A. S. COOPER.

CEMENTING WELLS.

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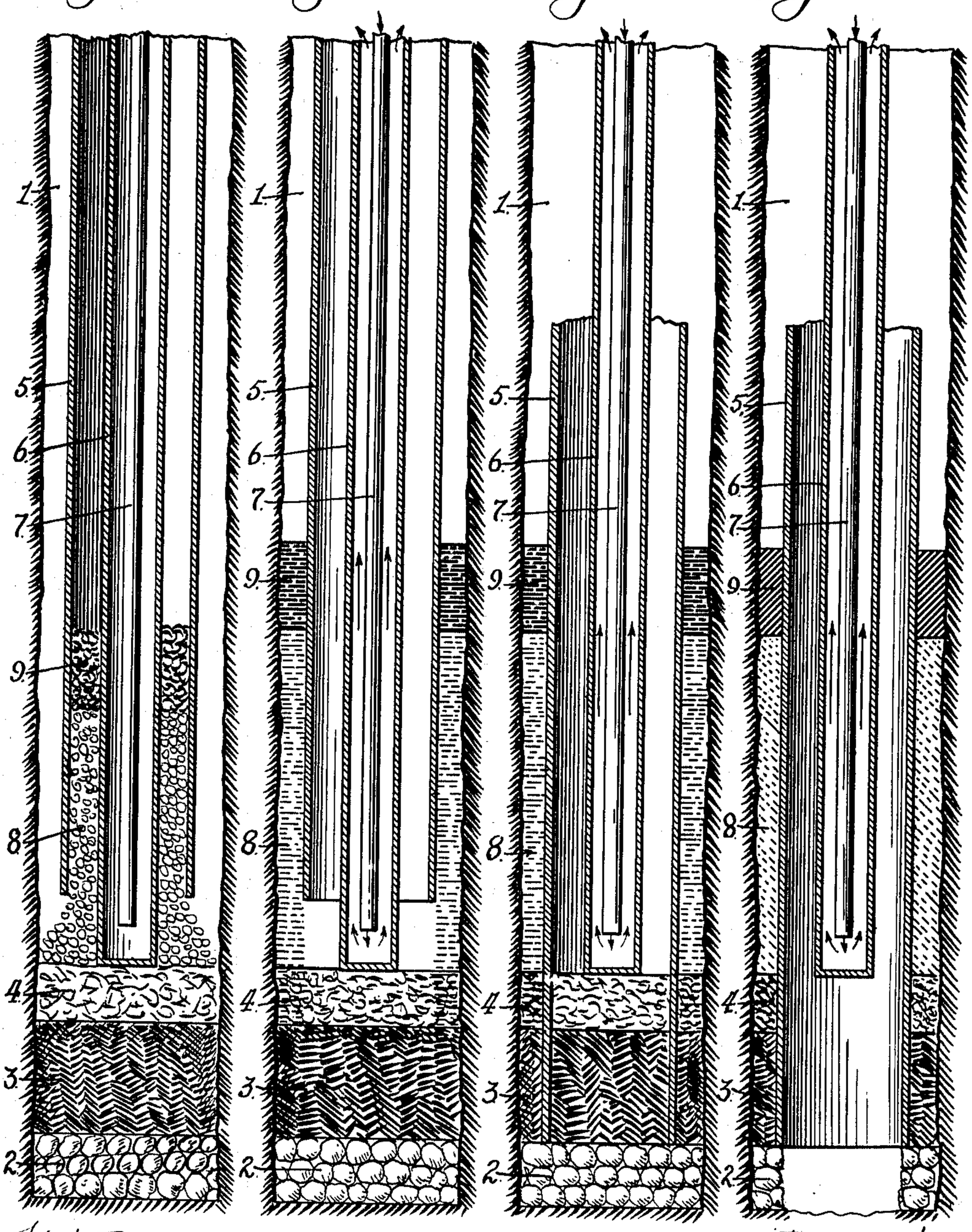
Fig. 1. Fig. 2. Fig. 3. Fig. 4.



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UNITED STATES PATENT OFFICE.

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Application filed June 27, 1910. Serial No. 569,033.

To all whom it may concern:

Be it known that I, AUGUSTUS STEIGER COOPER, a citizen of the United States, residing at Los Olivos, in the county of Santa Barbara and State of California, have invented certain new and useful Improvements in Cementing Wells, of which the following is a specification.

My invention relates to the art of cementing wells by which the surface water is cut off, and it consists essentially in an improved method and a novel closure as the product of said method; said method and its product involving the use of sulfur, best applied in connection with asphaltum, as I shall hereinafter fully describe.

My method, though embracing some of the general steps of the usual process of cementing with a fluid aqueous mass of Portland cement, differs therefrom in such essentials as are necessarily required by the employment of sulfur and asphaltum and these distinctions result not only in a change of the method in certain particulars but in decided advantages in the use of these materials, and in the closure formed by their employment.

These advantages are the objects of my invention, and they will hereinafter be fully demonstrated by reference to the accompanying drawings, in which are illustrated the several steps of my method, and the product thereof.

In these drawings Figure 1 is a sectional view of a well bore showing the initial location of parts and the beginning of the process. Fig. 2 is a similar view showing the condition of affairs when the sulfur and asphaltum are melted and pressure applied to drive the liquid mass up between the casing and the wall of the well bore. Fig. 3 is a similar view showing the lowering of the casing through the penetrable seal below, while the sulfur and asphaltum are still in a fluid state. Fig. 4 is a view showing the condition when the sulfur and asphaltum are hardened and the closure completed. This view also shows that drilling has been resumed, and it also illustrates the re-insertion of the hot water circulation when it is desired to remelt the closure and remove the casing.

Referring first to Fig. 1, the well bore is 1. The first step is to fill the bottom of the bore with cobble-stones 2 and pack them down firmly to form a support for the casing. Upon the cobble-stones is placed a well packed body 3 of some material which, while penetrable to the casing, will form a seal around said casing against the passage into it of any liquid. In practice, what is known as bituminous sand rock, such as is often used for paving streets and sidewalks will serve the purpose. To prevent the heat, the use of which I shall presently describe, from affecting this sealing body I place on top of it a body 4 of clay, adobe, or similar earth. The supporting cobbles 2, and the overlying bodies 3 and 4, reach to the height in the bore at which it is desired to effect the cementing or closure to shut off the surface water. Into the well-bore is then lowered a casing 5 or string of casing, and this is suspended above the surface of the clay body 4 a few feet. From the surface of the well is let down into and through the casing a pipe 6 with a closed bottom which rests on the clay 4; and into this pipe and reaching nearly to its bottom is let an inner pipe 7 the lower end of which is open. Sulfur in pieces about the size of an egg is then dropped down through the casing 5, forming a mass 8 resting on the clay 4 and rising in the casing around the pipe 6 to a proper height, I deem it best to use in connection with the sulfur, asphaltum 9. This is broken into pieces of about egg-size, which are dropped into the casing on top of the sulfur. Everything being now ready, a stream of water heated to, say 250° F., is passed down through pipe 7 and forced up through pipe 6, the circulation being indicated by the arrows, in Fig. 2. This will melt both the sulfur 8 and the asphaltum 9, and while in this liquefied state pressure is applied through the top of the casing to the liquid mass and it is thereby forced out of the casing and up around it and fills the space between it and the wall of the bore as shown in Fig. 2; the asphaltum on account of its lesser specific gravity seeking the top of the liquid mass as shown, and it will fill any cracks in the sulfur and prevent leaks. Now while the sulfur and asphaltum are still in liquid state and under pressure, the casing is lowered and by its own weight descends through the clay 4 and the sealing bituminous sand rock 3 until it rests upon the cobble support 2, as shown in Fig. 3. Being thus sealed, the liquid sulfur cannot pass back into the casing when the pressure is relieved, and the sealing body 3 is fully

protected from the heat by the clay body 4. The sealing also stops any circulation of water between the casing and bore, and the sulfur and asphaltum are not disturbed in hardening. Now the circulating heating medium is stopped and the sulfur and asphaltum may be allowed to cool and harden in due course which will be in a day or two, or their hardening may be hastened, if time be a factor, by circulating cold water through the pipes 7 and 6. The asphaltum keeps the sulfur from crystalizing and becoming brittle, when it cools. When the sulfur and asphaltum are solidified, as indicated in Fig. 4, they cement the casing to the well-bore and form a closure to the surface water. The pipes 7 and 6 are then removed and drilling resumed through the casing, which resumption will, as shown in Fig. 4, remove the clay, the bitumen and the rocks from the inside of the casing.

If for any reason a mistake has been made in the zone at which the bore should be cemented, the string of casing thus used is not lost, for it may easily be removed by letting down the pipes 7 and 6 again, as shown in Fig. 4, reëstablishing the circulation of the superheated water and thereby melting the cementing sulfur and asphaltum, whereupon the casing may be lifted; and, moreover, both the sulfur and asphaltum may be recovered for use again, as upon remelting them, they will drop down in the well. This is in decided contrast to the results of cementing a well with Portland cement, which is obviously permanent, resulting in a loss of both casing and the cementitious substances, if, as frequently happens, the judgment of the operator as to the proper zone of cementing is at fault.

With the Portland cement process, the work must be done hastily and, therefore, with questionable precision, because of the quick initial set of the fluid aqueous mass, and, thereafter, one must wait for two or three weeks for the final set of the cement before resuming drilling, during which delay the employees are usually drawing wages. With my process there need be no undue initial haste for the mobility of the melted substances is preserved as long as the liquefying heat is maintained, nor is there the loss attendant upon a long wait, because the sulfur and asphaltum will, even under natural conditions, solidify in a day or two; and this time may be abbreviated by artificial cooling.

There is a further advantage to be noted in economy due to the fact that sulfur and asphaltum may be easily applied and may be recovered and used again, while Portland cement once used is wholly lost.

Another advantage of the use of sulfur and asphaltum is that they will liquefy and harden even if petroleum be present, where as Portland cement is kept from hardening or setting by a small amount of oil. Sulfur and asphaltum will also liquefy and harden even if water be present in excess.

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

1. The method of cementing wells to shut off surface water, which consists in placing in the bottom of the well-bore a foundation filling; then lowering into the bore a casing with its lower open end separated from the surface of said foundation; then supplying said casing with sulfur; then circulating through the casing a heating medium of a temperature to melt the sulfur; then when the sulfur is melted applying pressure sufficient to drive it out of the casing and up between said casing and the wall of the well-bore, and, finally, effecting the hardening of the sulfur by cooling.

2. The method of cementing wells to shut off surface water, which consists in placing in the bottom of the well-bore a foundation filling; then lowering into the bore a casing with its lower open end separated from the surface of said foundation; then supplying said casing with sulfur; then supplying the casing with asphaltum resting on the sulfur; then circulating through the casing a heating medium of a temperature to melt the sulfur and asphaltum; then when the sulfur and asphaltum are melted applying pressure sufficient to drive them out of the casing and up between said casing and the wall of the well-bore; and, finally, effecting the hardening of the sulfur and asphaltum by cooling.

3. The method of cementing wells to shut off surface water, which consists in placing in the bottom of the well bore, a sealing body penetrable to the casing but impervious to liquid; then lowering into the bore a casing with its lower open end separated from the surface of said sealing body; then supplying said casing with sulfur; then circulating through the casing a heating medium of a temperature to melt the sulfur; then applying pressure to the melted sulfur to drive it out of the casing and up between said casing and the wall of the well-bore; then while the sulfur is still melted, lowering the casing to cause its lower end to penetrate the sealing body; and, finally, effecting the hardening of the sulfur by cooling.

4. The method of cementing wells to shut off surface water, which consists in placing in the bottom of the well bore a sealing body penetrable to the casing but impervious to liquid; then lowering into the bore a casing with its lower open end separated from the surface of said sealing body; then supplying said casing with sulfur; then supplying the casing with asphaltum above the sulfur; then circulating through the casing a heat-

ing medium of a temperature to melt the surfur and asphaltum; then applying pressure to drive the melted sulfur and asphaltum out of the casing and up between said casing and the wall of the well-bore; then while the sulfur and asphaltum are still melted, lowering the casing to cause its lower end to penetrate the sealing body; and, finally, effecting the hardening of the sulfur and asphaltum by cooling.

5. The method of cementing wells to shut off surface water, which consists in placing in the bottom of the well-bore a bituminous body penetrable to the casing to form a seal for said casing when lowered; then covering said sealing body with a body of material also penetrable to the casing, to form a protection against heat for the sealing body; then lowering into the bore a casing with its lower open end separated from the surface of said protecting body; then supplying said casing with sulfur; then circulating through the casing a heating medium of a temperature to melt the sulfur; then applying pressure to the melted sulfur to drive it out of the casing and up between said casing and the wall of the well-bore; then while the sulfur is still melted, lowering the casing to cause its lower end to penetrate the sealing body and its protecting covering; and, finally, effecting the hardening of the sulfur by cooling.

6. The method of cementing wells to shut off surface water, which consists in placing in the bottom of the well-bore a bituminous body penetrable to the casing to form a seal for said casing when lowered; then covering said sealing body with a body of material also penetrable to the casing, to form a protection against heat for the sealing body; then lowering into the bore a casing with its lower open end separated from the surface of said protecting body; then supplying said casing with sulfur; then supplying the casing with asphaltum above the sulfur; then circulating through the casing a heating medium of a temperature to melt the sulfur and asphaltum; then applying pressure to drive the melted sulfur and asphaltum out of the casing and up between said casing and the wall of the well-bore; then while the sulfur and asphaltum are still melted, lowering the casing to cause its lower end to penetrate the sealing body and its protecting covering; and, finally, effecting the hardening of the sulfur and asphaltum by cooling.

7. A closure for well-bores to shut off surface water, comprising a casing in the bore, a surrounding sulfur-plug and a surrounding asphaltum-plug on top of the sulfur-plug, said plugs cementing the casing to the wall of the bore.

8. A closure for well-bores to shut off surface water, comprising a casing in the bore; a sealing body surrounding its lower end and closing the space between it and the wall of the bore, and an overlying sulfur plug surrounding the casing and cementing it to the wall of the bore.

9. A closure for well-bores to shut off surface water, comprising a casing in the bore; a sealing body surrounding its lower end and closing the space between it and the wall of the bore, an overlying sulfur plug surrounding the casing and cementing it to the wall of the bore and an asphaltum plug overlying the sulfur-plug.

10. A closure for well-bores to shut off surface water, comprising a casing in the bore; a bitumen seal around the lower end of the casing; a heat-protecting body above said seal; a sulfur-plug surrounding the casing and cementing it to the wall of the bore and an asphaltum plug overlying the sulfur-plug.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUSTUS STEIGER COOPER.

Witnesses:
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M. P. HOURIHAN.