

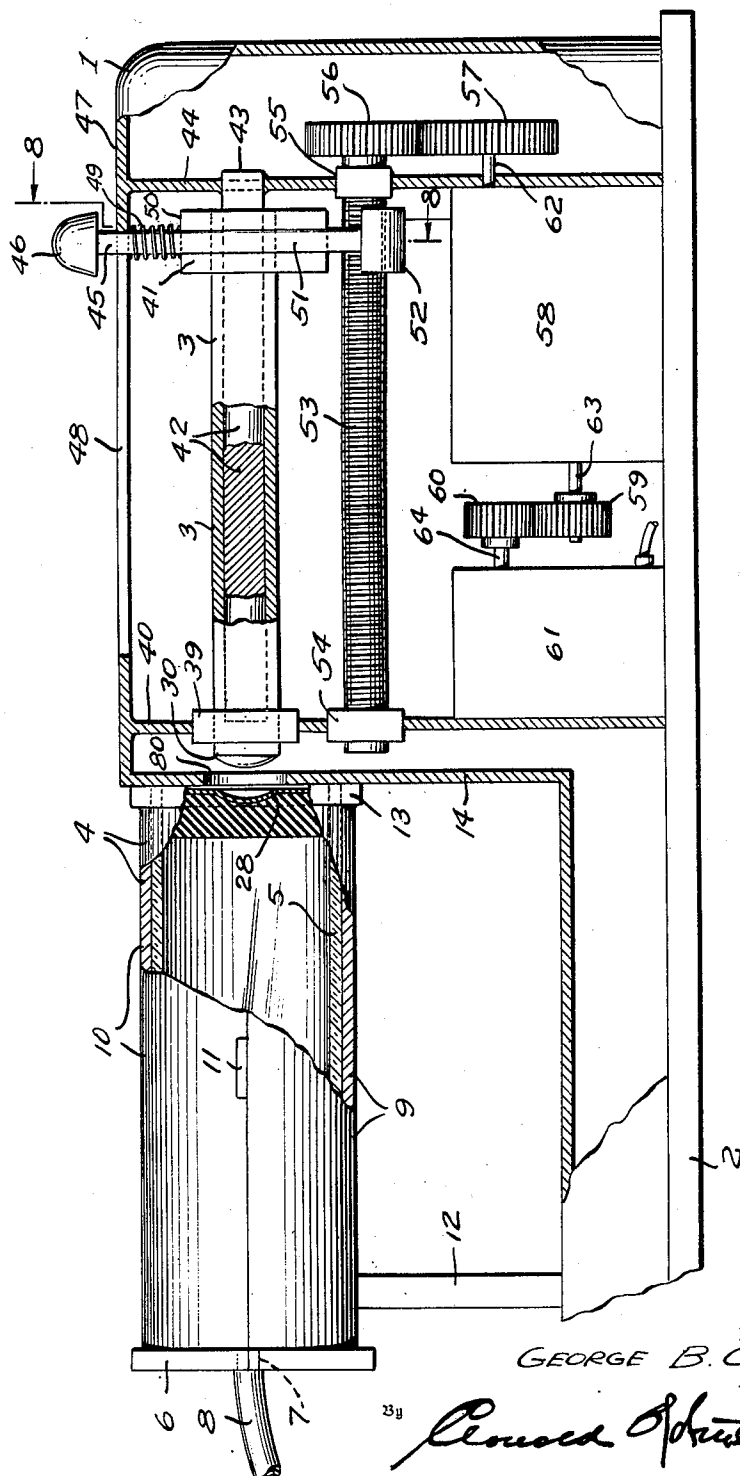
Feb. 22, 1955

G. B. GLASS
MOTOR-DRIVEN MEDICAL INJECTION APPARATUS
AND CARTRIDGES THEREFOR

2,702,547

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3 Sheets-Sheet 1



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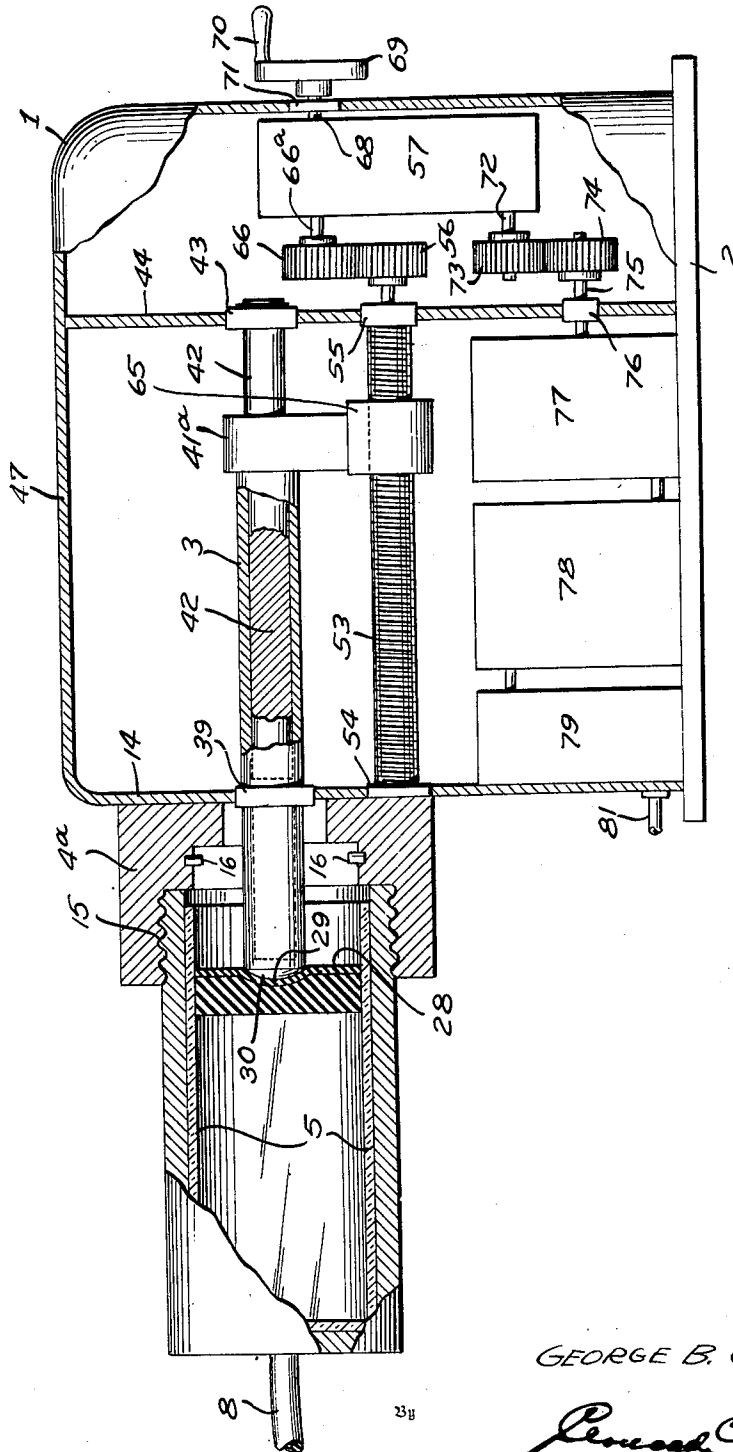
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Fig. 2.



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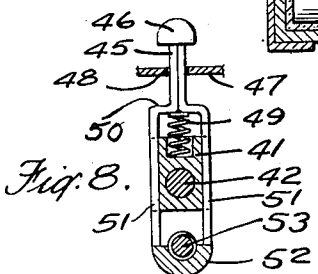
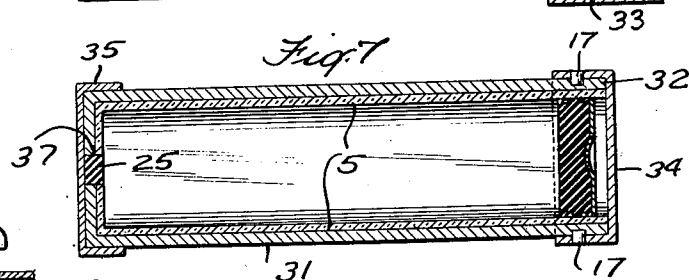
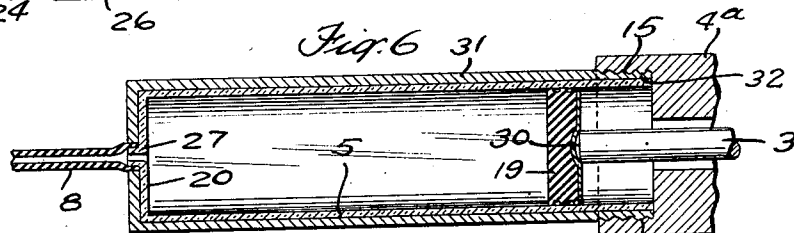
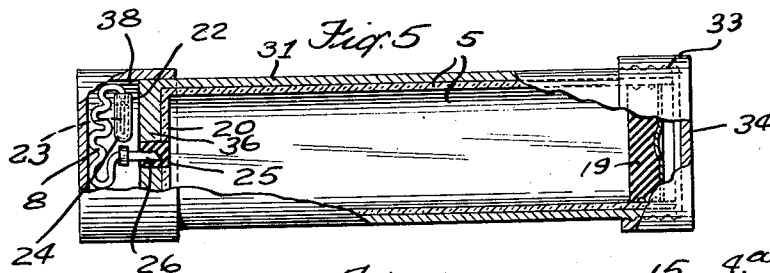
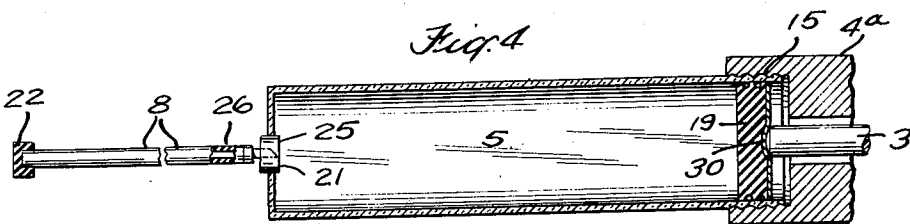
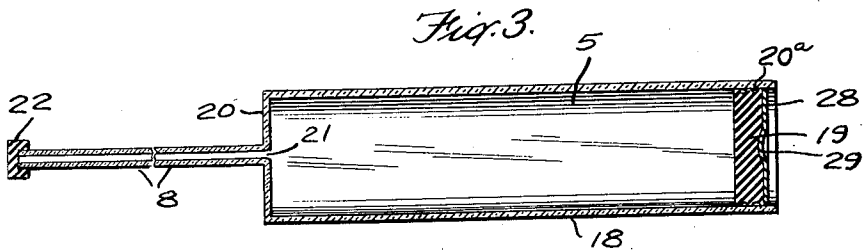
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MOTOR-DRIVEN MEDICAL INJECTION APPARATUS AND CARTRIDGES THEREFOR

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Application February 27, 1950, Serial No. 146,551

10 Claims. (Cl. 128—218)

This invention relates to improvements in motor driven medical injection apparatus for the controlled automatic administration to patients of therapeutic fluids, such as salines, drugs, etc.

More particularly, the invention relates to an automatic machine for discharging the therapeutic contents of a fluid container, such as of an ampule or cartridge, into the body of a patient through the agency of a hypodermic needle and a conduit connecting said needle to said container. The invention also relates to improved and disposable fluid containers or cartridges, for such automatic injection apparatus.

This application is a continuation-in-part of my application Serial No. 646,611, filed February 9, 1946, now Patent No. 2,627,270.

Because of the limitations inherent in the use of hand-operated hypodermic syringes, a need has arisen for the provision of an automatic injection apparatus in which large as well as small amounts of medicaments can be administered intravenously or subcutaneously over predetermined periods of time and at predetermined rates. There is a special need for such devices in the administration of drugs which require to be injected very slowly. At present, infusions of this kind are administered either by repeated injections by hand or by the imprecise drip method commonly used with the parenteral administration of saline, plasma, and glucose solutions. Routine medical syringes have capacities of not more than 100 cc. and it is therefore impossible with standard equipment to discharge large volumes of fluid medicaments from a single standard syringe as well as small volumes of fluid from gravity flasks.

It is an object of the present invention to provide a completely automatic injection apparatus for injecting medicaments directly from prefabricated sterile cartridges. A further object of the invention is to provide an apparatus for the controlled injection of drugs, etc., from cartridges located relatively distant from the patient, which cartridges are provided with tubular extensions connecting the hypodermic needle with the body of the cartridge proper. A further more particular object of the invention is to provide an automatic medical injection apparatus in which pre-fabricated cartridges can be readily located for use, the apparatus comprising an adapter for the rigid securing of a cartridge in operative alignment with a motor driven piston.

Another object of this invention is to provide a disposable ampule or cartridge, for direct use with motor driven injection apparatus.

Another object of this invention is to provide a cartridge provided with a tubular extension for connecting the hypodermic needle with the cartridge proper. A still further object is to provide in combination, a cartridge with a tubular extension packaged in a protecting casing which casing also serves as an adapter for the cartridge in the injection apparatus.

In accordance with this invention there is provided in a motor driven injection apparatus comprising a stationary base, a motor secured to said base and a piston operatively associated with the drive shaft of the motor and mounted on said base, a housing on said base for securing a replaceable cartridge containing a fluid medicament in operative alignment with said piston, whereby the contents of said cartridges are automatically discharged on operation of the motor.

The automatic mechanism for operating the piston to discharge the cartridge contents may take one of several

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forms. Essentially however, in accordance with this invention, the motor and the piston operatively associated with it are secured to a stationary base adapted to be located at some distance from the patient and to function independently of human supervision. Manual means for operating the piston independently of the motor are provided to enable the mechanism to be hand operated if desired and to facilitate the return to inoperable position of the piston once the contents of a cartridge have been emptied or if, for any reason, the cartridge is to be replaced before being emptied. The rate of travel of the piston is controlled by suitable mechanical or electrical timing mechanisms so that the whole or a predetermined part of the contents of a cartridge can be discharged continuously or intermittently at any predetermined rate. The piston is guided in its forward movement by suitable guide means provided in the apparatus.

The improved disposable cartridge of this invention comprises a barrel portion for containing an injectable fluid, pressure-responsive fluid-tight closure means at one end of said barrel portion for discharging the contents of said barrel portion in response to externally applied pressure, a discharge opening in the other end of said barrel portion, a conduit for connection to the discharge opening and means for connecting a hypodermic needle to the other end of said conduit. In the preferred arrangement, the conduit is a length of flexible tubing, as of rubber, adapted to communicate with the interior of the cartridge through a penetrable plug or stopper normally closing the discharge opening.

The invention will be more readily understood by reference to the accompanying drawings in which:

Fig. 1 illustrates an improved injection apparatus in accordance with this invention in partial longitudinal cross section;

Fig. 2 illustrates a modified form of the improved injection apparatus also in partial longitudinal cross section;

Fig. 3 shows in longitudinal cross section an improved cartridge in accordance with this invention;

Fig. 4 illustrates a modified form of cartridge shown in loaded position in an injection apparatus of the kind illustrated in Fig. 2;

Fig. 5 shows in partial longitudinal cross section a packaged cartridge;

Fig. 6 illustrates a modified form of cartridge loaded in operative position in an injection apparatus of the kind illustrated in Fig. 2;

Fig. 7 illustrates a still further modified form of packaged cartridge in accordance with this invention, and

Fig. 8 shows a detail along line 8—8 of Fig. 1.

Referring to the drawings, and especially to Figs. 1 and 2, the apparatus generally comprises a casing 1 mounted on a support 2 and housing a motor-driven mechanism, to be described in detail below, for propelling a piston 3 at a controlled and predetermined rate. Externally of the motor housing 1 there is provided a receptacle or attaching means 4 or 4a arranged to contain or hold an ampule 5 in operative alignment with the piston 3.

As shown in Fig. 1, the receptacle 4 is a sleeve member open to the rear and provided at its forward end with a wall portion 6 against which the forward end of the cartridge 5 abuts, the front wall 6 being provided with a central opening 7 through which a tubular extension or conduit 8, extends. The longitudinal barrel portion of the receptacle 4 is divided into two semi-cylindrical portions 9 and 10, suitably hinged at the rear (not shown) and connected by means of catch 11 enabling the upper portion 10 to be opened and a cartridge placed in the receptacle in operative alignment with the piston 3. The lower semi-cylindrical portion 9 is supported by upright 12 and bearing 13 secured to the external forward wall portion 14 of the motor housing 1.

As shown in Fig. 2, the means for securing the cartridge 5 in operative alignment with the piston 3 comprises a hollow socket member 4a internally screw-threaded at 15. Alternatively, or in addition, the socket 4a may be provided with a bayonet flange 16 for reception therein of correspondingly flanged portion 17 (Fig. 7) of a cartridge casing. The socket member 4a in Fig. 2 can also be provided with a series of internally screw threaded portions (not shown), of different diameters for the recep-

tion of cartridges, or of packages containing cartridges, of correspondingly different diameters, to enable cartridges of different sizes to be loaded in operative position in the same device.

Referring particularly to Fig. 3, the cartridge comprises a longitudinal barrel portion 18, to the rear of which is provided an internal plug or stopper 19 adapted to slide inwardly of the cartridge in response to externally applied pressure. The plug 19 is preferably formed of flexible material such as rubber, cork or suitable plastic, and it engages the inner wall of the barrel portion in a fluid-tight relationship. The plug 19 is provided with one or more annular recesses 20a forming sealing rings for preventing the back discharge of liquid around the rim of the plug during its forward movement. These annular recesses become filled with the fluid in case of any flaw in the forward peripheral surface of the plug 19 and function to seal the rim of the plug to the rear of any such flaw. The rear end of the cartridge is otherwise open. The front end has an integral wall portion 20 with a centrally located opening 21 opening into a tubular extension or conduit 8, the other end of which is normally closed by a removable or penetrable closure member 22.

The tubular member 8 is of any suitable length for connecting the cartridge 5 with a hypodermic needle to be inserted in the body of the patient. The hypodermic needle 23 may be secured to the end of the tubular extension 8 through closure means 22, as illustrated in Fig. 5.

The tubular extension 8 is an integral extension of the ampule 5 as shown in Fig. 3. In the modifications shown in Figs. 4, 5 and 7, the opening 21 is provided with a plug or closure member 25, adapted to be penetrated by a perforator 26 (Figs. 4 and 5) secured to the rear end of the tubular extension 8. In the modification illustrated in Fig. 6 the forward wall 20 of the cartridge 5 is provided with an integral neck portion 27 around which the end of the tubular extension 8 is attached. In the modification illustrated in Fig. 4, the rear end portion of the cartridge 5 is externally screw threaded to enable it to be directly loaded in the correspondingly screw threaded portion 15 of socket 4a of the injection apparatus.

The piston 3 in each instance is arranged in operation in alignment with the central rear wall of the plug 19. This rear wall is preferably reinforced by a metal or hard rubber coating 28 and is formed with a centrally located spherical detent portion 29 corresponding to and for reception of the forward end 30 of the piston 3.

The body of the cartridge is made of glass or of other suitable material. The conduit 8 is formed of rubber or of other suitable flexible material.

The embodiment of the invention illustrated in Figs. 2 and 5 through 7 shows cartridge 5 encased in a casing 31 formed of relatively strong material, such as corrugated paper, metal, etc., enabling the cartridge to be shipped and handled without danger of fracturing. The casing 31 thus forms a transportable cartridge receptacle. It is open at its rear end 32, which end is externally screw-threaded at 33 (Fig. 5) or bayonet slotted at 17 (Fig. 7) for reception in the correspondingly formed socket 4a. Over the rear end 32 of the casing 31 a cap member 34 is attached for protection during storage and shipment. The cap member 34 is arranged to cooperate with screw threaded portion 33 or bayonet slot 17 through corresponding internal screw-threaded or flange portions.

The forward end of the casing 31 is provided with a cover member 35 adapted to fit tightly over the forward end 36 of the casing 31. The forward end 36 covers the forward wall portion 20 of the cartridge 5 and has a bore 37 for reception therein of the plug 25. In general, the casing 31 conforms to the external shape of the cartridge, is open at the rear and comprises rearwardly arranged attaching means for locating the cartridge in operative alignment with the piston 3 of the injection apparatus.

As shown in Fig. 5, the forward cap member 35 may be of such size as to provide an external chamber 38 for location therein, externally of the cartridge casing, of the tubular extension 8 and hypodermic needle 23 carried in protective casing 24.

Referring again to Fig. 1, hollow piston 3 is slidably mounted in bearing 39 carried by upright 40 located in-

ternally of casing 1. To the rear, piston 3 is secured to or integral with connecting member 41. Internally of piston 3, rides guide rod 42 rearwardly mounted in bearing 43 on rear upright 44. The hollow piston 3 is thus adapted to reciprocate on guide rod 42. Opening 80 is provided in the forward wall 14 of casing 1 to allow piston 3 to pass into operative contact with plug 19 of ampule 5.

The connecting member 41 comprises a neck portion 45 terminating in knob 46 extending through the upper plate 47 of the housing 1. The plate 47 is slotted as at 48 to enable the neck portion 45 to travel forwardly on forward movement of the piston 3. The neck portion 45 is constrained upwardly by coil spring 49 located beneath shoulder portion 50 of the connecting member 41. The neck portion 45 is bifurcated (Fig. 8) to overlie the bearing 41 to distend into two parallel arms 51 down each side of member 41 to terminate in semi-circular internally screw-threaded split nut 52 adapted to mesh with screw-threaded drive shaft or lead screw 53. The normal pressure of spring 49 maintains split nut 52 in meshing alignment with shaft 53.

The screw-threaded drive shaft 53 is mounted in bearings 54 and 55 supported in uprights 40 and 44 respectively. Gears 56 and 57 operatively connect the drive shaft 53 through to an electric motor generally indicated at 61. Thus, gear 56 is secured to the rear end of drive shaft 53 and is mounted for cooperative action with gear 57 mounted on shaft 62 associated with variable gearing generally indicated at 58, which in turn is driven by spindle 63, gear 59, gear 60, spindle 64 and motor 61. The uprights 40 and 44, motor 61 and gear box 58 are all mounted on base 2 within casing 1.

In Fig. 2 the hollow piston 3 is forwardly mounted in bearing 39 and rides on guiding rod 42 which is rearwardly mounted in bearing 43. In this case the connecting member 41a is directly connected with internally screw-threaded travelling nut 65 meshing with screw-threaded drive shaft 53. Screw-threaded drive shaft 53 meshes through gears 56 and 66 and pinion 66a with differential gearing generally indicated at 57. The differential 57 is also adapted to be operated manually by spindle 68 and hand-operated wheel 69 carrying handle 70. The spindle 68, mounting wheel 69, passes externally of the casing 1 through bearing 71. The differential gearing 57 is connected by spindle 72 to gears 73 and 74, through spindle 75 mounted on bearing 76 to an electric motor generally indicated at 77. The electric motor in this instance is adapted to be controlled by a relay, generally indicated at 78, controlled by a timing motor generally indicated at 79 and provided with power inlet 81 leading to a suitably located switch (not shown).

In the modification shown in Fig. 2, the forward upright 40 is eliminated and instead the forward wall portion 14 of the casing 1 functions to carry the bearings 39 and 54 supporting the piston 3 and the screw-threaded drive shaft 53 respectively. The bearing 39 in Fig. 2 permits the hollow piston 3 to reciprocate through it.

It is contemplated that pre-formed sterile cartridges with their tubular conduits also in sterile condition, and loaded with selected medicament, will be prepared and supplied by manufacturers of medicaments. When not integral or permanently secured to the cartridge 5, the tubular extension member 8 is secured to the forward end of the cartridge 5. Prior to actual use, the perforator 26 (Fig. 4) of the tubular extension 8 is located part way through plug 25. In the modification illustrated in Figs. 5 to 7, the cartridge is then assembled in supporting casing 31 and capped by end members 34 and 35. The package is then transmitted to the physician or hospital and stored ready for use.

When it is desired to effect an injection by this improved apparatus, it is suitably located on a table or shelf at an appropriate distance from the patient and connected to a source of electric power. The cartridge is then placed in the receptacle 4 (Fig. 1), or, if of the type illustrated in Figs. 4 to 7, the rear end portion of the casing 31 or of the cartridge is screwed or slotted into place in the annular socket member 4a of the apparatus shown in Fig. 2.

The hypodermic needle, if not already provided as illustrated in Fig. 5, is then attached in the forward end of the tubular extension 8 and inserted in the body of the patient by the physician. In the proximity of the point of insertion, the tubular extension 8 is secured in

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place by strips of adhesive tape attached to the patient.

If the tubular extension 8 forms an integral extension of the cartridge 5 as illustrated in Figs. 3 and 6, the therapeutic fluid fills the tubular portion, and the arrangement is ready for immediate use. When the tubular portion is not immediately in communication with the interior of the cartridge, the attending physician has, prior to the insertion of the needle, to operate the piston for a short spell, preferably by hand, to eject the air from the tubular portion and the attached needle before inserting it into the patient.

Hand operation of the apparatus for this purpose may be effected in the arrangement shown in Fig. 1 by pushing the knob 46 downwardly and then forwardly to a slight extent. The downward pressure on knob 46 disengages screw-threaded split nut 52 from the drive shaft 53 and enables the connecting member 41 with associated piston 3 to be propelled forwardly. In the arrangement shown in Fig. 2, a similar effect is secured by a slight rotation of wheel 69 by handle 70 which through differential gearing 57, pinion 66a and gear train 66 and 56 propels the drive shaft 53 and causes connecting member 41a through nut 65 to propel piston 3 forwardly.

After all the air has been expelled from the tubular portion and the needle itself and the needle inserted, the motor is set for operation at a predetermined rate of speed. In the arrangement shown in Fig. 2, this is done by setting timing motor 79 to operate the timer 78 which in turn controls the action of the motor 77.

The motor propels the screw-threaded drive shaft 53 through the appropriate gearing described above. In turn the connecting member 41 or 41a driven by the lead screw 53 propels the piston 3 to the left (in the drawings) and this in turn pushes plug 19 of cartridge 5 to the left to expel the fluid contents of cartridge 5 through the tubular portion 8 and needle 23 into the patient. The piston 3 therefore is propelled forwardly but not rotatably by the drive-shaft or lead screw 53.

By suitably selecting the speed of rotation of the lead screw 53 and controlling it by the mechanisms referred to, the contents of a cartridge may be discharged at any predetermined rate in a continuous or intermittent fashion.

At the completion of an injection the piston 3 is returned to its inoperative position to the right by simple hand manipulation of the connecting member 41 in the device shown in Fig. 1, or by reverse rotation of the wheel 69 in the device shown in Fig. 2. The casing, or the cartridge, as the case may be, is then taken out of the receptacle 4 or socket 4a and discarded.

Both large and minute amounts of medicaments may thus be injected over long or short periods of time as required. The contents of a single cartridge may also be employed for multiple injections since after a part of the contents of the cartridge has been injected, the needle can be removed and replaced by a new needle which may then be inserted to administer another quantity of the same drug to another patient.

This arrangement thus permits mass injections to be effected efficiently where large numbers are to be treated substantially simultaneously, as in the Army or in connection with means for combatting threatened epidemics in city populations, among cattle, etc.

Insofar as normal hospital use is concerned, the device provides an efficient means for injecting variable quantities of therapeutic agents over extended periods of time. This is important in the treatment of many diseases where in some instances injections of small volumes of drugs continuing over several days' time are desirable but have heretofore been difficult or impossible. The apparatus, therefore, not only facilitates the known administration of certain drugs over extended periods of time, but it also permits the principles of prolonged injections to be extended over a wide range of drugs, etc., which heretofore have not been so applied.

Numerous modifications may be made within the spirit and scope of this invention. Particularly the attaching means for locating the cartridge in operative alignment with the piston, the specific means for propelling the piston, and the particular nature of the material of which the cartridge and its tubular extension may be formed, may be varied in accordance with the skill and knowledge of the expert.

The cartridge forming part of this invention is adapted

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for immediate use and for disposal after use. The contemplated prefabrication, loading, sterilization and packaging of the cartridges, and their tubular extensions, by manufacturers of medicinals, facilitates their use in hospitals, etc.

The employment of electric controls permits the amount of drug, etc., injected over a given time to be precisely measured and, if desired, as precisely repeated, and the mechanism provided enables drugs to be administered under hand control as well as mechanically, as the situation demands.

I claim:

1. In a motor driven injection apparatus, a stationary support, a motor secured to said support, a piston on said support operatively associated with the drive shaft of said motor, a hollow socket member on the stationary part of the apparatus disposed in alignment with the path of travel of said piston for reception therein of a cartridge containing medicament, and means for releasably securing said cartridge in said socket member in operative alignment with said piston, whereby the contents of said cartridge are discharged on operation of said motor.

2. In a motor driven injection apparatus as claimed in claim 1, wherein said means for releasably securing said cartridge in said socket member comprise cooperatively screw-threaded portions on said cartridge and said socket member.

3. In a motor driven injection apparatus as claimed in claim 1, wherein said means for releasably securing said cartridge in said socket member comprise a casing embracing the front and side walls of said cartridge, but open to the rear and having a forward outlet port, and cooperative attaching means on the rear portion of said casing and within said socket member.

4. In a motor driven injection apparatus as claimed in claim 3, wherein said cooperative means for releasably securing said cartridge to said injection apparatus comprise cooperatively screw-threaded portions on said casing and said socket member.

5. In a motor driven injection apparatus as claimed in claim 1, the provision of manually operating means for effecting the reverse operation of said piston.

6. An ampule-cartridge for a motor driven injection apparatus comprising a body portion, an outlet port at the front of said body portion, penetrable fluid-tight closure means for sealing said outlet port, an injectable fluid sealed within said ampule-cartridge, a flexible and sealed conduit having one end adapted for attaching a needle, closure means at said end of said conduit for sealing the latter, means connected with the other end of said conduit and with said penetrable closure means for establishing communication of injectable fluid between said body portion and said conduit through said penetrable closure means, displaceable piston means mounted at the rear end of said body portion for discharging said injectable fluid from the ampule-cartridge and said conduit in response to externally applied pressure, said piston means being adapted to engage the plunger of said motor driven injection apparatus, and securing means mounted on said ampule-cartridge for releasably engaging corresponding securing means on said injection apparatus and for holding said ampule-cartridge in operative alignment with the plunger of said apparatus.

7. An ampule-cartridge for a motor driven injection apparatus as claimed in claim 6, wherein said securing means on the ampule-cartridge comprise a screw-threaded portion on the rear end of said ampule-cartridge for operative association with cooperating screw-threaded securing means on said injection apparatus.

8. An ampule-cartridge for a motor driven injection apparatus as claimed in claim 6, wherein said securing means on the ampule-cartridge comprise a casing encasing the front and side walls of said ampule-cartridge and having front and rear opening for reception therethrough of said conduit and plunger of the injection apparatus respectively, and an externally screw-threaded portion at the rear end of said casing for operative association with cooperating screw threaded securing means on said injection apparatus.

9. An ampule-cartridge for a motor driven injection apparatus as claimed in claim 8, wherein said casing comprises removable front and rear cap members for closing the front and rear openings on the latter.

10. An ampule-cartridge for a motor driven injection apparatus as claimed in claim 6, wherein said securing

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means on the ampule-cartridge comprise a casing encasing the front and side walls of said ampule-cartridge and having front and rear opening for reception therethrough of said conduit and plunger of the injection apparatus respectively, and a bayonet-flanged portion mounted at the rear end of said casing for operative association with cooperating securing means on said injection apparatus.

References Cited in the file of this patent

UNITED STATES PATENTS

1,869,443	Stocklin	Aug. 2, 1932
2,127,203	Brand	Aug. 16, 1938

2,134,145
2,176,042
2,259,276
2,457,977
2,498,672
2,502,676
2,505,308
2,574,263
2,605,765

10

399,824

8

Pincock	Oct. 25, 1938
Pittenger	Oct. 10, 1939
Swabacker	Oct. 14, 1941
Cookson	Jan. 4, 1949
Glass	Feb. 28, 1950
Smith	Apr. 4, 1950
Smith	Apr. 25, 1950
Hinds	Nov. 6, 1951
Kollsman	Aug. 5, 1952

FOREIGN PATENTS

France	May 5, 1909
--------	-------------