

Nov. 26, 1940.

G. PICKFORD ET AL

2,222,630

IMPREGNATING APPARATUS

Filed Oct. 3, 1938

4 Sheets—sheet 1

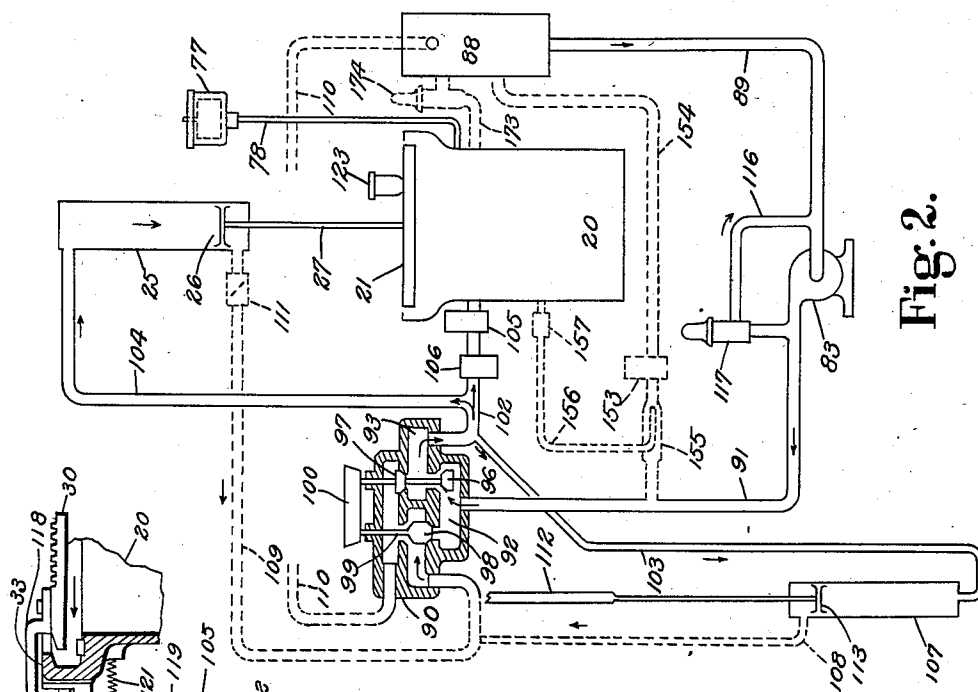


Fig. 2.

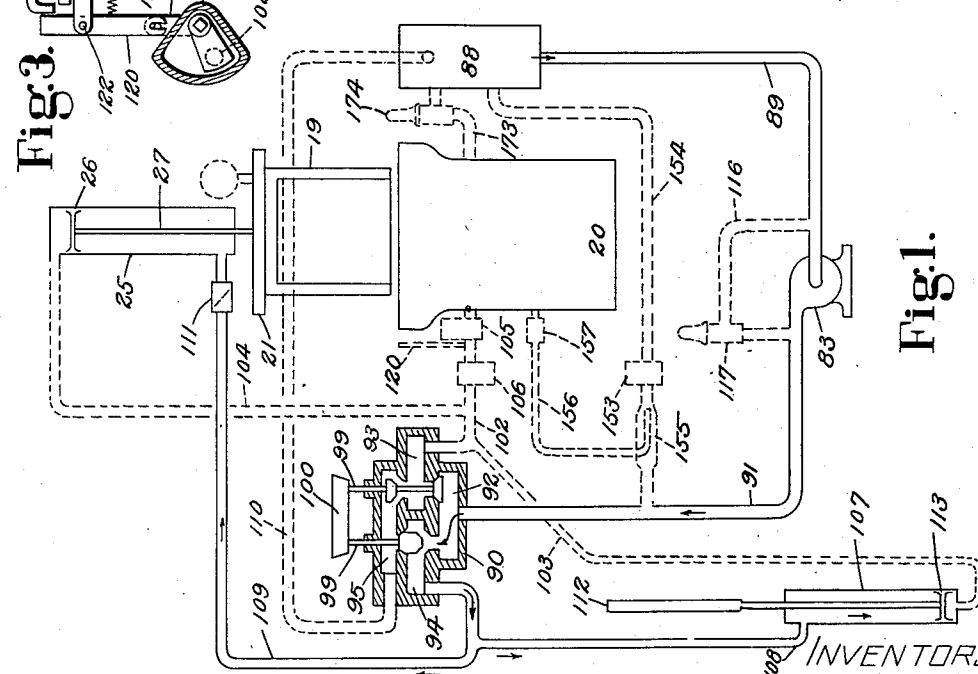


Fig. 1.

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4 Sheets-Sheet 2

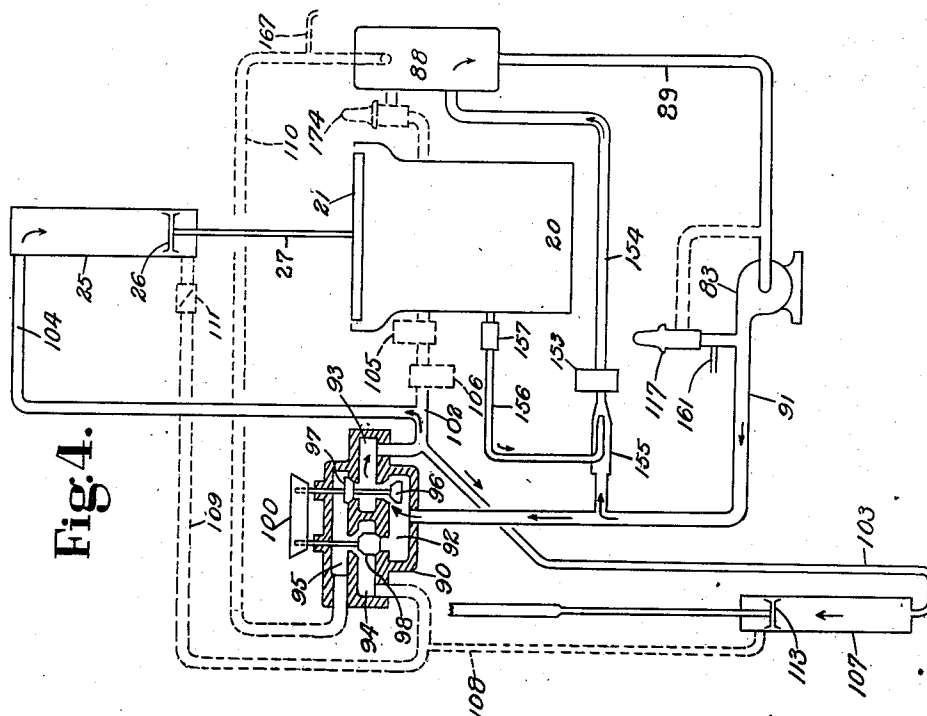


Fig. 4.

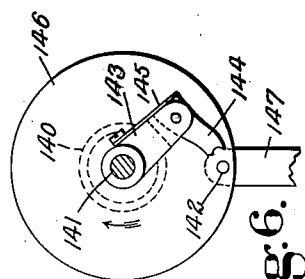


Fig. 6.

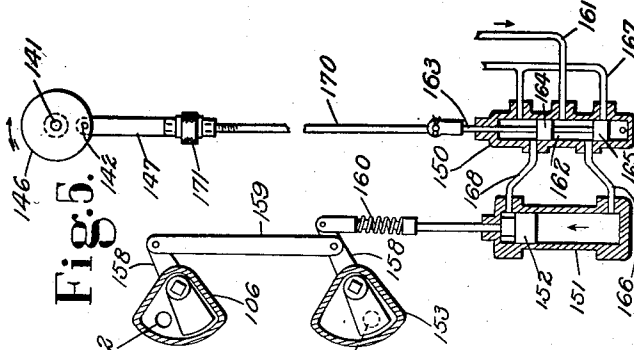


Fig. 5.

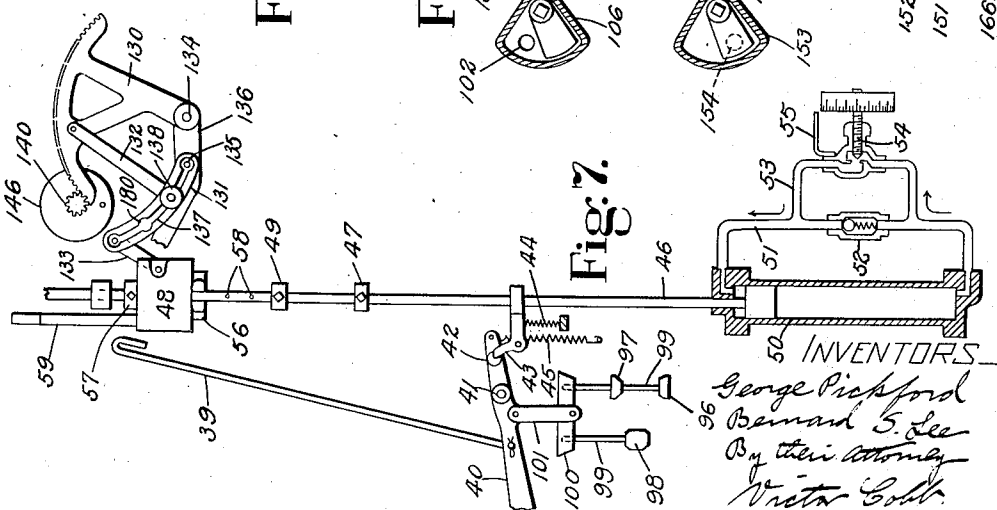


Fig. 7.

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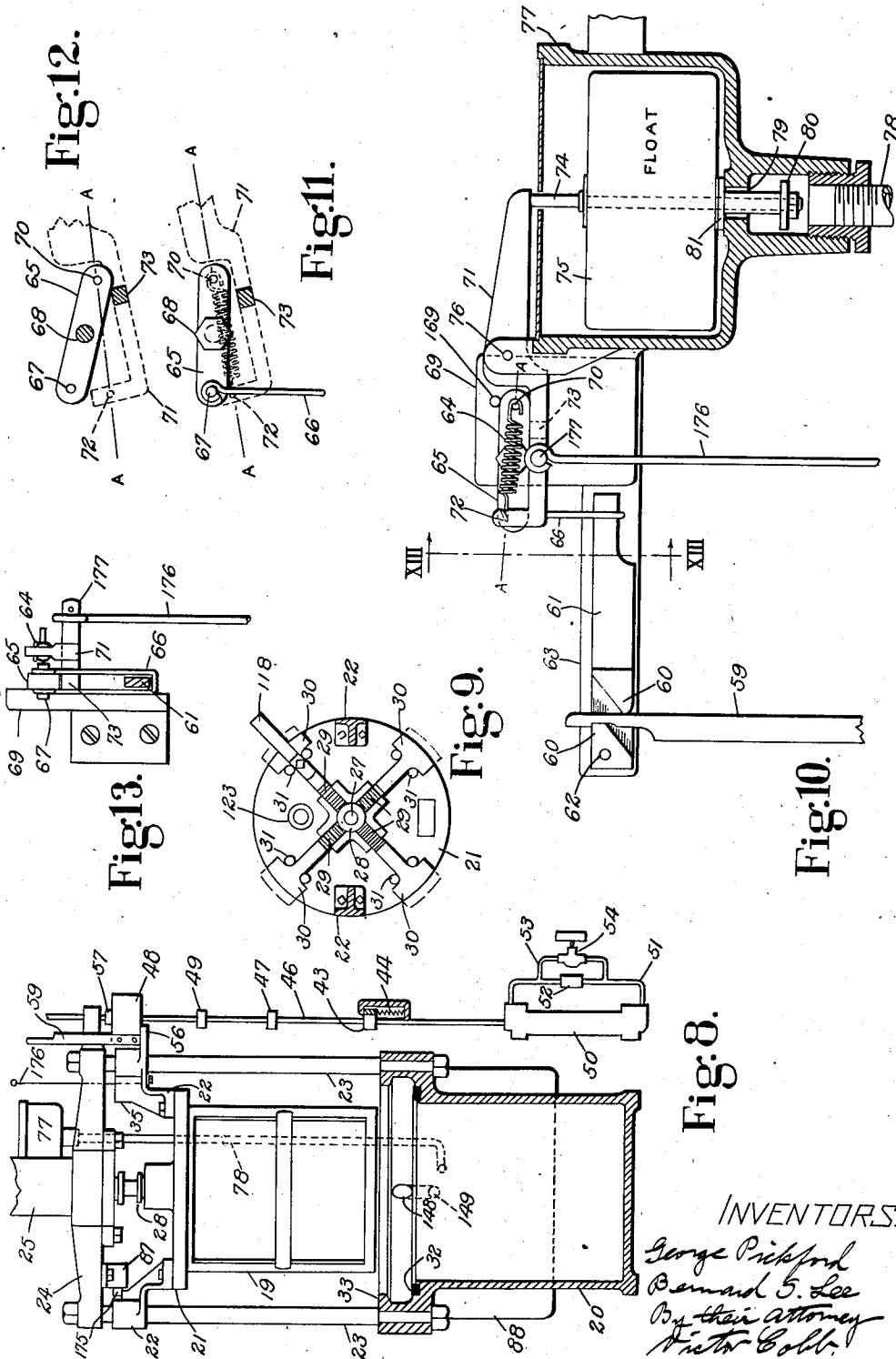
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4 Sheets-Sheet 4

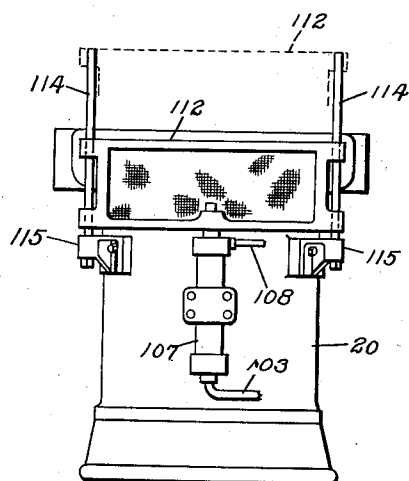


Fig. 14.

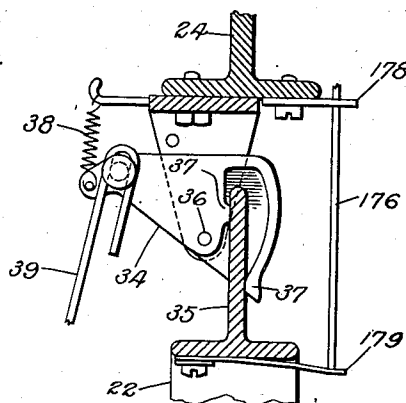


Fig. 15.

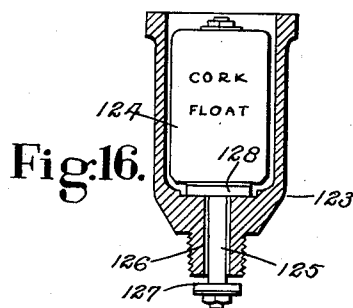


Fig. 16.

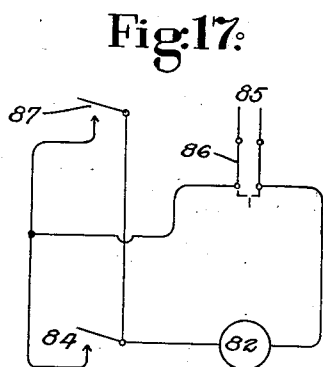


Fig. 17.

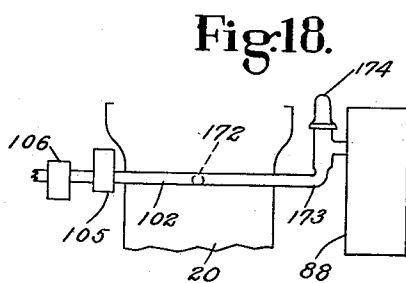


Fig. 18.

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UNITED STATES PATENT OFFICE

2,222,630

IMPREGNATING APPARATUS

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Application October 3, 1938, Serial No. 232,986

49 Claims. (Cl. 91—46)

This invention relates to apparatus for impregnating unattached leather soles with a suitable liquid to render them pliant and workable for sole-laying and various other operations that follow.

An object of the invention is to provide improved apparatus for speeding impregnation and for affording automatic operation in which the treatment may be regulated by preliminary adjustments to determine not only its duration but also the number and kind of pressure changes to be brought about in a cycle.

The liquid most commonly used to temper soles is water, and although some shoe manufacturers add one or more other liquids to the water to provide emulsions according to their preference, it will be convenient for the purposes of the present description to refer to the impregnating liquid as water. The apparatus herein illustrated provides for immersing the work in water in a pressure-sustaining receptacle, closing the receptacle to render it pressure-tight after expelling all the free air therefrom by filling it to capacity with water, reducing the pressure of the water in the receptacle below that of the atmosphere (this stage of pressure being hereinafter termed "minus pressure"), maintaining the minus pressure for a period sufficient to withdraw much if not all the air from the pores of the leather, relieving the hydrostatic tension of the water at the conclusion of a predetermined and regulatable period of time, developing plus pressure (above atmospheric pressure) of the water, maintaining that stage of pressure for a predetermined and regulatable period of time, opening the receptacle, and removing the work therefrom.

The invention further provides for developing a series of stages of minus pressure in alternation with a series of stages of plus pressure, the number of which stages may be varied by preliminary adjustment according to the preference of the user, and the total or aggregate elapsed time of which may also be varied and controlled by preliminary adjustment.

The illustrated apparatus provides for maintaining circulation of the water through the impregnation receptacle during each period of plus pressure, such circulation having the advantage of removing dirt, small particles of leather and other substances while maintaining replenishment of the water in the receptacle. The apparatus includes automatic controls by which the several stages of a cycle may be initiated according to a predetermined sequence without intervention on the part of the user after a cycle has been started. The apparatus is so organized and controlled as to remove the treated work from the receptacle and finally to stop the operation

of all the moving parts when a cycle has been completed.

The several features of the invention are hereinafter described and claimed and are illustrated in the accompanying drawings, in which

Figs. 1 and 2 are diagrams of the principal elements of the hydraulic circuit at different stages of a cycle, the conditions represented in Fig. 1 being those existing at the conclusion of a cycle, and the conditions represented in Fig. 2 being those existing while the impregnation chamber is being filled with water;

Fig. 3 is a vertical section of a fragment of the receptacle and the filling valve, and includes also the mechanism for operating the latter;

Fig. 4 is another diagram of the elements included in Figs. 1 and 2, the conditions differing from those of Fig. 2 in that the output of the pump is being utilized to develop and maintain plus pressure in the impregnation chamber;

Fig. 5 is an elevation and partial section including automatic hydraulic valve mechanisms by which the pressure of the water in the impregnation chamber may be rendered minus and plus alternately;

Fig. 6 is an elevation on a larger scale of a valve-operating mechanism included in Fig. 5;

Fig. 7 is an elevation, partly in section, including a manually operable starting lever, the primary valves operable thereby, automatic valve-operating mechanism and a regulatable timing device for controlling the changes of pressure and the aggregate length of time allotted to treatment of the work in the impregnation chamber;

Fig. 8 is a view, partly in front elevation and partly in section, including the receptacle, the closure, the work-carrier, the timing device, and other units, all the movable elements being represented in their initial positions;

Fig. 9 is a top-plan view of the closure and the mechanism for locking it to the receptacle;

Fig. 10 is an elevation, partly in vertical section, of a float-operated mechanism for supporting an operating weight in its initial position and for releasing it at the conclusion of the filling operation. In this figure the parts occupy their initial positions;

Figs. 11 and 12 represent successive positions of certain elements of the mechanism shown in Fig. 10;

Fig. 13 is an elevation, partly in section, indicated by line XIII—XIII in Fig. 10;

Fig. 14 is a front elevation including the receptacle, a movable guard, and an hydraulic unit for operating the guard;

Fig. 15 is a vertical section including a detent by which the closure is supported at its highest level during the intervals between cycles of operation;

Fig. 16 is a vertical section of a double-acting

float-operated valve-assembly for releasing air from the impregnation chamber when the closure is secured to the receptacle;

Fig. 17 is a diagram of the electric circuit for operating and controlling an electric motor from which the hydraulic pump derives its operating power; and

Fig. 18 represents an alternative arrangement of piping whereby circulation of the water through the impregnation chamber may be eliminated without affecting any other condition of operation.

In some respects the accompanying drawings are diagrammatic because in an apparatus organized for commercial use many of the elements are so closely related and obscured, one by another, that true pictorial representation thereof would be confusing. For this reason the views that represent the hydraulic circuit and its branches are in the form of diagrams or flat developments in which the individual units are, to some extent, separated merely for the sake of rendering their effective relationships clear. In these views some non-essential details of structure have been omitted in the interest of a clear showing of principles of operation, but relationships and proportions are maintained as nearly as possible consistently with diagrammatic representation.

An outline of a typical cycle of operations will lay a foundation for subsequent description of individual units, operations and details of apparatus. The work to be impregnated will be placed in an open cage or carrier suspended from the bottom of a vertically movable closure that cooperates with a stationary receptacle to form a pressure-tight impregnation chamber. The closure and the work-carrier are initially raised far enough above the receptacle to facilitate loading the carrier with soles to be treated. A motor for operating the pump in the hydraulic circuit is initially out of operation, but once the work has been placed in the carrier, the user has only to initiate a cycle by depressing a starting lever against the force of a returning spring. When this lever is fully depressed, it is caught by a latch that maintains it in the starting position until the treating or conditioning period is concluded.

The starting lever operates a detent to release the closure, closes the electrical circuit that operates the pump-motor, and operates a primary valve in the hydraulic circuit, this valve being a quadruple valve according to the construction shown.

The first effect produced by the hydraulic circuit is to project a movable guard from an inoperative position to its operative position adjacent to the mouth of the impregnation receptacle for the purpose of deflecting the user's hand if it has not already been removed from the path of the closure. This movement of the guard is completed before the closure can descend far enough to touch the operator's hand. When the closure is seated in the mouth of the receptacle, it is immediately locked in pressure-tight relation thereto. If the water initially in the receptacle is not sufficient to fill the chamber when the closure is seated, a supply of water will flow from the hydraulic circuit into the chamber until the latter is filled, thereby expelling all the free air from the chamber through vents that close automatically when the filling is completed. The supply of water for filling is automatically controlled by a secondary valve that is initially closed but

is opened by an element of the mechanism for locking the closure.

The description will proceed on the assumption that the apparatus has been regulated to provide for one stage of minus pressure and one stage of plus pressure of two minutes each. The final stage of the filling operation causes a float to trip a detent by which an operating weight is released. This results in closing a tertiary valve in the filling pipe and at the same time opening a valve in another pipe through which the water from the pump returns at high velocity to a storage tank. This return pipe includes a hydraulic aspirator by which minus pressure is developed in the impregnation chamber and maintained for a measured period of time (e. g., two minutes). When the weight has dropped far enough to initiate this period of minus pressure, its load is sustained by a timing mechanism which is thereupon set in operation by the load, further descent of the weight being retarded by the timing mechanism which has subsequent functions to perform within the time allotted for treatment.

At the conclusion of the period allotted for minus pressure a mechanism that derives its movement from the descending weight, causes a reversal of the two valves last mentioned, one of which terminates the operation of the aspirator and the other of which reopens the filling pipe to supply more water from the pump to the impregnation chamber. Water is now pumped into this chamber, and when a certain predetermined plus pressure is developed therein, water may flow from the chamber to the storage tank through a return pipe including an adjustable pressure-regulating valve. So long as this condition is maintained, the water in the hydraulic circuit will flow through the impregnation chamber, the pressure-regulating valve, the storage tank and thence to the intake side of the pump to be supplied again to the impregnation chamber. In the meantime, the weight continues to descend under control of the timing mechanism until it trips the latch that holds the starting lever in its starting position.

The primary valve and the starting lever are now returned to their initial positions by a spring, thereby diverting the output of the pump from the impregnation chamber to two hydraulic units one of which returns the guard to its initial position and the other of which unlocks the closure and raises it to its initial position. The primary valve also releases the positive pressure in the impregnation chamber. The return of the starting lever to its initial position also opens the electrical starting switch by which the operation of the pump-motor was initiated, but at this stage, the motor is maintained in operation by a supplemental switch in a branch of the motor circuit. As the closure is elevated by its hydraulic unit, it picks up and carries the weight that operates the timing mechanism and other parts of the apparatus, and the weight returns the timing mechanism to its initial position. When the closure has risen to its initial level, it opens the supplemental switch in the stopping branch of the motor circuit. All flow in the hydraulic circuit now ceases. In returning to its initial level, the closure is caught by its detent and is maintained at that level without the aid of other means until the starting lever is operated to initiate the next cycle.

When the operating weight reaches its highest level, it is caught by another detent that supports

it individually until the closure is locked to the impregnation receptacle in the next cycle. This detent is the one hereinbefore mentioned that is tripped by a float at the conclusion of the operation of filling the impregnation chamber to full capacity prior to development of minus pressure therein.

The general organization of the illustrated apparatus is similar in some respects to that illustrated and described in United States Letters Patent No. 2,114,999, granted April 26, 1938, on application of Fickett, Forman, and Arthur, the similarities being hereinafter pointed out, but whereas the apparatus illustrated herein has provisions for developing both minus pressure and plus pressure in the impregnation chamber, the patented apparatus has provisions for developing only plus pressure.

A metallic receptacle 20 and a closure 21 (Figs. 1, 2, 4 and 8) are organized in co-operative relation to form a non-expansible pressure-sustaining chamber in which the work is to be impregnated. Brackets 22 (Fig. 8) affixed to the closure are arranged to slide up and down on guide-rods 23 affixed to the receptacle and connected above the latter by a stationary cross-head 24 that supports a hydraulic cylinder 25. A foraminous cage 19 is affixed to the under side of the closure to receive the work to be impregnated and to carry the work into and out of the impregnation chamber. The closure is depressed and raised once in each cycle by a piston 26 (Fig. 4) in the cylinder 25, the piston and the closure being connected by a rod 27 not affixed to the closure but connected thereto through the medium of locking mechanism represented in Fig. 9 and to some extent in Fig. 3.

The locking mechanism comprises a cylindrical toothed rack 28 affixed to the lower end of the piston-rod 27, and intermeshed with four pinions 29 mounted on the cover, and engaging respectively rack-teeth formed on four radial locking bars 30 (Fig. 3). These bars are arranged to slide out and in on the upper surface of the closure 21. When the closure is supported by the piston-rod, the weight of the closure retracts the locking bars 30 against stops 31 as shown in Fig. 9, the outer ends of the bars being then flush with the rim of the closure which may descend into the mouth of the receptacle 20 to be seated upon a rubber gasket 32 (Fig. 8) surrounding the mouth of the chamber. A slight additional downward movement of the piston-rod after the closure is arrested by the gasket causes the cylindrical rack 28 to turn the pinions 29 and thereby project the locking bars 30 under an internal flange 33. This flange and the locking bars cooperate not only to lock the closure to the receptacle but also to produce a wedging effect by which the closure is forced with increased pressure against the gasket. When the piston-rod is raised, it first retracts the locking bars 30 to unlock and release the closure and thereafter raises the latter. This mechanism for operating the closure and the locking members is virtually the same as the corresponding mechanism illustrated and described in the above-mentioned patent.

The elements represented in Fig. 8 are shown in their initial positions, the closure being supported at its highest level by a detent arranged to be tripped manually when a cycle of operations is initiated. The detent for this purpose is shown in Fig. 15 and comprises a member 34 supported by the cross-head 24 and arranged to be engaged

by a vertical flange 35 of one of the brackets 22. The detent is mounted on a horizontal pivot-pin 36 and is provided with two cooperative gripping portions 37 arranged to be engaged by opposite faces of the flange 35. A light tension spring 38 exerts a pull against the detent in a direction to cause a gripping action of the portion 37 when the flange 35 is between them, and this gripping effect is augmented by the load thus supported. The flange 35 may rise between the portions 37 without encountering any appreciable resistance therefrom but once the gripping relation is established, the flange 35 cannot be released except by rocking the detent in a direction counter to that induced by the spring 38.

A tripping rod 39 connects the detent 34 with a manually movable starting lever 40 (Fig. 7). The upper end of this rod is bent to form a hook and the hook is loosely engaged with a stud affixed to the detent, the connection affording a slight range of lost motion to insure gripping action of the detent under the influence of the spring 38. The starting lever 40 is affixed to a rock-shaft 41 and is mounted adjacent to the mouth of the receptacle 20, preferably at the right of the receptacle. When the handle portion of the starting lever is depressed (Fig. 7), a projection 42 formed on the lever near its rear end is caught by a pivoted latch 43, and the lever is thereby maintained in the starting position until the latch is automatically tripped at the conclusion of an impregnating period of predetermined and regulatable duration. A compression spring 44 normally raises the rear end of the latch to maintain the latching relation, and a tension spring 45 is arranged to return the lever 40 to its initial position.

Fig. 7 also includes regulatable mechanism for tripping the latch 43, this mechanism comprising a vertically movable rod 46, a collar 47 affixed thereto for depressing the rear end of the latch, a weight 48 arranged to slide on the rod 46, and a collar 49 affixed to the rod below the weight for receiving the load of the weight at an intermediate stage of the cycle. The descent of the rod, when thus loaded, is retarded by a regulatable timing device 50 represented as a hydraulic dash-pot but it has no hydraulic communication with the other hydraulic circuit hereinafter described. This hydraulic timing device is, to all intents and purposes, similar to the corresponding timing device shown and described in the above-mentioned patent, but the details for regulating its timing effect are otherwise arranged.

The upper and lower ends of the dash-pot cylinder are connected by a hydraulic transfer pipe 51 in which a check-valve 52 is interposed to prevent upward flow except that afforded by a bypass 53 which includes an adjustable needle-valve 54. The restriction due to this valve 54 controls the speed of descent of the piston in the dash-pot cylinder, but when the piston rises during the last stage of a cycle of operations, the check-valve 52 permits rapid transfer of the liquid from the upper end of the cylinder to the lower end thereof. The stem of the needle-valve is provided with a cylindrical hand-wheel having a scale of marks which cooperate with a stationary index-pointer 55 for regulating purposes.

The weight 48 is elevated to its highest level by a lug 56 that projects under it from one of the brackets 22 (Fig. 8) that guide the closure 21. When the weight is being raised by this lug, it acts against a collar 57 affixed to the rod

46. The space between the collars 49 and 57 is greater than the depth of the weight to provide a range of relative movement between the weight and the rod for a purpose hereinafter explained. The range of this relative movement may be altered by securing the collar 49 to the rod at various levels for purposes of regulation, three different predetermined positions of adjustment being provided by a series of small depressions formed in the rod to receive the point of the set-screw in the collar. In Fig. 7, the set-screw is engaged with the lowest of these three depressions but two of them are exposed to view and indicated at 58.

15 When the closure 21 descends at the beginning of a cycle of operations, the weight 48 does not descend with it but remains caught at its highest level until shortly after the closure is locked to the receptacle. For this purpose a bar 20 59 is affixed to the weight (Fig. 8) and projects upwardly therefrom. The upper end of this bar (Fig. 10) is formed to extend between two cooperative jaws 60, 60 that project laterally from a lever 61 to grip the bar and provide a detent. A horizontal pivot-pin 62 connects this 25 detent with a stationary supporting bar 63. Because of the location of the pivot-pin 62, the weight of the detent causes the jaws normally to grip the bar 59 and the gripping effect is amplified by the load of the weight 48, but to insure a positive supporting effect, a shallow depression is formed in one face of the bar 59 to receive the upper jaw 60 and to provide a narrow ledge or shoulder to overlie the latter. 30 A slight upward movement of the free end of the lever 61 is sufficient to release the bar 59, and a slight force is sufficient to produce such movement.

Tripping movement of the lever 61 is caused 40 by a mechanism comprising a tension spring 64, a rocker 65, and a link 66. This link is shown in Fig. 13 as a loop of wire through which the free end of the lever 61 extends loosely. The link is suspended from a pivot-pin 67 projecting from one end of the rocker 65. At a point 45 midway between its ends, the rocker is mounted on a supporting pivot 68 that may be secured to any convenient fixture such as a bracket 69. The opposite end of the rocker carries a laterally projecting pin 70 to which one end of the operating spring 64 is hooked. The other end of this spring is hooked through a small hole 72 bored in a trigger 71. The spring is always extended and is effective to operate the rocker 65 50 but its operation is controlled by the trigger 71. A finger 73 formed on the trigger projects under one end of the rocker to raise that end initially to the position shown in Figs. 10 and 11. Another portion of the trigger overlies a vertically movable valve-stem 74 to which a float 75 55 is secured. Between its ends the trigger is mounted on a supporting pivot 76.

When the parts are in their initial positions, as shown in Fig. 10, the line of force exerted by the spring 64 is slightly above the axis of the pivot-member 68. This line is represented by broken lines A—A in Figs. 10, 11, and 12 and in each instance it intersects the points 70 and 72. The spring is therefore effective to maintain the 70 rocker 65 initially against a stop 169 (Fig. 10), but when the trigger is tilted to the position represented in Fig. 11, as by upward movement of the float, it carries the line of force A—A below the axis of the pivot-member 68, whereupon the 75 spring becomes effective to tilt the rocker to the

position shown in Fig. 12 and thereby raise the lever 61 to release the bar 59 and the weight 48.

The float 75 is arranged in a bowl 77 that initially contains no water but is connected with the impregnation chamber (Fig. 8) by a pipe 78 that constitutes a vertical extension of that chamber. The final stage of the filling operation fills the pipe 78 and partially fills the bowl 77 to operate the float. Air initially in the pipe 78 may escape through a port 79 in the bowl and thence around the upper end of the valve-stem 74, but when the float is raised by water in the bowl, it not only operates the trigger 71 but also closes the port 79 by carrying a valve-member 80 to a seat at the lower end of this port. This valve is effective to maintain plus pressure of the liquid in the receptacle 20, but the valve-stem 74 also carries a valve 81 arranged to engage a seat at the upper end of the part 79 to maintain minus pressure of the liquid in the receptacle. 20

One other result of moving the starting lever 40 to its starting position as shown in Fig. 7 is to close an electrical circuit for operating an electric motor 82 represented conventionally in Fig. 17. The purpose of this motor is to operate a pump 25 83 (Figs. 1, 2, and 4) by which water is forced through a hydraulic circuit to be utilized not only for impregnating the work but also for operating various units to be described. When the rock-shaft 41 is turned by depressing the handle of the starting lever, it closes a starting switch 84 that is initially maintained in open position by the spring 45, if not by an individual spring.

As shown in Fig. 17, the motor 82 and the starting switch 84 are in series in a circuit that 35 derives current from a supply circuit 85. A knife switch 86 may be provided to connect the motor-circuit with the supply circuit. The motor-circuit also includes a branch in which a stopping switch 87 is interposed to maintain the motor in operation after the starting switch 84 is 40 opened. The switch 87 is effective only during the final stage of a cycle while the closure 21 is rising from the receptacle 20 to its initial position, at which time the starting switch 84 is open, but when the closure reaches its highest level, the stopping switch 87 is opened automatically to terminate the cycle. For this purpose the switch 87 is secured to the under side of the cross-head 24 (Fig. 8) to be opened by one of the 50 guiding brackets 22 in opposition to a closing spring (not shown). The switches 84 and 87 may both be limit switches of well-known commercial construction. With the circuit thus controlled, the motor 82 will receive operating current when either of the switches 84 and 87 is closed and will be deprived of current only when both are open.

The hydraulic operating circuit including various branches is represented diagrammatically in 60 Figs. 1, 2, 4, and 5. In Figs. 1, 2, and 4, certain units and operating connections are represented in continuous lines and others are represented in dotted or broken lines, the significance of the dotted lines being that no water flows in the elements so represented at the respective 65 stages of the cycle with which these views are concerned.

The pump 83 is supplied with water from a storage tank 88 through a pipe 89 and the output of the pump is forced with considerable pressure through a pipe 91 to a primary controlling valve indicated as a whole at 90. This valve comprises four individual chambers 92, 93, 94, and 95 through which the water may flow under the 75

control of valve members 96, 97, and 98 carried by two vertically movable stems 99. The valve members stand initially in the positions shown in Fig. 1 but they are all depressed simultaneously to the positions represented in Fig. 2 by depressing the handle of the starting lever 40 as hereinbefore described. The operating connection between the starting lever and the valve-stems includes an equalizing bar or block 100 and a pair of connecting links such as that indicated at 101 (Fig. 7). The equalizing bar is not rigidly fastened to the valve-stems but has some capacity for rocking to equalize the pressure of the valve-members against their seats. This connection provides not only for depressing the valve stems but also for lifting them.

Once the pump 83 is set in operation with the primary valve-members depressed as in Fig. 2, the output of the pump flows through pipe 91, chamber 92, chamber 93, pipe 102, and branch pipes 103 and 104. The pipe 102 hereinafter termed a "filling pipe" is connected to the receptacle 20 to supply water to the impregnation chamber therein, but between the branch 104 and the receptacle, this pipe is provided with a secondary valve 105 and a tertiary valve 106. The valve 106 is initially open but the valve 105 is initially closed. Consequently, the first result of supplying water under pressure to the pipe 102 is to distribute the supply only to the branch pipes 103 and 104. The pipe 103 conducts some of the water into the lower end of a small hydraulic cylinder 107 while the pipe 104 conducts some of it into the upper end of the cylinder 25. Pipes 108 and 109 provide for returning water from the upper end of the cylinder 107 and from the lower end of cylinder 25 into the valve chamber 94 from which it flows into the chamber 95 and thence through a return pipe 110 to the storage tank 88. No part of the latter pipe is above the level of the chamber 95, and the water is therefore drained by the force of gravity from the chamber 95 into the storage tank.

A check-valve 111 in the pipe 109 has a construction that permits restricted flow from the lower end of the cylinder 25 to the chamber 94 and, at a later stage in the cycle, permits unrestricted flow in the opposite direction. The purpose of this check-valve is to retard the descent of the closure 21 and thereby accelerate the elevation of a guard 112 carried by the piston 113 in the cylinder 107.

As shown in Fig. 14, which is a front elevation, the guard 112 extends across the front of the receptacle 20 and its upper edge is initially below the mouth of the receptacle, but when the guard is raised it will deflect the operator's hand from the mouth of the receptacle and thus give warning that the closure is about to descend. It will also prevent thrusting one's hand between the mouth of the receptacle and the closure when the latter is nearing the receptacle, thus counteracting any impulse to rearrange the soles previously deposited in the carrier 19. The ends of the guard 112 are arranged to slide on parallel guide rods 114 projecting upwardly from supporting brackets 115 fastened to the receptacle.

Continuing the description of the cycle, the first hydraulic effect is to raise the guard 112 to its operative position where it remains until the conclusion of the impregnating treatment. The raising of the guard is followed immediately by the descent of the closure 21 which, on being seated against the gasket 32 (Fig. 8), is immediately locked to the receptacle as hereinbefore

described. If, at any stage of a cycle, the output of the pump 83 is in excess of the quantity of water utilized, the surplus of the output will flow through a by-pass 116 which returns it to the pipe 89 at the intake side of the pump. This by-pass includes an adjustable pressure-regulating valve 117 by which the pressure in the pipe 91 may be restricted to any desired limit.

Referring to Fig. 3, one of the locking bars 30 carries a member 118 the purpose of which is to open the secondary valve (filling valve) 105 incidentally to locking the closure. This valve is preferably of the gate type and is initially closed, as shown in this figure, to prevent flow of water into the receptacle 20 prior to locking the closure. An arm 119 affixed to the stem of this valve is engaged by a fork at one end of an operating lever 120 that is normally maintained in closing position by a compression spring 121. The upper end of the operating lever extends above the fulcrum pin 122 on which the lever is mounted, and when the closure is seated, the member 118 and the operating lever are cooperatively related as shown in this figure. Consequently, when the locking mechanism is operated, the member 118 opens the valve 105 to admit water from the pipe 102 into the receptacle.

Even though considerable water remains in the receptacle 20 at the conclusion of each cycle it is necessary to supply some additional water in the next cycle to fill the impregnation chamber and operate the float 75 (Fig. 10). This requirement is satisfied by the above-described operation of the filling valve 105. As the filling progresses the water expels air from the impregnation chamber first through an automatic double-acting venting valve 123 screwed into a tapped hole in the closure 21 (Figs. 9 and 16). The casing of this valve is in the form of a cup and contains a float 124 from which a valve-stem 125 extends downwardly through a venting port 126. The valve-stem carries two valve members 127 and 128 arranged respectively below and above the venting port. The valve member 128 is normally seated as shown in Fig. 16, and in this position it is effective to maintain minus pressure in the impregnation chamber 20, but when the valve-casing contains sufficient water to raise the float, the valve 127 is seated to maintain plus pressure in the impregnation chamber. In these respects the pressure-sustaining functions of the device shown in Fig. 16 are the same as those of the float-operated valves 81 and 80 shown in Fig. 10. The only difference so far as the pressure-controlling effects are concerned is that the float shown in Fig. 16 is raised a fraction of a second earlier than the float shown in Fig. 10 because the latter is at a higher level.

An earlier part of this description concerning the mechanism included in Fig. 10 explains how the weight 48 is released from the member 61 when the float 75 rises. At that instant the lug 56 does not stand at the level shown in Fig. 7 because it has already been carried nearly to the mouth of the receptacle 20 by the descent of the closure. Consequently, when the weight 48 is released as a result of filling the impregnation chamber with water, the weight drops immediately to the collar 49 by which it is momentarily arrested and thereafter permitted to descend slowly to depress the rod 46. As hereinbefore stated this description of a cycle of operations is predicated upon the assumption that the various hydraulic controls are adjusted to subject the work in the impregnation chamber to

one two-minute stage of minus pressure and one two-minute stage of plus pressure. Accordingly, the needle-valve 54 is adjusted to require four minutes for the descent of the rod 46 from the instant when the weight 48 is tripped until the collar 47 trips the latch 43 to release the starting lever 40.

The mechanism at the upper right of Fig. 7 is instrumental in bringing about successive stages of minus pressure and plus pressure in the impregnation chamber. This mechanism comprises a toothed quadrant 130, a lever 131, a link 132 connecting them, and a link 133 connecting the lever 131 and the weight 48. The quadrant is arranged to be oscillated about a fixed axis provided by a fulcrum pin 134, and the lever 131 is arranged to be oscillated about another fixed axis provided by a fulcrum pin 135, both of these fulcrum pins being supported by a fixture 136. The lever 131 is provided with an arcuate groove or slot 137 in which a clamping stud forming a pivotal connection with the link 132 may be adjusted toward and from the axis of the fulcrum pin 135, this stud having a hand-nut 138 by which to secure the desired setting. The radius of the curvature of the slot or groove 137 is commensurate with the effective length of the link 132, and the parts are so organized that when they stand in their initial positions as shown in Fig. 7, this curved slot or groove is concentric with respect to the pivot-pin by which the upper end of the link 132 and the quadrant 130 are connected. The total range of vertical movement of the weight 48 is the same under all conditions of regulation but its movement is communicated to the quadrant in various ratios according to the setting of the link 132 except when the hand-nut 138 is set at the neutral position in coaxial relation to the fulcrum pin 135.

The gear-teeth formed on the quadrant 130 engage a pinion 140 to impart rotation thereto. This pinion is affixed to a shaft 141 (Fig. 6) which also carries means for rotating a wrist-pin 142 in one direction only, indicated by an arrow.

The driving mechanism carried by the shaft 141 comprises an arm 143, a pawl 144 carried thereby and a leaf-spring 145 by which the pawl is normally maintained in a position to abut and drive the wrist-pin, but the leaf-spring 145 permits the pawl to click over the wrist-pin when the shaft rotates reversely. The pawl and the arm 143 are connected by a pivot-pin. The wrist-pin 142 is affixed to a disk 146 and projects to one side of the disk for connection with a member 147 and from the opposite side of the disk for co-operation with the driving pawl. The disk 146 is mounted on the shaft 141 but is not driven thereby except as it may be driven in one direction by the pawl. The function of this mechanism is to operate a pilot valve 150 (Fig. 5) by which water is supplied from the pipe 91 by way of the pipe 161 to a hydraulic cylinder 151. The piston 152 in this cylinder operates the tertiary valve 106 and a similar valve 153 both at the same time to develop minus pressure and plus pressure alternately in the impregnation chamber 20. Fig. 5 represents the valves 106 and 153 in their initial positions, the valve 106 being open and the valve 153 being closed. The valve 153 is interposed in a pipe 154 through which water may flow at high velocity from an intermediate point in the pipe 91 to the storage tank 88, but since this valve is initially closed no water

can flow through it while the impregnation chamber is being filled.

On the other hand, the initial drop of the weight 48 brought about by filling the impregnation chamber produces a rapid initial movement of the quadrant 130 (Fig. 7), and the range of this initial movement is sufficient to turn the pinion 140 through about 180° of one revolution, thereby producing a rapid hydraulic operation which closes the valve 106 and at the same time opens the valve 153. Now, the output of the pump 83, being no longer required for any other purpose, flows through the pipe 154 and through a hydraulic aspirator 155 interposed therein. The suction pipe 156 is in communication with the impregnation chamber and is provided with a check-valve 157 that has no effect when the aspirator is in operation but prevents water from flowing into that chamber from the aspirator at other times. So long as the valves 106 and 153 remain in the position last described the water flowing through the aspirator 155 will maintain a powerful minus pressure in the impregnation chamber to withdraw air from the pores of the soles therein.

Continuing the description of the mechanism for operating the valves 106 and 153, the stems of these valves are provided with operating arms 158 and these arms are coupled by a link 159 that causes one valve to open when the other closes, and vice versa. The operating connection between the piston 152 and these coupled valves preferably includes a resilient member such as a moderately stiff helical spring 160 both ends of which are secured to fittings to insure a pulling action as well as a pushing action. This spring counteracts the curvilinear component of the operating arm to which it is connected and insures tight closing of first one valve and then the other. Accordingly, the range of travel of the piston 152 is in excess of that required by the valves, but the surplus motion of the piston is expended in distending and compressing the spring alternately.

The water for operating the piston 152 flows from the output side of the pump 83 through a small pipe 161 by which it is conducted into a chamber 162 in the pilot valve 150. The stem 163 of the pilot valve is provided with two slide valves 164 and 165 both affixed thereto and arranged to remain respectively above and below the inlet port to which the pipe 161 delivers the water. When the slide valves are in their initial positions as shown in Fig. 5, the hydraulic pressure is communicated to the lower end of the cylinder 151 by the chamber 162 and a connecting pipe 166, but when the valve-stem 163 is raised to the upper limit of its travel, the slide valve 165 closes communication between the supply pipe 161 and the pipe 166 and opens communication between the latter and a return pipe 167. At the same time the slide valve 164 rises above a connecting pipe 168, thereby opening communication between the supply pipe 161 and the upper end of the cylinder 151. The operating liquid is thus caused to depress the piston 152, the water expelled thereby from the lower end of the cylinder being caused to flow through pipe 166, chamber 162, and return pipe 167 which conducts it into the return pipe 110 (Fig. 4). In like manner, when the piston 152 is rising to its initial position the water thereby expelled from the upper end of the cylinder 151 flows through

the pipe 168, the chamber 162, and thence through a branch of the return pipe 167.

The valve-stem 163 receives its motions from the wrist-pin 142 to which it is connected by a link preferably made in two parts that are relatively adjustable to regulate its effective length within close limits and thereby vary inversely the length of time allotted to minus pressure in the impregnation chamber and the length of time allotted to plus pressure. By shortening the effective length of the link the range of travel of the slide valves 164 and 165 will be raised, with respect to the casing of the pilot-valve and will thereby retard or postpone the termination of the minus stages and the beginning of the plus stages. The minus stages will be correspondingly prolonged and the plus stages will be correspondingly shortened, but to prolong the plus stages and shorten the minus stages it is only necessary to increase the effective length of the link. The lower section of the link is a cylindric rod 170 having a right-angular bend at its lower end to provide a pivotal connection with the valve-stem 163. The upper end of this rod is provided with a screw-thread, and is arranged to slide in holes bored in spaced confronting lugs formed on the member 147. The space between these lugs is occupied by an adjusting nut 171 with which the threads of the rod cooperate.

Continuing the description of the cycle of operations from the point at which the weight 48 (Fig. 7) drops to the collar 49, further descent of the weight and further rotation of the pinion 140 are retarded by the needle-valve 54, and at the conclusion of a two-minute period of minus pressure in the impregnation chamber, the slide members 164 and 165 in the pilot valve will have returned to their initial positions as shown in Fig. 5 and will thereby cause the piston 152 to close the valve 153 and open the valve 106. This will restore the conditions of flow and pressure represented in Fig. 2, and water being pumped through the pipe 91 will no longer flow through the aspirator 155 but will flow through valve chambers 92 and 93, pipe 102, valves 106 and 105, thence through the impregnation chamber 20 and back to the storage tank 88 through a return pipe 173 which would be represented in solid lines were it not for the fact that this figure is primarily intended to represent conditions established at an earlier stage in the cycle (filling stage) in which the return pipe 173 had no duty. This return pipe is provided with a pressure-regulating valve 174 capable of being adjusted to require any desired pressure to force the water through it. Consequently, the pressure thus developed by the pump and the valve 174 is maintained in the impregnation chamber during the remainder of the time allotted for treatment of the work, and at the same time the water continues to flow through the chamber at the established positive pressure. Preferably the pressure-regulating valve 174 will be adjusted for a pressure above that for which the valve 174 is adjusted, to insure pressure in the impregnation chamber for which the valve 174 is adjusted.

Ultimately, the collar 47 (Fig. 7) on the rod 46 trips the latch 43 to release the starting lever 40, whereupon the tension spring 45 returns the starting lever to its initial position. Both valve-stems 99 are thereby raised to their initial positions (Fig. 1) and the output of the pump 83 now flows from pipe 91 through chambers 92 and 94 and pipes 108 and 109. The water flowing

through pipe 108 depresses the guard 112 to its inoperative position and that flowing through pipe 109 operates the piston 26 first to unlock the closure 21 and thereafter to raise the closure, but before the unlocking motion begins the pressure in the impregnation chamber is relieved by the valve member 97 which permits water to flow back through pipe 102, chambers 93 and 95, and thence to the return pipe 110. As the piston 113 descends, the water below it is expelled through pipes 103 and 102 into the chamber 93 and thence to the return pipe 110. Also, as the piston 26 rises, the water above it is expelled through pipes 104 and 102 and thence through the chambers 93 and 95 to the return pipe 110.

As the locking member 30 shown in Fig. 3 is retracted to release the closure it also releases the operating lever 120, whereupon the spring 121 operates to close the filling valve 105, but between the instant of relieving the pressure in the impregnation chamber and that of closing the valve 105 the water in the stand-pipe 78 and the bowl 77 (Fig. 2) returns to the receptacle 20 and expels a corresponding quantity through the valve 105 and the pipe 102.

Although the return of the starting lever 40 to its initial position opens the starting switch 84 (Fig. 17) in the electrical circuit, the motor 82 and the pump continue in operation because the stopping switch 87 remains closed while the closure is rising and is not opened until its operating arm 175 (Fig. 8) is raised by a portion of the guiding bracket 22 shown at the left of that figure. When the switch 87 is opened, the detent 34 (Fig. 15) becomes effective to grip the flange 35 for the purpose of supporting the closure in its elevated position.

As the closure 21 rises, the lug 56 that projects laterally from the guiding bracket 22 at the right of Fig. 8 picks up the operating weight 48, the weight in turn picking up the collar 57 on the rod 46. The weight and the rod are thus returned to their initial positions and the weight is finally caught and supported by the gripping lever 61 (Fig. 10).

In the final stage of upward movement of the closure the trigger 71 (Fig. 10) is returned to its initial position by a light rod 176 suspended therefrom, the upper end of this rod having an eye that surrounds a lug 177 projecting from the trigger. The rod 176 extends loosely through a guiding fixture 178 (Fig. 15) and its lower end is arranged to be engaged by a striker 179 carried by the adjacent guiding bracket 22. To insure resetting the trigger without damaging any of the parts, some member of this mechanism should be capable of yielding, and for this reason the striker 179 is represented as a leaf-spring capable of being deflected while resetting the trigger. As the trigger returns to its initial position from that represented in Fig. 12, the lug 73 projecting therefrom restores the rocker 65 to its initial position, thereby raising the pin 70. At the same time the hole 72 in the trigger rises until finally the line A—A of spring force is raised just far enough above the axis of the pivot member 68 to maintain the parts in readiness for the next tripping operation.

Referring to Figs. 5, 6, and 7, since one complete revolution of the wrist-pin 142 is required for each complete cycle of pressure oscillation in the impregnation chamber, and since the mechanism shown at the upper right of Fig. 7 is capable of being regulated to produce one, two, or three cycles of pressure oscillation at the option

of the user, the method of procedure to vary the number of such oscillations is as follows: Assuming that three cycles of pressure oscillation are desired, the user will loosen the hand-nut 138 and shift it away from the fulcrum member 135 to the remote end of the groove or slot 137 where he will tighten it to preserve the adjustment. This will increase the range of movement imparted to the quadrant 130 by the weight 48 which has constant limits of vertical movement. The maximum movement of which the quadrant 130 is capable under these conditions is sufficient to impart three complete revolutions to the wrist-pin 142 instead of only one complete revolution as when the link 132 is adjusted as shown in this figure.

Now, when the link 132 is set to impart the maximum length of movement to the quadrant a relatively short initial drop of the weight 48 will be sufficient to terminate the filling operation and initiate the first stage of minus pressure which, under all conditions of regulation, are brought about by the first semi-revolution of the disk 146. Therefore, to coordinate the length of the initial drop of the weight and the setting of the link 132 for a series of three cycles of pressure oscillation, the load-sustaining collar 49 on the rod 46 should be raised to place the set-screw of that collar in register with the highest depression 58.

For a series of two cycles of pressure oscillation the collar 49 will be located in register with the intermediate depression 58 and the link 132 will be located in register with an intermediate notch 180 formed in the lever 131 to receive a boss on the nut 138. If plus pressure alone is desired in the impregnation chamber without any stage of minus pressure it is only necessary to shift the connecting link 132 to the position where the nut 138 will be in coaxial relation to the fulcrum pin 135. With such an adjustment the quadrant 130 will remain stationary while the weight 48 and the lever 131 execute their regular movements, but this will not deprive the latch 43 of the tripping effect of the weight under the control of the dash-pot 50.

When the controlling mechanism is adjusted for plus pressure alone, such pressure will be developed in the impregnation chamber at the conclusion of the filling operation (Fig. 2) and the water will continue to be pumped into and through the chamber and will return to the storage tank 88 through the pressure-regulating valve 174 until the starting lever is tripped as hereinbefore described.

The alternative arrangement of piping represented in Fig. 18 may be used if it is desired to eliminate circulation of the water through the impregnation chamber during the periods of plus pressure therein. According to this diagram, the supply pipe 102 and the return pipe 173 are connected directly one with the other to return the circulated water to the storage tank 88 without flowing it through the receptacle 20, but a short pipe 172 leading from the pipe 102 to the impregnation chamber provides a connection for filling the chamber and for developing plus pressure therein. Circulation through the impregnation chamber may be otherwise eliminated without providing this alternative arrangement of piping, as by adjusting the pressure-regulating valve 174 to require a greater opening pressure than the valve 117.

As shown in Fig. 8, the receptacle 20 is provided with a duct 148 the mouth of which is above the

level of the gasket 32 but below the upper end of the receptacle. If any water overflows the gasket it will flow at atmospheric pressure into this duct and thence through a return pipe 149 and into the storage tank 88.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. A hydraulic apparatus comprising means arranged to form a pressure-sustaining impregnation chamber, means arranged to supply an impregnating liquid under a head of pressure to said chamber, a valve arranged to close communication between said chamber and the source of said liquid, hydraulic means arranged to produce minus pressure of the liquid in said chamber when said valve is closed, and a valve arranged to control the operation of said hydraulic means.

2. A hydraulic apparatus as defined in claim 1 in which the liquid for operating said hydraulic means and the liquid for supplying said chamber are both derived from a common source.

3. A hydraulic apparatus as defined in claim 1 in which said valves are operatively coupled by means arranged to impart opening movement to one when the other closes, and vice versa.

4. A hydraulic apparatus as defined in claim 1 in which a power-operated mechanism is arranged to close one of said valves and open the other, and vice versa.

5. A hydraulic apparatus as defined in claim 1 in which said supply means, said impregnation chamber and a return conduit are organized to form an endless hydraulic circuit and to circulate the liquid through said impregnation chamber when said valves are set to develop plus pressure therein.

6. A hydraulic apparatus as defined in claim 1 in which said supply means, said hydraulic means and a return conduit are organized to form an endless hydraulic circuit.

7. A hydraulic apparatus as defined in claim 1 in which said supply means, said impregnation chamber and a return conduit are organized to form an endless hydraulic circuit and in which said hydraulic means is arranged to form a bypass in said circuit around said chamber.

8. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means for supplying an impregnating liquid above atmospheric pressure to said chamber, and automatic hydraulic means responsive to the pressure of said liquid to produce successive stages of minus and plus pressure of the liquid in said chamber.

9. A hydraulic apparatus as defined in claim 8 in which said automatic means are regulatable to vary the durations of said stages of minus and plus pressure.

10. A hydraulic apparatus as defined in claim 8 in which said automatic means utilize liquid from said supply means to produce said stages of minus and plus pressure in the impregnation chamber.

11. A hydraulic apparatus as defined in claim 8 in which said automatic means include an adjustable mechanism capable of regulating the stages of minus pressure and those of plus pressure of the liquid in said chamber by inversely varying their durations.

12. A hydraulic apparatus as defined in claim 7

8 in which said automatic means include a regulatable control by which to vary the number of stages of minus pressure and plus pressure of the liquid in said impregnation chamber in an allotted period of time.

13. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means for supplying an impregnating liquid above atmospheric pressure to said chamber, a timing device, automatic means controlled by said timing device to retract said closure at the conclusion of a measured time interval, and automatic means also controlled by said timing device to produce alternate stages of plus pressure and minus pressure of the liquid in said impregnation chamber during said time interval.

14. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means including a valve for supplying an impregnating liquid above atmospheric pressure to said chamber, a hydraulic aspirator arranged to produce minus pressure of the liquid in said chamber when said valve is closed, and a valve arranged to control the flow of operating liquid through said aspirator.

15. A hydraulic apparatus as defined in claim 14 in which said means for supplying liquid to said chamber also supplies the operating liquid to said aspirator.

16. A hydraulic apparatus as defined in claim 14 in which automatic mechanism operates said valves in timed relation, one to the other, to produce successive stages of minus and plus pressure of the liquid in said chamber.

17. A hydraulic apparatus as defined in claim 14 in which a hydraulic unit is arranged to retract said closure from the receptacle, a valve is arranged to admit liquid from said supplying means to said unit, and automatic mechanism is arranged to operate said valves in a predetermined sequence to produce successive stages of minus pressure and plus pressure of the liquid in said chamber and thereafter to initiate the retracting operation of said hydraulic unit.

18. A hydraulic apparatus comprising means to provide a pressure-sustaining impregnation chamber, means including a valve for supplying an impregnating liquid under a head of pressure to said chamber, and means controlled by the rise of liquid in said chamber to close said valve and develop minus pressure of the liquid in said chamber.

19. A hydraulic apparatus comprising means forming a pressure-sustaining impregnation chamber, power-operated means for pumping an impregnating liquid into said chamber under a head of pressure, hydraulic means including said pumping means for developing minus pressure of the liquid in said chamber, and automatic means arranged to control the flow of liquid from said pumping means through alternative conduits to produce minus pressure and plus pressure alternately in said chamber.

20. A hydraulic apparatus as defined in claim 19 in which said automatic controlling means include regulatable timing mechanism arranged to regulate and control the durations of the individual stages of minus pressure and plus pressure in said chamber.

21. A hydraulic apparatus as defined in claim 19 in which said automatic controlling means include a regulatable assemblage by which the

durations of the stages of minus pressure and plus pressure in said chamber may be varied inversely.

22. A hydraulic apparatus as defined in claim 19 in which said automatic controlling means include hydraulic means operable by liquid from said pumping means to effect the alternate stages of minus and plus pressure in said chamber.

23. A hydraulic apparatus as defined in claim 19 in which said automatic controlling means include regulatable mechanism by which the number of stages of minus pressure and stages of plus pressure in said chamber in an allotted period of time may be regulated.

24. In a hydraulic apparatus of the type in which power-operated mechanism is arranged to raise a closure from its cooperative relationship with a pressure-sustaining receptacle in which work is to be impregnated and into which an impregnating liquid is to be admitted under pressure from a source of supply; means arranged to control the admission of liquid from said source, hydraulic means arranged to develop minus pressure of the liquid in said receptacle, a timing mechanism, means governed by said timing mechanism to arrest the admission of liquid into said receptacle and start the operation of said hydraulic minus-pressure means, and means also governed by said timing mechanism to relieve abnormal pressure of the liquid in said receptacle at the conclusion of a predetermined time interval and initiate the operation of said closure-raising means.

25. In a hydraulic apparatus of the type in which a pressure-sustaining chamber for work to be impregnated is formed by a receptacle and a removable closure; the combination comprising means including a power-operated pump to supply an impregnating liquid at plus pressure to said chamber, means arranged to develop minus pressure of the liquid in said chamber, power-operated means arranged to retract said closure from the receptacle, and automatic means by which the impregnating liquid is controlled to supply a certain quantity thereof to said chamber and thereafter to produce alternate stages of minus pressure and plus pressure of the liquid in said chamber, said automatic means including a timing mechanism by which the time allotted to said pressure stages is governed and by which the operation of said closure-retracting means is initiated at the conclusion thereof.

26. In a hydraulic apparatus of the type in which impregnating liquid is supplied with plus pressure from a source of supply to a pressure-sustaining impregnation chamber; a hydraulic aspirator in communication with said chamber and with said source of supply to develop minus pressure in the chamber, valve-operating mechanism and cooperating valves operable thereby to control the admission of liquid from said source to said chamber and to control the operation of said aspirator, and a timing mechanism by which said valve-operating mechanism is controlled to effect a series of stages of minus pressure and plus pressure alternately of the liquid in said chamber in an allotted period of time, said valve-operating mechanism being regulatable to produce one or more stages of minus pressure and one or more stages of plus pressure in each period allotted by said timing mechanism.

27. A hydraulic apparatus comprising means arranged to form a pressure-sustaining impregnation chamber, a hydraulic aspirator in communication therewith, a source of plus hydraulic pressure having a supply branch in communica-

tion with said chamber to develop plus pressure therein and a branch including said aspirator to develop minus pressure in said chamber, coupled valves in said branches respectively to close one
 5 when the other is open, and vice versa, and a check-valve arranged to prevent flow from said aspirator into said chamber.

28. A hydraulic apparatus comprising an endless hydraulic circuit including a pump and a plurality of branches for returning liquid from the output side of said pump to the intake side thereof, one of said branches including a pressure-regulating valve and a pressure-sustaining work-receiving chamber through which the liquid
 15 must flow before reaching said valve, another one of said branches forming a by-pass around said chamber and said valve and including an aspirator in communication with said chamber, and valve means arranged to direct the liquid through
 20 said branches alternatively to develop minus pressure, on the one hand, and plus pressure, on the other, in said chamber.

29. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a
 25 pressure-sustaining impregnation chamber, means including a valve to supply an impregnating liquid above atmospheric pressure to said chamber, means operable automatically to open said valve, hydraulic means arranged to produce successive
 30 stages of minus pressure and plus pressure of the liquid in said chamber, hydraulic means arranged to retract said closure from the receptacle, means arranged to arrest the supply of impregnating liquid to said chamber and supply the liquid to
 35 operate said retracting means, and automatic mechanism including a timing unit arranged to control the durations of said pressure-stages and initiate the operation of said retracting means.

30. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a
 40 pressure-sustaining impregnation chamber, means arranged to supply an impregnating liquid above atmospheric pressure to said chamber, hydraulic means arranged to produce minus pressure of the
 45 liquid in said chamber, automatic means arranged to control the liquid to effect successive stages of minus and plus pressure of the liquid in said chamber, and means controlled by said controlling means to arrest the supply of liquid
 50 to said chamber and retract said closure from the receptacle.

31. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a
 55 pressure-sustaining impregnation chamber, means including a valve for supplying an impregnating liquid above atmospheric pressure to said chamber, means operable automatically to open said valve, hydraulic means arranged to produce successive stages of minus pressure and
 60 plus pressure of the liquid in said chamber, and means responsive to the rise of liquid in said chamber to initiate the operation of said hydraulic means.

32. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a
 65 pressure-sustaining impregnation chamber, means including a valve for supplying an impregnating liquid above atmospheric pressure to said chamber, means operable automatically to
 70 open and close said valve, means arranged to produce successive stages of minus pressure and plus pressure of the liquid in said chamber, means operable automatically to retract said closure from the receptacle, and automatic controlling means arranged to initiate the opera-

tion of said retracting means at the conclusion of a series of said minus and plus pressure stages.

33. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means for supplying an impregnating liquid above atmospheric pressure to said chamber, a timing device, automatic means controlled by said timing device to retract said closure at the conclusion of a measured period of time, and automatic means also controlled by said timing device to produce minus pressure and finally to relieve abnormal pressure of the liquid in said chamber during said measured period of time.

34. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, hydraulic means arranged to move said closure to and from said receptacle, a timing device by which said hydraulic means is controlled to retract said closure at the conclusion of a measured time interval, means controlled by said hydraulic means to supply an impregnating liquid above atmospheric pressure to said impregnating chamber, and means controlled by said timing device to produce successive stages of minus pressure and plus pressure of the liquid in said chamber during said time interval.

35. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, a source of impregnating liquid above atmospheric pressure, hydraulic means operable by liquid from said source to move said closure to and from the mouth of said receptacle, automatic controlling means including a timing device to supply liquid from said source to said hydraulic means for retracting said closure at the conclusion of a measured time interval, means for supplying liquid from said source to said impregnation chamber, and means controlled by said timing device during said time interval to produce successive stages of minus pressure and plus pressure of the liquid in said chamber.

36. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means including a primary valve, a secondary valve, and a tertiary valve, all in a series, to supply liquid above atmospheric pressure to said chamber, a double-acting hydraulic unit controlled by said primary valve for operating said closure, means operable by said hydraulic unit to open said secondary valve, automatic means arranged to close said tertiary valve and develop minus pressure of the liquid in said chamber, a timing device, and automatic means controlled by said timing device to shift said primary valve at the conclusion of a measured time interval to effect closure-retracting operation of said hydraulic unit.

37. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining immersion chamber, means including a primary valve, a secondary valve, and a tertiary valve, all in a series, to supply liquid above atmospheric pressure to said chamber, hydraulic means controlled by said primary valve to operate said closure, means operable by said hydraulic means to open said secondary valve, and means controlled by the rise of liquid in said chamber to close said ter-

tiary valve and develop minus pressure of the liquid in said chamber.

38. A hydraulic apparatus comprising, in combination with the organization defined in claim 37, a timing device, and automatic means controlled by said timing device to open said tertiary valve and arrest the operation of said minus-pressure means at the conclusion of a measured time interval.

39. An impregnating apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means arranged to fasten said closure in chamber-closing position, means including a valve to supply an impregnating liquid to said chamber, a timing device, means controlled by the rise of liquid in said chamber to start said timing device, and means controlled by said timing device to impart successive opening and closing movements to said valve with measured time intervals between such movements.

40. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means including a pump and a distributing valve to supply an impregnating liquid to said chamber, hydraulic means controlled by said distributing valve to retract said closure from said receptacle, an electrical circuit including a motor for operating said pump, and means operable by said hydraulic means to open said electrical circuit in consequence of retracting said closure.

41. A hydraulic apparatus comprising means forming a pressure-sustaining impregnation chamber and including a receptacle and a removable closure therefor, hydraulic means including a pump and a double-acting ram arranged to move said closure to and from the mouth of said receptacle, an electrical circuit including the motor for operating said pump, coupled means arranged to close said circuit and supply liquid from said pump to impart closing movement to said ram, means operable by said ram to supply liquid from said pump to said impregnation chamber, a regulatable timing device, means controlled by said timing device to arrest the supply of liquid to said chamber and supply liquid from said pump to the retracting side of said ram at the conclusion of a regulated time interval, and means operable by said ram to open said circuit when the closure is retracted.

42. A hydraulic apparatus comprising a receptacle forming a work-receiving chamber, a work-carrier movable to and fro to carry work into and out of said chamber, means including a pump to supply liquid to treat the work supported in said chamber by said carrier, an electrical circuit including a motor for operating said pump, hydraulic means for operating said work-carrier to retract the work from said chamber, a timing device, automatic means controlled by said timing device to supply liquid from said pump to said hydraulic means at the conclusion of a measured time interval, and means operable by retractor movement of said hydraulic means to open said electrical circuit.

43. A hydraulic apparatus comprising a receptacle forming a work-receiving chamber, a work-carrier movable to and fro to carry work into and out of said chamber, hydraulic means arranged to retract said carrier from said recep-

tacle, means including a pump and a distributing valve to supply liquid alternatively to said chamber and said hydraulic means, an electrical circuit including a motor for operating said pump, means operable by said valve to close said circuit when the valve is operated to supply liquid to said chamber, and means operable by said hydraulic means to open said circuit when the work-carrier is retracted.

44. In a hydraulic apparatus of the type in which a locking member is carried by a closure to secure the latter to a receptacle in which work is to be impregnated and into which an impregnating liquid is to be admitted at plus pressure from a source of supply; the combination comprising an initially closed valve for controlling the admission of the liquid into said receptacle, and operating means by which locking movement of said locking member causes opening movement of said valve.

45. An impregnating apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means arranged to fasten said closure in chamber-closing position, means including two individually operable valves in a series to supply an impregnating liquid to said chamber, one of said valves being arranged to be opened by said fastening means, a timing device, means controlled by the rise of liquid in said chamber to close the other one of said valves, start said timing device and thereafter reopen the valve so closed, the reopening operation of said means being controlled by said timing device to take effect at the conclusion of a measured time interval.

46. An impregnating apparatus comprising a receptacle and a removable closure designed to form a pressure-sustaining impregnation chamber, means arranged to fasten said closure in chamber-closing position, means including two individually operable valves in a series to supply an impregnating liquid to said chamber, one of said valves being arranged to be opened by said fastening means, and means controlled by the rise of liquid in said chamber for closing the other one of said valves.

47. A hydraulic apparatus comprising a receptacle and a removable closure designed to form a work-treating chamber, a hydraulic unit arranged to operate said closure, a guard movable to and from an operative position with respect to said receptacle, a hydraulic unit arranged to operate said guard, means for supplying an operating liquid to said units, a valve arranged to control the supply of liquid to said units, and automatic means arranged to operate said valves.

48. A hydraulic apparatus comprising a reciprocatory member and a reciprocatory guard therefor, hydraulic cylinders having individually movable pistons by which said member and said guard may be operated respectively, and means including a valve and distributing conduits for supplying operating liquid above atmospheric pressure to opposite ends alternately of said pistons.

49. An apparatus as defined in claim 48 in which the elements are organized to complete the strokes of said guard earlier than the corresponding strokes of said member.

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