July 5, 1932. G. F. JOHNSON 1,866,038

METHOD AND DEVICE FOR CEMENTING OIL WELLS

Filed Aug. 28, 1931 3 Sheets-Sheet 1

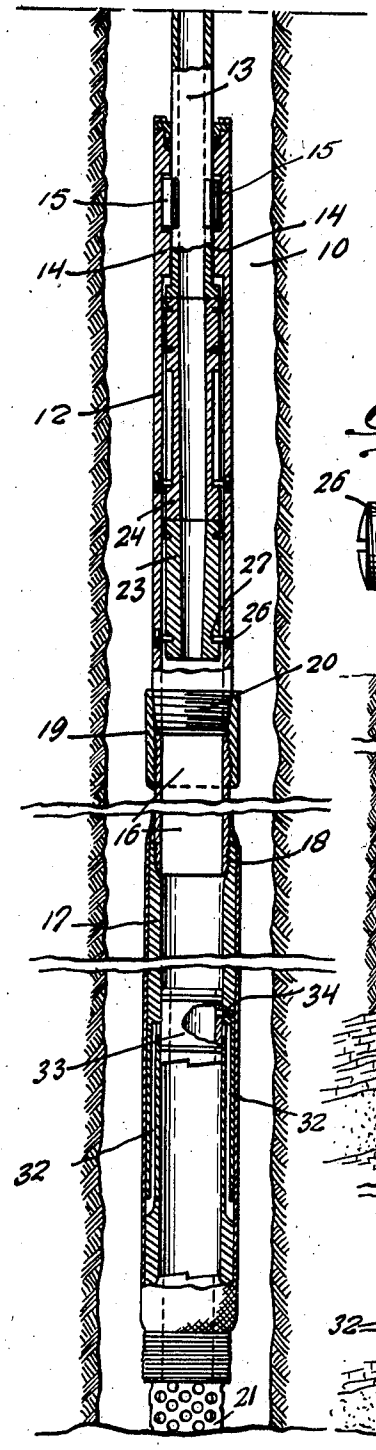


Fig. 1.

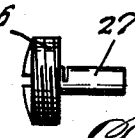


Fig. 11.

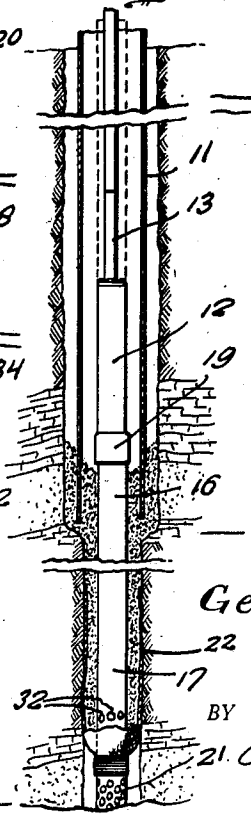


Fig. 12.

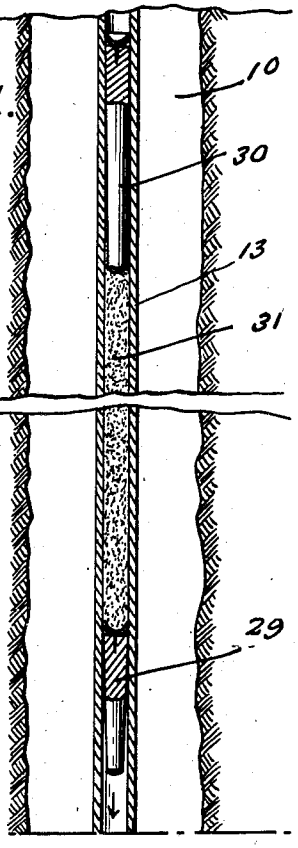


Fig. 2.

George F. Johnson,
INVENTOR.

BY J. Stanley Bruch
ATTORNEY.

July 5, 1932. G. F. JOHNSON 1,866,038

METHOD AND DEVICE FOR CEMENTING OIL WELLS

Filed Aug. 28, 1931 3 Sheets-Sheet 2

Fig. 3.

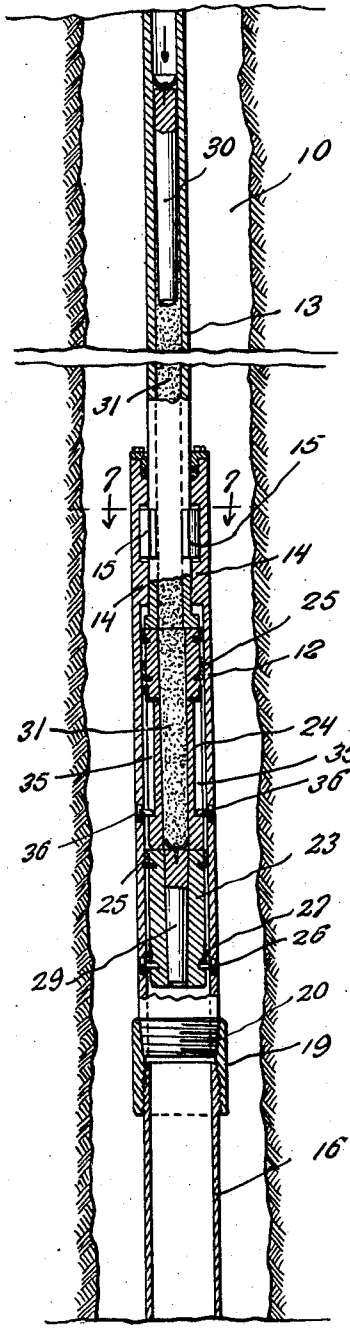


Fig. 4.

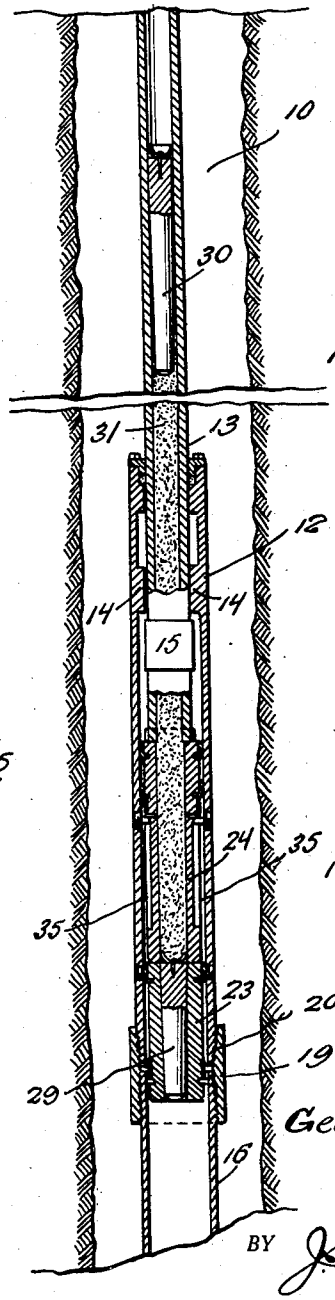


Fig. 7.

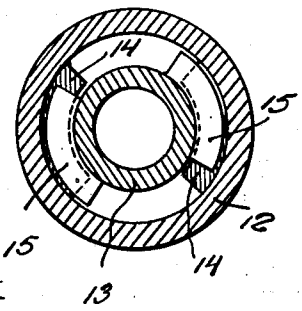
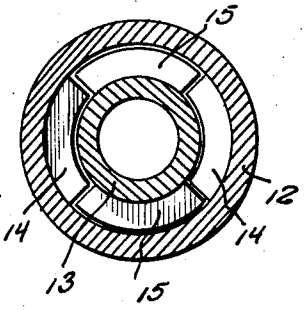


Fig. 8.



George F. Johnson,
INVENTOR.

BY J. Stanley Bruch
ATTORNEY.

July 5, 1932. G. F. JOHNSON 1,866,038

METHOD AND DEVICE FOR CEMENTING OIL WELLS

Filed Aug. 28, 1931 3 Sheets-Sheet 3

Fig. 5.

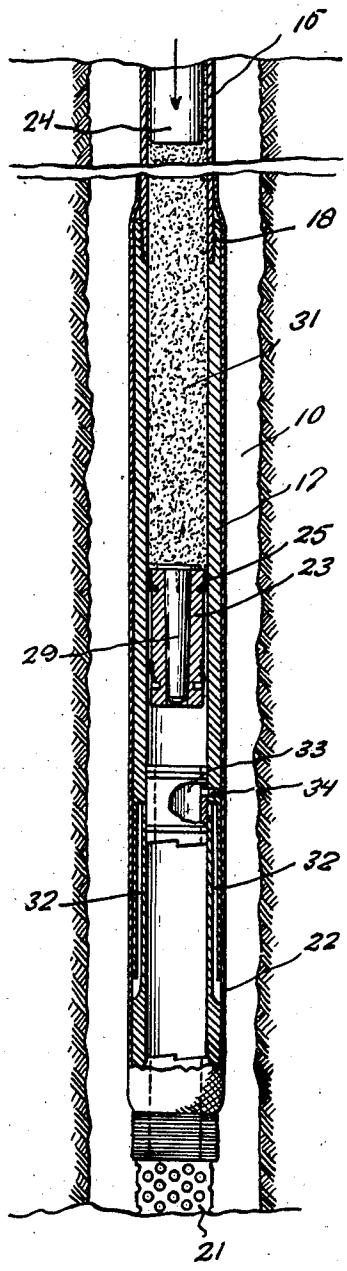


Fig. 6.

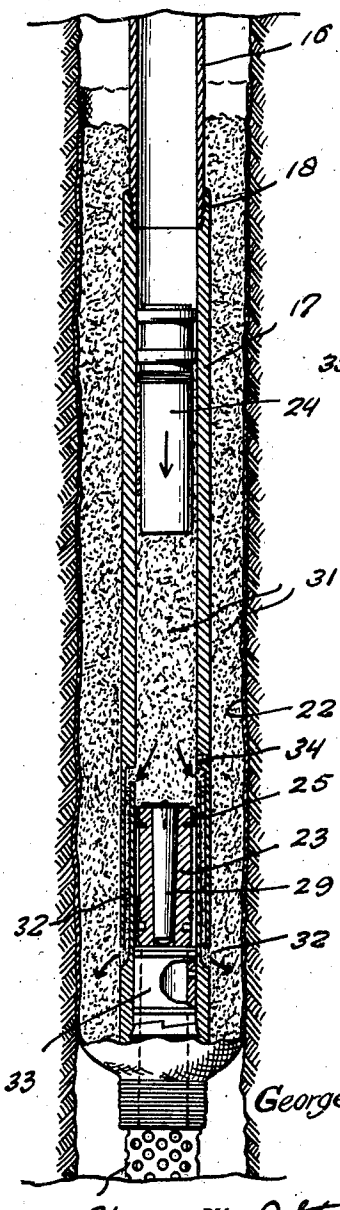


Fig. 9.

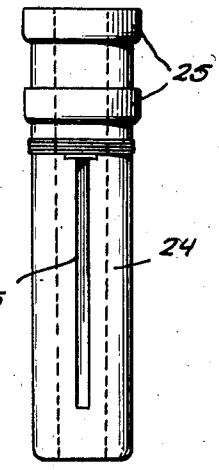
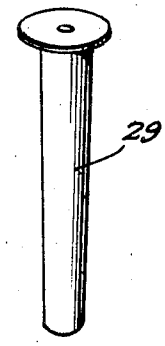


Fig. 10.



George F. Johnson,
INVENTOR.

BY J. Stanley Bunch

ATTORNEY.

Patented July 5, 1932 1,866,038

UNITED STATES PATENT OFFICE

GEORGE FULLERTON JOHNSON, OF LOGANSPORT, LOUISIANA, ASSIGNOR OF ONE-HALF TO F. K. JOHNSON AND THOMAS RUSSELL, OF DE SOTO PARISH, LOUISIANA

METHOD AND DEVICE FOR CEMENTING OIL WELLS

Application filed August 28, 1931. Serial No. 560,020.

The present invention comprehends a new method and device for cementing oil wells, and is particularly useful where it is found necessary to deepen the well.

It is a well known practice in the art, to cement the walls of a well casing to protect the oil bearing sand from the detrimental effects of liquid mud water, and this is accomplished by use of plugs inserted within the well casing at opposite ends of a column of cement, which as a unit is forced by pressure to the bottom of the well and distributed about the casing, between the latter and the earth wall of the bore therefor.

It is sometimes necessary to deepen a well in order to strike a lower oil producing sand, which of course necessitates drilling the well to a greater depth than the depth of the well casing. After the desired depth has been reached, it is customary to insert within the well casing an additional casing of smaller diameter, extending from the top to the bottom of the well and beyond the lower end of the regular well casing. This is not only a very expensive practice, especially if the well is deepened to a very great extent, because of the amount of additional casing used, and the time and labor required for its installation, but it is exceptionally difficult to cement the casing under such circumstances, by the usual method, hereinabove referred to, wherein the cement must be forced by pressure through the entire length of the well casing.

It is therefore the object of the present invention to provide a new and improved method and means for cementing the well casing through the drill pipe, thereby eliminating the necessity of forcing the cement through the entire length of the well casing.

Another object of the invention resides in the provision of a device for this purpose, including a tubular member adapted to be lowered into the well with the drill pipe, and subsequently receive the cement mixture, and from which tubular member the cement mixture is forced into the earth bore for the well casing.

It is one of the chief characteristics of the present invention to provide a device for cementing a well casing, in a manner whereby a short length of an additional well casing can be lowered through the regular well casing and cemented to the latter and to the earth wall of the bore therefor, where it is necessary to deepen the well, and thereby eliminate the necessity of using an additional well casing for the entire length of the well, and without forcing the cement through the well casing throughout its entire length.

The invention comprehends a device whereby a short length of additional well casing can be lowered into the well and positioned in the bore of the earth provided where it is necessary to deepen the well, and subsequently cement the additional well casing within its bore and to the lower end of the regular well casing, in a novel and unique manner, with a view of saving in the amount of well casing used for deepening the well, and with a view of minimizing both the time and effort required in cementing the additional well casing in place.

Another object of the invention resides in the provision of a new and improved method and means for cementing an additional length of well casing in place to form a continuity of the regular well casing, where deepening of the well is necessary, without the necessity of forcing the cement through the entire length of the well casing, and to permit this work to be quickly and accurately accomplished, without requiring any subsequent drilling of the cement from either casing.

The nature and advantages of the invention will be better understood when the following detail description is read in connection with the accompanying drawings, the invention residing in the construction, combination and arrangement of parts as claimed.

In the drawings forming part of this application like numerals of reference indicate similar parts in the several views and wherein:

Figure 1 is a vertical fragmentary view of the invention.

Figure 2 is a similar view showing the upper part of the drill pipe.

Figure 3 is a similar view showing the posi-

tion of parts during the first step of the operation.

Figure 4 is a similar view showing the next step of the operation.

Figure 5 is a similar view showing the normal position of the valve for covering the outlet passages for the cement mixture, formed in the short length of additional well casing.

Figure 6 is a similar view showing how the cement is forced from the additional length of well casing.

Figure 7 is a sectional view on line 7—7 of Figure 3.

Figure 8 is a similar view showing the relative arrangement of the lugs to permit of sliding movement of the drill pipe through the tubular member of the device.

Figure 9 is a detail view of one of the female plugs.

Figure 10 is a similar view of one of the male plugs.

Figure 11 is a detail view of the weakened pin for normally holding one of the female plugs fixed with relation to the tubular member of the device.

Figure 12 is a fragmentary vertical sectional view showing how the additional length of well casing is placed in position beneath the lower end of the regular well casing, and cemented to the latter and also within the earth bore therefor.

Referring to the drawings in detail 10 indicates the earth bore of a well in which the regular well casing is adapted to be arranged, this casing being eliminated in all figures of the drawings with the exception of Figure 12, wherein the casing is indicated at 11.

As hereinabove stated, the present invention aims to provide a device by means of which a cement mixture can be quickly and easily lowered through the well casing 11, and subsequently distributed about the wall thereof to protect the oil producing sand from the effect of liquid mud water, and at the same time lower into the well casing an additional length of casing of smaller diameter, to form a continuity of the regular well casing, where it is necessary to deepen the well, and to simultaneously cement the additional length of well casing in position for use.

In carrying out the invention I preferably employ a hollow tubular member 12 which is adapted to be supported by a pipe section 13, and this pipe section is preferably coupled in any suitable manner to a drill pipe (not shown), after the drilling tool has been removed therefrom. The pipe 13 is capable of sliding movement within the tubular member 12 for a purpose to be hereinafter described, but is normally held fixed relatively to the tubular member in any suitable manner. For this purpose I preferably provide the tubular member with a pair of spaced diametrically opposed lugs 14 upon which similarly constructed lugs 15 carried by the pipe 13 are adapted to repose. The position of these lugs for supporting the tubular member on the pipe 13 is clearly illustrated in Figure 7, while in Figure 8 I have shown how the lugs are arranged at right angular relation to each other to permit of sliding movement of the pipe within the tubular member when desired. The tubular member may be of any desired length, and include any number of sections suitably coupled together, and adapted to be lowered with the pipe 13 into the well through the casing 11, and from which a cement mixture is adapted to be forced, in a manner to be hereinafter described for cementing the well. The tubular member is primarily intended to support an additional length of well casing, of smaller diameter than the well casing 11, and adapted to be lowered into the well through the latter, to form a continuity thereof where it is necessary to deepen the well. The additional well casing can of course vary in length and be made up of any number of sections of desired length suitably coupled together, although I have illustrated two of such sections indicated at 16 and 17 respectively which are joined together by threads 18. The uppermost section 16 is connected to the lower end of the tubular member 12 by a coupling sleeve 19 threaded to the adjacent ends of the tubular member 12 and well casing section 16, the lower end of the tubular member 12 having left hand threads 20 so that the tubular member can be separated from the additional length of well casing, in a manner to be hereinafter described, after the well casing has been properly positioned in the earth bore therefor. The additional length of well casing also includes the usual screen or strainer 21, and the flexible sack or cover 22.

Supported within the tubular member 12 is a pair of female plugs of relatively different lengths and indicated at 23 and 24 respectively. These plugs have tapered bores as illustrated and are normally arranged in end to end contacting engagement, each plug being equipped with one or more flexible composition washers 25. The lowermost relatively short plug 23 is normally held fixed with relation to the tubular member 12, but in a manner to permit this plug to be easily and conveniently separated therefrom, to permit the plug to pass into the additional length of pipe casing, in spaced relation to the plug 24, and with the cement mixture therebetween, which position of the plugs is clearly illustrated in Figure 5. While any suitable means may be employed for this purpose, I preferably use a headed pin of the character shown in Figure 11, the head 26 of which is adapted to be threaded into an opening in the tubular member 12 and have its shank 27 received by a bore or recess in the plug 23. Several of these elements are

used in connection with the plug as shown in Figure 3, and the shank 27 of each element is slotted as at 28 to weaken the same, so that the shanks can be easily broken off to free the plug 23 as the occasion requires.

Used in conjunction with the female plugs 23 and 24 is a pair of male plugs 29 and 30 respectively which are normally placed within the pipe 13 in spaced relation, with the cement mixture 31 therebetween, and these plugs are adapted to be subsequently positioned within their corresponding female plugs 23 and 24 during the operation of the device in a manner which will be hereinafter described. The plugs 29 and 30 are not, however, associated with their corresponding female plugs 23 and 24, until after the latter have been spaced apart, so that when the corresponding plugs of each pair are united, and arranged within the additional length of pipe casing supported by the tubular member 12, the cement mixture 31 is positioned between the plugs as illustrated in Figure 5. The plugs together with the cement mixture continue to move downwardly through the additional length of pipe casing, until the lowermost pair of united plugs strike the bottom of the additional length of well casing, whereupon the upper pair of united plugs during their continued movement through the well casing 16, will force the cement mixture from the casing through passages 32 formed in the lower end of the additional well casing, and thereby distribute this cement mixture about the wall of the casing, to cement the latter to the earth bore therefor and also to the lower end of the regular well casing 11 as indicated in Figure 12. The passages 32 through which the cement mixture escapes into the bore of the well are normally closed by a valve piston 33 as clearly illustrated in Figure 5, and this valve is normally held fixed in its active position by means of a pin 34, the shank of which is weakened in any suitable manner, so that it can be easily broken when the piston is subjected to pressure, and thereby allow the piston to move downwardly in the well casing 16 to permit the escape or passage of the cement mixture 31 from the well casing into the bore of the well as will be readily understood.

In practice, when it is desired to deepen the well, a drilling apparatus is lowered through the well casing 11, to drill the well to a greater depth than the depth of the well casing 11 as clearly illustrated in Figure 12, and subsequent to the removal of the drilling apparatus the well is thoroughly washed and cleaned in any ordinary well known manner.

In contradistinction to then passing through the well casing 11, an additional well casing of lesser diameter, a comparatively short length of additional well casing is coupled to the lower end of the tubular member 12, and secured thereto by a collar 19 having a left hand threaded connection with the lower end of the tubular member. After the drilling tool has been removed from the drill pipe (not shown), the pipe 13 is suitably coupled to the drill pipe to form a continuity thereof, and the pipe 13 obviously supports the tubular member 12, so that the additional pipe section can be easily and quickly lowered through the well casing 11 into the earth bore provided therefor. However, this additional length of well casing partly extends within the well casing 11 when it assumes its final position as shown in Figure 12, and is adapted to be cemented both to the lower end of the well casing 11 and to the wall of the earth bore provided therefor.

Prior to lowering of the additional well casing within the well, the male plugs 29 and 30 are arranged within the pipe 13 with the cement mixture 31 therebetween and it is of course understood that the corresponding female plugs 23 and 24 are positioned in the tubular member 12 as illustrated in Figure 3. Pressure of any suitable character, preferably a hydraulic pressure is introduced into the pipe 13 and against the uppermost male plug 30, thereby forcing both of these plugs together with the column of cement mixture 31 downwardly through the pipe, until the lowermost male plug 29 has been positioned within its corresponding female plug 23 as shown in Figure 3. Up to this point of the operation, the two female plugs 23 and 24 are in end to end contacting relation, and the female plug 23 held against movement by the headed element 27. After the male plug 29 has been positioned in its corresponding female plug 23, the pipe 13 is partially rotated to move the lugs 15 thereof into the spaces between the lugs 14 of the tubular member in the manner illustrated in Figure 8, which allows the pipe 13 to move longitudinally within the tubular member, so that the weight thereof and its associated parts will be sufficient to break the stem of the element 27, and thereby release the united plugs 23 and 29 respectively from the tubular member 12. During this operation the pressure within the pipe 13 is cut off, and after the pin 27 has been broken in the manner just described, presure is again admitted to the pipe 13 to continue the movement of the plugs and cement mixture therethrough. It will be noted upon inspection of Figures 3 and 9 that the female plug 24 is provided with diametrically opposed longitudinal grooves 35 which receive pins 36 carried by the tubular member 12, and in the normal position of the plug 24 as shown in Figure 3, these pins are arranged adjacent the lower ends of the grooves 35. Consequently, after the female plug 23 has been loosened or separated from its connection 27 with the tubular member 12, and pressure again applied to the pipe 13, the female plugs 23 and 24 move as a unit down-

wardly through the tubular member 12, until the upper ends of the grooves 35 of the female member 24 strike the pins 36, thus temporarily retarding the movement of the female plug 24, while the other female plug 23 together with its associated male plug 29 continues to move downwardly into the additional well casing 16. During this operation the female plugs 23 and 24 are spaced apart, and the cement mixture forced through the uppermost female plug 24 thereby permitting the uppermost male plug 30 to enter its corresponding female plug 24. Manifestly the plugs 23 and 24 are not only spaced apart, but the cement mixture arranged between the same, and the parts remain in this position while they travel as a unit through the additional well casing 16 under pressure supplied to the pipe 13. It is of course understood that after the pipe 13 has been rotated and positioned to permit of its sliding movement with relation to the tubular member 12 to separate the female plug 23 therefrom, the pipe section 13 is restored to its normal position to move with the tubular member as a unit.

During the continued movement of the spaced pairs of united plugs and the cement column therebetween through the section 17 of the additional well casing, the lowermost pair of said united plugs is brought into contacting engagement with the piston valve 33, separating this valve from the said section of the well casing in the manner hereinabove described, and moving this valve downwardly to the lower end of the well as shown in Figure 6. During this operation the inlet ends of the passages 32 are uncovered, and when the lowermost pair of united plugs are brought to rest at the lower end of the well, pressure on the uppermost pair of united plugs 24 and 30 will break the pins 36 so that the latter plugs will continue to move downwardly through the section 17 of the additional well casing, and thereby force the cement mixture through the passages 32 into the earth bore of the well for the purpose above stated. The tubular member and pipe 13 can then be easily separated from the additional well casing and removed from the well, and this can be accomplished by again turning the pipe 13 to position the lugs 15 thereof between the lugs 14 of the tubular member 12 as shown in Figure 8. Inasmuch as the tubular member 12 is connected with the coupling sleeve by left hand threads 20, it is manifest that by turning the pipe 13 in the proper direction, the lugs 15 thereof will engage the lugs 14 of the tubular member, and thereby turn the tubular member with the pipe 13 to separate the tubular member from the collar 19.

Manifestly the invention provides for the saving of a great amount of well casing, where deepening of the well is necessary, and the additional well casing used can be very accurately cemented in its proper position for use, as plugs are used of the same size as the pipe and tubular member through which the cement mixture is forced. Furthermore this work can be accomplished in a minimum of time and effort, and after the additional length of pipe has been cemented in place, the necessity of subsequent drilling out of cement is obviated.

While it is believed that from the foregoing description, the nature and advantages of the invention will be readily apparent, I desire to have it understood, that I do not limit myself to what is herein shown and described and that such changes may be resorted to when desired as fall within the scope of what is claimed.

What is claimed is:

1. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a sectional tubular member supported by said pipe to receive said plugs and column of cement mixture, a pair of female plugs arranged in the uppermost section of the tubular member normally in end to end relation, with the lowermost female plug adapted to initially receive its male plug and be forced away from the other of said female plugs during continued downward movement of the male plugs and column of cement, and until the uppermost male plug is received by its female plug, said tubular member having outlet passages through which the cement mixture is forced by continued movement of one pair of united plugs with relation to the other pair of said plugs, and a valve normally covering the inlet ends of said passages and adapted to be opened by one pair of plugs.

2. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a sectional hollow tubular member supported by said pipe and adapted to be lowered therewith through the well casing, a pair of female plugs supported within the uppermost section of the tubular member in end to end relation and adapted to successively receive their respective male plugs with the column of cement mixture therebetween during the downward movement of the male plugs, thereby causing the lowermost pair of corresponding plugs to be initially united and moved away from the uppermost female plug in spaced relation thereto, until the latter receives its corresponding male plug, and cement discharge means for the lower section of the tubular member, including a normally closed valve adapted to be opened by one pair

of said plugs, said cement mixture being discharged through said means by continued downward movement of one pair of said plugs with relation to the other pair thereof.

3. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a hollow tubular member supported by said pipe to receive said plugs and column of cement mixture, means for supporting an auxiliary well casing from the lower end of said tubular member to be received in an earth bore provided therefor, a pair of female plugs supported in said tubular member in end to end relation and adapted to successively receive their corresponding male plugs with the column of cement therebetween during the downward movement of said male plugs, thereby causing the lowermost pair of corresponding plugs to be initially united and moved into said auxiliary well casing in spaced relation to the uppermost pair of united plugs, said auxiliary well casing having outlet passages through which the cement mixture is forced by continued movement of one pair of said plugs with relation to the other.

4. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a tubular member supported by said pipe to receive said plugs and column of cement mixture, means for supporting an auxiliary well casing from the lower end of said tubular member to be received in an earth bore provided therefor, a pair of female plugs supported in the tubular member in end to end relation and adapted to successively receive their corresponding male plugs with the column of cement therebetween during the downward movement of said male plugs, thereby causing the lowermost pair of corresponding plugs to be initially united and forced into said auxiliary well casing in spaced relation to the uppermost pair of united plugs, said auxilary well casing having outlet passages through which the cement mixture is forced by continued movement of one pair of plugs with relation to the other pair thereof, a piston valve normally closing the inlet ends of said passages, and breakable means supporting the valve in the auxiliary casing, whereby said valve is forced to an inactive position in the lower end of said casing by the adjacent pair of said plugs.

5. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a tubular member supported by said pipe to receive said plugs and column of cement mixture, means for supporting an auxiliary well casing from the lower end of said tubular member to be received in an earth bore provided therefor, a pair of female plugs supported in the tubular member in end to end relation and adapted to successively receive their corresponding male plugs with the column of cement therebetween during the downward movement of said male plugs, thereby causing the lowermost pair of plugs to be initially united and moved into said auxiliary well casing in spaced relation to the uppermost pair of united plugs, means for holding the uppermost female plug within the tubular member until it receives its corresponding male plug, said auxiliary well casing having outlet passages through which the cement mixture is forced by continued movement of one pair of plugs with relation to the other pair thereof, and a normally closed valve for said passages, adapted to be moved to an inactive position by one pair of said plugs.

6. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a tubular member supported by said pipe to receive said plugs and column of cement mixture, means for supporting an auxiliary well casing from the lower end of said tubular member to be received in an earth bore provided therefor, a pair of female plugs supported in the tubular member in end to end relation and adapted to successively receive their corresponding male plugs with the column of cement therebetween during the downward movement of said male plugs, thereby causing the lowermost pair of plugs to be initially united and moved into said auxiliary well casing in spaced relation to the uppermost pair of united plugs, breakable means limiting the sliding movement of the uppermost female plug in the tubular member and holding it therein until it receives its corresponding male plug, said auxiliary casing having outlet passages through which the cement mixture is forced by continued movement of one pair of plugs with relation to the other, and a valve normally covering said passages and adapted to be moved to an inactive position by one pair of plugs.

7. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a

tubular member supported by said pipe to receive said plugs and column of cement mixture, means for supporting an auxiliary well casing from the lower end of said tubular member to be received in an earth bore provided therefor, a pair of female plugs supported in the tubular member in end to end relation and adapted to successively receive their corresponding male plugs with the column of cement therebetween during the downward movement of said male plugs, thereby causing the lowermost pair of plugs to be initially united and moved into said auxiliary well casing in spaced relation to the uppermost pair of united plugs, breakable means for limiting the sliding movement of the uppermost female plug in the tubular member and holding it therein until it receives its corresponding male plug, means including said pipe, whereby said female plug is subsequently released from said breakable means for continued downward movement, said auxiliary casing having outlet passages through which the cement mixture is forced by continued movement of one pair of plugs with relation to the other.

8. Means for cementing wells, comprising a pipe adapted to be lowered into the well through the well casing, a pair of spaced male plugs adapted to be placed in said pipe with a column of cement mixture therebetween and forced downwardly therefrom by pressure, a hollow tubular member slidably and rotatably receiving said pipe, cooperating means carried by said pipe and tubular member for supporting the latter from said pipe, means for supporting an auxiliary well casing from the tubular member to be received within an earth bore provided therefor, a pair of female plugs arranged in the tubular member in end to end relation, breakable means carried by said member for holding the lowermost female plug fixed relatively thereto and adapted to be released therefrom by sliding movement of the pipe within said member, said female plugs being adapted to successively receive their corresponding male plugs with the column of cement therebetween, whereby the corresponding lowermost plugs are initially united and moved into the auxiliary casing in spaced relation to the uppermost pair of said plugs, means for limiting the sliding movement of the uppermost female plug and holding it within the tubular member until it receives its corresponding male plug, said auxiliary casing having outlet passages through which the cement mixture is forced by continued movement of one pair of plugs with relation to the other pair thereof.

9. The method of cementing wells, which consists in introducing into a pipe having cement discharge means, a pair of female plugs and a column of cement mixture between a pair of spaced male plugs located above the female plugs, then lowering said pipe through the well casing, then applying pressure to one of the male plugs to force the column of cement and other plug downwardly through the pipe until the lowermost male plug is fitted into its corresponding female plug, causing the united plugs to move away from the other female plug, until the uppermost male plug is fitted into its corresponding female plug with the column of cement between the respective pairs of united plugs, and then continuing said pressure to force the lowermost pair of united plugs to a position of rest and thereby deflect the cement mixture through said discharge means into the space about the casing during the continued downward movement of the upper pair of said plugs.

10. The method of cementing an auxiliary well casing having cement discharge means in a bore of a deepened well, which consists in introducing into a pipe supporting said casing, a pair of female plugs and a column of cement mixture between a pair of spaced male plugs located above the female plugs, then lowering said pipe and auxiliary casing through the well casing until the auxiliary casing is positioned in said bore, then applying pressure to one of said male plugs to force the column of cement and other male plug downwardly through the pipe until the lowermost male plug is fitted into its corresponding female plug, causing the united plugs to move away from the other female plug, until the uppermost male plug is fitted into its corresponding female plug with the column of cement mixture arranged between the respective pairs of united plugs, and then continuing said pressure to force the lowermost pair of united plugs to a position of rest and thereby deflect the cement mixture from the auxiliary casing into said bore and upwardly in the space about the well casing during continued downward movement of the upper pair of said plugs.

In testimony whereof I affix my signature.

GEORGE FULLERTON JOHNSON.