June 7, 1955 A. W. KAMMERER, JR 2,710,172

EXPANSIBLE DRILL BITS FOR ENLARGING WELL BORES

Filed Nov. 23, 1953 2 Sheets-Sheet 1

Fig. 1.

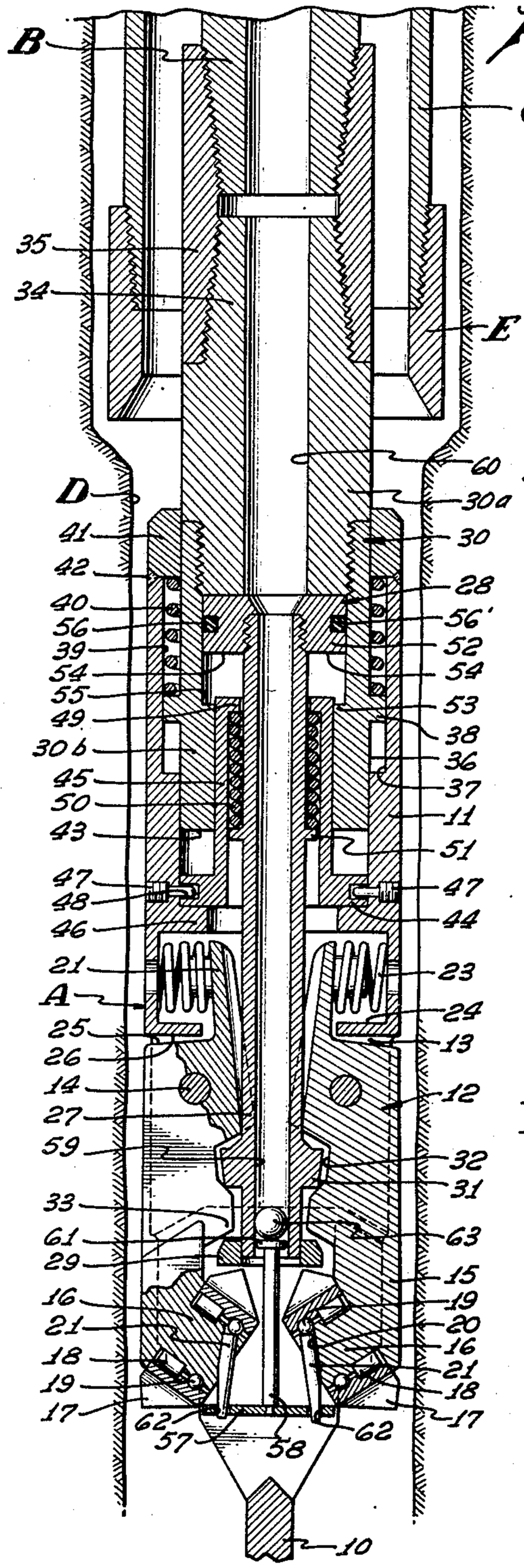

Fig. 2.

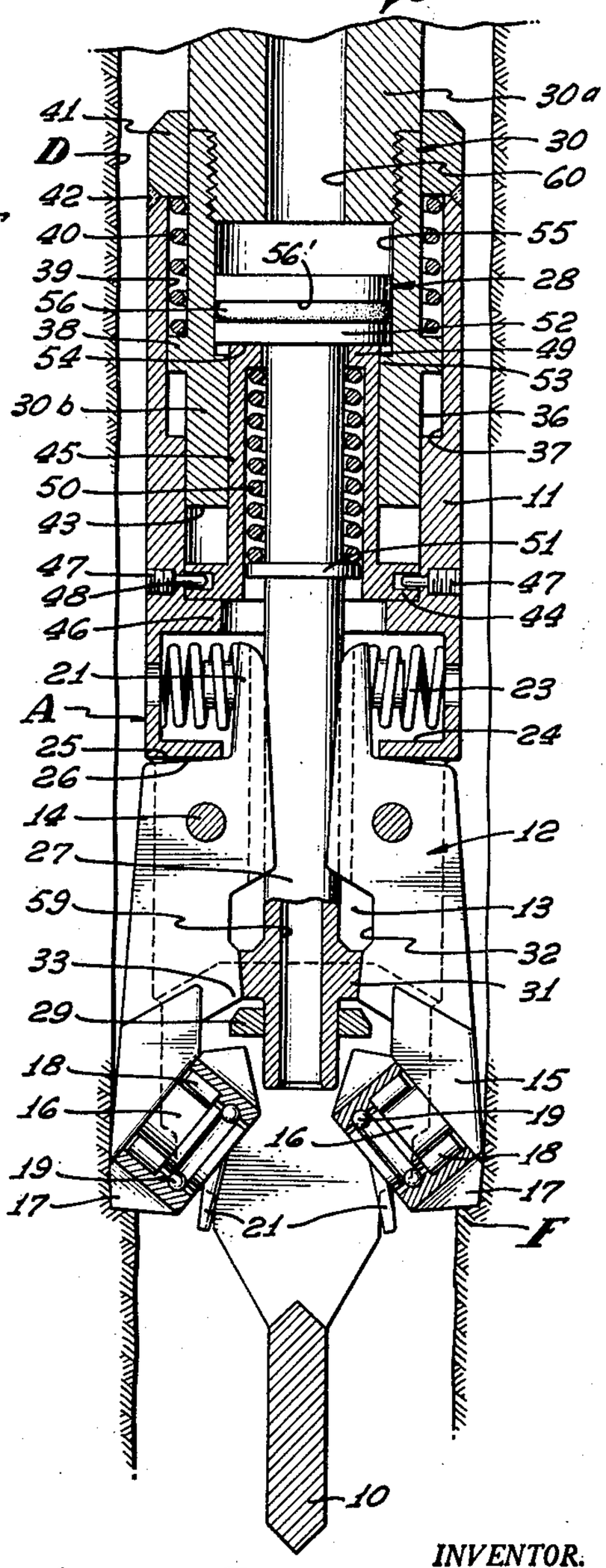

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Fig. 3.

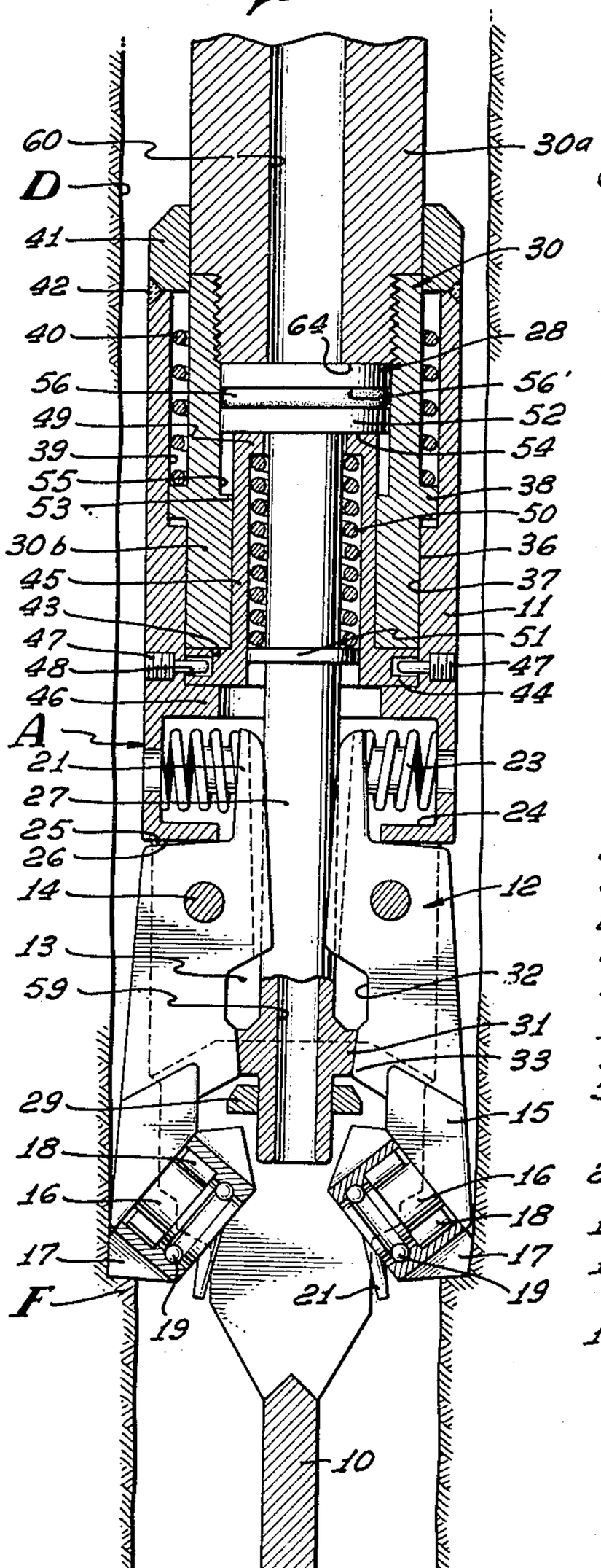
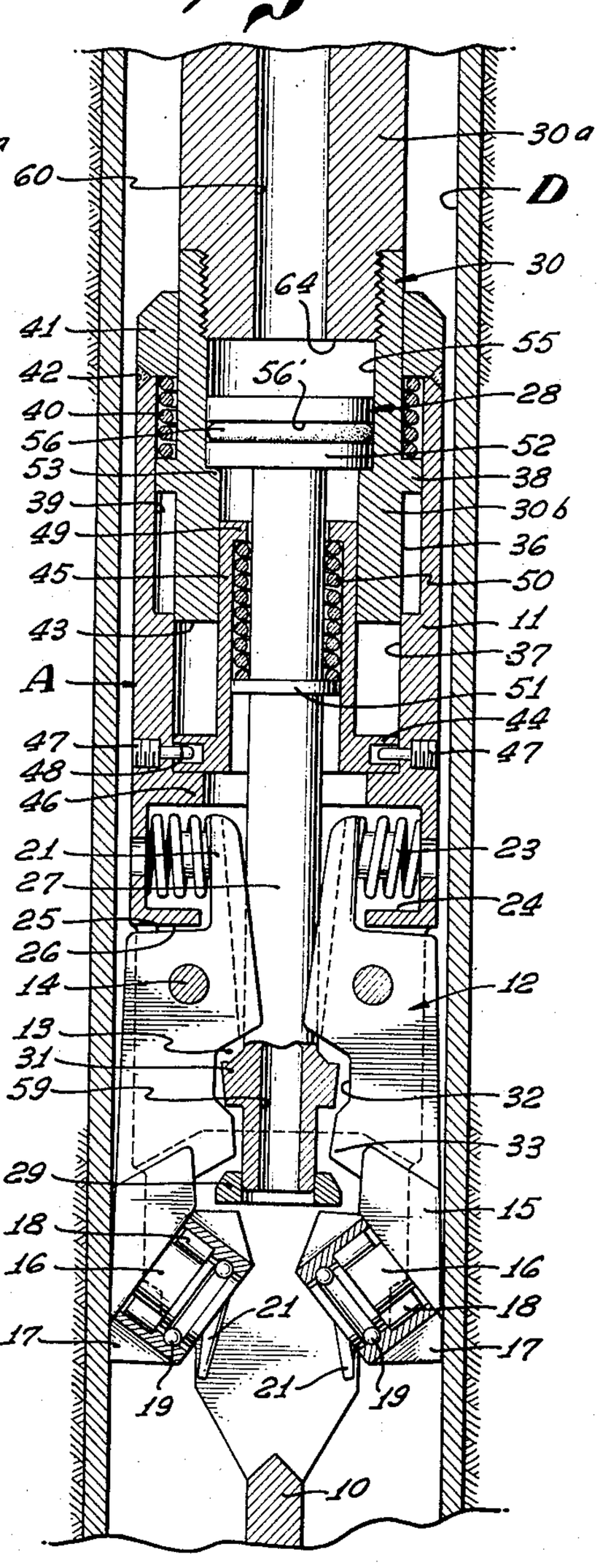


Fig. 4.



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United States Patent Office

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EXPANSIBLE DRILL BITS FOR ENLARGING WELL BORES

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Application November 23, 1953, Serial No. 393,772

18 Claims. (Cl. 255—76)

The present invention relates to rotary drill bits of the expansible type for drilling or enlarging well bores below well casing to a larger diameter than the inside diameter of the well casing itself.

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. It is necessary to move the mandrel down relative to the body to lock the cutters in an outward position. Elevation of the mandrel with respect to the body releases the cutters from their locked condition, enabling them to move inwardly toward retracted position.

Certain disadvantages are associated with bits of the above type, in that 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, permits the body and cutters to move or drop down with respect to the mandrel, thereby, in effect, producing relative elevation of the mandrel within the body and shifting of the mandrel to an unlocked position that could allow the cutters to retract, at least partially. It then becomes necessary to reshift the mandrel downwardly of the body, to again lock the cutters in their fully expanded position.

It is an object of the present invention to provide an expansible type of rotary drill bit in which the cutters are locked automatically in their fully expanded position without the necessity for moving a mandrel, telescopically arranged in the bit body, downwardly of the body. The locking action occurs as a result of structure embodied in the bit itself, and without the need for imposing any external forces on the bit.

Another object of the invention is to provide an expansible rotary drill bit of the type having a mandrel connectible to a drill string telescopically arranged in the bit body, in which the cutters are locked automatically in their maximum outwardly expanded position without the necessity for imposing drilling weight on the cutters, or for moving the mandrel with respect to the body.

A further object of the invention is to provide an expansible rotary drill bit in which the cutters can be locked in their outwardly expanded position by a combination of spring force, hydraulic force and drilling weight imposed on the cutters, or by one or more of the foregoing.

Another object of the invention is to provide an expansible rotary drill bit, in which the cutters are locked automatically in their fully expanded position without the necessity for telescoping the mandrel with respect to the bit body. Downward telescoping of the mandrel relative to the body positively prevents any unlocking of the cutters.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It 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 an embodiment of the invention disposed in a well bore, with the cutters and other parts in their initial retracted position;

Fig. 2 is a longitudinal section, similar to Fig. 1, disclosing the cutters locked in their fully expanded position prior to the imposition of drilling weight on the cutters;

Fig. 3 is a longitudinal section, similar to Fig. 1, disclosing the cutters locked in their outwardly expanded position and with downward or drilling weight being imposed on the cutters;

Fig. 4 is a longitudinal section, similar to Fig. 1, disclosing the locking portion of the device shifted to a retracted position to enable the cutter mechanism to be returned to its retracted position within a well casing.

The expansible drill bit A disclosed in the drawings is of the general type 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 B, by means of which it is lowered through a well casing C in a well bore D to a point below the casing shoe E 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 a pre-existing hole. The main portion of the bit is capable of enlarging the bore hole by producing and operating upon a formation shoulder F, as hereinafter described.

The main body **11** of the bit has a plurality of expansible parts mounted on it, comprising cutter supporting members **12** pivotally mounted in body slots **13** on hinge pins **14** suitably welded to the body. Each cutter supporting member consists of a depending leg **15** having a bearing supporting pin **16** inclined inwardly and downwardly and on which a roller side cutter **17** is rotatably mounted. Anti-friction roller and ball bearing elements **18, 19** are preferably placed between each cutter and bearing pin, the roller bearings **18** transmitting radial thrusts and the ball bearings **19** both radial and axial thrusts. The ball bearings also retain each cutter on a pin **16**, being inserted in place through a passage **20** in the bearing support, which is then closed by a plug **21** welded to the pin. The plug **21** depends from the passage and is used to hold the cutters **17** in retracted position, as explained below.

Each cutter supporting member **12** also includes an upwardly extending arm **22** against which an elastic expander **23** bears. This expander, which is in the form of a compressed coil spring, is received within a retainer pocket **24** in the body and exerts its force against the arm **21**, tending to swing the latter inwardly and thus urge the cutter **17** on the other side of the fulcrum pin **14** in an outward direction. The extent of this outward movement is limited by engagement of a suitable stop shoulder **25** on each cutter supporting member **12** with a cooperable stop portion **26** on the body **11**.

After the cutters **17** have been expanded outwardly by the springs **23** to a maximum extent, they can be locked in this position by a tubular member **27** of a composite mandrel **28** telescopically arranged with respect to the body **11**. The tubular member **27** is disposed centrally of the body, its lower end being slidable within a lower body guide **29** and its upper end within a Kelly or driving portion **30** of the composite mandrel **28**. The tubu-

lar member **27** is provided with a lock portion **31** at its lower region movable from an upper position in transverse alignment with inner supporting member recesses **32**, which allow retraction of the cutters **17**, to a lower position opposite lugs **33** formed on and projecting inwardly from the cutter supporting legs **15**, which prevents retraction of the cutters.

As stated above, the tubular member **27** is telescopically arranged within the Kelly portion **30** of the mandrel, the member **27** and Kelly **30** being capable of partaking of relative longitudinal movement. The upper portion **30***a* of the Kelly has an upper threaded pin **34** connected to a collar **35** threadedly secured to the lower end of the string of drill pipe B extending to the top of the well bore.

A lower Kelly member **30***b* is threadedly attached to the upper Kelly member **30***a*, being disposed within the upper portion of the body **11** and slidably splined to the latter. Such slidable splining is secured by making the exterior **36** of the Kelly of non-circular or hexagonal shape, which is telescopically received in a companion non-circular or hexagonal socket **37** formed in the body. The Kelly **30** has a limited range of movement within the body. Its upward movement is restrained by the engagement of an external shoulder **38** on the lower Kelly portion **30***b*, disposed within a counterbore **39** in the body, with the lower end of a yieldable stop and body supporting spring **40**, the upper end of which engages a retainer ring **41** at the upper end of the body **11** which may be secured to the latter, as by the use of welding material **42**.

The body supporting spring **40** causes the Kelly **30** to yieldably support the bit body **11** and the cutter mechanism carried thereby in an intermediate position with respect to the Kelly. However, the Kelly **30** is still movable upwardly, as explained hereinbelow, with respect to the body, such relative upward movement being permitted by the compression of the spring **40**. The Kelly is also capable of movement downwardly of the body to a limited extent, determined by the engagement of the lower end **43** of the lower Kelly portion **30**b with the connecting flange **44** of a spring housing **45** which rests upon a body shoulder **46**. This spring housing **45** is secured to the body by one or more screws **47** threaded transversely through the body and disposed within a peripheral groove **48** in the connecting flange **44**.

In the specific tool disclosed in the drawings, the tubular member **27** cannot move downwardly to dispose its lock ring **31** behind the supporting member lugs **33** until the supporting members **12** and their cutters **17** have been expanded outwardly to their maximum extent. The member **27** is prevented from moving downwardly until this condition occurs by virtue of the fact that the lower end of the lock ring **31** rests upon the upper portions of the lugs **33** (Fig. 1). After the cutter supporting members and cutters have been expanded outwardly to their maximum extent, the lock ring **31** of the tubular member is automatically shifted downwardly, to be disposed behind the lugs **33** independently of the movement of the Kelly **30**. A spring force is availed of for accomplishing this purpose. Thus, the spring housing **45** extends upwardly around the tubular mandrel member **27** and has a thrust head or upper spring seat **49** extending inwardly toward the tubular member. A helical compression spring **50** encompasses the member **27**, its upper end engaging the upper thrust head **49** and its lower end a lower mandrel head or spring seat **51**, so that the compression spring **50** tends to move the tubular member **27** in a downward direction. Such downward movement can occur after the cutters **17** have been expanded outwardly to the maximum position, inasmuch as an upper head **52** on the tubular member is spaced initially a sufficient distance above the upper end of the spring housing head **49** and the tubular member head **52** is also disposed a sufficient distance above an inwardly extending release shoulder **53**

formed on the lower Kelly portion **30***b*. After the cutter supporting members **12** and cutters **17** have been expanded outwardly to the maximum extent, the spring **50** can expand, to shift the tubular member **27** downwardly and dispose the lock ring **51** in its locking position behind the supporting member lugs **33**. This position is definitely located by the engagement of the lower surface **54** of the tubular member head **52** with the upper end of the spring housing **45**, as disclosed in Fig. 2.

If desired, the tubular member head **52** may be constituted as a piston slidable along an inner cylindrical wall **55** of the lower Kelly member **30***b*. Leakage of fluid between the piston and cylindrical wall in a downward direction may be prevented by providing a suitable piston ring **56**, such as a rubber O ring, in a ring groove **56**[1] in the piston which slidably and sealingly engages the cylindrical wall **55**. If need be or desired, the mandrel member **27** may be moved downwardly hydraulically by the application of hydraulic pressure to the upper surface of the piston **52**, urging it and its tubular member **27** downwardly, to dispose the lock portion or ring **31** behind the supporting member lugs **33**.

The compression spring **50** is constantly urging the tubular member **27** in a downward direction toward its locking position behind the lugs. However, such downward movement is initially prevented by holding the cutters **17** and their supporting members **12** positively in an inward direction, so that the lower end of the lock portion **31** rests upon upper portions of the lugs **33**. As disclosed in the drawings, a hydraulically releasable latch or holding device is employed. This holding device includes a holding member **57** secured to the lower end of a central rod **58** whose upper end projects into a passage **59** extending completely through the tubular member **27**. This passage communicates with a central passage **60** extending upwardly through the Kelly portion **30** of the tubular mandrel **28**. The passage **59** through the tubular member **27** is substantially smaller in diameter than the passage **60** through the Kelly. A head **61** is secured to the upper end of the rod **58**, having substantial clearance in the passage **59** to allow fluid to pass upwardly into the central passages **59**, **60** and into the drill string B. The holding member **57** has spaced holes **62** in its outer portion for receiving the lower ends of the bearing plugs **21**.

When the holding device **57** is disposed over the plugs **21**, the cutter supporting members **12** are prevented from expanding under the influence of the springs **23**, thereby holding the cutters **17** in retracted position. Such retracted condition of the cutter supporting members **12** prevents the helical compression spring **50** from shifting the tubular member **27** downwardly to its locking position. The holding member **57** can be released from the plugs **21** as a result of fluid pressure acting downwardly on a ball **63**, which can be disposed in the passage **59** and which will come to rest on the head **61**, the ball having substantially the same diameter as the diameter of the passage **59**, to allow fluid pressure to be built up thereabove. When fluid pressure is applied to the fluid in the drill pipe B and the mandrel passages **60**, **59**, it can shift the ball **63**, rod **58** and holding member **57** downwardly, to free the latter from the plugs **21** and allow the springs **23** to move the arms **21** inwardly and the cutters **17** outwardly. The drill pipe B and drill bit A are rotated, the springs **23** urging the cutters **17** outwardly until they are in their fully expanded position and have produced a formation shoulder F in the wall of the well bore D. Thereafter, the compression spring **50** is effective to shift the tubular member **27** downwardly automatically, to place its lock portion **31** behind the supporting member lugs **33**, to positively hold the cutters in their outward position (Fig. 2).

A further retention of the mandrel member **27** in its cutter locking position can take place when drilling weight is to be imposed on the cutters **17**. Thus, the imposition of drilling weight on the cutters is effected by moving

the drill pipe B downwardly, which shifts the Kelly portion **30** of the mandrel in a downward direction to the extent determined by engagement of its lower end **43** on with the connecting flange **44** of the spring housing **45**. When such engagement occurs, the lower end **64** of the upper Kelly section **30***a* is preferably disposed contiguous the upper end of the tubular member head or piston **52**, which provides a positive stop limiting upward movement of the tubular member **27** with respect to the body **11** (Fig. 3).

In the operation of the drill bit in a well bore, the cutters **17** and their supporting members **12** are locked in their retracted position by the hydraulically releasable latch device **57**, the parts occupying the position disclosed in Fig. 1. The tubular member **27** is in its upward position, its lock portion **31** engaging the upper portions of the supporting member lugs **33**, with the tubular member head or piston **52** disposed adjacent the lower end **64** of the upper Kelly section **30***a* and substantially above the upper end of the spring housing **45** and the release shoulder **53** on the lower Kelly section **30***b*. The yieldable body supporting spring **40** is holding the body of the tool and the other parts in a desired upper position with respect to the mandrel **28**, so as to appropriately locate the parts in the position shown in Fig. 1, with the lower end **43** of Kelly **30** an appropriate distance above the flange **44**.

The apparatus is lowered through the casing C to the open well bore D therebelow, and, when the region in the latter is reached at which the hole enlarging operation is to occur, pressure is applied to the fluid in the drill pipe B, to move the ball **63** into the tubular member passage **59** and into engagement with the rod head **61** of the latch mechanism. The application of sufficient pressure on this ball **63** moves it and the latch **57** downwardly, to shift the latter off the plugs **21** secured to the cutter supporting members **12**. When such release occurs, the tubular string B can be rotated, the springs **23** urging the arms **21** inwardly and forcing the cutters **17** outwardly into engagement with the wall of the well bore D. Rotation of the drill pipe B rotates the Kelly portion **30** of the mandrel **28**, and, through the splined connection **36**, **37**, the body **11** of the tool, the cutters **17** beginning to dig into the wall of the well bore. During such rotation, no drilling weight is imposed on the tool, so that the mandrel portion **28** of the apparatus still occupies essentially the position disclosed in Fig. 1. When the springs **23** have expanded the cutters **17** outwardly to their maximum extent, the mandrel compression spring **50** is then effective to immediately shift the tubular member **27** downwardly, to dispose its lock portion **31** behind the lugs **33**, the tubular member head **52** engaging the upper end of the cylindrical housing **45** (Fig. 2).

Inasmuch as the drilling mud is usually being pumped down the drill pipe B and through the tool A at this time, for the purpose of removing the cuttings to the top of the well bore, a hydraulic force is also available, acting on the tubular member head or piston **52**, to urge the latter in a downward direction, in view of the throttling effect of the fluid as it enters the smaller diameter passage **59** through the tubular member **27**. Accordingly, should the spring **50**, for some reason, be incapable of shifting the tubular member **27** downwardly to its fullest extent, then a hydraulic force is available to insure the shifting of the tubular member downwardly to its locked position. Accordingly, it is evident that the force of the compression spring **50** is supplemented by a hydraulic force acting on the piston **52**, to insure the disposition of the lock portion **31** behind the lugs **33**.

It is to be noted that the tubular member **27** has moved downwardly to its locked position behind the cutter supporting members **12** automatically after the latter have been expanded outwardly to their maximum extent. It is unnecessary for the operator to partake of any other action. After the formation shoulder F has been produced and it is desired to drill away the hole to the enlarged diameter, downweight is imposed on the drill pipe B, which will shift the Kelly portion **30** of the composite mandrel **28** downwardly of the body **11** and of the spring housing **45**, to the extent limited by engagement of the lower end **43** of the Kelly **30** with the spring housing flange **44**. The drilling weight is then transferred directly from the Kelly **30** to the body **11**, and from the latter to the cutter supporting members **12** and cutters **17**. This position of the parts is disclosed in Fig. 3, from which it will be noted that the lower end **64** of the upper portion **30***a* of the Kelly has now been disposed immediately above the tubular member head or piston **52**, which will further insure the retention of the tubular member **27** in its downward locked position behind the cutter supporting members **12**.

Drilling will proceed to the desired extent, with the cutters **17** locked in their outward position. Should the apparatus be elevated, to raise the cutters above the formation shoulder F, then the tubular member **27** will still remain in its locked position, inasmuch as the spring **50** is effective to hold the mandrel member **27** in its downward postition, the force of this spring being supplemented by the action of the fluid pressure acting on the upper surface of the piston **52**, assuming that the pumping of the drilling fluid through the apparatus continues. Accordingly, it is evident that the parts remain in their outward locked position, regardless of the elevation or lowering of the drill string. Moreover, it is to be noted that it is unnecessary for the cutters **17** to remain in engagement with the formation shoulder F, or the like, and for drilling weight to be imposed on the cutters, for the purpose of holding them locked in their outwardly expanded position.

When it is desired to retrieve the expansible drill bit A from the well bore, the drilling fluid is no longer pumped through the tool and the drill pipe B is elevated, the tool being moved up the hole until a smaller diameter portion or the casing shoe E is reached. When this occurs, the outer surfaces of the cutter supporting members **12** engage the lower end of the shoe E and tend to prevent upward movement of the bit body **11**. An upward strain can then be taken on the drill pipe B and on the kelly **30** of the tool, the releasing shoulder **53** on the lower kelly portion **30***b* engaging the underside of the tubular member head or piston **52**, to forcibly pull the tubular member **27** in an upward direction against the action of the compression spring **50** surrounding the tubular member. The tubular member **27** is thus pulled upwardly, to relocate its locking portion **31** in alignment with the supporting member recesses **32** and above the lugs **33**, which then allows the casing shoe E to urge the cutter supporting legs **15** and cutters **17** in an inward direction, disposing the lugs **33** under the lock portion **31** and thereby preventing the compression spring **50** from reshifting the tubular member **27** in a downward direction into its locked position behind the lugs. The upward movement of the kelly portion **30**, for the purpose of forcibly moving the tubular member **27** upwardly to its released position is permitted, since the body supporting spring **40** will merely be compressed to a further extent as the release shoulder **53** carries the tubular member head **52** upwardly to its initial position above the upper end of the spring housing **45** (Fig. 4). After the cutter supporting members **12** have been shifted inwardly by the casing shoe E, they are held inwardly by the wall of the well casing C, to secure the lugs **33** under the lock portion **31** of the tubular mandrel member **27**. When this occurs, it is immaterial whether the kelly portion **30** of the tool is lowered with respect to the body **11**, since the compression spring **50** is then incapable of reshifting the tubular member **27** back to its locked position within and behind the supporting member lugs **33**.

The tool A may now be elevated in the well casing C and withdrawn completely from the well bore.

It is, accordingly, apparent that an expansible rotary drill bit has been provided in which the cutters **17** and their supporting members **12** are positively locked in their outward position automatically, regardless of the downward movement of the Kelly portion **30** of the mandrel with respect to the body **11** of the tool. The lock device **31** is shifted to and held in its locked position behind the cutter supporting member lugs **33** by the force being exerted constantly by the compression spring **50**. This force may be supplemented, if desired, by the pressure of the fluid being pumped through the apparatus and acting on the upper piston **52**. Of course, it is not necessary that the upper piston **52** be used at all. The upper member **52** may merely constitute a guide head for the tubular member **27**, to insure its proper longitudinal movement with respect to the other parts. In addition to the presence of the spring force and the hydraulic force to hold the lock member **31** behind the supporting member lugs **33**, the imposition of downweight on the apparatus provides an additional mechanical holding device by locating the Kelly portion **30***a* of the tool immediately above the tubular member head **52**, which further prevents the lock portion of the mandrel from being retracted from its locking position behind the supporting member lugs.

In the event that the application of drilling weight to the cutters is discontinued, as through elevation of the Kelly portion **30** of the mandrel within the body, the tubular member **27** will still remain in its locked position behind the cutter supporting members **12**, such result being produced by the compression spring **50** and by the hydraulic force of the drilling fluid acting on the piston **52**, if a piston is provided in the apparatus. Regardless of such retention of the tubular mandrel member **27** in its locked position, it is still capable of being forcibly released from such locked position upon elevation of the apparatus in the well bore, and particularly into the casing string C.

The inventor claims:

1. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, and means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member.

2. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member movable longitudinally with respect to said body and first mandrel member in one direction to hold said cutter means laterally outward, and means operatively engaging said body and second mandrel member to urge said second mandrel member in said one longitudinal direction relative to said body and first mandrel member.

3. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member movable longitudinally with respect to said body and first mandrel

member in one direction to hold said cutter means laterally outward, and means operatively engaging said body and second mandrel member to urge said second mandrel member in said one longitudinal direction relative to said body and first mandrel member, said first mandrel member being movable in said one longitudinal direction with respect to said body into juxtaposed relation to said second mandrel member to prevent longitudinal movement of said second mandrel member in the opposite longitudinal direction.

4. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, and means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being moved downwardly with respect to said body into juxtaposed relation to said second mandrel member to prevent upward movement of said second mandrel member out of its position holding said cutter means laterally outward.

5. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member movable longitudinally with respect to said body and first mandrel member in one direction to hold said cutter means laterally outward, means operatively engaging said body and second mandrel member to urge said second mandrel member in said one longitudinal direction relative to said body and first mandrel member, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member in the opposite longitudinal direction out of holding relation to said cutter means.

6. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member upwardly out of holding relation to said cutter means.

7. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member movable longitudinally with respect to said body and first mandrel member in one direction to hold said cutter means laterally outward, means operatively engaging said body and second mandrel member to urge said second mandrel member in said one longitudinal direction relative to said body and first mandrel member, said first mandrel mem-

ber being movable in said one longitudinal direction with respect to said body into juxtaposed relation to said second mandrel member to prevent longitudinal movement of said mandrel member in the opposite longitudinal direction, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member in the opposite longitudinal direction out of holding relation to said cutter means.

8. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being moved downwardly with respect to said body into juxtaposed relation to said second mandrel member to prevent upward movement of said second mandrel member out of its position holding said cutter means laterally outward, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member upwardly out of holding relation to said cutter means.

9. A rotary well drilling bit, including a main body, cutter means mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member movable relatively downward of said body to hold said cutter means laterally outward, and means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member.

10. A rotary well drilling bit, including a main body, cutter means mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member movable relatively downward of said body to hold said cutter means laterally outward, and means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being movable downwardly with respect to said body into juxtaposed relation to said second mandrel member after said second mandrel member has been shifted into holding relation to said cutter means to prevent upward movement of said second mandrel member out of holding relation to said cutter means.

11. A rotary well drilling bit, including a main body, cutter means mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member movable relatively downward of said body to hold said cutter means laterally outward, means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being movable downwardly with respect to said body into juxtaposed relation to said second mandrel member after said second mandrel member has been shifted into holding relation to said cutter means to prevent upward movement of said second mandrel member out of holding relation to said cutter means, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member upwardly out of holding relation to said cutter means.

12. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, and spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member.

13. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, and hydraulic means connected to said second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member in response to fluid pressure in the drill string.

14. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member telescopically related to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, and spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being movable downwardly with respect to said body into juxtaposed relation to said second mandrel member to prevent upward movement of said second mandrel member out of holding relation to said cutter means.

15. A rotary well drilling bit, including a main body, cutter means 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 comprising a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member telescopically relative to said first mandrel member and movable relatively downward of said body to hold said cutter means laterally outward, spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being movable downwardly with respect to said body into juxtaposed relation to said second mandrel member to prevent upward movement of said second mandrel member out of holding relation to said cutter means, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member upwardly out of holding relation to said cutter means.

16. A rotary well drilling bit, including a main body, cutter means mounted on said body, means engaging said cutter means for expanding said cutter means laterally

outward of said body, a first mandrel member having a connection for securing said mandrel member directly to a drill string, said mandrel member being slidably splined to said body, a second mandrel member movable relatively downward of said body to hold said cutter means laterally outward, and spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member.

17. A rotary well drilling bit, including a main body, cutter means mounted on said body, means engaging said cutter means for expanding said cutter means laterally outward of said body, a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member movable relatively downward of said body to hold said cutter means laterally outward, spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being movable downwardly with respect to said body into juxtaposed relation to said second mandrel member after said second mandrel member has been shifted into holding relation to said cutter means to prevent upward movement of said second mandrel member out of holding relation to said cutter means, and means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member upwardly out of holding relation to said cutter means.

18. A rotary well drilling bit, including a main body, cutter means mounted on said body, means engaging said

cutter means for expanding said cutter means laterally outward of said body, a first mandrel member connectible to a drill string and slidably splined to said body, a second mandrel member movable relatively downward of said body to hold said cutter means laterally outward, spring means operatively engaging said body and second mandrel member to urge said second mandrel member relatively downward of said body and first mandrel member, said first mandrel member being movable downwardly with respect to said body into juxtaposed relation to said second mandrel member after said second mandrel member has been shifted into holding relation to said cutter means to prevent upward movement of said second mandrel member out of holding relation to said cutter means, means on said first mandrel member engageable with said second mandrel member to shift said second mandrel member upwardly out of holding relation to said cutter means, and hydraulic means connected to said second mandrel member and shiftable by fluid pressure in the drill string for urging said second mandrel member relatively downward of said body and first mandrel member.

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