Oct. 9, 1928. 1,687,424

A. BOYNTON

METHOD OF AND APPARATUS FOR CEMENTING OIL, GAS, AND WATER WELLS

Filed Sept. 25, 1925 2 Sheets-Sheet 1

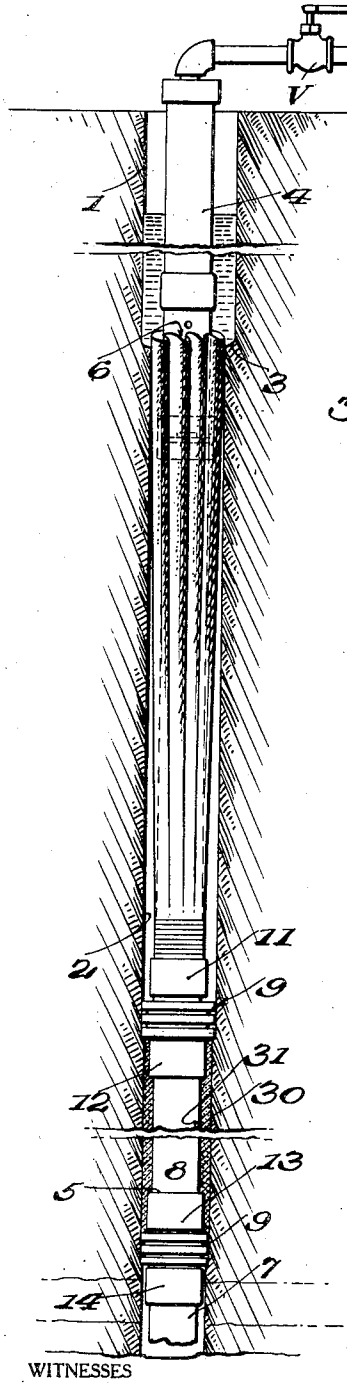


Fig. 1.

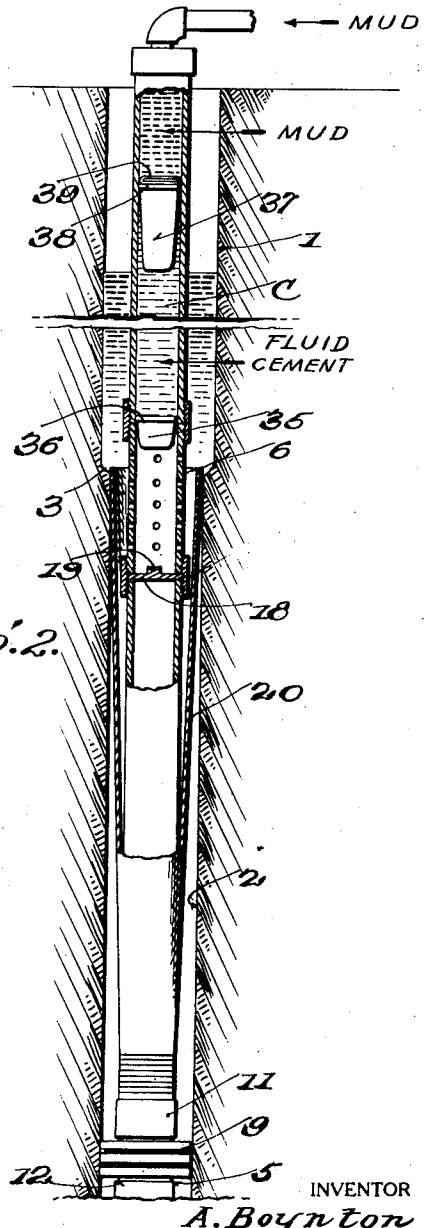


Fig. 2.

WITNESSES

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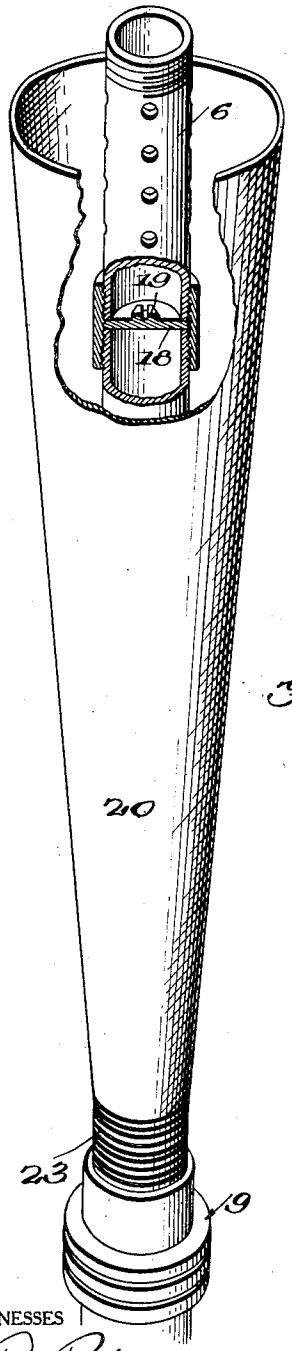


Fig. 3.

Fig. 4.

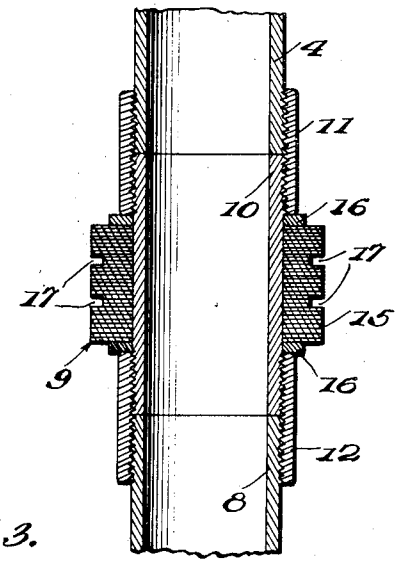
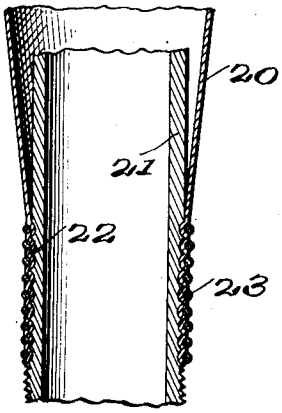


Fig. 5.



WITNESSES

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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR CEMENTING OIL, GAS, AND WATER WELLS.

Application filed September 25, 1925. Serial No. 58,584.

This invention relates to a method of and an apparatus for cementing oil, gas and water wells.

The object of the invention resides in the provision of a method and apparatus of this character which enables the operator to accurately determine the proper regions of the well to be cemented and to cement such regions and which makes it possible to use a liner of the same size as the casing and to hang or suspend the liner from the casing in such manner as to prevent the liner from being bent or distorted by weight of casing above resting upon it and caving formation in wall of well, a hanging liner being less liable to bend than a standing liner. Another advantage resides in the fact that the portion of the hole which extends through the oil producing formation may be enlarged by reaming or by means of explosives either after drilling is completed and before liner is set or anywhere below bottom of liner after the liner is set, this resulting from the fact that the liner is suspended from the casing and does not rest on the bottom of the well in accordance with the usual practice. Obviously, when the liner is supported or rests on the bottom of the well, as has been the practice heretofore, the well could not be enlarged at the bottom since to do so would destroy the liner.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a fragmentary view in elevation showing an apparatus embodying the present invention positioned in a well,

Figure 2 is a fragmentary view partly in vertical section and partly in elevation further illustrating the arrangement shown in Fig. 1,

Figure 3 is a fragmentary perspective view with parts broken away and shown in section and illustrating the auxiliary packer,

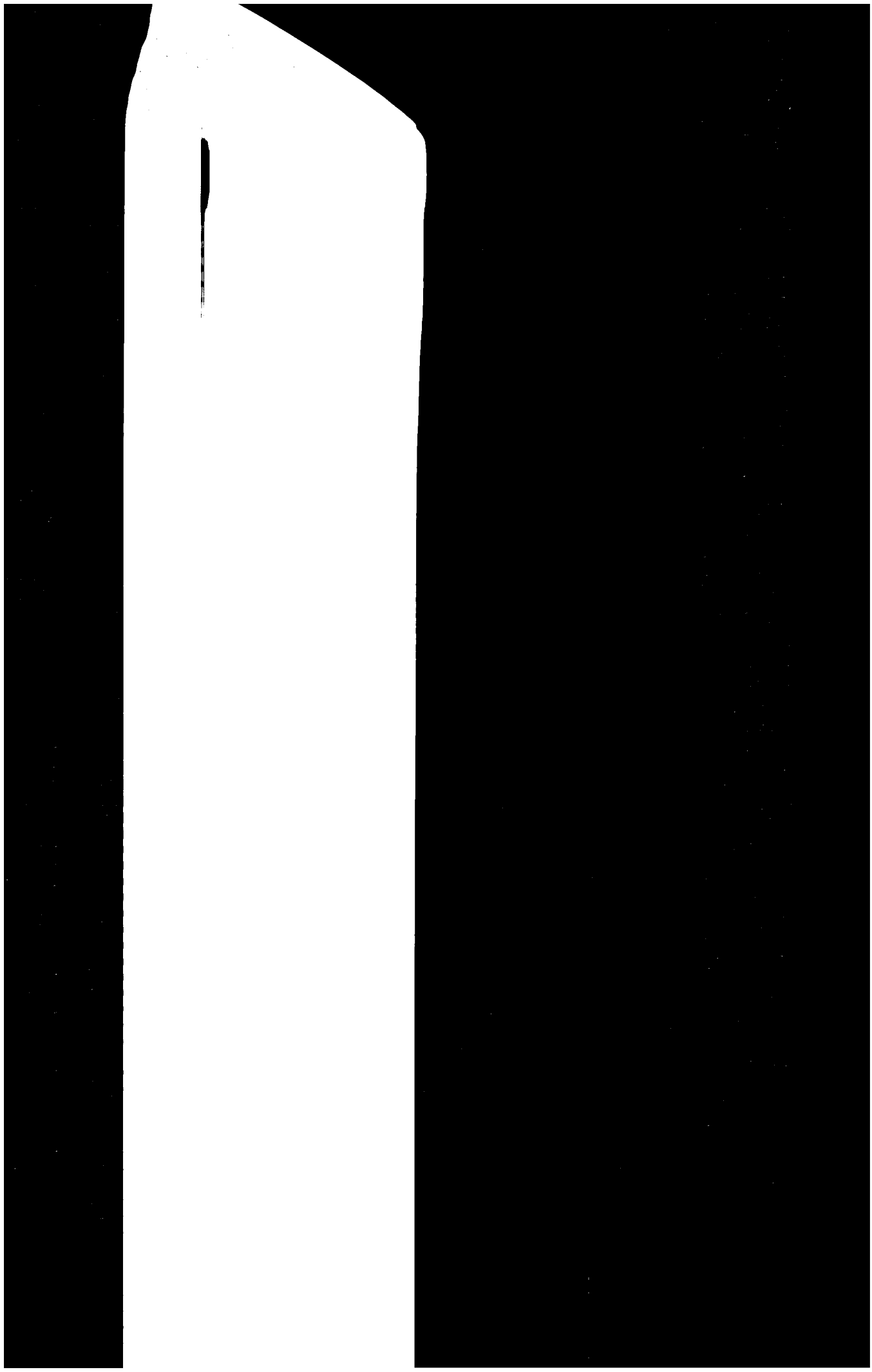
Figure 4 is a detail view in section showing the construction of one of the sealing members employed between the well casing and the wall of the well hole, and

Figure 5 is a detail view in section illustrating how the flexible container constituting the auxiliary packer is mounted on the well casing.

In drilling a well in accordance with the present invention, the well hole is formed so as to have an upper section 1 of a relatively large diameter and a lower section 2 of relatively small diameter, there being a shoulder 3 at the juncture of the two sections. In the well shown in the present invention the upper section 1 of the well hole has a diameter of 7⅞″. Below the shoulder 3 the well has a diameter of 6½″. The dimensions are given in order to more clearly illustrate the structure of the well hole. The shoulder 3 is located just above the oil producing formations.

The present invention proposes the use of an ordinary well casing 4 in which a main packer element, designated generally at 5 and a perforated cement discharge pipe or nipple 6 is incorporated. A liner of the same size as the well casing or larger if desired is suspended on the well casing by virtue of the fact that it is screwed onto the lower end of the packer.

The packer 5 includes a main section 8 and a pair of spaced packer or sealing members, designated generally at 9, one sealing member being located at each end of the main section. These sealing or packer members are shown in detail in Fig. 4 each includes a tubular body portion 10. Coupling sleeves 11, 12, 13 and 14 are threadedly connected to the body portions of the sealing members. The sealing or packing members are identical except that the bottom member is slightly smaller than the top member. In this manner each sealing member comes into powerful contact with the wall of the well. The top sealing member shears off a portion of the wall and forces the sheared formation down. This sheared formation cannot pass the bottom sealing member and an impaction of great density is thus formed between upper and lower sealing members. The coupling sleeves 12 and 13 are also threadedly connected with the main section 8, the coupling sleeve 11 with the well casing and the coupling sleeve 14 with the liner. Annular belt washers 15 which are cut from rubber belting or other durable and pliable metal or fabric are mounted on the tubular body 10, the belting or other kind of washers being assembled in face to face relation and being forced into one compact assembly



sand without danger of sand bridging in the casing or settling on the plug and causing an impaction in the well casing. As each batch of cement is mixed to the consistency of pancake batter, a port in the mixing box which is connected with the casing by a suitable tube is opened and cement is allowed to run into the well casing. The cement being heavier than the mud fluid will force the bottom plug downward even though the well on the outside of the casing is full of mud fluid to the top of the ground. After the required amount of cement has been poured into the well casing or pumped in as desired a taper top plug 37 is inserted. The plug 37 also has its greatest diameter slightly less than the internal diameter of the well casing. This top plug is somewhat longer than the bottom plug and the combined length of the two plugs should be sufficient to entirely close off the perforated cement discharge section 6. On top of the plug 36 a belt washer 38 and suitable fibrous packing, which may be a cement sack 39, are placed. The pump P is then connected up to the top of the well casing and mud fluid is pumped in on top of the plug 37. This forces the plug 37 down through the well casing and the plug 37 in turn forces the cement C and plug 35 down through the well casing. Eventually the cement flows out through the perforations of the section 6 and is held outside of the well casing and in proper position by the action of the pump upon plugs 35 and 37. The operator is notified of the fact that the cement has been forced outside of the casing by virtue of the stalling of the pump which occurs when the plugs 35 and 37 abut each other and the lower plug 35 abuts the brass plug 18. The plug 37 is retained in position by closing the valve V which holds the pressure in the well casing that has been built up by the pump. The flexible packing element 20 is merely a safeguard to provide against the contingency of a leak developing around the belt washers 15. It collapses downward upon the top sealing member instantly upon any downward movement of cement.

In considering the advantages of the present method, it must be remembered that in the old method of cementing, the casing is cemented before the well is drilled in. If 6″ casing is cemented the well must be drilled in with not larger than a 5⅞″ bit. Then not larger than 4½″ liner can be set. Therefore the old well has 6″ casing where I use 4½″ casing, and it has the same size liner that I use. The saving is the difference in cost between the 6″ and the 4½″ casing. Furthermore, by drilling my wells in before I set 4½″ casing and liner, I make the hole through the oil sands 6½″ diameter or even larger, whereas, the old method, as stated, makes a well not larger than 5⅞″. If I should drill my wells 7⅞″ in diameter in the top section, I could drill the bottom section 7″ or 7¼″ in diameter. The difference between the 7¼″ and 7⅞″ affords ample shoulder for my packer to rest upon. You can therefore see that I can drill my wells in through the oil sands with a diameter of 7¼″; whereas, the old type of well cannot possibly be drilled in with larger than a 5⅞″ bit, assuming that 6″ casing is set.

Another advantage to be considered is that a liner hanging from the top is less apt to be bent by caves from the side of the well than a liner standing upon its bottom. A long liner standing upon its bottom will often bend and go out into openings or caved away places in the wall by force of its own weight from above, whereas, my type of liner suspended from the casing is under tension which tends to keep it straight and resist forces exerted from the side.

My type of well can be reamed or shot to a larger diameter in the oil sands before being cemented because this type of well is drilled in before it is cemented; consequently the sands can be reached; whereas the old type of well has not reached the oil sand before the casing is cemented. Therefore, if it is decided to ream an old type well, in which 6″ casing has been set, the diameter of the reaming tool is necessarily limited to less than 6″; whereas, my type of well can be reamed with a much larger tool before casing and liner are set, because, as stated above, this type of well can be drilled in with as large as a 7¼″ bit, the upper section being drilled with a 7⅞″ bit.

The pay sands in this type of well may be enlarged by shooting below the bottom of the hanging liner, and it may be reamed in the oil sands with a much larger tool than could possibly be inserted through the old type of well, after it is drilled in, because, as above stated, the old type of well must then be entered through the casing which has not yet been put into my type of well when it is ready to ream, just before liner is set.

I claim:

1. An apparatus for use in cementing oil, gas and water wells comprising in combination with the usual well casing, a perforated cement discharge nipple incorporated in the well casing, and a plurality of spaced packers also incorporated in the well casing, the upper packer being designed to shear off some of the material making up the wall of the well hole, the packers confining the sheared off material between them and causing the sheared off material to be compacted into a dense mass, and a liner carried by the well casing.

2. An apparatus for use in cementing oil, gas and water wells comprising a well casing having cement discharge means incorporated therein and also having externally project-

ing packers below the cement discharge means, one of the packers being larger than the other to shear off material from the formation, the other packers confining the sealed off material between them and causing the sheared off material to be compacted into a dense mass.

3. An apparatus for use in cementing oil, gas and water wells comprising a well casing having cement discharge means incorporated therein and also having externally projecting packers below the cement discharge means, one of the packers being larger than the other to shear off material from the formation, the other packers confining the sheared off material between them and causing the sheared off material to be compacted into a dense mass, and an auxiliary packing element above said spaced packers and adjacent the cement discharge means, said auxiliary packing element comprising a flexible container having its lower end secured to the well casing and having its upper end open.

4. An apparatus for use in cementing oil, gas and water wells, comprising in combination with the usual well casing a perforated cement discharge nipple incorporated in the well casing, a removable closure element blocking the bore of the well casing just below the cement discharge nipple and spaced plugs inserted in the casing between the mud fluid and the cement, said plugs being tapered and having their greatest diameters slightly less than the internal diameter of the well casing, a flexible packing element mounted on top of each plug, the lower plug being relatively short, the combined length of the two plugs being sufficient to completely block the discharge opening.

5. An apparatus for use in cementing oil, gas and water wells comprising in combination with the usual well casing, a perforated cement discharge nipple incorporated in the well casing, and a plurality of spaced packers also incorporated in the well casing, the upper packer being designed to shear off some of the material making up the wall of the well hole, the packers confining the sheared off material between them and causing the sheared off material to be compacted into a dense mass, and a liner carried by the well casing, in combination with an auxiliary packing element consisting of a flexible container having its lower end fastened to the casing and its upper end opened and surrounding a portion of the perforated discharge nipple.

6. An apparatus for use in cementing oil, gas and water wells comprising in combination with the usual well casing, a perforated cement discharge nipple incorporated in the well casing, and a plurality of spaced packers also incorporated in the well casing, the upper packer being designed to shear off some of the material making up the wall of the well hole, the packers confining the sheared off material between them and causing the sheared off material to be compacted into a dense mass, and a liner carried by the well casing, in combination with an auxiliary packing element comprising a flexible container, means for securing the lower end of the flexible container to the well casing including a binding of wire on the lower end of the flexible container, the well casing having peripheral grooves co-acting with the wire binding, and a covering of solder for said wire binding.

7. The herein described method of cementing oil, gas and water wells which consists in forming a well with a relatively small lower portion and a relatively large upper portion and leaving a shoulder at the juncture of such portions and just above the oil producing formations, in introducing an assembled well casing, cement discharge nipple, packer and liner into the well hole, and shearing off a portion of the wall of the small lower section of the well hole between the elements of the packer to aid the packer in sealing off the oil producing formations from above and in introducing cement through the well casing and out through the perforated nipple into the well between the casing and formation.

8. The herein described method of cementing oil, gas and water wells which consists in introducing cement down through the well casing between plugs and under the action of fluid pressure in the ordinary way and in holding the plugs in position to keep the cement out of the well casing by maintaining the pressure above the plugs until the cement is set.

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