

Oct. 14, 1969

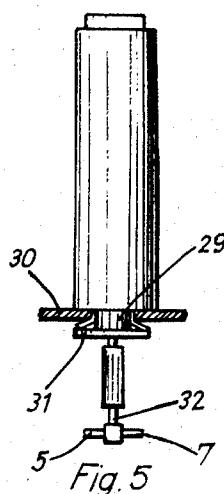
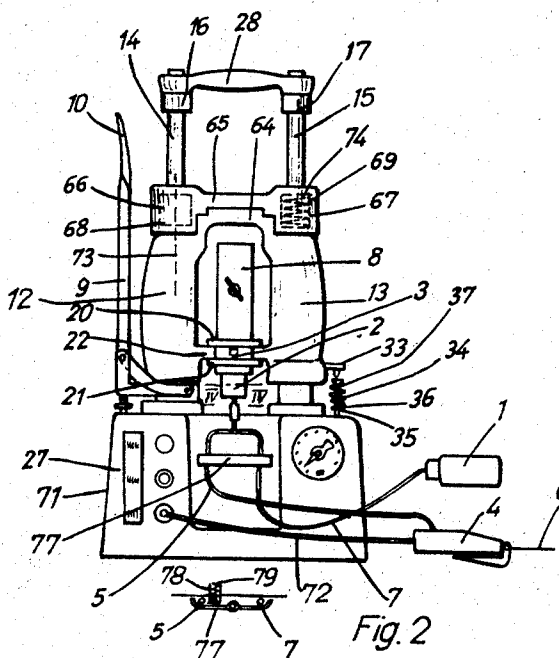
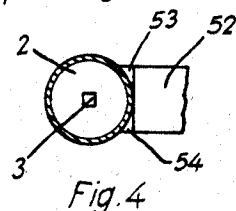
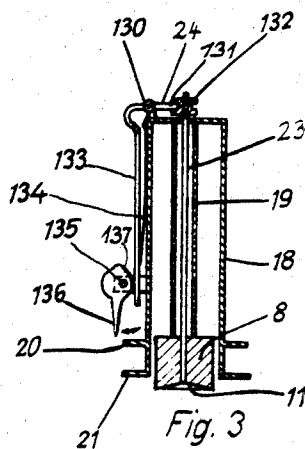
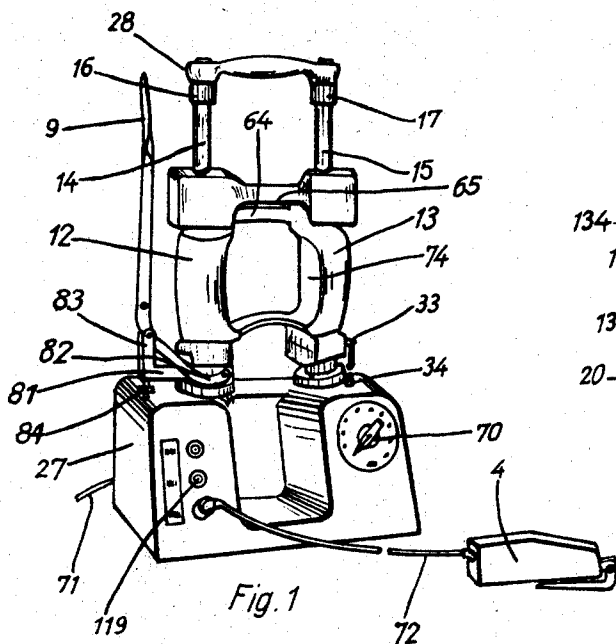
C. HABER

3,472,226

DEVICE FOR SERIAL INOCULATIONS AND FOR THE EXECUTION
OF SUCCESSIVE SEROLOGICAL AND BACTERIOLOGICAL TESTS

Filed Jan. 3, 1966

3 Sheets-Sheet 1



INVENTOR
Christian Haber

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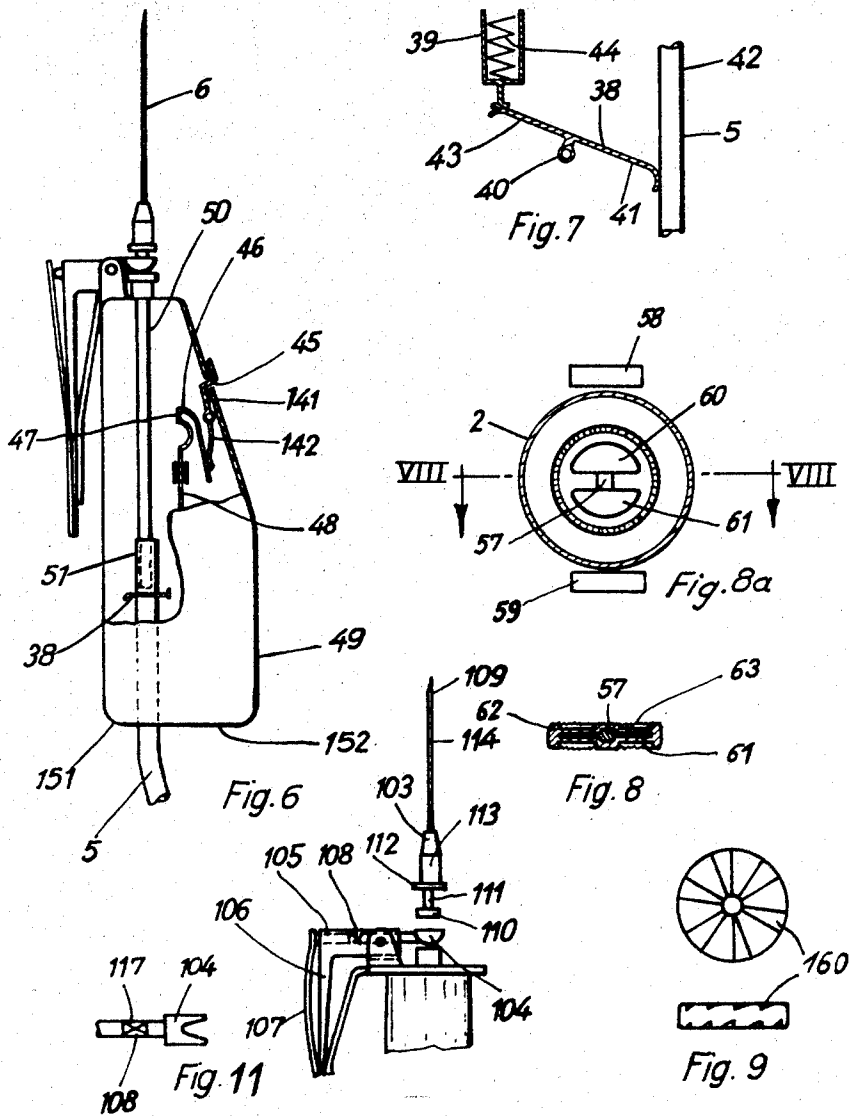
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FIG. 12

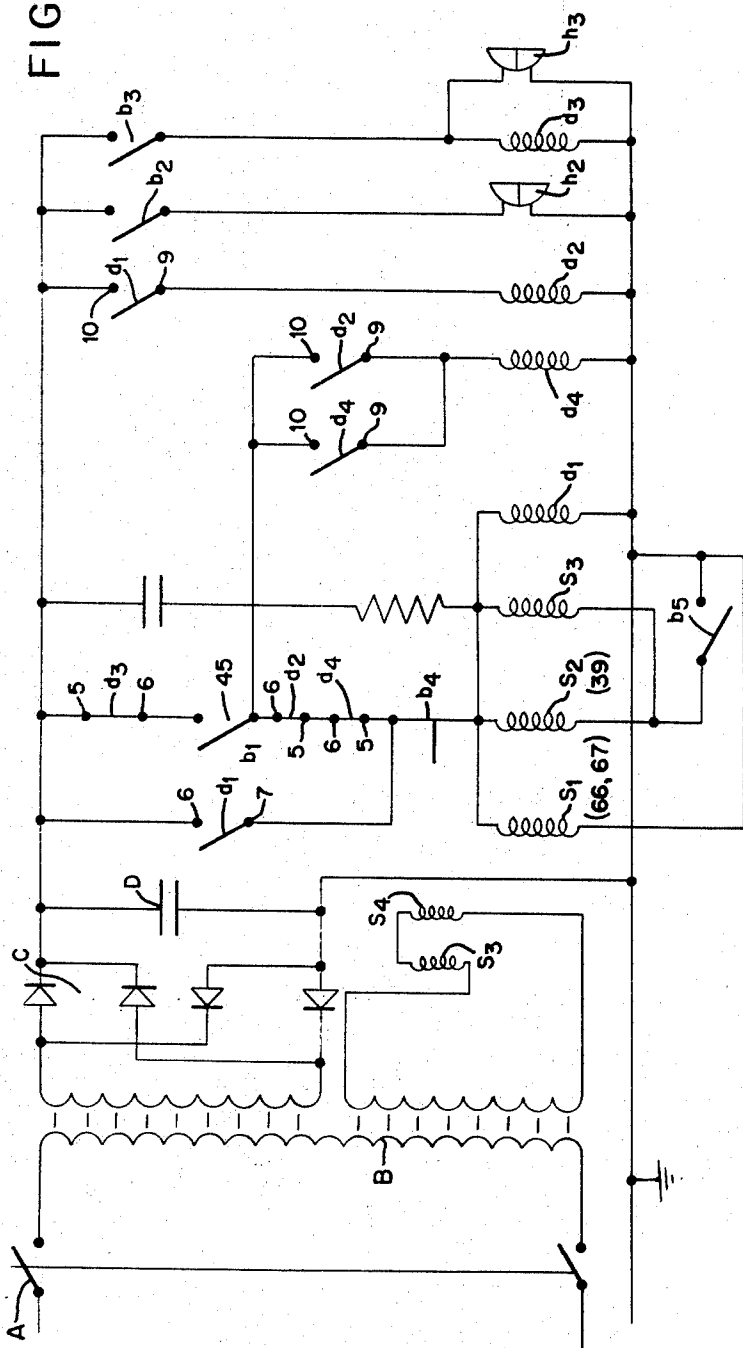
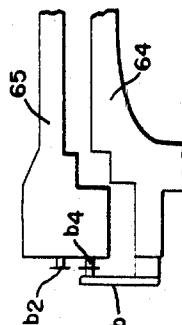


FIG. 10



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DEVICE FOR SERIAL INOCULATIONS AND FOR THE EXECUTION OF SUCCESSIVE SEROLOGICAL AND BACTERIOLOGICAL TESTS

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Continuation-in-part of application Ser. No. 148,678, Oct. 30, 1961. This application Jan. 3, 1966, Ser. No. 518,189

Claims priority, application Germany, Nov. 3, 1960, H 40,843

Int. Cl. A61m 5/32, 5/18; B67d 5/30

U.S. Cl. 128—218

17 Claims

ABSTRACT OF THE DISCLOSURE

A dosing device for injection or inoculation includes a vertically arranged cylinder for holding a liquid in which a plunger is slidable under the action of weights to expel liquid from the cylinder. A hand piece holding an injection member contains a switch which when closed operates to open a valve in a conduit connecting the injection member to the cylinder. Means are provided responsive to movement of the weighted plunger through a certain distance to close the valve so that to terminate the injection. There is also a limit switch which, when the plunger approaches its lower most position, operates to prevent further injection until the cylinder is refilled while permitting the injection which is in progress to be completed. There are also signal devices which indicate when the injection is going on and when the supply has become so low that the limit switch operates.

This application is a continuation-in-part of application Ser. No. 148,678, now abandoned.

The invention relates to a device for performing serial inoculations and successive serological and bacteriological tests and more particularly to a device of the aforesaid kind having a container for the inoculation serum or vaccine replenishable from a stock container wherefrom the said inoculation serum or vaccine is ejectable in measured quantities according to the prescribed dosage by the successive actuating of a dosing device by an operator.

The main object of the invention is to provide a device of the aforesaid kind which enables the physicians to concentrate more than hitherto on the purely therapeutic features of their activities by sparing them the attention to or execution of operations of a more mechanical character.

A further object of the invention consists in to provide a device of the general character described which saves the physician the trouble of verifying the correct, prescribed dosage of the injection or inoculation.

Another object of the invention consists in to provide a device of the above character which makes any repeated check, such as hitherto been necessary, of the correct suspension of the particles of the inoculation serum or vaccine unnecessary.

A still further object of the invention consists in to provide a device as above described with which the injection or inoculation pressure, and, consequently, the injection or inoculation rate, become independent of the subjective, personal equation of the inoculating operator and can be accurately predetermined and controlled by adjusting the weight or mass of the syringe plunger, this being automatically maintained during the inoculation operation.

Yet another object of the invention consists in to provide a device of the above defined character which enables physicians to save much time and labour, makes a

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part of the hitherto usual assistant or accessory labour, performed by assistant personnel, superfluous, and ensures that physicians are less overworked during long series of injections and inoculations than has hitherto been the case.

A further object of the invention consists in to provide a device of the general character described in which the container for the inoculation serum or vaccine is connected through a feed-pipe controllable by a quantity-measuring element with an inoculation hand syringe equipped with interchangeably attachable inoculation canulas or needles, successively removed after each individual dosage or inoculation whereby the instantaneous dose of inoculation serum or vaccine is automatically measured off in correct quantity, and the inoculation serum or vaccine is after agitation and homogenisation by means of an electrically or electromagnetically actuated stirring element expressed by means of a plunger reciprocatingly slidable between an initial position and a final or end position, which plunger, after having opened access for the inoculation serum or vaccine to the inoculation cannula or needle, is caused to move into its end position by the action of an element located in the operating position and by its own weight, through a path of adjustable length whereby the quantity of inoculation serum or vaccine corresponding to the said length of path is ejected by a pressure only slightly exceeding the atmospheric pressure and the resistance of the body tissues, through the aforesaid cannula or needle.

These and other objects, features, and advantages of the present invention will become further apparent from the following detailed description thereof, particularly when the same is read with reference to the accompanying drawings, in which:

FIGURE 1 shows a perspective, front elevation of a device according to the invention;

FIGURE 2 shows the device according to FIGURE 1 in partly-sectional, front elevation;

FIGURE 3 shows the plunger of the device according to FIGURE 2, in a front view, in axial section;

FIGURE 4 shows a part of the device according to FIGURE 2, in a section along the line IV—IV of FIGURE 2;

FIGURE 5 shows the container for the inoculant according to FIGURE 1 in side elevation;

FIGURE 6 shows the inoculating hand instrument or syringe according to the invention, in a sectional plan view;

FIGURE 7 shows a part of the inoculating hand instrument according to FIGURE 6, in diagrammatic, side elevation;

FIGURE 8 shows a modified form of embodiment of the stirring element in the arrangement according to FIGURE 1, in section on the line VIII—VIII of FIGURE 8a, and FIGURE 8a shows the stirring element in plan view;

FIGURE 9 shows a further, modified form of embodiment of the stirring element of the device according to FIGURE 1, in a side view and a plan view respectively;

FIGURE 10 shows the mechanism for controlling certain of the switches;

FIGURE 11 shows a cannula or needle according to the invention with a corresponding gripping device, in perspective view; and

FIGURE 12 shows the electric circuit diagram of the device according to the invention.

The device according to the invention is intended to be used for performing serial or successive inoculations or vaccinations or serological or bacteriological tests.

The device shown in the drawings incorporates a serum or vaccine container 2, connectable to, and at need refillable from, a stock container 1, having an electrically or electro-magnetically propellable stirrer or agitator 3 for

the automatic stirring and mixing of the serum or vaccine in the serum or vaccine container, and an inoculating hand syringe 4 communicating with the aforesaid serum or vaccine container 2 through the intermediary of a feed-pipe 5 controlled by a quantity-measuring element or volumeter, supplying the said serum or vaccine. The inoculating hand syringe 4 incorporates a holder for the interchangeable insertion of an inoculating cannula or needle 6 supplied from the serum or vaccine containing vessel, through the feed-pipe, automatically with individually-dosed quantities of the serum or vaccine by means of the incorporated, quantity-measuring or volumetric control device, as well as an element for operative control which in the active position admits the serum or vaccine to the inoculating cannula or needle and in the inactive position interrupts such admission. The device according to the invention further incorporates a control arrangement whereby the automatic progression of the individual operating stages in the required succession is ensured. This arrangement is such that all individual parts and elements coming in contact with the serum or vaccine are individually removable and separately sterilizable.

The serum or vaccine container 2 has the form of a suitable cylinder of a transparent material, such as glass, to one end whereof the feed pipe 7 from the stock container and the feed pipe 5 to the manual inoculating element or syringe 4 are attached, and wherein a plunger 8 is reciprocatingly movable whereby when the said plunger moves away from the opening of the feed pipe 7, serum or vaccine is drawn into the container and when it moves in the opposite direction, serum or vaccine is expelled from the container into the manual inoculating element or syringe. The cylindrical serum or vaccine container 2 is set approximately vertically, the pipes 5 and 7 opening into its lower end. The plunger 8 is vertically guided in the container barrel and moves reciprocatingly. The plunger 8 can also be raised in the container barrel 2, for instance, by means of a manually-operated, filling or charging lever 9, or the like, arranged at one end 10 of the container. In doing so, it produces a vacuum in the lower part of the container barrel and thus enables serum or vaccine to be drawn thereinto from the stock container or stock bottle 1. On its return or downward stroke, effected by gravity, the plunger expels serum or vaccine from the container towards the manual inoculating element or syringe 4. The plunger 8 has an outwardly-opening relief or sniffer valve 11, through which the air contained in the empty barrel can be expelled by the entering serum or vaccine. The general arrangement is such that the plunger resting on the column of serum or vaccine in the container, when the outlet therefrom is open, falls by its own weight at a constant rate and thereby displaces a volume of serum or vaccine from the container to the outside; while, when the container outlet is closed it is maintained by the said column of serum or vaccine in the container, at a constant level; means being provided to ensure that, during an inoculation or discharging operation, the plunger only falls through constant intervals of distance and at constant rate corresponding to the dose of serum or vaccine required to be delivered from the container for a single inoculation or injection.

The plunger 8 has on either side symmetrically placed loading weights 12, 13, which are reciprocatingly slidable on upright guide posts 14, 15; their upward motion being suitably limited by steps 16, 17 at the top of the guide posts.

As will be seen from FIG. 3, the plunger 8, slidably guided in the serum or vaccine container 2, is connected with a cylindrical casing 18, concentrically surrounding the serum or vaccine container; e.g. by means of a hollow rod 19, the inside bore whereof acts as a connection between the air-release or sniffer valve in the plunger, and the external atmosphere; the aforesaid cylindrical casing 18 being equipped with reciprocally parallel and annular, circumferential collars 20, 21, for the attach-

ment of the plunger-balancing weights between which lugs 22 on the weights 12, 13 engage. In the exemplary embodiment represented, the air release or sniffer valve 11 is a conical valve actuated by the rods 23, 24. The cross-bar 24 is rotatably attached to the casing 18 at 130, and linked by the rod 23 to the fork 131, which engages with the nut 132, into which the rod 23 is screwed. The arrangement is such that by suitably moving and screwing the nut 132 up and down, the effective length of the valve rod 23 can be adjustably varied. The lever 133 is influenced on the one hand by the spring 134 and otherwise by the rocking lever 136, rotatably pivoted at 135, the anti-clockwise motion whereof closes the valve against the spring pressure, and the stroke whereof is restricted by the stop 137.

The upright guide posts 14, 15 for the weights 12, 13 associated with the plunger 8, are attached on the housing 27 and connected at their upper ends by the crosshead 28 which at the same time acts as a handle for carrying the instrument.

The inoculant (serum or vaccine) container consists of a cylinder open at the top, suitably made of some transparent material such as glass which is constricted at its lower end to form a neck 29, detachably held on the instrument casing in a forked clip 30 and secured therein by a leaf or plate spring 31 or the like; from which through a lower union 32, the connecting pipe 7 to the stock container 1 and the feed pipe 5 to the hand syringe 4 are led.

Moving with the plunger 8 or a component fixed thereon, in the lower part of the plunger stroke is a contactor element 33, working outside the container barrel which during its downstroke actuates a limit switch 34 and thus electrically releases a signal, indicating that the inoculant level in the container is getting low, and only one, controllable dosage volume remains. When the limit switch 34 is actuated, a relay responds, which closes the inoculant feed for the next inoculation of the series; but allows the individual inoculation already initiated to be completed. The limit switch 34 consists of a lower, contact plate 35 and an upper contact pin 37, suitably insulated and bearing on the preceding by the pressure from a spring 36. When the plunger descends, the contact 33 moving with it, actuates the switch by pressing the contacts 35 and 37 together, an audible signal (e.g. a buzzer h_3) being simultaneously given. The operator now knows that there is only a small residue left in the container, which must be replenished from the stock bottle.

The actuating element on the manual inoculating device 4 consists of a clip 38 which is by excitation of the electromagnet 39 drawn away from the working position, in which it interrupts the pipe 5 coming from the inoculant container 2 and leading to the inoculating cannula or needle 6; and when the magnet is inactive, falls back into the closed position. As can be seen for instance from FIGS. 6 and 7, this clip has the form of a double-armed lever, pivoted at 40, the one arm 41 whereof in the closed position bears on the feed pipe 5 from the inoculant container 2 to the inoculating cannula 4, thereby pinching this pipe against the bearing plate 42, and interrupting the flow of inoculant through the pipe to the inoculating cannula; whereas the other arm 43 thereof contacts with an electro-magnet 39 connected in a circuit closable by pulses controlled by the operator, in such manner that when the electric circuit is closed and the electromagnet energized, the one arm of the double lever is attracted by the electro-magnet and the other arm drawn away from its closed position; while, when the circuit is opened, the two arms of the double lever are actuated in the reverse sense by the spring 44. The circuit energizing the electromagnet controlling the actuating element is operated by a switch 45, which may be of the press- or push-button type, and can be manipulated by the operator holding the injection needle. A push button (i.e. sliding) switch has the advantage that

it cannot be pressed by accident, as would be the case with a press-button type. The arrangement is such that the switch responds to only one order at a time and does not accept the next order until the first has been fulfilled. As will be seen from FIGS. 6 and 7, this switch 45 is fitted on one end of the double lever 141, 142, the other end of which, through the leaf spring 46 and the spring 47 actuates the click switch (quick-break switch) 48 which in turn closes the circuit energizing the electromagnet 39 controlling the actuating element. The holder for the inoculation cannula and the actuating element controlling the inoculant feed to this cannula are contained in a casing 49 into which the feed pipe 5 from the inoculant container 2 is led and to which the inoculating cannula or injection needle can be attached, the externally-operable switch 45 controlling the actuating element being fitted on the outer wall thereof. The holder for the inoculating cannula 6 has a metal feed pipe 50, penetrating into the manual inoculating element 4, over the front end 51 whereof the flexible inoculant feed pipe 5 is passed; the clip 38 for interrupting and opening the inoculant feed to the inoculating cannula being arranged directly in front of the joint between the metal connecting pipe and the flexible feed pipe, thus preventing the latter from becoming distended by the body-fluid pressure of the inoculated subject. The casing has two, disconnectable parts 151, 152, one containing the elements of the hand instrument requiring sterilization, i.e., the cannula holder and the inoculant pipe; and the other, the remaining components, e.g. the electrical elements.

The inoculating medium (serum or vaccine) in the inoculant container is stirred and mixed by a magnetic agitator 3 at least partially immersed in the inoculant, the immersed part whereof is by means of an electromagnetically controlled power magnet 52 caused to reciprocate or rotate vertically or horizontally, and thus to stir and mix the inoculant thoroughly; this power magnet with a large effective surface being arranged outside the inoculant container fairly close thereto, and the magnetic agitator being inside the said container.

In the exemplary embodiment represented in the drawing, the power magnet is of the alternating-current type and has the form of an oblong plate, advantageously so shaped as to pass around a part of the circumference of the container, its poles 53, 54 being offset reciprocally transversely to the centerline of the container. The magnetic agitator 3 is a permanent magnet in block form having two pairs of poles on opposite faces. The magnetic agitator or block magnet is sheathed for protection against attack by sterilising liquids or media, with a plastic such as known by the trade names silicone rubber, Teflon, or the like.

In a further exemplary embodiment shown by FIG. 8, the magnetic agitator inside the inoculant container consists of a central, permanent magnet, suitably in the form of a block or cube, and a peripheral, soft-iron frame for increasing the circumference of the agitator. This assembly is actuated by two pole-pieces 58, 59, arranged diametrically opposite each other on the outside of the container, in contact or nearly in contact with its surface. The soft-iron frame consists of two semicircular, soft-iron discs 60, 61, applied at opposite sides to the central cubical permanent magnet 57, the entire agitator assembly being sheathed with a substance resistant to sterilizing fluids, such as those known by the trade names of Teflon or silicon rubber, as will be seen at 62. The edge of this sheathing is grooved, toothed or knurled along its circumference as shown at 63. An agitator assembly of this kind can for instance be run on 50 cycle A.-C. at up to 3000 r.p.m., the ridges on the edge of the agitator maintaining the inoculating fluid in motion. The purpose of the agitator, to prevent precipitation or sedimentation of solid particles suspended in the inoculating fluid, is thus most reliably fulfilled.

With the plunger 8, or rather, the weights 12, 13 coupled therewith, an electrically-conducting, lower yoke 64 is associated, on which an upper yoke 65, parallel therewith, rests freely, at one end, or, preferably both ends whereof, holding magnets 66, 67 are arranged which when not energized admit of vertical motion of the upper yoke together with the lower yoke, but when excited, by coacting with a fixed part of the arrangement, hold the upper yoke fast in its instantaneous position, so that the lower yoke moves away from the upper yoke during descent of the plunger through a distance depending on the quantity or volume of the inoculant being discharged. The holding magnet is energized when the element 39 is actuated; and thus, while the upper yoke 65 is being held in its instantaneous position, and the lower yoke 64 is descending with the plunger 8, following the falling level of the inoculating fluid in the inoculant container. The control circuit described below operates, according to the distance travelled by the lower yoke from the stationary upper yoke and the quantity of inoculating medium which has issued from the container 2, on the one hand to electrically de-energize the magnet 39 influencing the control element and thereby interrupted the flow of the inoculant to the inoculating cannula 6; while on the other hand, the de-energizing of the holding magnet or magnets 66, 67 acting on the upper yoke, causes it to drop down on the lower yoke 64.

The weights 12, 13, on either side of the plunger 8, are connected by the flat, lower yoke 64 to form a U-shaped assembly, the two arms whereof, formed by the weights, are slidable up and down on the upright guide posts 14, 15 for the plunger; these guides passing, for instance, through suitably-arranged holes in the said weights; the aforesaid upper yoke 65 then resting freely on the lower yoke 64, and having at either end holding magnets 66, 67, in a casing 68, 69, which has a through hole receiving each of the guide posts 14, 15 for the plunger 8. The plunger is thus guided between the two arms of the U-assembly and detachably connected with the latter at their ends, as has already been described.

The control circuit is accommodated together with the control relay 55, in the instrument casing 27, on the top of which the inoculant container 2 with the upright guide posts 14, 15 for the plunger 8 is fixed, together with the charging lever or trigger 4, on the one hand, the electromagnet 39 of the clip 38 of the hand element 4 is energized; and on the other hand, a relay 76 is energized controlling the holding magnets 66, 67. Consequently, inoculant can now pass to the inoculating cannula 6 while, simultaneously, the holding magnets retain the upper yoke in the starting position for the particular inoculation or injection to be performed on the guide posts. Since inoculant can now flow out of the container, so as to vary the distance between the two yokes, until a value is reached corresponding to the particular capacity of a predetermined dose. Then as will be described below, the flow of inoculant to the cannula is interrupted by the magnet 39 being de-energized, the holding magnets 66 and 67 release the upper yoke 65 which falls on the lower yoke 64. The particular inoculation or injection is completed, and the next can proceed. When the limit switch 34 is operated by the contactor 33 at the lower end of the plunger stroke, the circuit is broken so that, while the individual inoculation already in progress is able to be completed, the next inoculation cannot yet be initiated, since the control relay is and remains inactive until the plunger has been raised again to fill the container.

The individual quantities of inoculant can be measurably recorded by means of a beam of light acting on a photoelectric cell.

The open feed pipe 5 between the inoculant container 2 and the hand element 4 can be cut off by applying a safety clamp 77, which can, for instance, be operated manually when starting the instrument, or automatically by means of an electromagnet. The arrangement is then

such that both the feed pipe 5 and the connecting pipe 7 can be closed by a common safety clamp 77, suitably a double-armed lever pivoted in the middle, influenced on the one side by a magnet 78 and on the other side by the opposing force of a spring 79; which, when the charging trigger or filling lever 9 is actuated, closes the pipe 6 and opens the pipe 7, while, when the trigger is released, the operation is reversed. The charging trigger is so pivoted and connected with the plunger 8 that when its one end 10 is pressed down against the force of a spring 81, its other end 82 raises the plunger and simultaneously actuates a rocker 83 which closes a contact 84 and energizes a magnet 78 on the side of the feed pipe 5 to the hand element 4, thereby attracting the corresponding end of the double lever of the safety clamp 77, which nips the pipe 5 between itself and an opposed bearing surface.

The device is equipped with a pilot lamp 119 which shows when the device is in working order. The pilot lamp 119 is in circuit with and controlled by a thermal relay coupled with the switch on the hand element, with which this relay is also in circuit and only responds with a certain delay period after connecting the instrument to the current supply, allowing the main switch to be operated only when the instrument is ready for inoculation, when the pilot lamp lights and the control relay can respond to actuation by the hand element. Thus, the performance of inoculations or injections during the starting or warming-up period, when the instrument is not yet ready for use, is prevented by failure of the pilot lamp to ignite, indicating unreadiness to the operator; and the failure to act of the control relay, unless the pilot lamp has ignited, even if the warning given by non-response of the pilot lamp should be overlooked and the switch on the hand element nevertheless operated.

The holder 103 for the cannulas or needles (see FIG. 11) incorporates a forked grip 104 into which the foot of the cannula is inserted from the side, which is rotatable through a predetermined angle about its own axis in an aperture 105 of the actuating lever 106 of the cannula holder, and further longitudinally movable by the action of a spring 107 on its end opposite the cannula. The limited rotation of the grip is obtained by making its shaft 117 cylindrical and flattened on one side over a part of its length as shown at 108. This adjustable arrangement of the grip enables the cannula foot and the holder to be set truly plane parallel to each other by simple means, and further allows the cannula to be easily ejected after use.

The interchangeable cannula 103 has at the end opposite to its point 109 a flat, cylindrical head 110, a relatively long shank 111 of smaller diameter, an upper collar 112 of the same diameter as the head and a partly cylindrical and partly tapering distance piece 113 forming a transition to the needle 114; the weight of material being so distributed over the whole length of the cannula that when thrown off the holder or ejected it falls parallel with its original position.

The amount by which the grip is longitudinally displaceable and the mass distribution in the cannula head are reciprocally so matched that when the cannula is thrown off the holder and ejected, it must always fall parallel to its own plane.

It has further been found that a magnetic agitator sheathed with plastic under the trade name "Teflon" can be particularly well maintained in motion if in addition to the driving magnets already described, there are fitted outside the inoculant container diametrically opposite the driving magnets, two permanent magnets of cubical or disc shape, arranged symmetrically to a diameter of the inoculant chamber.

Finally, the magnetic agitator can be made in the form shown in FIG. 9 of a flattened cylinder the upper surface whereof has radially and outwardly extending grooves or slots 160, suitably increasing in width outwardly, which assist thorough mixing and stirring of the liquid contained in the cylinder. In FIG. 12 there is shown an elec-

tric circuit diagram of another embodiment of the invention. This embodiment can be operated with a voltage of 220 v./50 hertz or 110 v./50 hertz. The power input is 50 volt-ampere. The apparatus is connected to the public current supply by means of a flexible conduit which contains a two pole-cord-switch A.

As soon as the apparatus is started, the coil S4 (53, 54) of the agitator is supplied with an A.C. voltage of 27 volts. The coil of the agitator produces a magnetic field which makes the agitator to dance within the container 2.

A further secondary winding of the transformer B gives a voltage of 28 volts which is rectified by means of the current redresser C and is smoothened by means of the condenser D. The D. C. voltage of about 36 volts thereby obtained is connected on the one side with the protective earth and the chassis or casing.

Suppose now that the container 2 is filled with liquid, i.e. that the plunger 8 is situated within the upper portion or area of the container. As soon as the starting key or knob (45) on the manual inoculating element or syringe 4 is actuated, the relay d_1 responds so as to be self-locking. At the same time the coil S1 of the hammer-like magnet (66, 67) on the upper yoke is supplied with voltage. The magnets are energized and clampingly secure the upper yoke to the guide posts. As soon as the magnets reach their end position, the control and survey contact b_5 is closed via conventional limit means. The current flows now through the contact b_5 to the two magnetic coils S2 and S3. The magnetic coil S2 (39) is allotted to the manual inoculating element and serves as dosage valve of the manual inoculating element for measuring out the liquid issuing therefrom. The magnetic valve S3 is allotted to the apparatus itself and serves also as dosage valve. At the same time with the operation above described the relay d_2 responds via the contact d_1 , 9-10. The contact d_2 , 5-6 opens so that the starting key or knob b_1 cannot influence anymore the sequence of the control operations, i.e. the dosage. The contact d_3 , 9-10 closes. The relay d_4 responds and is locked via its contact d_4 , 9-10. The contact d_4 , 5-6 opens. It serves as further locking means for the starting key or knob b_1 .

Due to the fact that both dosage valves are opened, the liquid to be dosed flows off and the plunger within the container moves downwards. By this means, a dosage control member b is moved also downwards, and a contact b_2 movably arranged on the upper yoke is engaged thereby, whereby the buzzer h_2 is energized via the contact b_2 . The sound thereby produced is a signal: "dosage is running."

As soon as the dosage control member sliding downwards reaches the dosage contact b_4 , this contact is suddenly opened. The two magnets S2 and S3 are de-energized wherefor the two magnetic valves S2 and S3 are closed. The plunger, the dosage disk and the lower yoke cannot further slide downwards. The coil S1 of the hammer-like magnets is also de-energized, the hammer returns to its inoperative position. The clamping interaction between the guide posts and the upper yoke is interrupted. The control and survey contact b_5 opens. The upper yoke slides downwards until it reaches the lower yoke. The contact b_2 opens, the sound "dosage is running" is interrupted.

At the same time with the opening of the dosage contact b_4 , the relays d_1 and d_2 are de-energized. The dosage contact b_1 closes again when the upper yoke slides downwards.

The control operations between starting and the end of the dosage operation take only fractions of seconds. Suppose now, for example, that the starting key b_1 is still actuated, i.e. closed even after a dosage operation has been finished. In this case the relay d_4 cannot be de-energized. The hammer-like magnets and magnetic valves are locked via the opened contact d_4 , 5-6. Relay d_4 can be de-energized only when the starting key or knob

b_1 has reached the inoperative position. Only now a further dosage operation can be initiated by a new actuation of the starting key or knob.

In the case in which during a new dosage operation the end position of the lower yoke is attained (the plunger being thereby almost in its lowermost position), the contact b_3 for the end position is closed. The vibrator n_3 or buzzer is actuated and can now be heard. At the same time the relay d_3 is energized. The dosage operation running at this time is finished as usual, however, a further dosage operation is prevented through the opened contact d_3 , 5-6. Only when the container is filled again, the contact b_3 opens. The acoustic signal "end position reached" is no more heard, the relay d_3 is de-energized, the contact d_3 , 5-6 closes again. A new dosage operation can be initiated via the starting key or knob.

The individual functional units of the apparatus, for example, the upper yoke, the manual inoculating element, the valve etc. are connected with the relay control by a plug-and-socket connection. These plug-and-socket connections are marked with 1, 2, 3, and 4 in FIG. 12. So, for example, the starting key or knob b_1 in the manual inoculating element is connected with the relay control through the plug-and-socket-connections 2.3 and 2.4.

The dosage disk not shown in the drawings is a control element connected with the plunger and, therefore, with the lower yoke and moving therewith. The contact b_2 is allotted to the upper yoke as it is the case also with the hammer-like magnets. Therefore, when liquid is discharged from the cylinder, the plunger, the lower yoke and the dosage disk move downwards whereby this latter actuates contacts b_2 and b_4 . Upon actuation of b_4 the outlet for the liquid is closed, the holding magnets S2 and S3 are de-energized, the lower yoke cannot further move downwards and the upper yoke slides downwards until reaching the lower yoke.

As can be seen, the circuit diagram of FIG. 12 represents the relay control of an embodiment of the invention somewhat different from the above described embodiments, since the control of the dosage operation is now effectuated by relays and contacts instead of condensers as with the formerly described embodiments.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. A device for performing serial inoculations comprising, in combination, a liquid container; an inoculating member; a supply conduit connecting said inoculating member with said liquid container; valve means in said supply conduit for controlling the flow of inoculant to said inoculating member; a plunger mounted within said liquid container for displacement between an initial position and an end position, said plunger serving to drive out during its displacement liquid from within said liquid container into said supply conduit; a first control switch and a coil in series therewith for opening said valve means and initiating the flow of fluid therethrough; upon closing of the first control switch; locking means responsive to closing of the first switch keep it closed; means responsive to operation of the first switch to disconnect it from the coil; said plunger moving within the container when said valve means is open, and control a second switch operatively connected to said plunger and to said valve means and responsive to movement of said plunger through a predetermined distance to close said valve means so as to stop the outflow of serum from the container.

2. In a device as claimed in claim 1, in which said plunger moves vertically downward to discharge serum from the container; vertically movable weight means op-

eratively connected with the plunger; a member mounted above said weight means for vertically sliding movement; magnetic means for normally holding said member against downward movement, whereby when said weight means moves downwardly it is displaced away from said movable member, and said second switch being responsive to a predetermined movement of the weight means away from the movable member.

3. The device set forth in claim 1, wherein a sock container is connected to said liquid container and a charging lever is provided for moving the piston in upward direction within said serum or vaccine container, said charging lever being adapted to be operated on its one end by hand, whereby upon upward movement of said plunger within the lower part of said liquid container a partial vacuum is produced for sucking in serum or vaccine and upon downward movement of said plunger under the influence of its own weight serum or vaccine from within said liquid container is displaced towards said hand element.

4. The device set forth in claim 3, wherein said plunger is provided with an air relief valve, said valve opening outwards, said valve serving to expel the air present within said liquid when said container has been emptied and serum or vaccine has been sucked into said serum or vaccine container.

5. The device set forth in claim 1, wherein a cylindrical sleeve is provided, said sleeve surrounding said liquid container and being concentric to said plunger within said container, said cylindrical sleeve being connected with said plunger by means of a hollow rod which acts as a connection between said air relief valve of said plunger and the external atmosphere, said sleeve having two ring-like shoulders parallel to one another and running around about its periphery, said shoulders serving to couple said loading weights, by lugs or said loading weights which penetrate between said shoulders.

6. The device set forth in claim 5, wherein said air relief valve is a conical valve, a linkage being provided for opening said valve against the action of a spring.

7. The device set forth in claim 1, wherein a contactor element is arranged outside the liquid container, said contactor element being connected to said plunger in such a way as to move with said plunger in the area of the lower end of the plunger stroke, said contactor on its downward movement it operating a limit switch and thereby releases electrically a signal indicating that the serum or vaccine supply within said liquid container is running short.

8. The device set forth in claim 7, wherein a relay is provided in cooperative relationship with said limit switch, said relay becoming effective upon operation of said limit switch to stop the supply of serum or vaccine to said inoculating member for the next individual or single inoculation while it permits the individual or single inoculation already initiated to be complete.

9. The device set forth in claim 1, wherein said liquid container comprises a cylinder open on its top and tapering at its lower end so as to form a throat which can be releasably and securably inserted into a forked clip on the housing of the device.

10. The device set forth in claim 1, wherein said valve means comprises a clip which upon the excitation of an electromagnet is drawn away by this latter from its operative position in which it interrupts the supply conduit from said serum or vaccine container to said hand element and which de-energization of said electromagnet returns to its closed position.

11. The device set forth in claim 10, wherein said clip comprises a double armed lever mounted pivotally in its central region, one arm of said double armed lever bearing in its closed position against the supply conduit from said serum or vaccine container to said hand element, thereby pinching said supply conduit against a bearing plate and interrupting the flow of serum or vaccine

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through said supply conduit to said hand element, the other arm of said double armed lever so cooperating with electromagnet.

12. The device set forth in claim 11, wherein for opening and closing the circuit energizing the electromagnet there is provided a switch to be operated by the person manipulating the inoculation needle or cannula, said switch being so connected in said circuit as to respond to one order only at a time and as to not accept the next order until the first has been fulfilled.

13. The device set forth in claim 12, wherein the switch is fitted on the one end of a double armed lever supported pivotally in its central region, the other end of said double armed lever operating a snap-action switch through a suitable spring arrangement, said snap-action switch closing in its turn the circuit energizing the electromagnet.

14. The device set forth in claim 1, wherein for stirring and mixing the serum or vaccine contained in the liquid container there is provided a magnetic agitator member immersed at least partially in the inoculant.

15. In a device as claimed in claim 1, a third switch (d_3 , 5-6) in series with the first switch, and means (b_3 , d_3), responsive to the movement of the plunger to the bottom part of its path to open said third switch (d_3 , 5-6).

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16. In a device as claimed in claim 15, said second switch (d_1 , 6-7) being also in parallel with said third switch (b_1).

17. In a device as claimed in claim 16, a fourth switch (d_4 , 5-6) in series with the first (b_1) and third (d_3 , 5-6) switches and means (d_4) responsive to closing of the first switch (b_1) to open the fourth switch (d_4 , 5-6).

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