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E. B. STRINGHAM III

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SLEEVE PACKER FOR CHEMICAL GROUTING

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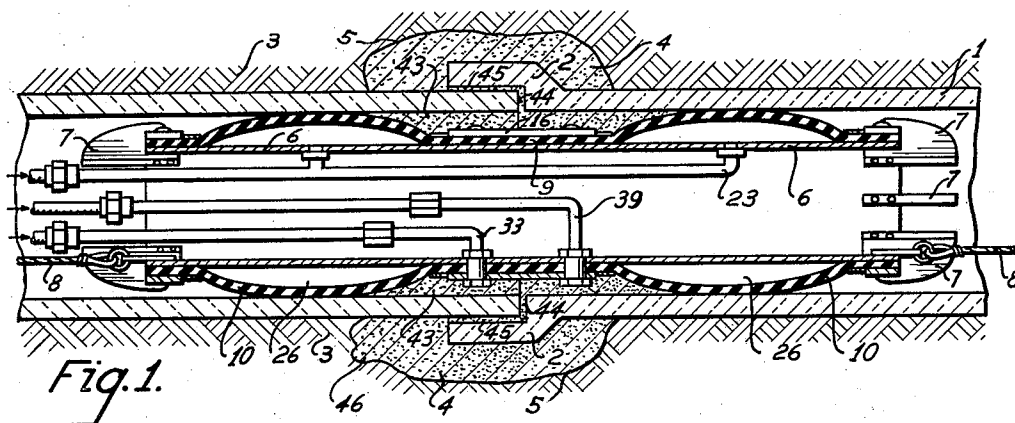


Fig.1.

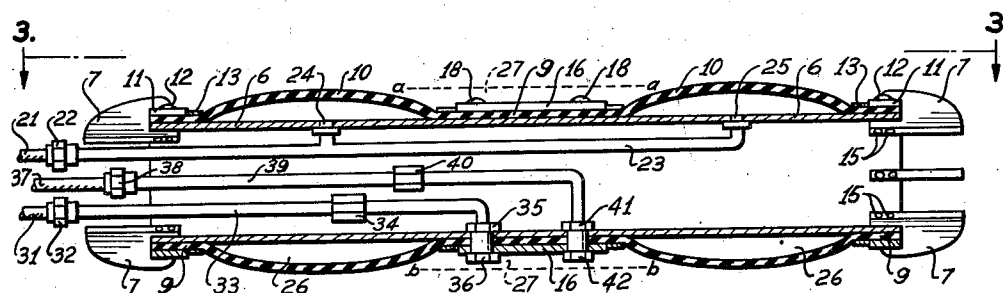


Fig. 2.

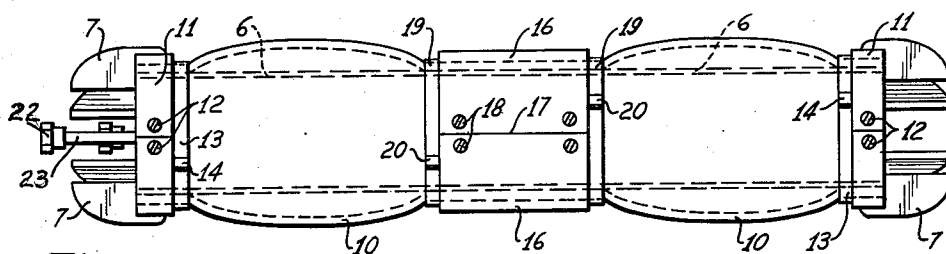


Fig. 3.

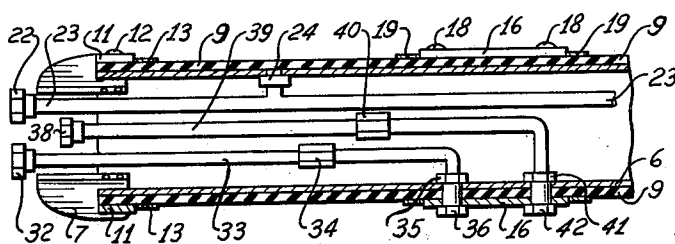


Fig. 4.

INVENTOR.

EDWARD B. STRINGHAM, III.

BY *Barnworth, Sessions,
Hemstrom & Knowles*
ATTORNEYS.

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SLEEVE PACKER FOR CHEMICAL GROUTING
Edward B. Stringham III, Delmar, N.Y., assignor to The Penetron System, Inc., Cleveland, Ohio, a corporation of Ohio

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This invention has to do with a sleeve packer for use with fast-gelling chemical grouts.

In grouting subterranean conduits, fast gelling is desirable, partly because it minimizes the likelihood of dilution and waste of grout as a result of ground water flow, partly because it makes for uniformity of penetration, and partly because it promotes gelling close to the area in which the grout is needed. Widely used for these and other reasons is a low-viscosity chemical grout comprising a catalyzed aqueous mixture of acrylamide and N, N'-methylenebisacrylamide which gels rapidly at ordinary concentrations and temperatures. Provided the mixture is not permitted to gel in the packer itself, its use does not preclude continued pumping of the material even after the nominal limit imposed by its gelling time. This characteristic, which is decidedly advantageous, comes about in part from the tendency of the grout being pumped to break out of the membrane constituting the incipient gel enclosure.

The principal object of the invention is to provide a packer that lends itself to use with fast-gelling grouts of this kind, particularly a sleeve packer that is at once simple, sturdy, leak-proof and not given to clogging as a result of premature gelling of the chemicals within the packer.

Other objects, advantages and features of the invention will be apparent from the description which follows and from the accompanying drawings in which:

FIGURE 1 is a longitudinal vertical section showing the sleeve packer of the present invention in use in a subterranean conduit.

FIGURE 2 is a similar section through the packer itself.

FIGURE 3 is a top plan of the packer as seen from line 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary section similar to that of FIGURE 2 showing a packer with the sleeve in its idle position.

FIGURE 1 shows a subterranean conduit 1 with a joint 2 that is being sealed with the aid of the packer of the present invention. The conduit is shown as surrounded on all sides by soil 3 that has been penetrated in the immediate vicinity of the joint by an irregular mass 4 of gelled grouting within an easily disrupted membrane 5. Within the conduit, in opposition to joint 2, is the sleeve packer of the present invention, the same comprising, among other things, an open-ended metal cylinder 6, removable skids 7, fittings for accommodating tow lines 8, and an expandable sleeve 9 of a resilient material such as vulcanized rubber. When the packer is not in use, sleeve 9 lies smoothly against the exterior surface of cylinder 6, as in FIGURE 4, but when the packer is being used in chemical grouting operations, as in FIGURE 1, the sleeve is expanded by a fluid under pressure to form two widely-spaced annular bladders 10, one toward each end of the cylinder.

As appears from FIGURE 2, the two ends of sleeve 9 are attached to cylinder 6 in two correspondingly located nonexpansion zones, a first zone at the left and the second zone at the right of the figure. In order that cylinder 6 and the ends of sleeve 9 may be in fluid-tight relation to each other, a suitable cement (not shown) is applied to them to bond them together, after which split rings 11 of metal or other suitable material are slipped over the ends

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of sleeve 9 and fastened in place by bolts 12 (FIGURE 3). A flexible steel strap 13 is applied adjacent each split ring, the ends of the straps being fastened together as at 14. Skids 7 are fastened in position on cylinder 6 and split rings 11 by means of set screws 15 that bear against the inside surface of the cylinder at its two ends.

Intermediate the two end zones is a third non-expansion zone wherein approximately a quarter of sleeve 9 is prevented from expanding under the influence of the pressure fluid. In this zone, expansion is restrained by a broad sleeve-confining band 16 of a suitable material such as metal. Sleeve-confining band 16 is split at 17 (FIGURE 3) and may, if desired, be split on the diametrically opposite side as well. It is held in place by means of bolts 18. Within the intermediate zone so formed, sleeve 9 is clamped firmly in place on cylinder 6. Band 16 not only prevents expansion of the sleeve in this zone but divides sleeve 9 into the two previously mentioned annular bladders 10 and, so doing, forms an annular void midway of the periphery of the packer, as will appear below. Flanking sleeve-confining band 16 are two flexible metal straps 19 the ends of which are fastened together at 20 to hold them in place.

A fluid supply line for providing a pressure fluid; e.g., compressed air, for inflating annular bladders 10 forms part of the assembly. It consists of a flexible hose 21, a coupling 22 and a longitudinally extending pipe 23 provided with fittings 24 and 25 that project through suitable openings in cylinder 6 inwardly of the equators of the two annular bladders. When compressed air is supplied through hose 21, bladders 10 develop air chambers 26 within them, assuming the generally ellipsoidal shapes shown in FIGURES 1, 2 and 3.

In consequence of the presence of band 16 and its restraining effect on sleeve 9 and because annular bladders 10 assume ellipsoidal shapes, an annular void which in a general way resembles a flat-sided torus develops outwardly of band 16 when the packer is in use. Designated 27, this void is indicated by dotted lines in FIGURE 2. Its outer limits are represented by lines a—a and b—b. When grout is supplied to the packer, which is done only when it is in juxtaposition to the joint to be sealed, void 27 fills with grout, as will be apparent from FIGURE 1. Although the grout gels after a short time, the jelled grout filling void 27 remains penetrable by the same chemicals that react to form it.

To supply these chemicals to what was initially an empty void, two or more supply lines are usually required. In the embodiment of the invention shown, one consists of a flexible hose 31, coupling 32, pipe 33, check valve 34, fitting 35 and discharge nozzle 36. The other consists of a flexible hose 37, coupling 38, pipe 39, check valve 40, fitting 41 and discharge nozzle 42. The chemicals supplied through these lines, one of which is of the nature of a catalyst, do not come into physical contact with each other within the packer itself but mix in void 27. They remain there only a few seconds before finding their way through the partially gelled mass in the void into the spaces in the joint to be sealed. The low viscosity of the aqueous acrylamide solution facilitates this action.

FIGURE 1 shows what happens at this stage. The chemicals discharged into and mixed in void 27 (indicated at 43) are under a fairly high pressure imposed by the system of proportioning means and of pumps (not shown) supplying the respective chemicals to lines 31 and 37. Accordingly, they cannot remain long in void 27; instead, they are forced out into the gaps 44 and 45 that separate the two pipe sections at joint 2. From space 45 they work their way into the surrounding soil. There they gel to form the mass 4 encased within membrane 5. The latter is given to easy disruption by fresh chemicals.

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When it ruptures, as it tends to do, it produces nodules 46 in its surface, thus extending the mass as a whole farther into the soil surrounding the conduit. This action tends to continue as long as pumping is continued, which may be for many minutes.

By supplying the chemicals through two or more separate lines, keeping them from coming into contact within the packer, and allowing them to mix in the annular void which surrounds the sleeve-confining band, the invention facilitates the use of modern chemical grouts having high gelling rates. For the most part, such grouts gel in the soil immediately surrounding the conduit, which is where they are needed. In any event, they do not clog the packer but at worst form a partially gelled but nevertheless penetrable mass in the annular void that surrounds it. Their presence in such void, once they fill it, does not preclude continuance of the pumping required to introduce into the soil the total amount of the grout needed to seal the conduit joint. The invention may, if desired, be used to equal advantage to seal off leaks in parts of a conduit intervening between joints.

It is intended that the patent shall cover, by summarization in appended claims, all features of patentable novelty residing in the invention.

What is claimed is:

1. A sleeve packer for performing a chemical grouting operation in a sub-surface conduit comprising an elongated cylinder provided with means for moving it endwise through the conduit; an elongated sleeve of expansible

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material jacketing the cylinder substantially from end to end; a first zone near one end and a second zone near the other end thereof, said elongated sleeve of expansible material lying smoothly against the exterior surface of the cylinder when the packer is not being used; means in said first and second zones for attaching the ends of the sleeve to the cylinder in fluid-tight relation; a broad sleeve-confining band surrounding the sleeve in a third zone intermediate said first and second zones, said band preventing expansion of the sleeve in said intermediate zone, dividing the sleeve into two widely spaced annular bladders, each of elongated shape, and producing an annular void around the confined portion of the sleeve; a first pipe for supplying a first chemical to said annular void, said pipe discharging through said sleeve-confining band; a second pipe for supplying a second chemical to said annular void, said pipe discharging through said sleeve-confining band; and means for supplying pressure fluid to each of said annular bladders.

2. A sleeve packer according to claim 1 in which the means for attaching the sleeve ends to the cylinder take the form of split rings.

3. A sleeve packer according to claim 2 in which metal straps flank the sleeve-confining band and split rings.

References Cited in the file of this patent

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