Sept. 18, 1962 H. H. WAGNON ETAL 3,054,466

ROLLER ASSEMBLIES

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Fig. 1

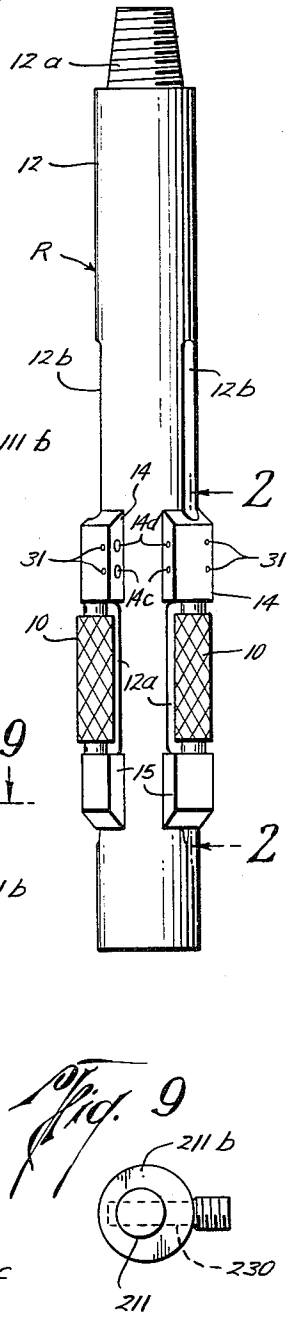


Fig. 7

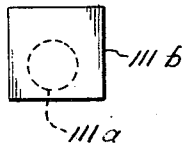


Fig. 8

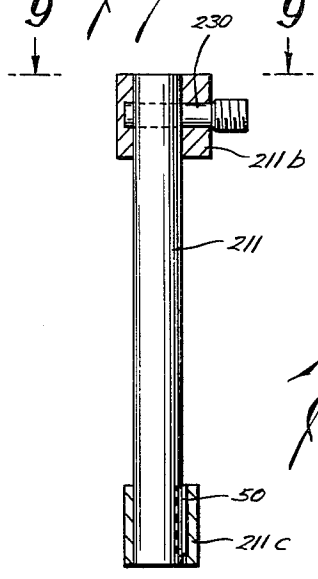
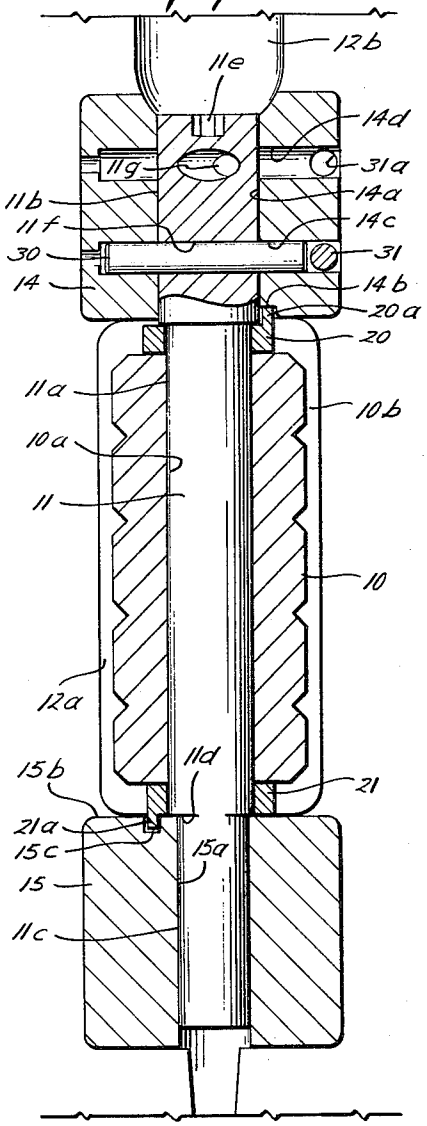


Fig. 9

Fig. 2



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Fig. 3

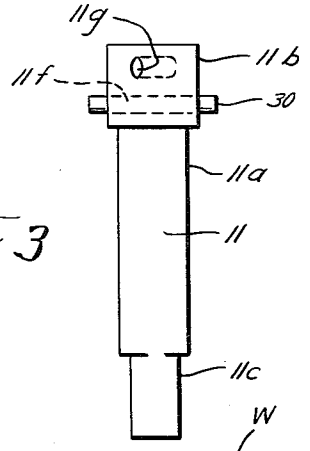


Fig. 3A

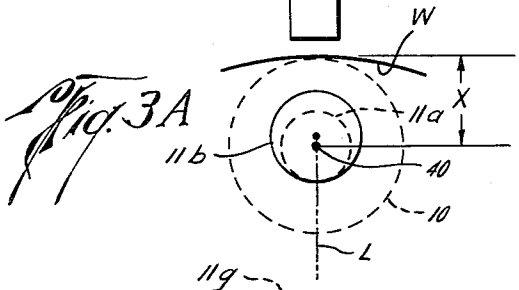


Fig. 4

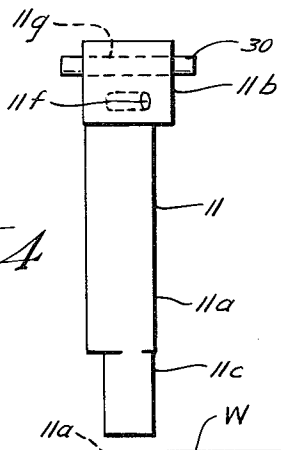


Fig. 4A

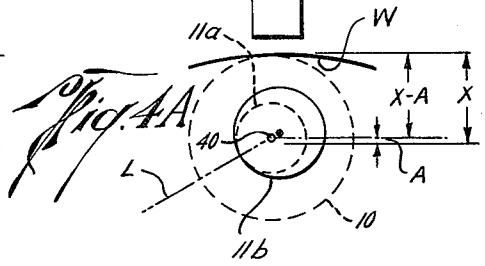


Fig. 5

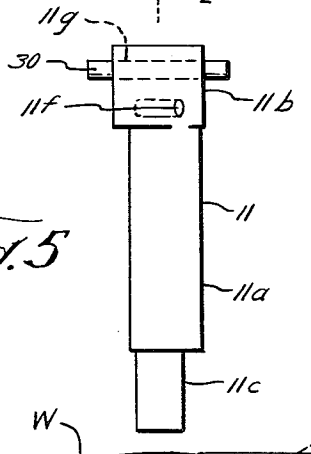


Fig. 5A

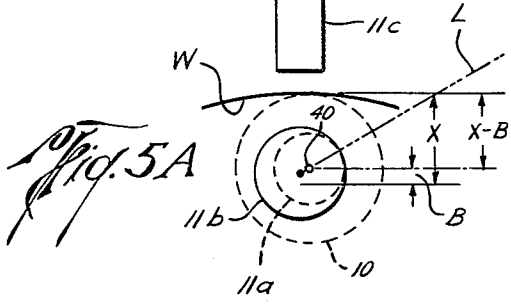


Fig. 6

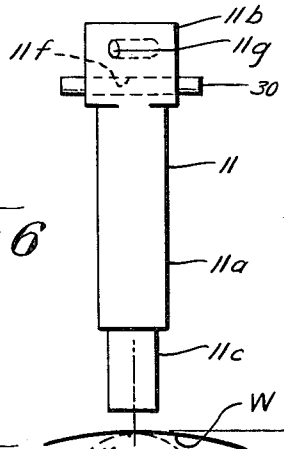
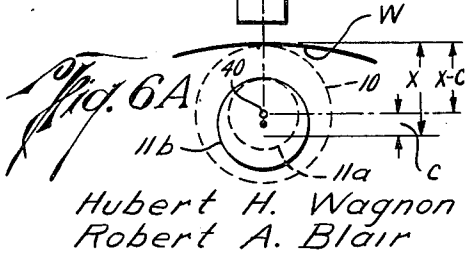


Fig. 6A



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Fig. 10

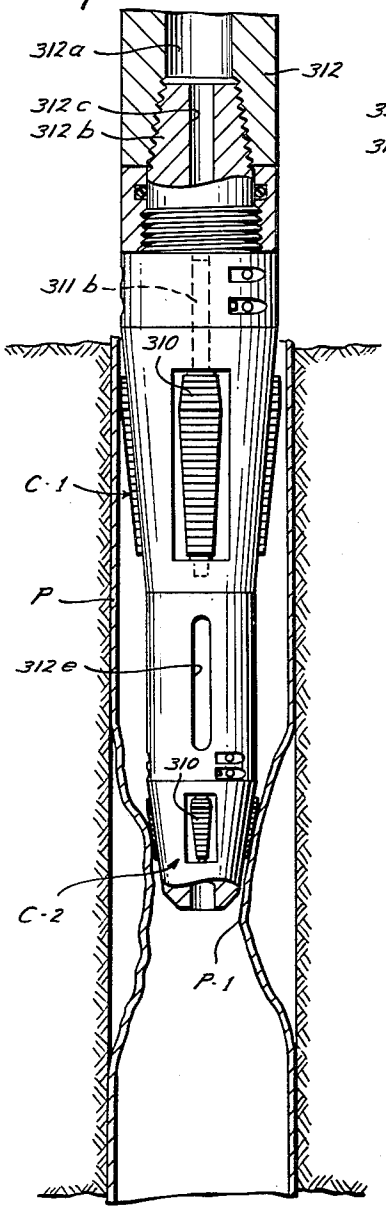
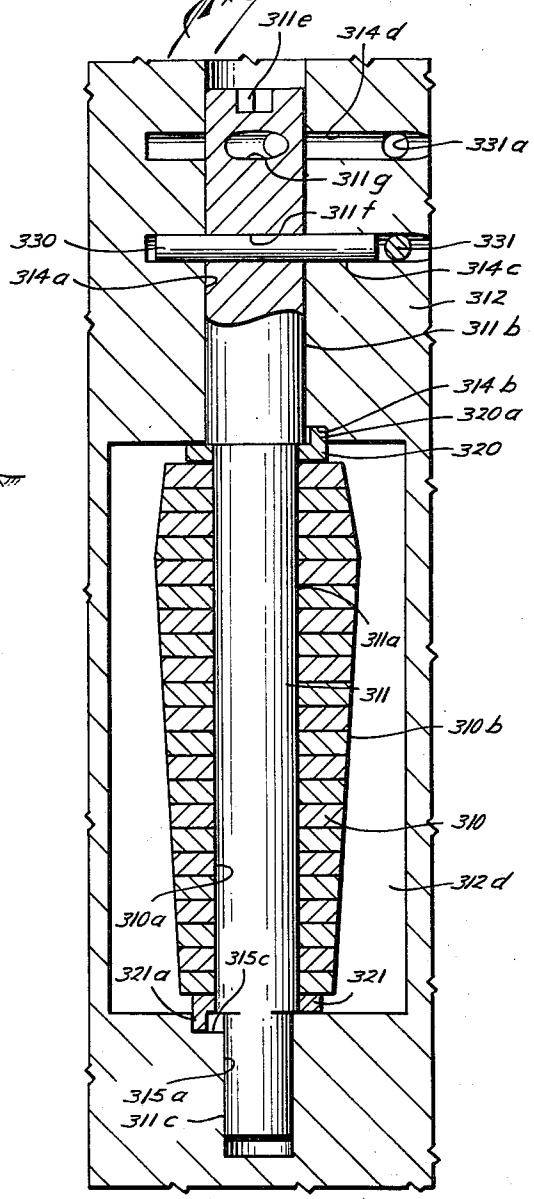


Fig. 11



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3,054,466

ROLLER ASSEMBLIES

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Filed Sept. 21, 1959, Ser. No. 841,405
11 Claims. (Cl. 175—347)

This invention relates to new and useful improvements in roller assemblies, and particularly those roller assemblies which are adapted for use in reaming out or enlarging well bores to a desired diameter and also those which are adapted for rolling out collapsed casing or pipe.

This application is a continuation in part of patent application, Serial No. 783,533, filed December 29, 1958, now abandoned.

An object of this invention is to provide a new and improved roller assembly for use in wells and the like, wherein the roller in the assembly is a reamer for enlarging well bores, or a casing roller for enlarging collapsed casing or pipe, or any other type of roller which may be advantageously used by moving same to different positions on a support body during various stages of use of the assembly.

Another object of this invention is to provide a new and improved reamer for use in wells and the like wherein each reamer cutter is adapted to be moved outwardly to one or more selected cutting or reaming positions with respect to the body of the reamer to compensate for the wearing of each cutter, whereby the useful life of each cutter is greatly increased.

An important object of this invention is to provide a new and improved mounting means for mounting a roller on a support body so that the axis of rotation of the roller is shifted outwardly in a well bore to one or more different selected positions during the use of the roller.

A further object of this invention is to provide a new and improved roller assembly wherein a roller is mounted on a pin for rotation relative thereto, wherein eccentric means are provided for shifting the pin to shift the axis of rotation of the roller thereon, and wherein means are provided to lock the pin in selected positions in which the axis of rotation of the roller is different for each position.

A particular object of this invention is to provide a new and improved reamer construction wherein a reamer cutter is mounted on a pin for rotation relative thereto, wherein eccentric means are provided for shifting the pin to shift the axis of rotation of the reamer cutter thereon, and wherein means are provided to lock the pin in selected cutting positions in which the axis of rotation of the reamer cutter is different for each cutting position.

A specific object of this invention is to provide a specific casing roller assembly having a plurality of rollers mounted on a support body for rolling the interior of a collapsed casing or pipe to enlarge the casing or pipe to its full internal diameter, wherein each casing roller is mounted on a shaft or pin which is eccentrically positioned on the support body for changing the position of casing roller relative to the support body without requiring removal of the roller from the body.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIG. 1 is an elevation of one form of this invention wherein a reamer incorporating the features of this invention is shown;

FIG. 2 is a view, partly in section and partly in elevation taken on line 2—2 of FIG. 1, to illustrate the details of the preferred form of the new and improved roller assembly mounting construction of this invention;

FIG. 3 is a schematic view illustrating the first position of the pin for supporting the roller such as a reamer cutter or casing roller;

FIG. 3A is a schematic view which is viewed from the top of the tool schematically shown in FIG. 3 to illustrate the initial position of one roller and the mounting assembly in use for reaming a hole or well bore, or for expanding a collapsed casing, or for performing similar operations;

FIG. 4 is a view similar to FIG. 3, but illustrating the pin for the roller or reamer cutter in a second cutting position;

FIG. 4A is a view similar to FIG. 3A and it is also a schematic plan view taken from the upper end of the illustration of FIG. 4 to illustrate the shifting of the central axis of the roller reamer cutter pin;

FIG. 5 is a view similar to FIGS. 3 and 4, but it illustrates a third position of the pin for the reamer cutter or casing roller;

FIG. 5A is a view similar to FIGS. 3A and 4A, but it illustrates the third position of the pin for the reamer cutter or casing roller as illustrated in FIG. 5 to show the further change in the position of the central axis of the pin as compared to FIGS. 3A and 4A;

FIG. 6 is a view similar to FIGS. 3, 4 and 5, except that a fourth position of the pin is shown;

FIG. 6A is a view similar to FIGS. 3A, 4A and 5A, and it shows a schematic plan illustration of the structure illustrated in FIG. 6 to illustrate the maximum shift in the central axis of the pin from the initial position shown in FIG. 3;

FIG. 7 is a plan view showing a modified form of the pin of this invention wherein the upper and lower pin sections are formed in a square shape rather than in a round shape as illustrated in FIGS. 2–6;

FIG. 8 is a view, partly in elevation and partly in section, illustrating a modification of the pin of FIG. 2, wherein separate sleeves are provided with the pin for mounting the pin to effect the shifting of the central axis of the pin;

FIG. 9 is a plan view taken on line 9—9 of FIG. 8 to illustrate more in detail the modified construction of FIG. 8;

FIG. 10 is a view, partly in elevation and partly in section, illustrating another form of the invention employing casing rollers which are mounted in accordance with the invention; and

FIG. 11 is a vertical sectional view of a portion of the structure shown in FIG. 10 to illustrate in detail the mounting of one of the casing rollers on a support body.

In the drawings, the letter R designates generally a reamer which includes one or more reamer cutters, or rollers **10**, which are preferably three in number, for engagement with the wall of a previously drilled hole or well bore. Briefly, in the form of this invention illustrated in FIGS. 1–9, each of the reamer cutters **10** is mounted on a reamer cutter pin **11** in such manner that the central axis of the portion of the pin **11** which is in the bore of the cutter **10** is moved outwardly with respect to the body **12** of the reamer R, so that as the diameter of each of the cutters **10** is reduced by wear during use or for other reasons, the reamer cutters **10** may still be used for reaming the same size of hole or well bore. Therefore, by reason of the construction of this invention, the useful life of each of the reamer cutters **10** on the reamer R is increased to a great extent. Also, as will be explained hereinafter, another form of this invention is illustrated in FIGS. 10 and 11, but except for the type

of rollers employed and the intended use thereof, the structure of FIGS. 10 and 11 is basically the same as the structure of FIGS. 1–9.

Considering the invention in detail, the reamer body **12** is tubular and is provided with a threaded coupling pin **12***a* at its upper end for connection with the usual pipe or string used to support a reamer during the reaming of a well bore or similar hole. The body **12** has a central opening (not shown) extending longitudinally through the body **12** in the usual manner for the circulation of drilling mud or other well fluid.

Since each of the reamer cutters **10** is mounted on the reamer body **12** in an identical manner in the preferred form of the invention, the mounting structure for one of the reamer cutters **10** only will be described because such description will apply to the other mounting structure for the other reamer cutters **10**. Thus, each reamer cutter **10** has associated therewith a pin **11** which extends through the bore **10***a* of the cutter **10**. The cutter **10** is provided with the usual cutting teeth **10***b* on the external surface thereof for cutting engagement with the wall of the well bore or other hole being reamed or cut by the reamer cutters **10**.

In the form of the invention illustrated in FIGS. 1 and 2 of the drawings, the pin **11** has a central pin section **11***a*, an upper pin section **11***b*, and a lower pin section **11***c*. The central longitudinal axis of the upper pin section **11***b* is coincident or in vertical alignment with the central longitudinal axis of the lower pin section **11***c*. The diameter of the lower pin section **11***c* is smaller than the diameter of the central pin section **11***a* and also, the upper pin section **11***b*. However, the relative diameters of the various sections of the pin **11** are immaterial so long as the central axes of the upper pin section **11***b* and the lower pin section **11***c* are coincident and are laterally offset with respect to the central axis of the central pin section **11***a*.

An upper support collar or member **14** is provided for receiving the upper pin section **11***b*, and a lower support collar or member **15** is provided for receiving the lower pin section **11***c* of each of the pins **11**. Such upper support collar **14** and lower support collar **15** are formed integrally with the body **12** of the reamer R or they are welded or are otherwise secured to the body **12**. The upper support collar **14** has a longitudinal opening or bore **14***a* therethrough for receiving the upper pin section **11***b*. Similarly the lower support collar **15** has a central longitudinal bore **15***a* for receiving the lower pin section **11***c*. The longitudinal central axes of the bore **14***a* and the lower bore **15***a* are in alignment or are coincident and therefore, the axes of the bores **14***a* and **15***a* are coincident with the axes of the pin sections **11***b* and **11***c*. However, all of such axes are offset laterally with respect to the central axis of the central pin section **11***a*.

The body **12** of the reamer R is formed with a longitudinal recess or external pocket **12***a* for each of the reamer cutters **10**. Each of such recesses or pockets **12***a* extends longitudinally between the upper collar **14** and the lower collar **15** and such recesses or pockets **12***a* are provided so that the inside portion of the cutters **10** will not contact the body **12** when the cutters **10** are mounted and are rotating in use. The body **12** also has a longitudinal groove or recess **12***b* formed above each of the upper collars **14**. Such grooves or recesses **12***b* are provided for the insertion of the pins **11** through the collars **14** and the reamers **10** and finally for the seating of the lower pin sections **11***c* in the lower collars **15**. Such assembly will be described more in detail hereinafter, but briefly it can be pointed out that the pins **11** are inserted from above the collars **14** and the grooves or recesses **12***b* permit the vertical alignment of the pins **11** with the openings or bores **14***a* and **15***a* so that the pins **11** may drop vertically downwardly and may pass through the bore **10***a* of each of the cutters **10** for the assembly of the cutters **10** on the pins **11**. In the preferred form of the invention, the central pin section **11***a* is of a larger diameter than the lower pin section **11***c* so that a shoulder **11***d* is provided between the central pin section **11***a* and the lower pin section **11***c* for engagement with the upper lateral surface **15***b* of the lower collar **15**. Such engagement prevents the dropping of the pin **11** below the position shown in FIG. 2 wherein the shoulder **11***d* is in engagement with the surface or shoulder **15***b*.

To eliminate wear on the collar **14** and on the collar **15** by the upper and lower ends, respectively, of the cutter **10** during the rotation of the cutter on the pin **11**, removable and replaceable wear rings **20** and **21** are provided at the upper and lower ends of the cutter **10**, respectively. The upper wear ring **20** has a vertically extending tab or projection **20***a* which extends into a hole or opening **14***b* in the collar **14**. Similarly, the wear ring **21** has a vertically extending tab or projection **21***a* which extends into an opening **15***c* in the collar **15**. Such tabs **20***a* and **21***a* serve to prevent the wear rings **20** and **21**, respectively, from rotating with the cutter **10**. The wear rings **20** and **21** may be replaced when the cutter **10** is replaced.

As will be more fully explained in connection with the operation or use of the reamer of this invention, the pin **11** is adapted to be rotated or otherwise moved so that each of the cutters **10** is moved radially or laterally outwardly from the body **12** to compensate for the wear on the external cutting teeth **10***b* of each of the cutters **10**, so that the cutters **10** can be used for cutting the same diameter hole or well bore for a much greater period of use than is normally possible before replacing the cutters. In the form of the invention illustrated in FIG. 2, the shifting or movement of the pin **11** to shift or move each of the cutters **10** is accomplished by a rotation of the pin **11** with each cutter **10**. Thus, as shown in FIG. 2, the pin **11** has an Allen socket or opening **11***e* at its upper end for receiving an Allen wrench or a similar tool. Of couse, other equivalent means for effecting the rotation of the pin **11** on the body **12** without necessitating the removal of the pin **11** could be substituted for the Allen head opening **11***e*.

The pin **11** must be locked in each cutting position. In order to accomplish such locking, in the form of the invention illustrated in FIG. 2, the upper pin section **11***b* is provided with laterally extending openings **11***f* and **11***g* which are placed at an angle with respect to each other. In the preferred form of the invention, the vertical plane in which the center of the upper opening **11***g* lies would intersect the vertical plane in which the center of the lower opening **11***f* lies at an angle which is one hundred twenty on one side of the intersection and sixty degrees on the other side of the intersection. With such relative positions of the openings **11***f* and **11***g*, it has been found that four positions for the use of each cutter **10** are made possible and a maximum use of the cutters **10** is also obtained.

The upper collar **14** has openings **14***c* and **14***d* formed therethrough which are positioned one above the other in the same vertical plane and parallel to each other. The lower opening **14***c* is adapted to be aligned with the opening **11***f* in the pin **11** for receiving a lock rod **30** for locking or holding the pin **11** in a selected position with respect to the body **12**. The pin **30** is retained in the openings **14***c* and **11***f* by means of a removable screw **31** or any other similar means which extends into the end of the opening **14***c* so that the rod **30** cannot be withdrawn from the opening **14***c* until the screw **31** or other means is removed.

The opening **11***g* is adapted to be aligned with the upper opening **14***d*, and when such alignment occurs, the rod **30**, or some other rod similar thereto is positioned in the openings **14***d* and **11***g*. A lock screw **31** or similar plug means is then used for retaining the lock rod **30** or similar rod in the openings **14***d* and **11***g*. It will be understood that the rod **30** or similar rod would be in either the lower position shown in FIG. 2 or it would be in the upper position through the openings **14***d* and **11***g*, but the rod **30**

would not be in both openings 14*c* and 14*d* at the same time.

The use of the form of the invention shown in FIGS. 1 and 2 is illustrated by the schematic illustrations appearing in FIGS. 3, 3A, 4, 4A, 5, 5A, 6 and 6A. FIGS. 3 and 3A illustrate the first position of one of the cutters 10 and the pin 11 therewith. The cutter is shown with a dotted line in FIG. 3A, the upper pin section 11*b* is shown in a solid line and the central pin section 11*a* is shown in dotted lines in FIG. 3A. The well bore or opening W is partially shown in FIG. 3A to illustrate the engagement of the cutter 10 with the wall of the well bore or hole W. In the illustration of FIG. 3, the cutter 10 has been omitted for clarity, and the position of the lock rod 30 in the opening 11*f* is illustrated for the initial cutting position. The longitudinal central axis of the central pin section 11*a* is indicated at 40 in FIG. 3A and the initial distance from the longitudinal central axis 40 to the well bore W or the external surface of the cutter 10 is indicated by the arrows and the letter X in FIG. 3A.

The reamer R of this invention is used with the cutters 10 in the initial cutting positions which is illustrated for one of the cutters 10 in FIG. 3 and 3A.

When the cutter 10 becomes worn so that it is not effectively cutting the same diameter or substantially the same diameter in the well bore or hole W, then the cutter pins 11 are turned or are rotated. Such rotation is accomplished by first removing the set screw or plug 31 (FIG. 2) and then sliding the lock rod 30 out of the openings 11*f* and 14*c*. Such sliding movement of the lock rod 30 would be in the right-hand direction as viewed in FIG. 2 of the drawings. The cutter pin 11 can then be turned or rotated by engaging the multi-sided opening 11*e* with an Allen wrench or similar tool until the opening 11*g* is aligned with the opening 14*d*. When such alignment occurs the cutter pin 11 is again locked to the body 12 by inserting the lock rod 30 into the openings 11*g* and 14*d*. The set screw or plug 31 is inserted in the opening provided at 31*a* in FIG. 2 so that the lock rod 30 is held in the openings 11*g* and 14*d*. Such position of the cutter pin 11 is illustrated in FIGS. 4 and 4A. The parts are illustrated in FIGS. 4 and 4A in the same manner as in FIGS. 3 and 3A except for the amount of rotation effected by the movement of the pin 11 to the new position with the lock rod 30 in the openings 11*g* and 14*d*. The comparison between the line L in FIG. 3A and the line L in FIG. 4A shows that the amount of movement with the particular form of the invention shown in FIG. 2 is sixty degrees because of the particular angles of the openings 11*g* and 11*f* with respect to each other. The cutter 10 is shown in FIG. 4A as reduced in diameter as compared to the diameter of the cutter 10 as illustrated in FIG. 3A to illustrate the wearing or reduction in diameter because of wearing or other causes as the cutter 10 is used. The shifting of the cutter pin 11 effects a shift in the position of the longitudinal central axis 40 of the central pin section 11. The amount of such movement is indicated in FIG. 4A by the letter A and the arrows therewith. The original distance X which was referred to in connection with FIG. 3A is also shown in FIG. 4A to illustrate the comparative movement of the longitudinal central axis 40 with respect to the outer surface of the cutter 10 and the well bore W. The distance X minus A shown with arrows in FIG. 4A shows the actual distance of the longitudinal central axis 40 from the well bore W. It can therefore be seen that the central axis 40 has moved outwardly from the body 12 a distance equal to the distance between the arrows designated with the letter A.

In FIG. 5, the next intermediate position is illustrated wherein the rod 30 is still in the opening 11*g*, but the pin 11 has been rotated one hundred eighty degrees as indicated by the position of the line L in FIG. 5A. In other words, the line L in FIG. 4A is exactly one hundred eighty degrees from the line L in FIG. 5A. This is because the pin 11 has been rotated one hundred eighty degrees and then the rod 30 has been reinserted into the opening 11*g* in the opening 14*d* to again lock the pin 11 in the second intermediate cutting position, the first intermediate cutting position being that shown in FIGS. 4 and 4A. In FIG. 5A, the letter B indicates the distance that the longitudinal central axis 40 has been moved or shifted with respect to the body 12 from its original position shown in FIG. 3A. The distance X shown by the arrows in FIG. 5A is the same distance X illustrated in FIG. 3A and the distance X minus B indicated by the arrows shows the distance the central axis 40 of the section 11*a* is from the wall of the well bore W. The diameter of the cutter 10 is reduced in FIG. 5A as compared to FIGS 3A and 4A to illustrate the effect of the reduction in diameter of the cutter 10. In other words, by the shifting of the central axis 40 as illustrated in FIG. 5A, the same diameter of well bore W is being cut with the cutter 10 even though the diameter of the cutter 10 is reduced from wear or otherwise.

FIG.6 illustrates the final position of the cuter pin 11 wherein the maximum movement of the longitudinal central axis 40 from its original position shown in FIG. 3 has been obtained. In FIG. 6, the rod 30 has been reinserted in the opening 11*f* and the opening 14*c* aligned therewith, but the pin 11 is rotated one hundred eighty degrees from the position illustrated in FIG. 3. The letter C designates the distance between the arrows for showing the extent of the movement of the central axis 40 from its original position shown in FIG. 3A. The letter C therefore designates the amount of movement of the cuter 10 and the pin 11 with respect to the body 12 of the reamer R. The distance designated with the letter X and with the arrows therewith is the same distance indicated in FIG. 3A and the ultimate or final distance of the central axis 40 from the wall of the well bore W is indicated by the arrows and the designation X minus C.

It can therefore be seen by a comparison of FIGS. 3–6, inclusive and FIGS. 3A–6A, inclusive, that the cutter pin 11 is adapted to be positioned in an initial cutting position, two intermediate cutting positions and a final cutting position. The number of the openings 11*f* and 11*g* may be increased and the angles of such openings with respect to each other may also be changed to obtain different amounts of movement of the pin 11 and also to obtain different numbers of intermediate positions, but it has been found that the two intermediate positions shown in FIGS. 4 and 5 provide the desired cutting action as the cutter 10 wears while avoiding the necessity for any excessive number of changes in the position of the cutter pin 11.

In FIG. 7, a modification is illustrated wherein the upper pin section 111*b* is square or is formed with flat sides rather than being formed in a cylindrical shape as the upper pin section 11*b*. The lower pin section 11*c* could likewise be formed in a square shape or in a flat sided shape rather than being cylindrical as illustrated in FIG. 2. However, it will be appreciated that if the square or flat sided construction of the upper pin section and the lower pin section are utilized, the pin support collars 14 and 15 would likewise have to be modified to accommodate such differences in shape. Otherwise, the use and operation would be substantially the came as that described heretofore in connection with the reamer illustrated in FIGS. 1–6.

FIGS. 8 and 9 illustrate another modification of the reamer of this invention, and particularly the pin 11 of this invention. In FIGS. 8 and 9, the pin 211 is of the same diameter throughout its length, but sleeves 211*b* and 211*c* are provided which form eccentric mountings for the pin 211 similar to the upper pin section 11*b* and the lower pin section 11*c*, respectively. The lower pin sleeve 211*c* would preferably be connected with the pin 211 with a key or spline 50 which pre-

vents relative rotation between the pin 211 and the sleeve 211c. The sleeve 211b would be locked with the pin 211 with a lock rod 230 or any other similar locking means similar to the rod 30 illustrated in FIG. 2. Such rod 230 would extend through the pin 211, the sleeve 211b and also through an opening such as the opening 14c in the support collar 14 of FIG. 2 (not shown in FIG. 8). The central longitudinal axes of the sleeve 211b and the sleeve 211c would be in alignment or would be coincident with each other, but they would be laterally offset with respect to the longitudinal central axis of the cutter pin 211. Therefore, in use, the modified form shown in FIGS. 8 and 9 would function in the same manner as explained previously in connection with the form of the invention shown in FIGS. 1–6. It will be appreciated that instead of the sleeves 211b and 211c being cylindrical, they can assume other shapes such as the square shape proposed in the modification of FIG. 7.

The form of the invention illustrated in particular in FIGS. 10 and 11 is basically the same as the structure illustrated and described in connection with FIGS. 1–6. Referring now to FIGS. 10 and 11, the support body 312 corresponds with the support body 12 of the reamer R. However, the particular manner of assembling the sections of the body 312 differs from that described above in connection with the body 12 because of the fact that the form of the invention disclosed in FIGS. 10 and 11 includes a plurality of sets of casing rollers C–1 and C–2 which are of different sizes for a purpose to be hereinafter described. The body 312 is suitably provided with an inner bore 312a which extends for the full length thereof so that drilling fluid or other well liquids may pass through the body 312 during the use of the casing roller construction of FIGS. 10 and 11, if desired. The bore 312a may be reduced by providing an insert 312b having an internal bore 312c in some instances and such construction is shown in FIG. 10.

Referring now to FIG. 11 in particular, such FIG. 11 of the drawings shows in detail one of the roller assemblies used in conjunction with either of the casing rollers C–1 or C–2, because each of such sets of casing rollers C–1 and C–2 is the same, except for size, as is evident from FIG. 10. The pin 311 is preferably substantially identical with the pin 11 of FIG. 2 and therefore it includes an intermediate section 311a, an upper section 311b and a lower section 311c. Normally, the upper section 311b is elongated as compared to the section 11b of FIG. 2, but such elongation is not essential. The roller 310 which is mounted on the intermediate portion 311a of the pin 311 is basically the same as the reamer cutter 10 of FIG. 2, except that the shape of the roller 310 is different than the cutter 10. The roller or rollers 310 may be formed in a single unitary piece, but preferably they are formed in a plurality of annular segments which are held together by adhesive or any other suitable means, and therefore, the rollers 310 are illustrated in the drawings as made up of a plurality of annular layers which are formed so that the external surface 310b is tapered downwardly except for a slight upward taper near the upper end thereof. The bore 310a of the roller 310 is provided of slightly greater internal diameter than the external diameter of the intermediate portion 311a of the pin 311 so that the roller 310 may rotate freely on the pin 311.

Instead of employing the outwardly extending support collars 14 and 15, the form shown in FIG. 11 is provided with the bores 314a extending into the body 312 for receiving the upper portion 312 of the pin 311. Likewise, the lower portion 311c of the pin 311 is received in an opening or hole 315a which is formed in the body 312. The body 312 is also provided with an enlarged recess 312d as compared with the recess 12a to accommodate the positioning of the roller 310 inwardly of the body 312 a greater distance than in connection with the form of the invention shown in FIGS. 1 and 2.

The body 312 is provided with an upper recess or notch 314b for receiving an upwardly extending tab or projection 320a on an upper wear ring 320. Similarly, the body 312 is provided with a recess or notch 315c for receiving a tab or projection 321a on a lower wear ring 321. Such wear rings 320 and 321 may not be necessary, as explained previously in connection with FIGS. 1 and 2, although they are desirable so that the wear rings may be replaced when the rollers 310 are replaced.

The upper portion 311b of the pin 311 is provided with laterally extending openings 311f and 311g which are identical in construction with the openings 11f and 11g of FIG. 2. Also, the body 312 is formed with laterally extending openings 314c and 314d which are identical with openings 14c and 14d of FIG. 2. Such openings 314c and 314d are adapted to be aligned with the openings 311f and 311g, respectively, in the same manner as heretofore described in connection with FIG. 2, and also in connection with FIGS. 3–6. Therefore, the pin 311 may be moved and positioned in any one of the positions shown in FIGS. 3–6. A removable screw 331 as shown in FIG. 11 would be utilized in the position shown in FIG. 11 to prevent the rod 330 from being withdrawn from the opening in which it is positioned prior to the time desired. For this purpose, a suitable threaded opening 331a corresponding to the opening 31a of FIG. 2 is provided in each of the openings 314c and 314d. It will be understood that the rod 330 for locking the pin 311 would be in either the hole 311f or the hole 311g, as explained previously in connection with the holes 11f and 11g of FIG. 2. Therefore, the same gradual outward movement of the rollers 310 with respect to the body 312 may be obtained with the form of the invention shown in FIGS. 10 and 11 as is described above in connection with FIGS. 1 and 2 and as illustrated in FIGS. 3–6.

In the use of the casing roller construction shown in FIGS. 10 and 11, the apparatus is lowered into a collapsed casing or pipe P which is collapsed as indicated at P–1 so that the inner diameter of the casing or pipe P is reduced. Such collapsing of the casing or pipe P may occur for various reasons and in various ways, as will be understood by those skilled in the art, but regardless of the manner in which such collapsing of the pipe or casing P occurs, the device illustrated in FIGS. 10 and 11 may be used for enlarging the casing or pipe P to return the collapsed section P–1 to its original bore or diameter.

To accomplish such expanding or enlargement of the collapsed section P–1 of the casing or pipe P, the apparatus or tool is lowered into the pipe or casing P until the lower set of casing rollers C–2 engage the restricted portion P–1 as shown in FIG. 10. The entire body 312 is then rotated from the surface and the rollers 310 roll in engagement with the inner surface of the casing or pipe P. Since the rollers 310 are tapered downwardly, they gradually enlarge or expand the collapsed portion P–1 of the pipe P as the body 312 is lowered and is rotated. When the collapsed portion or section P–1 has been expanded or enlarged to the maximum extent possible with the rollers 310 set in their original position, which would correspond with the position shown in FIG. 3 of the drawings, then the rollers 310 are rotated to the second position which would correspond to the position shown in FIG. 4 of the drawings. Such rotation is accomplished in the same manner as previously described in connection with FIGS. 1 and 2 wherein an Allen head wrench is inserted into the Allen opening 311e (FIG. 11), or the pin 311 is turned in any other suitable manner. It should be noted that access to the pin 311 is provided by elongated recesses 312e provided in the body 312. Only the lower rollers 310 would be initially changed in position since only the lower

set of rollers C–2 would be initially used until they had been used to their maximum extent. Thus, as the rollers in the set C–2 are changed in position until they reach the position shown in FIG. 6, they would gradually expand or enlarge the section P–1 to the maximum extent possible with the rollers **310** in the set C–2. Thereafter, the entire body **312** would be lowered to position the rollers **310** in the set C–1 in contact with the then partially enlarged collapsed portion P–1 of the pipe P. The same procedure would be repeated with the rollers **310** in the set C–1 and they would be successively used in the various positions illustrated schematically in FIGS. 3–6 until the pipe is expanded or enlarged at the collapsed portion P–1 to the same or substantially the same internal bore or diameter as the rest of the casing or pipe P.

It should be noted that a recess or groove **312***e* is provided above each of the rollers **310**, although such groove or recess **312***e* is not visible above the rollers **310** in the upper set C–1 as shown in FIG. 10.

After the complete enlargement or expansion of the collapsed portion P1 of the casing or pipe P, the rollers **310** in each set may be replaced if necessary. Such replacement can be accomplished by removing the pin **311** with any of the rollers **310** which is to be replaced. Such removal is effected in the same manner as described in connection with the reamer cutter **10** of FIGS. 1 and 2 and briefly is accomplished by pulling the pin **311** upwardly until the roller **310** may be moved laterally away from the pin **311**. For that reason, the slots or grooves **312***e* above the rollers **310** must be at least as long as the length of the pins **311** therebelow. The wear rings **320** and **321** may likewise be replaced when the pins **311** have been pulled upwardly to the release position.

The pin **311** may be modified as illustrated in FIGS. 7–9, and as described above in connection therewith, so that the upper portion **311***b* and the lower portion **311***c* are square as shown in FIG. 7, or so that the pin **311** is of uniform diameter with sleeves such as sleeves **211***b* and **211***c* mounted therewith for obtaining the movement of the rollers laterally outwardly.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A reamer comprising, a reamer body, a reamer cutter having a central bore therethrough and cutter teeth on the exterior thereof, a pin having a central pin section adapted to extend through said bore of said reamer cutter with an upper pin section extending above said cutter and a lower pin section extending below said cutter, a lower support collar on said reamer body having an opening for receiving said lower pin section, an upper support collar on said reamer body having an opening for receiving said upper pin section, the central axes of said openings in said collars being coincident, an upper sleeve positioned in said upper support collar and surrounding said upper pin section, a lower sleeve positioned in said lower support collar, the central axis of said upper sleeve and the central axis of said lower sleeve being coincident with each other and with the central axes of said upper and lower support collars, the central axes of said central pin section and said reamer cutter being coincident with each other but being laterally offset with respect to said central axes of said upper and lower sleeves, said sleeves being rotatable in said support collars to change the position of the central axes of said central pin section and said cutter, and means to lock said pin to prevent rotation thereof in at least two different positions wherein the distance from said central axis of said reamer cutter to the central axes of said upper and lower pin sections is different in each of such positions, whereby said cutter may be shifted and locked in the shifted position for reaming substantially the same size of well bore or hole even though the diameter of said cutter is reduced from wear.

2. The structure set forth in claim 1, wherein said means to lock said pin includes a lock rod, and laterally extending openings in said pin and said body which are adapted to be aligned for receiving said lock rod when said pin is in each of said different positions.

3. The structure set forth in claim 1, wherein said means to lock said pin includes a lock rod, one of said collars having at least one lateral hole therein which intersects the opening of the collar, and said pin having at least two lateral holes therethrough at different angles with respect to each other and each of which is adapted to be aligned with said lateral hole in said one of said collars for receiving said lock rod to lock said pin in said different positions.

4. The structure set forth in claim 1, wherein said means to lock said pin includes a lock rod, one of said collars having at least two lateral holes at different angles with respect to each other, said pin having at least one lateral hole adapted to be successively aligned with said holes in said one of said collars for receiving said lock pin to lock said pin in said different positions.

5. The structure set forth in claim 1, wherein said sleeves are connected to said pin for rotation therewith to said positions.

6. A reamer comprising, a reamer body, a reamer cutter having a central bore therethrough and cutter teeth on the exterior thereof, a pin having a central pin section adapted to extend through said bore of said reamer cutter with pin end sections extending above and below said cutter, said reamer body having a lower recess for receiving the lower one of said end sections and an upper opening for receiving the upper one of said end sections, the central axes of said central pin section being laterally offset with respect to the central axes through said recess and said opening in said body, said pin being rotatable in said body to change the position of the central axis of said central pin section with respect to said central axes of said recess and said opening, a first hole in one of said end sections and a first hole in said reamer body adapted to be aligned with each other, a second hole in one of said end sections longitudinally spaced and extending at an angle with respect to said first hole, a second hole in said reamer body longitudinally spaced from said first hole in said body and adapted to be aligned with said second hole in said end section when said pin has been rotated to the extent of said angle, and a locking pin adapted to be positioned in said first hole in said reamer body and in said end section to lock the reamer cutter in a first position and also adapted to be removed from said first hole and positioned in said second hole in said body and said end section when said pin has been rotated to align said second holes.

7. The structure set forth in claim 6, wherein the upper one of said end sections has a larger diameter than said central pin section, and wherein the lower one of said end sections has a smaller diameter than said central pin section, whereby said pin may be longitudinally removed from said body through said opening.

8. The structure set forth in claim 6, wherein said second hole in said body is parallel to said first hole, and wherein said angle is approximately sixty degrees.

9. A casing roller construction for use in expanding or enlarging a collapsed portion of a casing or pipe, comprising a support body, a casing roller having a central bore therethrough and an external surface adapted to engage the collapsed portion of the casing or pipe, a longitudinally extending pin having a central pin section extending through the bore of said casing roller and end sections extending above and below said roller, said body having a lower recess for receiving the lower one of said end sections and an upper opening for receiving the upper one of said end sections, the central axes of said central pin section being laterally offset with respect to the central axes through said recess and said opening, said pin being

rotatable in said body to change the position of the central axis of said central pin section with respect to said central axes of said recess and said opening, a first hole in one of said end sections and a first hole in said body adapted to be aligned with each other, a second hole in one of said end sections longitudinally spaced and extending at an angle with respect to said first hole, a second hole in said body longitudinally spaced from said first hole in said body and adapted to be aligned with said second hole in said end section when said pin has been rotated to the extent of said angle, and a locking pin adapted to be positioned in said first hole in said body and in said end section to lock the casing roller in a first position and also adapted to be removed from said first hole and positioned in said second hole in said body and said end section when said pin has been rotated to align said second holes.

10. The structure set forth in claim 9, wherein the upper one of said end sections has a larger diameter than said central pin section, and wherein the lower one of said end sections has a smaller diameter than said central pin section, whereby said pin may be longitudinally removed from said body through said opening.

11. The structure set forth in claim 9, wherein said second hole in said body is parallel to said first hole, and wherein said angle is approximately sixty degrees.

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