Aug. 2, 1938. W. F. BETTIS 2,125,665

SLEEVE PACKER CONSTRUCTION

Filed July 1, 1935 2 Sheets-Sheet 1

Fig 1

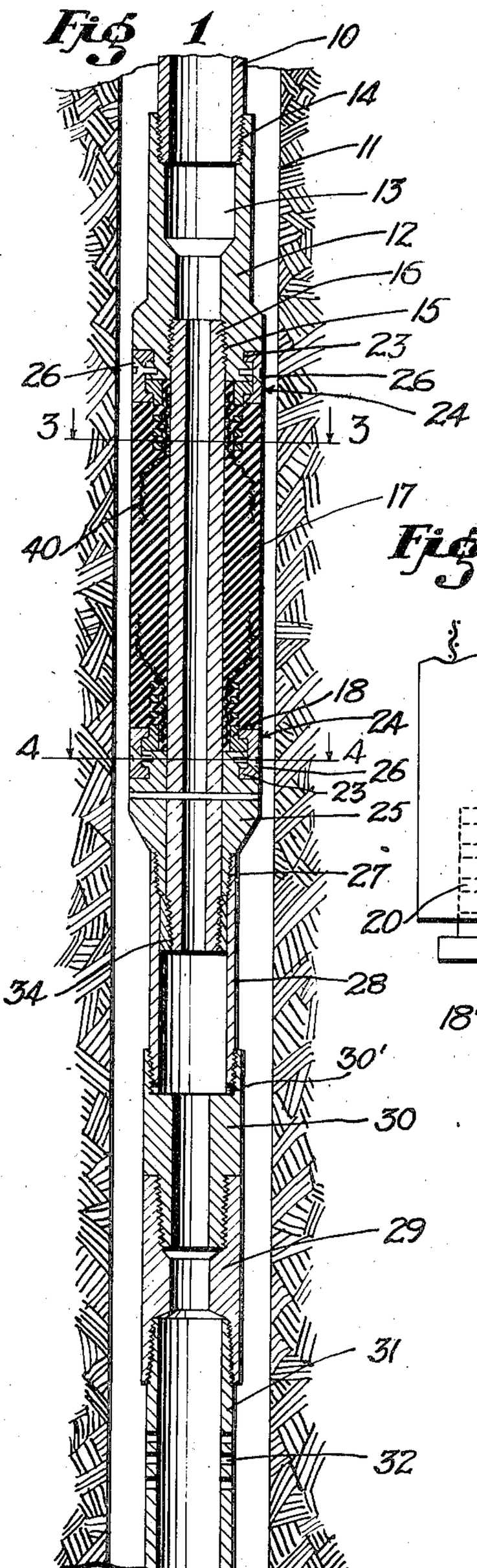

Fig 7

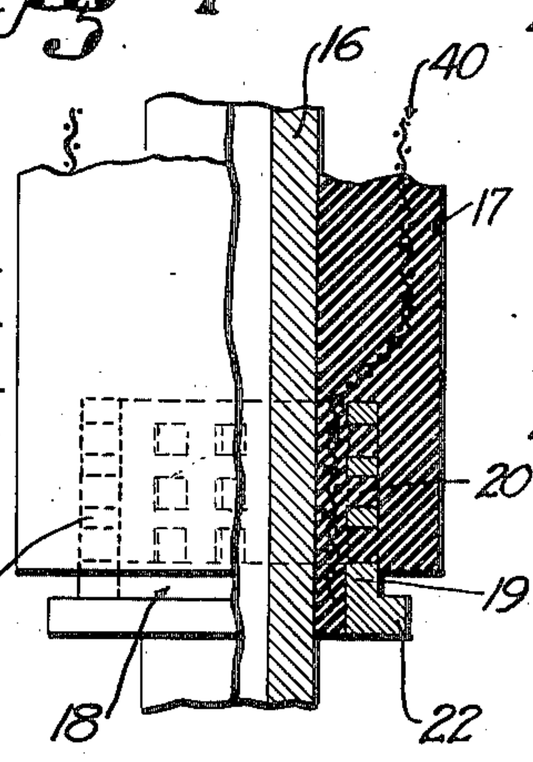

Fig 2

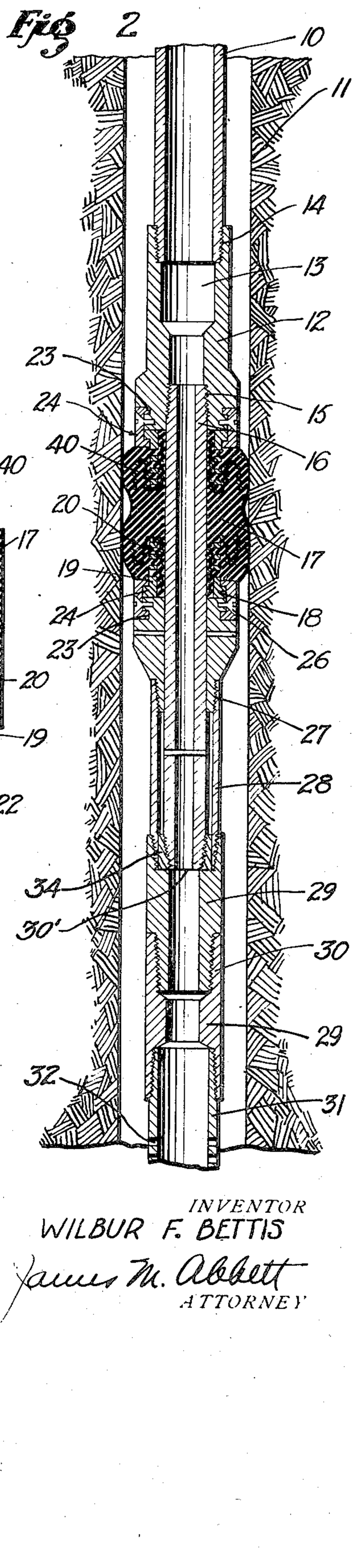

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Fig 5

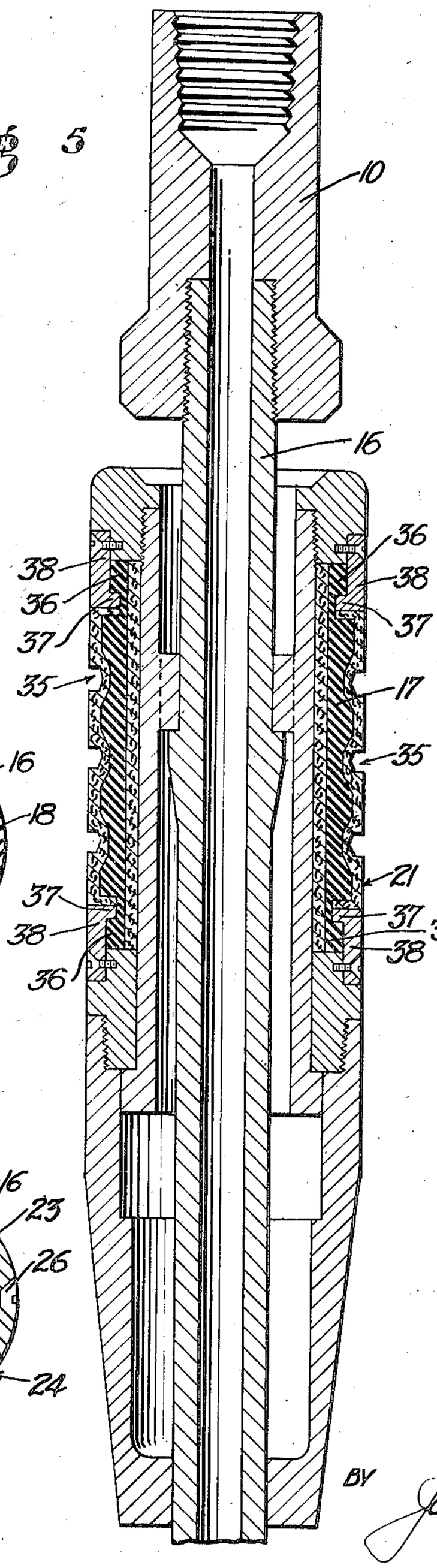


Fig 6

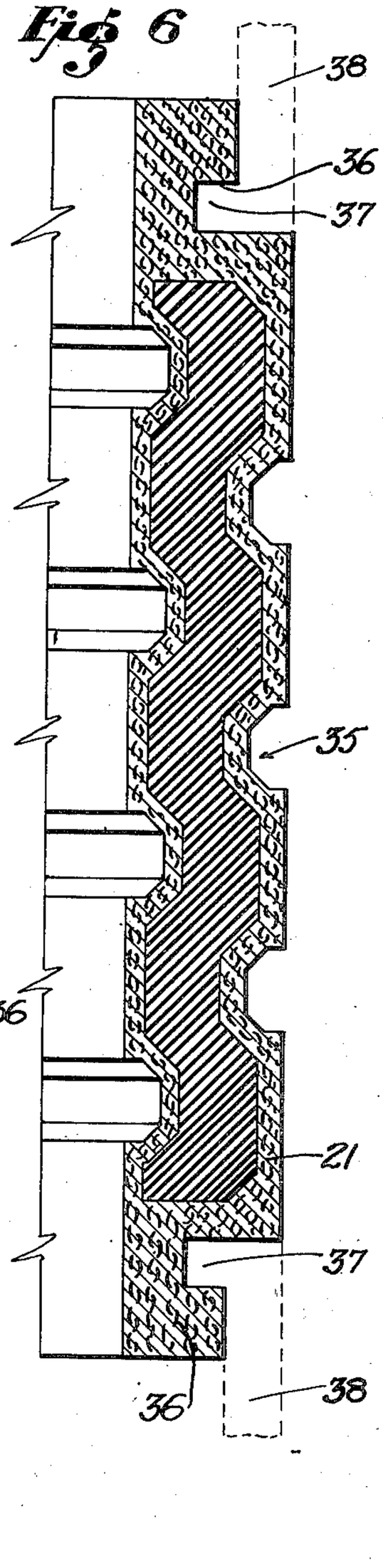


Fig 3

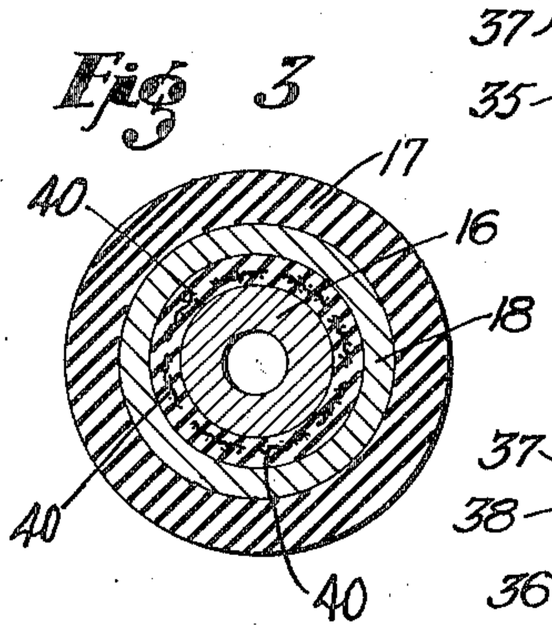
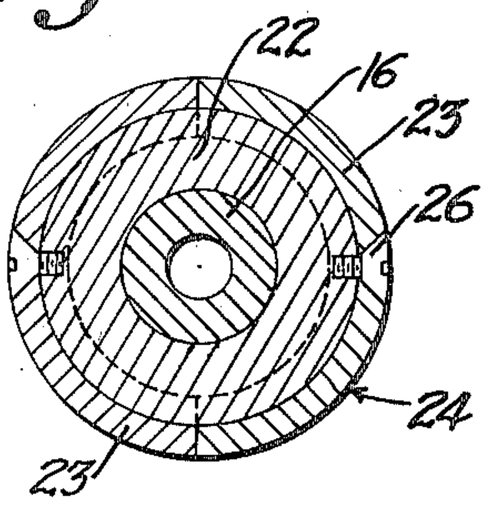


Fig 4



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SLEEVE PACKER CONSTRUCTION

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Application July 1, 1935, Serial No. 29,294

4 Claims. (Cl. 166—10)

This invention relates to well drilling equipment, and particularly pertains to a sleeve packer construction.

In various operations concerned with the drilling of an oil well it is necessary to form a temporary seal in the well to shut off a desired stratum of the earth formation from communication with a string of tubing introduced into the well. When a shutoff is necessary near the bottom of the well it is usual to form a tapered seat in the formation and to properly position upon it a tapered packing member carried at the lower end of a string of tubing and forced against the seat in a manner to prevent the flow of fluid within the hole from above the packer to a point therebelow. When a shutoff is required at some point in the length of an open well hole or well casing it is necessary to provide means for anchoring the lower end of the string of tubing. In an open hole this is done by extending an anchor member carried at the lower end of the string to the bottom of the hole. The length of said member being such as to insure that the packer will assume a desired position at a point in the length of the hole. When a shutoff is to be made within a casing, it is usually necessary to fit the tubing string with spring means yieldably engaging the wall of the casing and holding it so that the drill string may be manipulated to bring positive engaging means into contact with the casing wall.

In packers designed for use under the various conditions previously described, it is desirable that the packing element shall be mounted and controlled in a manner to insure that it will not be objectionably affected by the pressure of the fluid in the well. This acts in two ways; one to create a longitudinal pressure adjacent the end of the packer and between the packer body and the wall of the hole through which it is inserted; and the other is by pressure exerted by fluid which has had an opportunity to leak into the packer at its ends and to form a fluid pressure within the packer to distend the same. In the first instance the fluid pressure tends to cause the rubber to flow and to be deformed in a manner to pull it away from its mountings or from the shoulders between which it is positioned. When this occurs, the packer is so mutilated as to become jammed in the hole and to often require that the packing element be torn away in order to remove the packer structure from its jammed position. In the last named instance, the fluid pressure within the packer may remain constant so that even though the packing element is released from its compressed and expanded position, the packer will not contract. It is the principal object of the present invention, therefore, to anchor and seal the opposite ends of the packing element with relation to its mounting in a manner to positively engage the ends of the packing element so that direct mechanical expansion and contraction of the element may be brought about due to the manipulation of the tool and so that there will not be possibility of fluid leakage around the ends of the packing element and thereinto.

The present invention contemplates the provision of a pair of relatively movable packer elements between which a deformable packing sleeve is disposed, said sleeve being positively attached to said elements and connected in a manner to prevent a leak of fluid into the sleeve, and in a manner to permit a longitudinal pull to be made upon the sleeve to positively contract the sleeve and permit it to be removed from the well.

The invention is illustrated by way of example in the accompanying drawings, in which:—

Figure 1 is a view in vertical section taken longitudinally of a packer with which the present invention is concerned.

Fig. 2 is a view in elevation showing the packer as placed within a well bore and with the packing element in its packing position.

Fig. 3 is a view in transverse section through the packer as seen on the line 3—3 of Fig. 1 and showing the manner in which the anchor sleeve is secured within the packing element.

Fig. 4 is a view in transverse section through the packer as seen on the line 4—4 of Fig. 1 and shows the manner in which the ends of the packer element are secured in position with relation to the packer collars.

Fig. 5 is a view in vertical section through another form of device within which the deformable packing sleeve is embodied.

Fig. 6 is an enlarged fragmentary view in longitudinal section showing another form of the packing sleeve.

Fig. 7 is an enlarged view showing the construction of the end of the packing sleeve.

Referring more particularly to the drawings, 10 indicates a string of tubing which is introduced into a well bore 11. At the lower end of the string 10 is a top packer collar 12. This collar is preferably cylindrical, having a relatively large bore 13 in its upper end, the bore being threaded at 14 to receive the lower threaded end of the tubing string 10. The opposite end of the top collar 12 is formed with a threaded bore 15 of relatively small diameter, and which is termi-

nated by a shoulder portion formed within the collar. Threaded into the bore 15 of the top collar 12 is a tubular mandrel 16 which extends downwardly through a deformable packing sleeve 17. This packing sleeve is preferably cylindrical and has a central opening therethrough to receive the tubular mandrel 16. It will be understood, however, that packing structures of similar construction may be made with a tapered outer face such as would occur in a rat hole packer, and the outer wall of the deformable packing sleeve 17 may be formed with corrugations spaced from each other and each extending circumferentially of the packing sleeve as shown in Figs. 5 and 6 of the drawings. The packing sleeve 17 as shown in Figs. 1, 2 and 7 of the drawings, is provided at its opposite ends with anchor members 18. These members have a cylindrical portion 19 of a diameter and thickness to permit the cylindrical portion of the anchor member to be embedded within the wall of the packing sleeve 17. Openings 20 are formed through the wall of the cylindrical portion of the anchor member so that the rubber of the packing sleeve 17 may flow through these openings during the process of vulcanization, and will, in effect vulcanize the cylindrical portion 19 within the packing sleeve 17. It is to be understood that the body of the anchor member is preferably formed of rubber. It may be found desirable in some instances, as shown in Figs. 5 and 6, to encase the rubber in a covering 21 of graphite impregnated fabric which will add desirable wearing properties to the surface of the sleeve without materially interfering with its deformation under pressure. The anchor members are formed at their outer ends with enlarged shoulder portions 22. The end of the upper anchor member 18 abuts directly against the end face of the top collar 12. Adjacent this end face of the top collar and extending circumferentially thereof is a groove 23 which receives the lip of a split fastening ring 24. This ring is in channel section, one lip extending into the groove 23 and the other lip extending beneath the enlarged portion 22 of the anchor member 18. At the lower end of the packing sleeve 17 a bottom collar 25 is provided. This collar is also equipped with an annular groove 23 to receive a lip of a split fastening ring 24, the opposite lip of which fits over and engages the enlarged shoulder 22 of the lower anchor member 18. Screws 26 pass through the upper and lower split rings and into the respective collars to hold the split rings in their gripping and fastening position. The lower collar 25 is provided with a threaded extension portion 27 to receive the threaded end of a packer body tube 28. This tube extends for a desired distance and has an outward threaded portion at its lower end upon which a bottom sub 29 is mounted. A threaded pin 30 formed as a part of the bottom sub at its lower end is designed to receive a tubular anchor member 31 which extends to the bottom of the hole and abuts thereagainst said pin having a shoulder 30' formed therein to limit downward movement of the mandrel 16. This anchor member may be of any desired length and in fact, it may comprise a plurality of stands of tubing. At a desired point in its length it may be formed with perforations 32 to permit fluid to pass into it and upwardly through the passageway 33 of the sub, the passageway within the tubular member 28 and the mandrel 16. The mandrel 16 extends downwardly through the bottom collar 25 and is fitted with a cylindrical nut 34 which limits the upward movement of the mandrel with relation to the packer body 28 but permits downward movement of the mandrel in a telescoping action within the body 28.

Referring more particularly to Fig. 5 of the drawings, the packing element is shown as seated upon another form of structure requiring packing, such, for example, as a casing packer tool. In this figure the packing sleeve 17 is formed with a plurality of circumferential grooves 35 which would have the effect of producing a multiple ring packer without requiring the various parts now necessary to make such a device. In this particular form of the invention as shown in Fig. 5, the outer and inner walls of the packing sleeve 17 are covered with a flexible material such for example as fabric which has been impregnated with graphite. It will also be seen that in this particular form of the sleeve, the anchor members 18 are eliminated and shoulders 36 are formed directly in the sleeve to receive the lips 37 of retaining rings 38. In the form of the invention shown in Fig. 6 the impregnated fabric material is provided to form the shoulders 36 and to be engaged by the retaining rings 38.

In operation of the packer here shown, a string of anchor tubing 31 of appropriate length may be attached to the bottom sub, after which the entire assembled packer structure is assembled therewith, and suspended within the well from the tubing string 10. When the lower end of the anchor string strikes the bottom of the well, weight or pressure imposed upon the packing sleeve 17 through the medium of the tubing string 10 will cause the portion of the packing sleeve 17 which occurs between the contiguous ends of the anchor members 18 to be expanded and distended against the wall of the well bore 11 as indicated in Fig. 2. In the packer as shown in Figs. 1, 2 and 7 there is preferably incorporated a plurality of longitudinally extending strips of woven metallic material 40. These are embedded within the mass of the packer sleeve wall and will be vulcanized in position. These strips extend from opposite ends of the packer sleeve and terminate short of the transverse median line of the packer sleeve. Due to this the sleeve will expand to a greater extent adjacent the opposite ends thereof and will in effect form two packing rings which engage the wall of the well bore. This will also reinforce the packer against blowouts. In this manner the area of the well bore above the packer and the packer sleeve and the area of the well bore below the packer sleeve may be shut off from each other. Attention is directed to the fact that due to the length of extension of the anchor members 18 along the mandrel 16 the opposite ends of the sleeve will be held without deformation and in a manner to provide a satisfactorily tight joint between the mandrel and the sleeve and between the mandrel and the top and bottom collars 12 and 25, respectively. This construction will prevent fluid from being forced inwardly between the collars and the ends of the packing sleeve 17, and will thus insure that internal fluid pressure will not act to maintain the packing sleeve in an expanded position when it is desired to remove it.

Attention is also directed to the fact that since both ends of the packing element have been mechanically anchored to parts of the packer structure these ends will be positively held and there will not be any possibility for the packing element to be acted upon by fluid pressure exerted at either end thereof to deform the packing element

by pulling it away from its collar and by forcing the rubber down into the packing space in a manner to jam the rubber and distort the packing element so that it will not restore itself to its original position when the usual expanding action of the packer is relieved. This is accomplished not only by the manner in which the packing element is fastened to mechanical parts of the packer structure, but also due to the fact that the ends of the packer element are embraced by non-yielding means which cause them to closely conform to the mandrel of the packer, or by reenforcement embodied within the ends of the packing element to hold these ends in shape irrespective of longitudinal external fluid pressure applied thereto.

After the packer has been set as previously described, and after the purpose for which it has been used has been accomplished, the packer may be removed by pulling upwardly on the tubing string 10 which in the present instance will pull upwardly and directly upon the upper end of the packing sleeve 17. This upward pulling action will tend to stretch the packing sleeve 17 longitudinally and to pull it back into shape as shown in Fig. 1 of the drawings. It will also be seen that due to the manner in which the lower end of the packing sleeve is secured to the lower collar 25 it is possible to exert a pull through the packing sleeve 17 to the bottom sub 29 and thereby lift this member with the anchor string which is assembled therewith.

The operation of the form of the device shown in Figs. 5 and 6, would, of course, be the same, although the structure upon which it is applied is slightly different.

It will thus be seen that due to the construction within which the present invention is embodied an effective casing shutoff may be readily made without mutilation of the packing sleeve, either due to the expansive action of pressure fluid or the action which would take place in the event that the packing sleeve could not be drawn to a non-expanded position within the well bore or casing when desired. It is evident that by the use of the present construction, complete control of the packing sleeve is had at all times so that manipulation of the drill string will act directly to expand the sleeve or to positively contract it, all of which is accomplished by a structure decidedly simple in its construction and operation.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes may be made in combination, construction, and arrangement of parts by those skilled in the art without departing from the spirit of my invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A well packer comprising an upper anchor member carried by tubular suspending means, a tubular mandrel fixed at its upper end to said anchor and extending downwardly therefrom, a deformable packing sleeve mounted upon said mandrel and abutting at its upper end against the lower face of said upper anchor, a rigid anchor sleeve having a perforate cylindrical portion embedded in the packing sleeve and having a flanged extension projecting upwardly and against the end face of the upper anchor, means embracing said upper anchor and projecting portion of anchor sleeve to rigidly fasten the anchor to the packing sleeve, a lower anchor slidably mounted on said mandrel and against which the bottom face of the packing sleeve abuts, a lower anchor sleeve having a perforate cylindrical wall embedded in the wall of the packing sleeve and having a flanged portion projecting from the end of the packing sleeve, means embracing said lower anchor and the projecting portion of the anchor sleeve rigidly fastening said parts together.

2. Same as 1 and add: the outside diameters of the packing sleeve, the anchors and the embracing means being substantially uniform in diameter.

3. Same as 1 and add: restraining means comprising strips of flexible material embedded in the wall of packing element and extending longitudinally from a point in the length of wall embraced by the anchor sleeves to points intermediate the ends of the packing element.

4. A well packer comprising an upper anchor member carried by tubular suspending means, a tubular mandrel fixed at its upper end to said anchor and extending downwardly therefrom, a deformable packing sleeve mounted upon said mandrel and abutting at its upper end against the lower face of said upper anchor, a rigid anchor sleeve having a perforate cylindrical portion embedded in the packing sleeve and having a flanged extension projecting upwardly and against the end face of the upper anchor, means embracing said upper anchor and projecting portion of anchor sleeve to rigidly fasten the anchor to the packing sleeve, a lower anchor slidably mounted on said mandrel and against which the bottom face of the packing sleeve abuts, a lower anchor sleeve having a perforate cylindricall wall embedded in the wall of the packing sleeve and having a flanged portion projecting from the end of the packing sleeve, means embracing said lower anchor and the projecting portion of the anchor sleeve rigidly fastening said parts together, a temporarily stationary section below the lower anchor and connected therewith and into which said tubular mandrel moves as the packer is compressed, and an abutment formed in said section for limiting the downward movement of said mandrel.

WILBUR F. BETTIS.