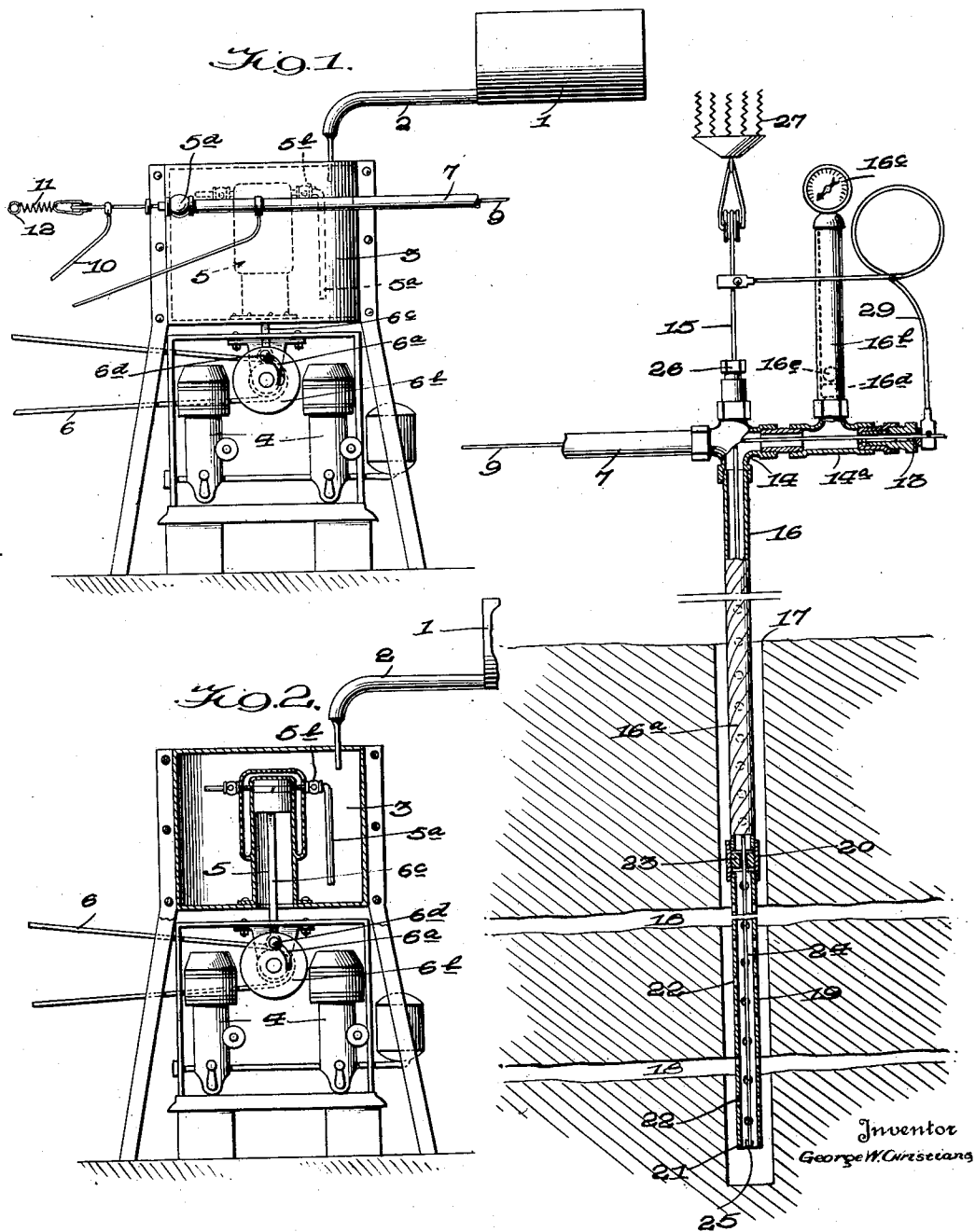


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IN ROCK FORMATIONS OR THE LIKE
Filed Aug. 7, 1926

1,858,952

3 Sheets-Sheet 1



Inventor
George W. Christians

384

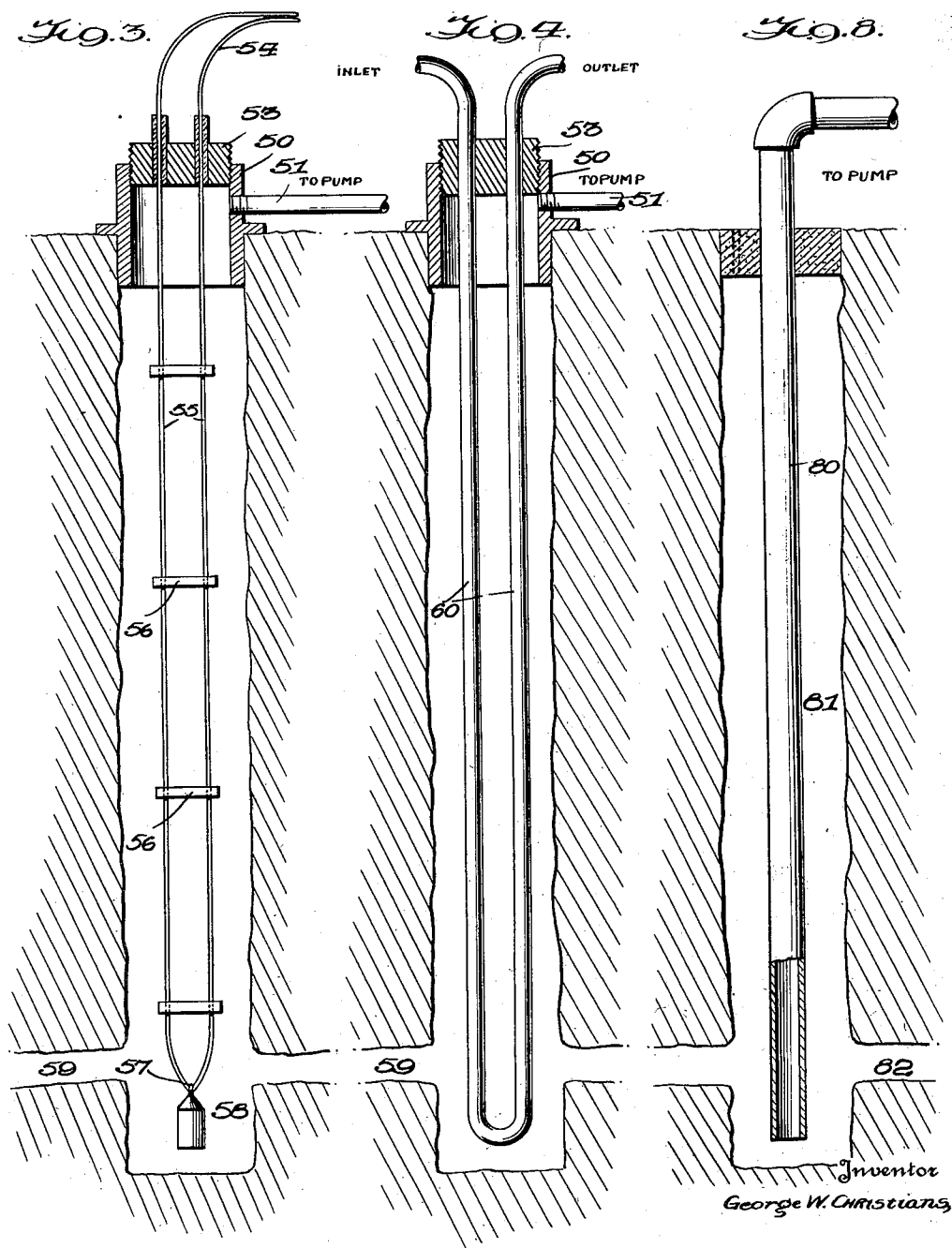
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Fig. 5.

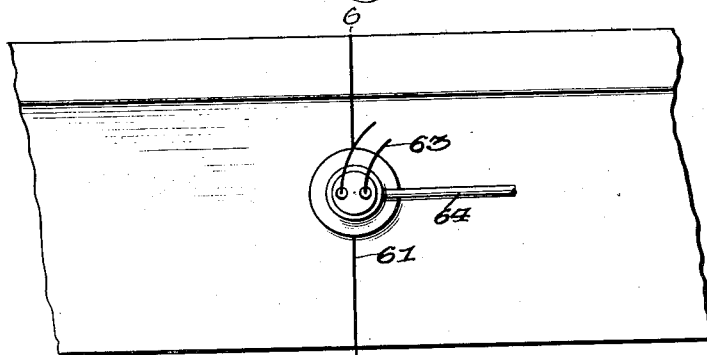
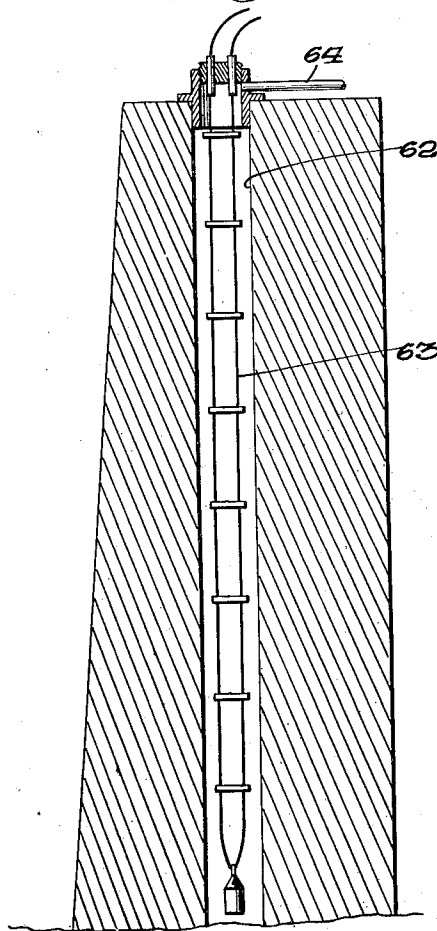
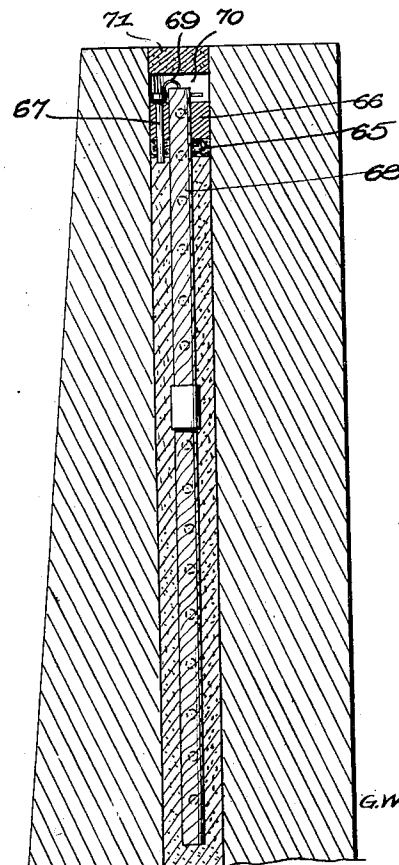


Fig. 6.

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Fig. 7.



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR SEALING CREVICES IN ROCK FORMATIONS OR THE LIKE

Application filed August 7, 1926. Serial No. 127,896.

This invention relates to improvements in a method and apparatus for sealing crevices in rock, stone or masonry formations.

In my Patents 1,327,268 and 1,327,269, dated Jan. 6, 1920, I have disclosed a method and apparatus invented by me, and employed for sealing fissures or crevices in rock formations and the like. In that method, a hole is provided at the place to be sealed, and this hole communicates with the crevices to be filled or plugged off. For filling said crevices, I force a thermo-plastic material, such as asphalt, pitch or sulphur, down this hole or conduit, and cause such sealing material to enter the interstices with which the hole communicates, and I maintain the sealing material in heated condition all the way down the hole or conduit, so that it will readily flow into the crevices, and seal the latter.

The primary object of the present invention is to improve the method and apparatus described in said patents.

Another object of the invention is to provide the perforated conducting pipe used in one form of the method, with a canvas wrapping or the like, which will temporarily close the perforations in the feed pipe, leaving the bottom only of the pipe open. This jacket will prevent sand, mud, small stones or other material from getting inside of the pipe after it is installed, and before it is used for sealing purposes. Furthermore, the canvas covering will withstand a small pressure on the entering asphalt, (about 50 to 75 pounds per square inch) and when pumping is started, it compels the asphalt to fill the pipe to the bottom before breaking out into any crevices, thus covering the electric heating wire in the pipe with asphalt at the start of the project, to prevent electrolysis, dust or corrosion. A little excess pressure will tear open the canvas, and permit the asphalt to flow out wherever there is available space. Moreover, if my patented method and apparatus are used with this canvas cov-

ering to seal expansion joints or the like in artificial stone formations, the canvas will permit the pipe to fill to the bottom, and then the asphalt or other sealing material will flow up the hole on the outside of the pipe, and seal the joint from the bottom up, thereby eliminating pockets of water or air.

A further object of the invention is to improve my patented apparatus by substituting a special gage device for the ordinary gage formerly used. It is important to keep close watch of the pressure on the asphalt at all times during actual operation, and without special provisions, this is difficult to do. I have found, in practice, that asphalt gets up into the gage, hardens and gives false indications. If the gage is heated to soften this hard asphalt, the heat affects the soldered joints of the gage, and may render the gage unfit for further use. I therefore provided, in the present invention, special means to overcome this difficulty.

A further object is to furnish the pump employed for forcing the thermo-plastic sealing material into the hole, with an adjustable stroke pump jack, which enables one, without changing speed, to obtain small volume at high pressure, or large volume at low pressure. The nature of movement of asphalt makes this essential. When starting a cold full pipe line, a high pressure is used with very small volume to get the asphalt started as the pipe line is being heated up. When the asphalt breaks through, and the pressure falls off, the pump stroke is opened up. When finishing a hole, the pressure builds up gradually to the desired maximum, and is held there at decreasing volume by shortening the pump stroke. My present apparatus gives from 0 to 5 inches stroke on a small piston pump.

A still further object is to improve my former method and apparatus by arranging a plug or stopper at the top of the hole, and passing a heating element such as an electric

heater or a steam pipe into the hole, through this stopper, the thermo-plastic grouting material being forced into the hole through this stopper and being maintained in heated condition within the hole by said electric heater or steam pipe. This particular apparatus and method is especially useful in sealing the joints of concrete walls or the like.

I have found in practice, that in filling crevices located only a short distance below the ground line or the like, say from 8 to 10 feet from the surface, that such holes may be effectively filled without specially heating the pipe through which the asphalt is pumped. In such cases, the heated sealing material, if rapidly pumped through a metal pipe extending to the bottom of the hole, will heat the pipe, and as the sealing material is discharged at the bottom of the pipe, it may work its way up around the pipe and seal the crevices or the like. The heated material traveling through the pipe will cause the outside of the pipe to be heated sufficiently to maintain the material in fluid condition as it passes up the hole around the pipe. Therefore, another object of my invention is to provide a method and apparatus capable of accomplishing this result.

The foregoing are some of the objects of the present invention, but other objects will appear as the following detail description proceeds. The invention will be described in connection with the accompanying drawings, in which,

Fig. 1 is a side view partly in section, of one form of my apparatus, and a section of fissured rock or stone into which heated thermo-plastic material is being pumped, the sealing material conveying pipe between the pumping tank and the down pipe, as well as one of the electric conductors, being broken away to facilitate illustration.

Fig. 2 is a detail view partly in section, showing the means for pumping and heating the material, the pump in this instance, including an adjustable stroke pump jack.

Fig. 3 is a vertical sectional view of fissured rock with a hole therein, and shown with another form of my apparatus employing an electric heater.

Fig. 4 is a similar view showing a steam heater substituted for the electric heater.

Fig. 5 is a top plan view of fragments of sections of a concrete wall or the like with one form of my apparatus installed at the joint thereof, to seal the joint with thermo-plastic material.

Fig. 6 is a vertical sectional view taken on line 6-6 of Fig. 5.

Fig. 7 is a view similar to Fig. 6, but showing the pipe form of my apparatus used with a plug at the top of the hole.

Fig. 8 is a side view of another form of the apparatus with which I rely on the heat of the material to maintain said material in

heated condition while it is traveling upwardly in the hole on the outside of the pipe.

In the embodiment of the invention illustrated in Figs. 1 and 2, 1 indicates a supply tank in which the thermo-plastic sealing material is stored, and this tank may be heated by any suitable means, (not shown) so as to maintain the fluid in flowable condition. The sealing material is fed from this tank by way of a pipe 2, into a chamber 3, which is maintained in heated condition by any suitable means, such as gaseous or liquid fuel burners 4.

A pump 5, used for forcing the sealing material to the crevices to be sealed, is arranged in the chamber 3, and as this chamber will be filled with the sealing material during operation, the pump will be entirely submerged in the heated material. Of course, if desired, the pump may be heated in any other suitable way. This pump is driven from any suitable prime mover, by means of a belt 6, and said pump is provided with an inlet pipe 5a having a check valve 5b which opens inwardly. The pump is connected by the pipe 5c with a material feeding pipe 7, and the pipe 5c is provided with an outwardly opening check valve 5d.

Extending through said pipe 7 is an electric heating wire 9 connected to a supply line wire 10. One end of the wire 9 is secured to a coil spring 11 that has its outer end connected to a fixed support 12. The opposite end of the wire passes through and is fixed to an insulated nipple 13, carried by a cross-shaped pipe fitting 14. The spring 11 acts to maintain the wire 9 in taut condition, and prevents the same from contacting with the inner surface of the pipe 7. A supply line wire 15 is also secured in electric connection with the pipe 7.

Extending downwardly from the fitting 14 and having its upper end connected thereto, is a material feeding pipe 16 which is inserted in a previously prepared hole 17 communicating with the crevices 18 which are to be sealed by the material passing through said pipes. The pipe 16 consists of a number of sections 19, having their adjacent ends connected together by couplings 20, and located in each of said couplings, between adjacent ends of the pipe sections, is an insulating member 23, which is preferably constructed to guard against short-circuiting between the electric heating wire 24 and the couplings 20. The sections of the pipe 16 that occupy positions adjacent to the crevices 18, are provided with series of apertures 22, through which the material may pass in its travel from the interior of the pipe 16 to said crevices. The heating wire 24, has its lower end connected at 25, to an apertured plug 21 that places said wire in electrical connection with the pipe 16, and this wire extends upwardly, and its upper portion passes through an insulated

nipple 26, and has its upper extremity connected to the lower end of a coil spring 27, which has its upper end secured to a fixed support 28. The wire 24 passes through the member 26 with a free fit, so that the spring 27 will draw the wire upwardly and maintain the same in taut condition. A wire 29 has its ends connected to the wires 24 and 9, so that current traveling through the wires 10, 9, 29 and 24 in the order named, will reach the apertured plug 21 at the lower end of the pipe 16, and will then travel upwardly through said pipe to the fitting 14, then over the pipe 7 and out of the wire 15, back to the line. With this construction, the electric current will maintain the wires 9 and 24 in heated condition, and the sealing material which is heated in the chamber 3, will be maintained in heated condition by the wires during its travel through the pipes 7 and 16.

The subject matter shown in Fig. 1, which has thus been described in detail is substantially the same as disclosed in my Patent 1,327,269, and I have improved the same in the following particulars. I spirally wrap the perforated portion of the pipe 16 with a canvas strip or strips 16a, to close the perforations, leaving the pipe open only at the bottom through the apertured plug 21. There are several reasons for this. One; to prevent sand, mud, small stones or other material from getting inside of the pipe after it is installed, and before it is used for sealing purposes. This foreign material may clog the pipe or interfere with centering the heating wire 24, and thus cause a short circuit. Two; the canvas covering will withstand a small pressure on the entering asphalt (about 50 to 75 lbs. per sq. inch) and when pumping is started, it compels the asphalt to fill the pipe to the bottom before breaking out into any crevices, thus covering the wire with asphalt at the start to protect it from electrolysis, rust or corrosion. A little excess pressure will rupture the canvas and permit the asphalt to flow out wherever there is available space. Three; in case the method and apparatus are used to seal expansion joints in walls or the like, the canvas enables me to fill the pipe to the bottom and then fill the expansion joint recess from the bottom up, thereby eliminating pockets of water or air. It will therefore be recognized that this canvas wrapping forms an important feature in practical operation.

Another feature of importance in the present invention, resides in the adjustable stroke pump or pump jack. This is provided by arranging a tangential slot 6a in the crank wheel 6b that is driven by the belt 6. The pitman 6c of the pump is provided with a pin 6d which is adjustable along this tangential slot to adjust the stroke of the pump. This is best illustrated in Fig. 2, and the structure enables me, without changing speed, to ob-

tain small volume at high pressure, or large volume at low pressure. The nature of thermo-plastic material such as asphalt, makes this necessary. When starting a cold full pipe line, a high pressure is used with very small volume, to get the asphalt started as the pipe line is being heated up. When the asphalt breaks through, and the pressure falls off, the pump stroke is opened up by adjusting the pin 6d. When finishing a hole, back pressure gradually builds up to the desired maximum, and it is held there at decreasing volume by shortening the pump stroke. My present apparatus gives from 0 to 5 inches stroke on a small piston pump.

In the apparatus shown in my Patent 1,327,269, I had a pressure gage at the inlet end of the pipe 7, but I have improved this structure by placing the gage at the outlet end of the pipe 7. For this purpose, the fitting 14 is provided with a metal connection 14a, adapted to be directly heated by the material passing through the pipes. The connection 14a carries the insulated fitting 13, and it also supports a short vertical pipe 16b provided at its upper end with any suitable form of pressure gage 16c. In operation, the lower end of the pipe 16b is plugged with an asphalt slug indicated at 16d, and a small rubber ball 16e rests on this slug and maintains the same out of contact with a column of coal tar oil or the like, which fills the pipe 16b.

I have found from experience, that it is important to keep close watch of pressure on the asphalt at all times, and without special apparatus, this is difficult of accomplishment. Asphalt is liable to get up in the gage, harden, and impart false indications. To overcome this difficulty, I have put the gage up on the stand pipe 16b. As the lower end of this pipe containing the hard slug of asphalt is directly attached to the connection 14a, the hot asphalt traveling through the pipe line, will melt this slug, and as the coal tar oil will not mix with asphalt, the pressure will be conveyed to the gage, and the gage will be more sensitive than in my previous construction. As the gage is spaced from the hot pipes by means of the pipe 16b and the column of oil, it will remain cool and unclogged by asphalt for a considerable period of time.

In the embodiment of the invention illustrated in Fig. 3, I eliminate the feed pipe within the hole, and instead, place a ring 50 at the top of the hole to receive the hot asphalt forced in through pipe 51 by the pump 52. In this construction, a removable plug 53 of insulating material, may be connected to the top of the ring 50, and an electrical loop or yoke 54 may be suspended in the hole from this plug. The heating wires 55, forming this yoke, are held apart by spacing members 56, and they are connected together at their lower ends as shown at 57. The wires may

be stiffened in any suitable way, and for the purpose of illustration, I have shown a weight 58 arranged at the lower end of these wires for this purpose. In operating this form of the invention, the wires 55 will be connected to a suitable source of electric current, so as to heat the wires up, and the hot asphalt or the like, pumped in through the pipe 51, will be maintained in heated condition by the heat from said wires as it travels through the hole and enters the crevices or the like 59.

In the form of the invention shown in Fig. 4, I substitute a steam pipe or loop 60, for the electric heater, the remainder of the structure being the same.

In Figs. 5 and 6, I have shown the apparatus of Fig. 3, used for sealing the expansion joint 61 or the like in a dam. For this purpose, adjacent faces of the wall sections may be recessed during the building of the wall, or may be drilled after the wall is built, to provide a hole 62, in which the heater 63 is placed. The hot asphalt forced down this hole through pipe 64, and maintained in heated condition in its passage through the hole, will seep out under pressure into the expansion joint 61, and seal the latter. Of course, the same method and apparatus may be used for each expansion joint in the wall structure.

In the modification shown in Fig. 7, I use an apparatus similar to that shown in Fig. 1, for the purpose of sealing the expansion joints in a wall or the like, but instead of leaving the top of the hole open as in Fig. 1, I arrange a packing 65 near the top of the hole, and around the perforated feeding pipe. Over this packing, I place a plug 66 of cement. A vent pipe 67 extends through the plug and packing. After a joint has been sealed, the parts 65 to 68 inclusive are left in the hole, and the heating wire 69 and perforated pipe are also left within the hole. To permit this, the upper section of the pipe is removed, and the heating wire is cut. Then, the upper end of the pipe and the heating wire are sealed by a plug of asphalt 70, which is poured over the same in heated condition, and acts to protect the wire. A cement cap 71 may be arranged at the top of the hole to finish off the structure.

If it is found desirable or necessary, at any future time, to force more thermo-plastic material into the hole to seal the joints, the cement cap and asphalt plug are removed, and the upper end of the pipe and wire are again connected to the part of the apparatus which is located above the hole. Operation is again started, and this permits re-sealing.

As before stated, I find that in certain cases, where it is desired to seal the crevices in short holes, say 8 to 10 feet, I may do this without a specially heated pipe or the like, providing I work in a certain way. To do this satisfactorily, I install a small pipe 80,

say $\frac{3}{4}$ inches in diameter, in a hole $1\frac{1}{2}$ inches in diameter, this pipe extending close to the bottom of the hole. I have found it absolutely necessary to extend this pipe close to the bottom of the hole in order that the pipe itself will function as a heater. Then, by pumping hot asphalt rapidly, it can be made to run down the pipe, out the bottom, and up the drilled hole 81, to any crevices 82 which may exist.

Putting the pipe down the bottom is the important point. If it was just open into the top of the hole, asphalt might run down the hole a little way beyond the first crevice, and "freeze" there, making further advance, after filling the first crevice, impossible. However, with the pipe running to the bottom, as long as a flow of hot asphalt is maintained, the pipe being hot, maintains a heated and fluid path on its surface to equalize the pressure from top to bottom of the hole, so that as one crevice is filled, the pressure may be applied up the outside of the pipe to the next, until all are filled. The pipe is cemented into the hole at the top, and a shut-down, for any reason, of course, finishes the hole.

From the foregoing, I believe that those skilled in the art may readily understand the construction of my apparatus, and the use of my method, and I am aware that changes may be made in the details disclosed, without departing from the spirit of the invention as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. The method of sealing a crevice in rock formation or the like, which consists in extending a hole to the place where the crevice occurs, placing a conduit having a perforated wall in said hole, closing the perforations in the conduit with puncturable material before placing the conduit in the hole, forcing a thermo-plastic substance through said conduit and exerting sufficient pressure on the same to cause it to puncture said material and exit through the perforations and into said crevice, directly heating the interior of said conduit, and utilizing the heat for maintaining the thermo-plastic substance in fluid and heated condition during its travel through said conduit and into said crevice.

2. The method of sealing a crevice in rock formations or the like, consisting in extending a hole to the place where the crevice occurs, placing a conduit having a perforated wall in said hole with the perforations adjacent said crevice, closing said perforations with puncturable material before placing the conduit in the hole, forcing a hot thermo-plastic substance into said conduit under sufficient pressure to puncture said material to permit the thermo-plastic substance to flow from the perforations and into the crevice, and maintaining said thermo-plastic mate-

rial in heated condition during its passage through said conduit.

3. The method of sealing a crevice in rock formations or the like, which consists in extending a hole to the place where the crevice occurs, placing a pipe having a perforated wall in said hole, covering the perforated portion of the pipe with puncturable material before placing the pipe in the hole, forcing a thermo-plastic substance through the pipe under sufficient pressure to puncture said material to permit the thermo-plastic substance to flow through the perforations into said crevice, and maintaining the thermo-plastic substance in heated fluid condition during its passage through said pipe and perforations into said crevice.

4. The method of sealing a crevice in rock formations or the like, consisting in extending a hole to the place where the crevice occurs, placing a perforated pipe in said hole, covering the perforations of the pipe with puncturable material before placing the pipe in the hole, forcing hot asphalt through said pipe under sufficient pressure to rupture the material and permit the asphalt to flow through the perforations and into said crevice, and maintaining said asphalt in heated fluid condition during its travel through said pipe and perforations into said crevice.

5. An apparatus for use in sealing crevices in fissured rock formations or the like, comprising a perforated pipe adapted to be placed in a hole extending to a crevice to be sealed, puncturable material closing the perforations of the pipe, means for forcing a hot thermo-plastic material through said pipe under sufficient pressure to permit it to rupture the puncturable material and to flow out through said perforations, and means for maintaining the pipe in heated condition, whereby the thermo-plastic material traveling through the same, will be maintained in heated fluid condition.

6. An apparatus for use in sealing crevices in fissured rock formations or the like, comprising a perforated pipe adapted to be placed in a hole extending to the crevice, fibrous puncturable material covering the perforated portion of the pipe, means for forcing a heated thermo-plastic substance through the pipe under sufficient pressure to cause said substance to rupture said fibrous material and to flow through said perforations, and means for maintaining the pipe in heated condition, whereby said thermo-plastic substance is kept in heated fluid condition during its travel through said pipe and perforations.

7. An apparatus as claimed in claim 6, in which the fibrous material closing said perforations is formed by a canvas layer.

8. In an apparatus for sealing crevices in fissured rock formations or the like, a perforated pipe, means closing said perforations

and capable of being punctured by thermo-plastic material passing through the pipe under super-atmospheric pressure.

9. An apparatus for sealing crevices in rock formations or the like, including a perforated pipe through which thermo-plastic material is adapted to be forced under super-atmospheric pressure, and a spirally wrapped canvas strip closing the perforations of the pipe.

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