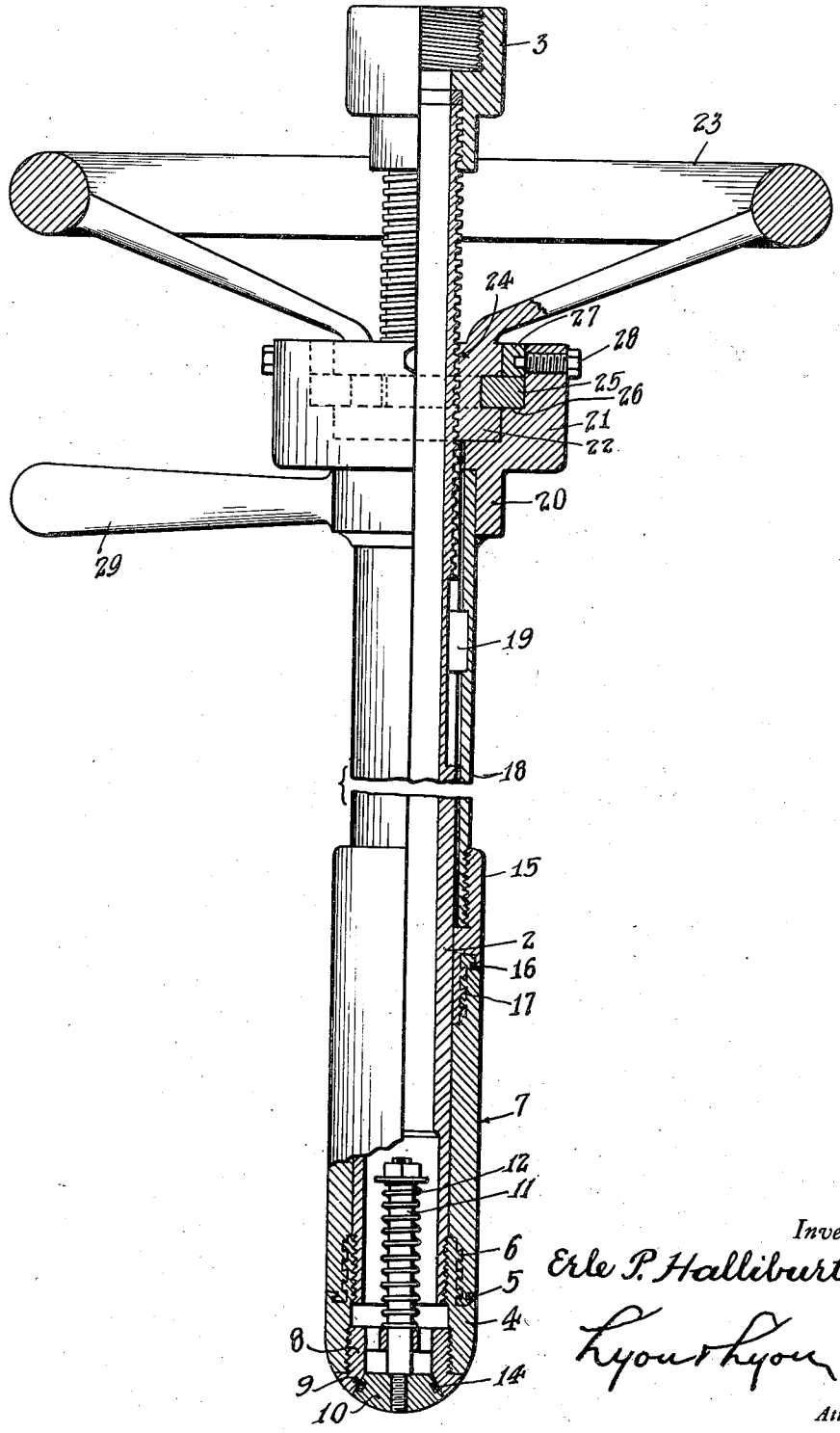
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GROUTING PLUG

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GROUTING PLUG

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This invention relates to a new grouting plug for grouting cement, and has a particular value in the grouting behind cement linings of tunnels.

In the construction of tunnels underground, particularly for carrying water when cement or concrete is poured to line the tunnel walls, it shrinks away from the formation leaving an empty space back of the hardened cement and concrete and the earth or rock formation.

There are also various cavities in the earth formation which are not closed up in the operations of lining the tunnel with concrete or cement, and the concrete or cement lining of the tunnels possesses frequent cracks, cavities, etc., which should be adequately sealed.

It is a major object of the present invention to provide a device by means of which cement or cementing material may be passed through a bore in the tunnel lining and enter the space between the tunnel lining and formation.

A further object of the present invention is to provide such a device as will permit the passage of cement under considerable pressure into this space between the lining and formation of the tunnel to the end that the cement will be forced into all crevices, cavities and openings in the earth formation, filling all of the pores of the formation and making the same a solid impervious concrete body and a rigid part of the tunnel lining, and to the like end that the cement will be forced into all cracks, cavities, fissures in the cement lining itself, thereby not only to fill the space between the lining and earth formation, but to adequately pack and fill all crevices and cracks in both the formation and the cement lining itself.

It is a further object of the present invention to provide such a grouting plug or device as can readily maintain itself in position by an engagement with the lining itself, and also to provide such a grouting plug as is readily placed in position, readily operated to make firm contact and seal the grouting holes, and readily disengage from the lining and withdraw from the grouting holes at the finish of the operation.

In grouting behind a tunnel lining, it may occur that it is desired to place the grouting cementing material under extremely high pressures, such as a thousand pounds per square inch. The present invention provides a device which can automatically hold the cement under this high pressure, even after it has been disconnected from the pumps supplying the cement, and provides an apparatus which can be so cleaned out during this period. In the present invention, a construction of grouting plug is provided which includes a valve so arranged as to automatically hold the cement under pressure after it has been placed in position while permitting the bore of the grouting plug to be cleaned out, so that it will not be cemented solidly with cement and may readily be removed after the completion of the cementing operations and be used for subsequent work in other grouting holes. The construction of the grouting plug is also so arranged that it provides little opportunity for becoming frozen or cemented in place. The grouting plug is further so arranged that the outer shell may be readily removed from the grouting plug in case of unusual freezing of the plug in position to permit the frozen end of the plug to be raised for freeing the same.

Various further objects and advantages of the invention will be apparent from a description of the preferred form, or example, of the grouting plug embodying the invention. For this purpose, there is hereafter described with reference to the accompanying drawing a preferred form or example of the grouting plug.

In the drawing,—

The single figure shows an elevation partially in longitudinal section of the grouting plug.

Referring to the drawing, the grouting plug is shown as comprising an induction tube 2 of suitable length to pass through a bore in the shell or lining of the tunnel, and is provided at one end with a collar 3, by means of which connection may be made with the hose leading to a source of cementing material under pressure. At the opposite end of the induction tube 2 there is provided a collar 4 which has a suitable flange 5 and ridges 6 for firmly anchoring the end of a packer member 7. The packer member 7 is preferably constructed of a stout rubber sleeve, although it is to be understood that any suitable form of packing means may be employed.

The collar 4 is internally threaded to a spider 8, which provides also a valve seat 9 for the valve head 10 of a check valve. This check valve is arranged so that the seat moves outwardly and permits the valve to automatically open when fluid is to be forced through the induction tube, but the valve automatically is forced closed by the pressure of cementing material beyond the plug when the passage of cement through the induction tube is discontinued.

An important feature of the invention is the forming of the collar 4, valve seat 9 and valve head 10 into one smooth curved surface in closed position. The curvature of this surface prefer-

ably diminishes rapidly so as to provide no straight surface to which the hardened cement may adhere for freezing the apparatus in the grouted hole. As an additional precaution against freezing the grounted plug in position, in practice the collar 4, exposed surface of the spider 8 and valve head 10 may be coated with a suitable material, such as paraffine or grease or wax mixtures.

The valve head 10 is connected to a valve stem 11 passing through the spider 8 and provided with a valve spring 12 which forms an addtional means for normally closing the valve head against the reverse passage of cementing materials through the induction tube 2. The valve head 10 is also provided with an annular groove hole and a ring of rubber packing 14, which in the operation of forming the device is vulcanized in position and provides a means for insuring a tight seal between the valve head and seat when the valve is in the closed position, and compensates for any possible abrasive effect of the cementing material on the merit of the valve head and seat.

The upper end of the packer sleeve is connected with suitable means for expanding and contracting the packer sleeve in operation, and such means preferably comprise a screw jack including a collar or packer follower 15 having the flange 16 and ribs 17 for tightly gripping and engaging the rubber sleeve 7. This packer collar or follower 15 is connected as by screw threads to an operating member, preferably in the form of a sleeve 18 telescoped over the induction tube 2 so that it provides the outer wall of the assembled grouting plug. This outer sleeve 18 is preferably provided with a key-way engagement 19 with the induction tube 2, which permits of relative longitudinal movement between the sleeve 18 and the induction tube 2, but locks said elements against relative rotation.

To the upper end of the packer operating sleeve 18 there is attached, as by welding, a collar 20, to which there is welded a laterally extending handle 29, and which collar terminates in a box 21, which receives the nut or hub 22 of an operating handle or wheel 23. The hub or nut 22 of said operating wheel 23 is provided with a screw-threaded engagement 24 with the upper screw-threaded end of the induction tube 2. There is also provided a groove in the nut 22 for holding a thrust collar 25 of bronze or other suitable bearing material, which engages a suitable shoulder 26 on the box 21 and provides a means for absorbing the longitudinal thrust during the relative rotation of the wheel 23 and handle 29 in the operations subsequently described of expanding and contracting the packer 7. A retaining ring 27 is set above the thrust member 25 and may be held in position by suitable means, such as set screws 28.

In the operation of the grouting plug thus described the grouting plug in the position shown in Figure 1, with the packer in the contracted position, is first inserted into a grouting hole bored in the tunnel lining, beyond which the grouting is to be conducted. The handle 29 is then gripped by the operator with one hand, while the operating wheel 23 is gripped by the other hand of the operator, and a relative rotation of the wheel and handle 29 effected in order to bring together the respective collars 15 and 4 between which the sleeve packing member 7 is held. This causes the sleeve packing member 7 to be thrust outwardly or expanded into contact with the walls of the grouting hole, and sufficient pressure may be placed upon the packer member 7 to hold any desired pressure in operation. When a sufficient pressure has been placed upon the sleeve packing member 7 to insure that the packer will hold in operation, a hose is connected to the collar 3 and cementing material, such as neat cement, pumped under pressure through the induction tube 2 and out by the valve head 10. The passage of cement through the grouting plug is continued until it is assured that the cement has entered all of the cavities, porosities in the earth formation, cracks and crevices in the casing or lining of the tunnel, and preferably until a high back pressure of a considerable amount of cement is built up, such, for example, as 1,000 pounds per square inch.

In this operation, the passage of cement is discontinued, the hose connected with the collar 3 disconnected, and the back pressure of the cement, together with the action of the spring 12, causes the valve head 10 to close and seals the device against any return of cement. This permits an immediate cleaning out of the bore of the induction tube 2 from cement, so that the cement will not become hardened, filling the bore tube, and the grouting plug may then be left in position until the cement introduced back of the lining has had an opportunity to become properly hardened.

After the cement or cementing material has been suitably hardened, the grouting plug may then be withdrawn from the bore, and for this purpose the wheel 23 and handle 29 are gripped by the operator's hands and relatively rotated to retract the packing sleeve 7 from its engagement with the bore in the lining, after which it is generally found that the grouting plug may be easily withdrawn from the lining.

In case of any tendency for the grouting plug to stick, a jack may be placed between the handle 29 and the lining wall. In extreme cases, it is possible even to continue operation of the wheel 23 until the packing sleeve 7 has been ripped from position, and then retract from the hole the entire outer sleeve 18, which provides an axis for tools to tap or otherwise disengage the lower end of the grouting plug from the hardened cement. The grouting plug thus may be used over and over again in like operations.

In other cases, the grouting plug may be employed for various and sundry operations auxiliary to pumping the cement back of the formation. In certain cases, it may be desirable to omit the use of the valve head 10 and spider 8, in order to provide for circulation of fluids back of the tunnel wall. In certain cases, it may be desirable to install a plurality of these grouting plugs in the lining of the tunnel at different points and force circulating fluid through one or more of the plugs and out of the other grouting plugs in order to clean out the formation back of the tunnel lining preparatory to cementing or other operations.

While the grouting plug herein described is well adapted to accomplish various objects of the invention, it is, of course, to be understood that various modifications may be made in the details of the construction of the plug without departing from the principles of the present invention, and this invention includes all such modifications and changes as come within the scope of the appended claims.

I claim:

1. A device for grouting cementing materials

through grouting holes in linings, which device comprises a tube for introducing cementing materials to said grouting holes, a sleeve packer surrounding said tube for packing the tube to the hole near the end of said hole, one end of said packer being fixed to the lower end of said tube, a sleeve telescoped over said tube and fixed to the other end of said sleeve packer for actuating said packer movable relative to said tube, a screw jack for actuating said sleeve and tube, and a check valve near the end of said tube adapted to be closed by the back pressure of the grouting material.

2. A device for grouting cementing materials through grouting holes in linings such as tunnel linings, which comprises a tube to be inserted in said grouting hole to convey cementing materials therethrough, said tube carrying a sleeve packer near its end, said packer being expansible into packing engagement with said hole, one end of said packer being fixed to said tube, a sleeve telescoped over said tube and fixed to the other end of said packer for expanding the same in relatively longitudinal motion with respect to said tube, a screw jack for relatively actuating said tube and sleeve, and a check valve near the end of said tube adapted to be closed by the back pressure of the grouting material.

3. A device for introducing grouting materials in grouting holes and linings and holding the same under pressure, which device comprises an induction tube adapted to extend into said grouting hole and carrying one end of a packer sleeve, a sleeve telescoped over said tube and longitudinally movable with respect to said tube, said sleeve engaging the other end of said packer sleeve for expanding and contracting the same into contact with the walls of said hole, and a check valve in said tube at the end thereof.

4. A device for introducing grouting materials in holes and linings and holding the same under pressure, which device comprises an induction tube adapted to extend into said bore and carrying one end of a packer sleeve, a sleeve telescoped over said tube and longitudinally movable with respect to said tube, the sleeve engaging the other end of said packer sleeve for expanding and contracting the same into contact with the walls of said hole, a check valve in said tube at the end thereof, and jack means for operating said relatively movable tube and sleeve.

5. A device for introducing grouting materials in holes and linings and holding the same under pressure, which device comprises an induction tube adapted to extend into said bore and carrying one end of a packer sleeve, a sleeve telescoped over said tube and longitudinally movable with respect to said tube, the sleeve engaging the other end of said packer sleeve for expanding and contracting the same into contact with the walls of said hole, a check valve in said tube at the end thereof, and a screw jack for actuating said relatively movable tube and sleeve.

6. A device for introducing grouting materials through holes and linings, which device comprises a tube to be inserted in said holes for conveying cementing materials therethrough, a check valve carried by said tube at its end and formed with smooth surface outer faces void of shoulders which might provide locking engagements with said cementing materials, a packer member carried by and attached to one end of said tube adapted to be engaged and disengaged with said hole, a sleeve locked from rotatable motion with respect to said tube and telescoped over and longitudinally movable relative to said tube to actuate said packer, and a screw jack for relatively moving said sleeve and tube.

7. A device for grouting through grouting holes and linings, comprising a tube having at one end a check valve and packer and provided at the other end with means for attachment to a cement-carrying conduit, a member adapted for relative longitudinal motion with respect to said tube for actuating said packer, a screw jack connected to said tube and member for operating the same, and a thrust bearing interposed between said screw jack and longitudinally movable member.

8. A grouting plug comprising an induction tube having a collar at one end carrying a check valve and attached to one end of a sleeve packer, an actuating sleeve for said packer carrying the other end thereof and telescoped over said tube, such sleeve carrying at its opposite end a handle and having a key-way engagement with said tube, which prevents relative rotation therebetween, a screw jack threaded to said tube and engaging a thrust bearing carried by said sleeve for relatively operating the sleeve and tube, said screw jack providing an operating handle.

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