well drilling bit, including a main body, cutter means pivotally mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel including a portion movable in one longitudinal direction relative to said body into engagement with said cutter means to prevent inward movement of said cutter means from its outwardly expanded position, and spring means disposed at least partially within said mandrel at the

region where said mandrel is slidably splined to said body and engaging said body and mandrel to urge said mandrel portion relative to said body in said one longitudinal direction to maintain said mandrel portion in said position wherein it holds said cutter means laterally outward.

4. A rotary well drilling bit, including a main body, cutter means pivotally mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel including a portion movable in one longitudinal direction relative to said body into engagement with said cutter means to prevent inward movement of said cutter means from its outwardly expanded position, and means disposed at least partially within said mandrel at the region where said mandrel is slidably splined to said body and acting between said mandrel portion and body to releasably secure said mandrel portion relative to said body in engagement with said cutter means to prevent inward movement of said cutter means from its outwardly expanded position.

5. A rotary well drilling bit, including a main body, cutter means pivotally mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel including a portion movable downward relative to said body into engagement with said cutter means to prevent inward movement of said cutter means from its outwardly expanded position, and spring means disposed at least partially within said mandrel at the region where said mandrel is slidably splined to said body and engaging said body and mandrel to urge said mandrel portion downwardly relative to said body to maintain said mandrel portion in said position wherein it holds said cutter means laterally outward.

6. A rotary well drilling bit, including a main body, cutter means pivotally mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel including a portion movable downward relative to said body into engagement with said cutter means to prevent inward movement of said cutter means from its outwardly expanded position, and tension spring means disposed at least partially within said mandrel at the region where said mandrel is slidably splined to said body, said tension spring means having its lower portion engaging said body and its upper portion engaging said mandrel to urge said mandrel portion downwardly relative to said body to secure said mandrel portion in holding engagement with said cutter means.

7. In a rotary well drilling bit, including a main body, cutter means pivotally mounted on said body for expansion laterally outward of said body, means for expanding and holding said cutter means laterally outward, said expanding and holding means including a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel being movable relatively downward of said body to hold said cutter means laterally outward, and tension spring means extending upwardly into said mandrel at the region where said mandrel is slidably splined to said body and connected to said body and mandrel above said cutter means and constantly tending to urge said mandrel downward relative to said body to tend to secure said mandrel in holding engagement with said cutter means.

8. In a rotary well drilling bit, including a main body, cutter means pivotally mounted on said body for expansion laterally outward of said body, means for expanding and holding said cutter means laterally outward, said expanding and holding means including a mandrel connectible to a drill string and slidably splined to said body above said cutter means, whereby torque is transmitted directly from said mandrel to said body, said mandrel being movable relatively downward of said body to hold said cutter means laterally outward, tension spring means extending upwardly into said mandrel at the region where said mandrel is slidably splined to said body and having its lower portion connected to said body and its upper portion connected to said mandrel above said cutter means and constantly tending to urge said mandrel downward relative to said body to tend to secure said mandrel in holding engagement with said cutter means, and releasable latch means connected to said cutter means to hold said cutter means initially in retracted position on said body and prevent operation of said tension spring means until said latch means is released.

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