

Nov. 9, 1937.

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2,098,484

PACKER

Filed April 21, 1936

2 Sheets-Sheet 1

Fig. 1.

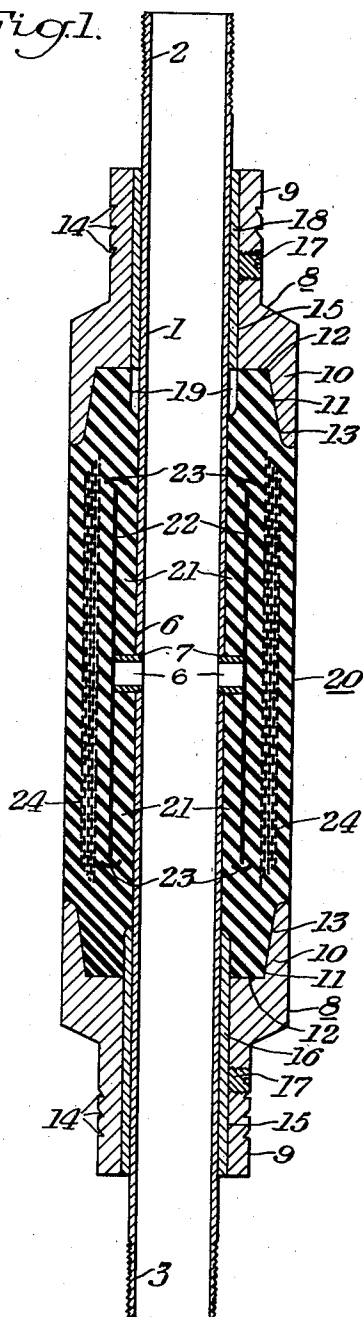
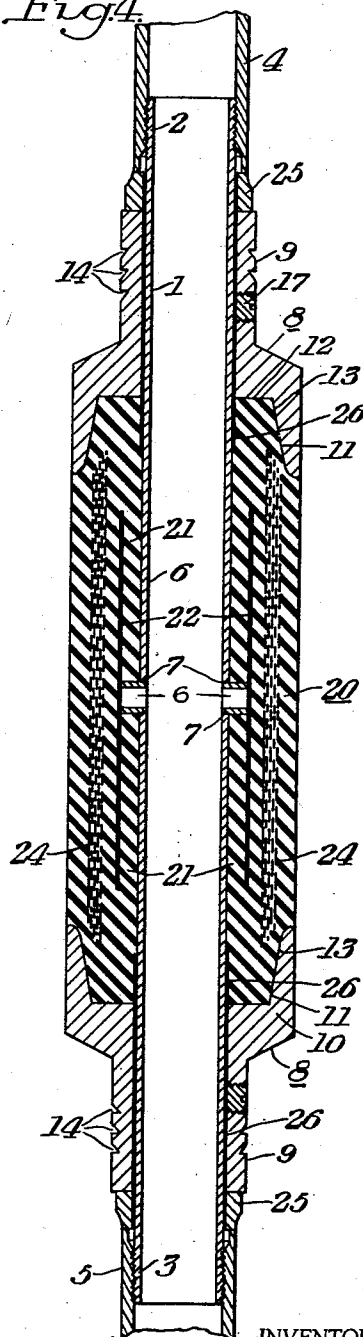


Fig. 4.



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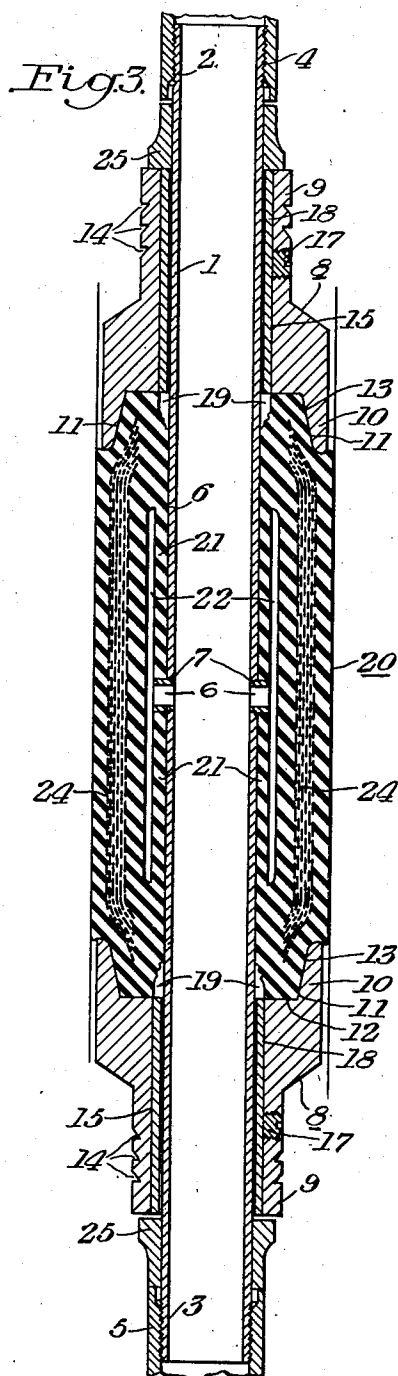
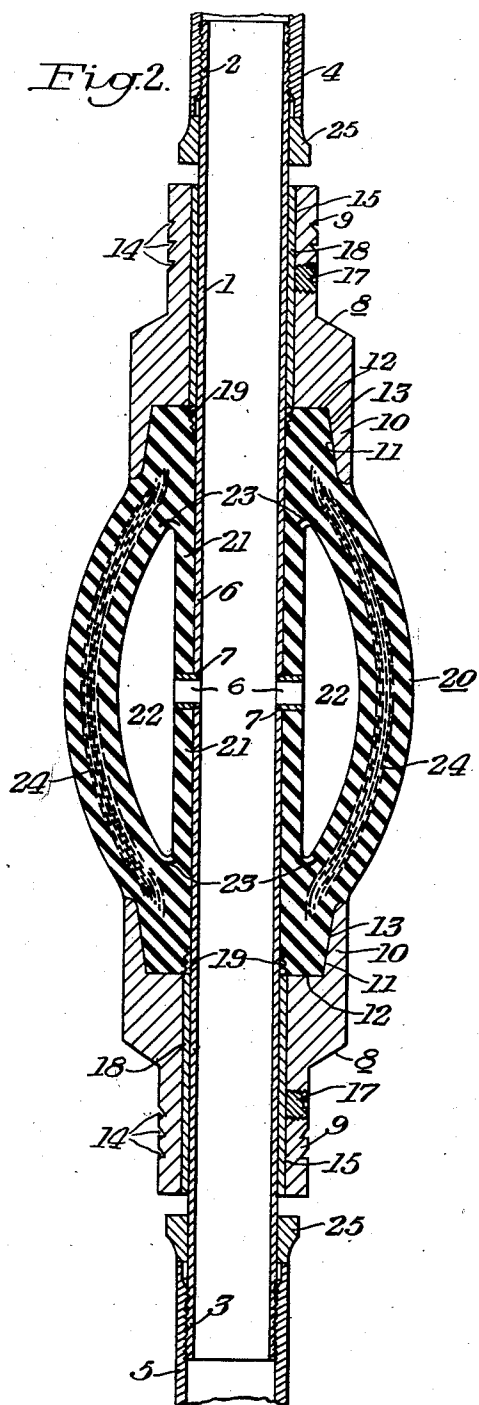
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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,098,484

PACKER

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7 Claims. (Cl. 166—10)

This invention relates generally to packers and the method of manufacturing the same, and more particularly to well packers for use in sealing off different strata of the earth within a well.

5 This invention may be conveniently applied to oil wells wherein the packer is used to segregate the strata of oil bearing sands for flooding, repressuring or otherwise working said strata individually from one another.

10 The principal object of this invention is the provision of a packer that is capable of being positioned at any desired depth within a well to seal off one stratum from another without limiting the number of packers that may be employed in the same well.

15 Another object of this invention is the provision of a packer that does not depend upon the movement or mechanical operation of a string of tubing to expand it into sealing engagement with the bore of the well.

20 Another object is the provision of a packer that will contract axially as it is expanded radially, to compensate for the displacement due to the distortion thereof, thereby minimizing the stretching strains in the packer when it is sealing irregularities in the walls of a well.

25 Other objects and advantages will appear hereinafter.

30 In the accompanying drawings wherein a practical embodiment of the principles of the invention is illustrated:

Fig. 1 is a vertical section of the packer mounted on a well tubing and shown deflated.

35 Fig. 2 is a view similar to Fig. 1 showing the packer inflated and not confined.

Fig. 3 is a view similar to Fig. 1 showing the packer inflated within a well.

Fig. 4 is a view similar to Fig. 1 showing a modification of this invention.

40 Referring to Figs. 1 to 3 of the drawings, 1 represents the packer stem which comprises a section of tubing having the threaded ends 2 and 3 for connection with the consecutive lengths of well tubing or coupling members 4 and 5 to form a string. The stem 1 is preferably made of tubing having the same internal diameter as the well tubing to permit the passage of a plurality of smaller pipes therethrough. These smaller pipes may or may not be arranged concentrically within the tubing string.

55 Intermediate of its ends the stem 1 is provided with one or more nipples 6 which extend laterally therefrom and may be secured thereto by means of threads or by welding, as indicated

at 7. These nipples communicate with ports in the stem.

8 represents cap members on each end of the stem 1 which are arranged to enclose and protect the ends of the packer. Each cap member has a cylindrical neck portion 9 which extends from an enlarged cylindrical portion 10. The opposite face of the cylindrical portion 10 is hollowed out to provide the cup 11, preferably having a flat bottom 12 and the outwardly flaring sides 13.

The perimetral surface of the neck 9 has formed thereon the annular notches 14 which may be engaged by a fishing tool or the like to withdraw the packer assembly from the well.

15 The cap members 8 are provided with the concentric bores 15 arranged to receive the sleeves 16 which may be detachably connected thereto as by the set screws 17. It should be noted that the sleeves 16 extend into the cups 11 as shown in the lower cap 8 of Fig. 1. The sleeves 16 are withdrawn after the packer has been formed thereon and are replaced by the shorter sleeves 18 which are secured by the set screws 17, as shown in the upper cap 8 of Fig. 1, thereby forming the pocket 19 in each end of the packer.

20 20 represents the packer which is preferably made of resilient material, such as rubber. The packer is molded on the stem 1, around the nipples 6 and between the caps 8, so that the material when vulcanized will adhere to the adjacent metal parts. The inner ends of the sleeves 16 may be covered or otherwise protected so that they will not adhere to the rubber and may be easily withdrawn therefrom and replaced by the shorter sleeves 18 to form the pockets 19. Thus the packer assembly comprises a unitary member made up of the resilient material, the stem and the cap members.

40 In forming the packer, first an inner or foundation wall 21 is formed about the stem and then a layer of material, such as kraft paper, which will not bond with the rubber, is placed around such wall, stopping short however of the cups 11 of the caps 8, and then additional rubber is added to complete the packer. This non-bonding material extends over the outer ends of the nipples 6 to prevent their being plugged with rubber. Thus an annular inflation chamber 22 is formed within the packer.

50 23 represents annular reenforcing members which may be embedded in the rubber in spaced relation from the ends of the inflation chamber to prevent the material of the packer from tearing.

It is preferable to design the packer in such manner that the reinforcing members 23 and the ends of the inflation chamber are positioned inwardly of the inner ends of the caps 8 so that the packer will be free to expand without setting up any undue strains in the end portions which are encased in the cups 11 of the cap members 8.

24 represents reinforcing means, such as fabric embedded in the rubber of the packer, which does not hinder the flexing characteristics of the packer. This reinforcing means encases the inflation chamber 22 and is spaced therefrom. It is desirable to extend these layers of reinforcing material into the cups 11 of the cap member 8 in order to strengthen the rubber at the points where the inflation thereof creates the greatest change between the portions that are stretched and the portions that are more or less fixed. The reinforcing material may be so wrapped or otherwise applied that the ends taper off and are in spaced relation to the bottom and sides of the cup 11.

The perimetral surface of the packer is formed over the reinforcing material 24, thereby providing a uniform wall of rubber on each side thereof. It may be desirable to provide an expansible sleeve (not shown) on the perimetral surface of the packer to protect the rubber. However, it has been found preferable to use a new synthetic compound known as Duprene or Thiokol which is not subject to deterioration when in contact with oil.

When assembling the packer in a well the lower end of the stem 1 is provided with the loosely fitting collar 25 and then screwed into a pipe section or joint member 5. Then a similar collar 25 is placed around the stem on top of the packer and the next consecutive pipe section or joint member 5 is screwed in place.

Referring to Fig. 2 wherein the packer is inflated, without restriction, by a fluid medium under pressure within the stem 1, it will be noted that the cap members 8 have been drawn inwardly toward the center of the packer. The cap members are free to move longitudinally on the stem and are permitted to slide inwardly to compensate for the lateral expansion of the rubber. The packer material comprising the wall 21 and the ends within the cups 11 is under compression and flows into the annular pockets 19 provided for that purpose. Thus the packer may be expanded by inflation to seal the wall of a well which is considerably larger in diameter than the packer itself.

However in practice it is preferable to design the packer small enough to clear irregularities of the well to be packed. The packer will then have a longer contacting surface with the portion of the wall to be sealed and repeated expansion and contraction will not materially affect the life thereof. Thus Fig. 3 shows a preferred application of a packer within a well wherein a small expansion of the packer is sufficient to seal one stratum from another. In this instance the annular pockets 19 are only partially filled by the flow of the resilient material that is under compression.

It has been found that when the packer is only partially inflated it has a tendency to become elongated. The collars 25 then serve as stops for limiting the longitudinal movement of the cap members 8 on the stem. Upon further inflation the packer expands radially to a greater degree, drawing the cap members 8 toward the center of the packer.

Referring to Fig. 4 which represents a modification of the packer, 26 represents a section of the perimetral surface on each end of the stem 1 that is covered with a material that will prevent the rubber from vulcanizing thereto. These sections function in the same manner as the pockets 19 and thereby eliminate the use of the sleeves 16 and 18. This construction of packer has been found to work satisfactorily for packers that are not required to expand to an excessive diameter to function as a seal. Sufficient space is provided in these small pockets to permit the material to flow therein when the packer is inflated.

The packer may also be used to seal a casing as well as the bare hole of a well and it is particularly advantageous for practical use in that it provides a clear path in the string of tubing of which the stem forms a section. Again the packer is not subjected to any mechanical stress other than the inflation thereof.

With this design of packer any number may be placed on a single string of tubing and all of them may be simultaneously inflated from a single source of fluid pressure or they may be segregated by placing them on concentric strings of tubing to seal one string from another.

It is to be noted that inasmuch as the ends of the packer are capable of movement, the inflation of the packer is not attended by such stresses as would be effective if its ends were held against movement. In the latter case the material of the packer would be subjected to static strains which stretch the material, causing the walls of the chamber to become thin and weak, and thereby shorten the effective life of the packer and also tend to develop leaks which would be fatal to the proper functioning of the device. It is of course understood that the replacement of a defective packer is a matter involving considerable time and expense.

An important advantage of the present invention is due to the fact that no mechanical pressure, such as the weight of a string of tubing or that of a threaded compression member is employed to deform the packer into sealing position. Thus the use of the present invention greatly simplifies the installation of the packers by the assemblage of the packer stems as part of an uninterrupted string of tubing having a continuously unobstructed bore.

It should be noted that the cap members 8 are freely slidable on the stem 1 and are not required to act as a pressure vessel in retaining fluid under pressure. The fluid pressure is retained within the string of tubing of which the stem 1 is made a section thereof.

By the use of this invention the packer may be conveniently and accurately placed in the exact position within a well at a predetermined depth to seal off one stratum from the other. In some instances the position of the packer must be determined accurately within a very few inches which is possible by the use of this method of packing.

What is claimed is:

1. In a packer the combination of a stem, a chambered packing element of resilient material surrounding the stem and having its intermediate portion secured thereto, and means for inflating the chamber in said packing element causing it to expand laterally and contract axially of the stem.
2. In a packer the combination of a tubular stem, a chambered packing element of resilient material surrounding the intermediate portion

of the stem, the intermediate portion of the packer being secured to the stem and the end portions being free to slide axially thereof, and means for inflating the chamber to expand it laterally causing the ends to slide axially of the stem toward the intermediate portion.

3. In a packer the combination of a tubular stem, a chambered packing element secured at its intermediate portion to the stem, cap members enclosing the ends of the packer and secured thereto, annular pockets formed by the ends of the packer with the stem and the cap members, and means for inflating the packer causing it to expand and drawing the cap members inwardly on the stem, the packer material in the ends flowing into the pockets as the cap members are contracted.

4. In a packer the combination of a tubular stem, a packer mounted on the stem and having its intermediate portion secured thereto and its end portions free therefrom, and means for inflating said packer causing it to expand laterally and causing the ends thereof to contract axially of the stem to compensate for the lateral expansion.

5. In means for packing a well, the combination of a tubular stem arranged to form a section in a string of pipe, a packer provided with an internal sleeve closely surrounding the tubular stem and an external sleeve, there being an

annular fluid space between said sleeves, the bore of said stem having access means to the fluid space for inflating said packer by fluid pressure within the stem.

6. In means for packing a well, the combination of a tubular stem arranged to be connected up as a section in a string of pipe, a packer provided with an internal sleeve closely surrounding the intermediate portion of the tubular stem and an external sleeve, there being an annular fluid space between said sleeves, and means for admitting fluid pressure from the stem into the annular fluid space to inflate the packer laterally.

7. In means for packing a well, the combination of a tubular stem arranged to be connected up as a section in a string of pipe, a packer provided with an internal sleeve closely surrounding the intermediate portion of the tubular stem and an external sleeve, there being an annular fluid space between said sleeves, and means for admitting fluid pressure from the stem into the annular fluid space to inflate the packer laterally, the packer being arranged to contract longitudinally on the stem in response to its lateral inflation.

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