Aug. 22, 1967 L. K. THOMPSON III 3,336,925

CONTROLLED MEDICAL INJECTION APPARATUS

Filed July 9, 1965

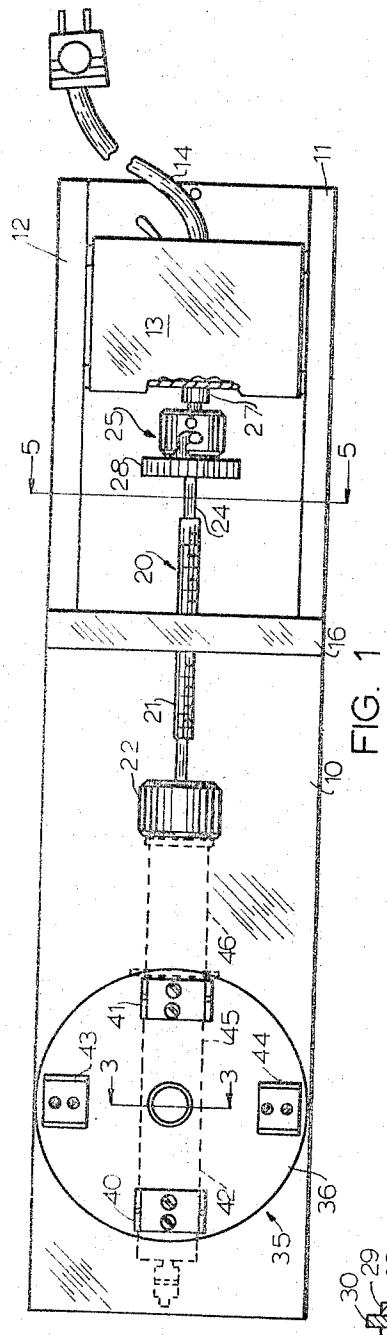


FIG. 1

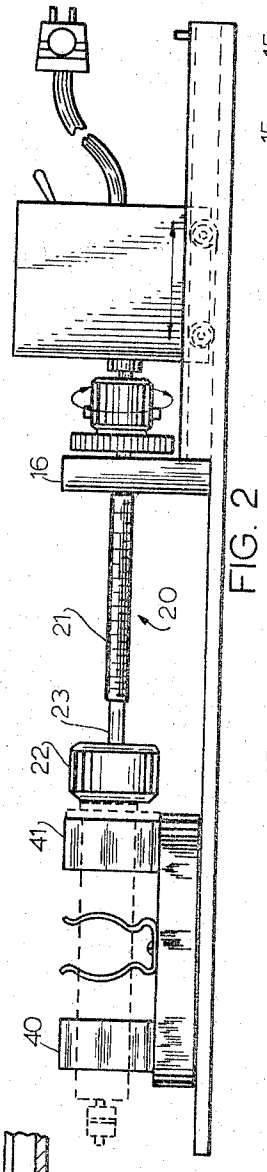


FIG. 2

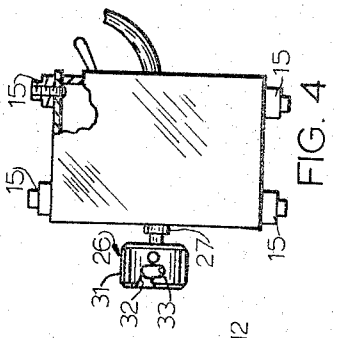


FIG. 4

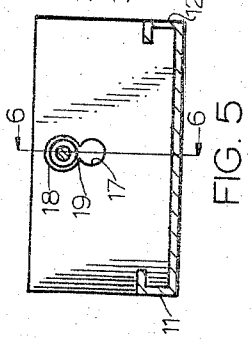


FIG. 5

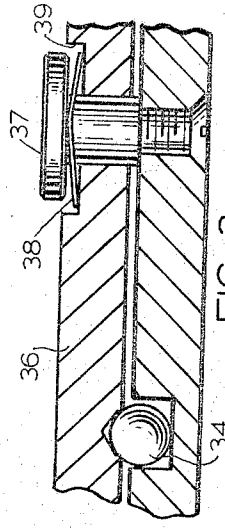


FIG. 3

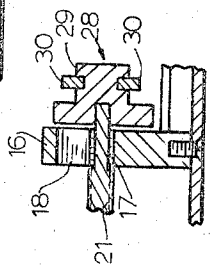


FIG. 6

INVENTOR.
Lawrence K. Thompson, III

BY

B. B. Olive
ATTORNEY

United States Patent Office 3,336,925
Patented Aug. 22, 1967

3,336,925

CONTROLLED MEDICAL INJECTION APPARATUS

Lawrence K. Thompson III, 3815 Tremont Drive, Durham, N.C. 27705

Filed July 9, 1965, Ser. No. 470,816
9 Claims. (Cl. 128—218)

This invention relates to a motor driven medical injection apparatus, and more particularly, to improvements in automatic injection apparatuses which control the administration of therapeutic fluids from a hypodermic syringe to a patient.

During the course of medical therapy and particularly during medical surgery, occasions arise when therapeutic fluids are to be administered to a patient over a relatively extended period of time. At present, infusions of this nature are administered either by repeated injections by hand or by the impercise gravity forced drip method. The prior art discloses some automatic injection devices; however, they are generally bulky, cumbersome and complicated to operate and expensive to manufacture.

The present invention provides an automatic injection device which may be easily operated by a hospital aid and an object of this invention is to provide a completely automatic injection apparatus for injecting therapeutic fluids at a controlled rate directly into a patient.

Another object of this invention is to provide an automatic injection apparatus which is adapted to inject a therapeutic fluid into a patient from a standard medical syringe.

A further object of this invention is to provide a completely automatic injection apparatus which causes a therapeutic fluid to be injected into the body of a patient at a uniform, continuous rate over a predetermined length of time.

Yet still another object of this invention is to provide in an automatic injection apparatus a power source which can travel as the apparatus operates.

These and other objects of this invention will become apparent from the following detailed specification, appended claims and attached drawings in which:

FIGURE 1 is a top plan view of the invention showing the threaded drive shaft coupled to the power source at one end and engaging the pistons of a syringe at the other.

FIGURE 2 is a side elevation of the apparatus showing the threaded drive shaft having been wormed through a block and into a position of non-advancement.

FIGURE 3 is a fragmentary section taken along lines 3—3 of FIGURE 1 showing the apparatus for mounting the syringe-receiving turntable.

FIGURE 4 is a plan view of the drive motor showing a slide bearing in partial section.

FIGURE 5 is a section taken along lines 5—5 of FIGURE 2 showing the drive shaft in a non-threaded opening.

FIGURE 6 is a section taken along lines 6—6 of FIGURE 5 showing the non-threaded portions of the drive shaft in the threaded passageway of the block.

In general, the embodiment of the invention illustrated by the drawings and following description is comprised of an elongated base plate which is adapted to receive a syringe at one end, a threaded drive shaft in the middle and a movably positioned motor at the other end. The threaded drive shaft has a head which seats against the piston portion of a syringe and which moves the piston inwardly into its cooperating cylinder when the drive shaft is rotated by the movably positioned motor. The motor output shaft engages the drive shaft by a coupling arrangement and upon rotation of the coupling, the drive shaft is wormed forwardly through a block which causes the motor to be pulled along the rear portion of the base plate. That is, as the drive shaft rotates the motor is pulled in the same direction as the travel of the drive shaft. The rear portion of the base is provided with guide rails which are parallel to each other and disposed on opposite sides of the base plate to provide a track which is adapted to receive motor slide bearings. The motor may also be mounted on wheels which in turn may be rollably mounted on a track formed by the guide rails.

An electric motor is mounted on the base plate and is provided with a current-carrying extension cord, an off-on switch, a gear reduction means which is located within the motor box, an output shaft connected to the gear reduction means and a couple mounted on the output shaft. When the motor is energized, the reduction gears turn the output shaft and the couple at a very slow speed, that is less than five revolutions per minute and preferably approximately one-half revolution per minute. The coupling assembly includes a female couple which is mounted on the output shaft that is energized by the gear reducing means. The female couple has a recess or cavity therein and has a slotted wall surface, the recess receiving a cylindrical shoulder which is mounted on a threaded drive shaft while the slotted portion receives locking pins which are mounted upon the collar. The shoulder and locking pins form a male couple. When the male and female couplings are in a locked position, the motor upon energization thereof turns in a direction which tends to keep the coupling locked to the threaded drive shaft. The drive shaft which is threadably received in a block by a threaded passageway is advanced upon the turning of the male coupling unit. While the threaded shaft is advancing through the block, the coupling arrangement causes the motor to be pulled along the surface portions of the base plate.

The threaded drive shaft is provided with a smooth section adjacent both the shaft head and the male coupling element. This non-threaded section of the shaft effectively serves as a stop means for when the threaded portion has wound its way through the block, the engaging threaded portions become disassociated and the shaft is prevented from advancing further. The drive shaft may be returned and repositioned for a next forward thrust by disengaging the male couple from the female couple, raising the smooth portion of the drive shaft through an opening into a clean, non-threaded passageway, pulling the drive shaft back through the clean passageway until only the non-threaded portion of the shaft adjacent the drive head is in engagement therewith, pushing this non-threaded portion back through the opening and into the threaded passageway of the block, threadably engaging the drive shaft with the threaded passageway and uniting in a locking position the male and female couplings.

The syringe or hypodermic needle which contains a therapeutic fluid is positioned in a pair of clamps which are mounted on a rotating table. It is to be noted that these clamps may be mounted directly on the base plate; however, to provide clamps which receive larger and smaller syringes, a plurality thereof are mounted on a base table which may be turned into a position for receiving most any size syringe. The piston of the syringe when extended is adapted to seat against the drive shaft head and is pushed inwardly into the syringe by this head.

Referring specifically to the drawings, a base plate **10** which is rectangular in the plan view is provided with a pair of opposed guide rails **11** and **12** which are arranged in parallel and on the opposite sides of the elongated base plate **10**. Base plate **10** and rails **11** and **12** provide a track along which a movably mounted motor box **13** may slide. Motor box **13** contains a motor and a gear reduction train (which are not shown), a current-carrying cord **14**, and a plurality of slide bearings **15** which are adapted to be received by rails **11** and **12** in a ver-

tically locking position. The track also provides stability in a direction transverse to the direction of the guide rails.

Shaft block **16** which is of the same material as base plate **10** is perpendicularly mounted thereon in a transverse direction at approximately the center thereof. Block **16** is provided with a threaded passageway **17** and a non-threaded or smooth passageway **18** which are openly connected by an opening **19**. Smooth passageway **18** has a diameter which is larger than the outside diameter of threaded passageway **17**. Passageway **17** is adapted to receive in a threaded engagement the threaded portion **21** of threaded drive shaft **20**. Drive shaft **20** is provided with a drive shaft head **22** being mounted at one end, a non-threaded shaft section **23** being adjacent drive shaft head **22**, a threaded drive shaft section **21** extending from section **23** to a second non-threaded drive shaft section **24**, and a male coupling arrangement **28** which is connected to second section **24**. Non-threaded drive shaft sections **23** and **24** are of a diameter smaller than the inner diameter of threaded shaft section **21**.

Motor **13** is adapted to be detachably coupled to drive shaft **20** by means of a coupling arrangement **25**. The coupling arrangement is comprised of a female couple **26** which is securely mounted on motor output shaft **27** and a male couple **28** which is securely mounted on threaded drive shaft **20**. Male couple **28** has a substantially cylindrical shoulder **29** which perpendicularly and integrally receives locking pins **30**. Female coupling **26** is provided with a collar **31** which has located therein a cavity **32** and a slot **33** extending through the wall portions thereof which receive shoulder **29** and locking pins **30** respectively of male coupling **29**. It is to be noted that the coupling arrangement may be reversed with male couple **28** being mounted on output shaft **27** and female couple **26** mounted on drive shaft **20**.

A turntable arrangement **35** is mounted on base plate **10** at the end and opposite that end of the base plate which receives motor **13**. Turret **36** is rotatably mounted on base plate **10** about shaft **37**, shaft **37** being rigidly and perpendicularly arranged on base plate **10**. A circular flat spring **38** is concentrically mounted on shaft **37** and in counterbore **39**. Leaf spring **38** is adapted to frictionally maintain turret **36** in a desired position. A plurality of ball bearings **34** are suitably positioned to reduce friction and to provide a detent type action. A pair of disposed and aligned brackets **40** and **41** are mounted on turret **36** for receiving a syringe **42**, syringe **42** being shown in dotted form. A second pair of spaced and aligned brackets **43** and **44** are mounted on turret **36** for receiving a syringe having a different cylindrical diameter. Brackets **43** and **44** may become operable by rotating turret **36** into a position which axially aligns cylindrical syringe **42** with threaded drive shaft **21**.

In operation, syringe **42** having a cylinder **45** and a piston **46** being in an extended position is securely mounted in brackets **40** and **41**. Drive head **22** of shaft **20** is placed in a pushing position against piston **46**. Threaded shaft **21** is threadably mounted in block **16** and male coupling **28** is received by female coupling **26** in a locking engagement. Upon the rotating of coupling **25** by motor output shaft **27**, threaded drive shaft **20** advances through block **16** pushing piston **46** into cylinder **45** and pulling motor **13** along guide rails **11** and **12**. The forward movement of the threaded drive shaft **20** and motor **13** is limited in that when threaded portion **21** of drive shaft **20** worms its way through block **16** and becomes threadably disengaged therefrom, block **16** receives non-threaded shaft portion **24** which is not adapted to advance drive shaft **20**. To repeat this stroke, female coupling **26** is removed from male coupling **28** and motor **13** is repositioned at one end of base plate **10**. Threaded drive shaft **20** is repositioned into a driving position by manually moving non-threaded portion **24** from threaded passageway **17** to non-threaded passageway **18** and sliding threaded shaft **21** the length thereof through non-threaded passageway **18** until non-threaded portion **23** is received by non-threaded passageway **18** whereupon non-threaded portion **23** is placed into threaded passageway **17** and threaded shaft **21** is threadably engaged with threaded passageway **17**. Upon uniting male coupling **28** with female coupling **26** and inserting a fresh syringe **42** in brackets **40** and **41**, the apparatus is again adapted to inject a therapeutic fluid into a patient at a uniform rate and over a predetermined length of time.

Since many variants may be obviously introduced into the features of this invention without departing from the spirit and scope thereof, it is to be understood that the accompanying drawings are to be interpreted in an illustrative rather than a limiting sense.

I claim:

1. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) a base having planar surfaces;

(b) means for firmly attaching said syringe to said base;

(c) a motor slidably mounted on said base, said motor having an output shaft being adapted for rotation;

(d) a block means stationarily mounted on said base and having a threaded passageway extending therethrough;

(e) a threaded drive shaft having a length thereof being in threadable engagement with said threaded passageway and having one end thereof positioned against the exposed end of said piston, said threaded drive shaft upon the rotation thereof being adapted to force said piston into said cylinder; and

(f) means for disengageably connecting the other end of said threaded drive shaft to said motor drive shaft whereby upon a rotation thereof said threaded drive shaft is advanced a distance through said block means thereby pulling said motor a distance along said base.

2. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) an elongated base plate having planar surfaces and having a pair of disposed guide rails mounted on a surface thereof, said guide rails on said surface cooperating to form a track;

(b) means for firmly attaching said syringe to a surface of said base;

(c) a motor having slide bearings fixed thereto, said bearings being received by said guide rails thereby adapting said motor to slide along said track, said motor having an output shaft being adapted for rotation;

(d) a block means stationarily mounted on said base and having a threaded passageway extending therethrough;

(e) a threaded drive shaft having a length thereof being in threadable engagement with said threaded passageway and having one end thereof positioned against the exposed end of said piston, said threaded drive shaft upon the rotation thereof being adapted to force said piston into the cylinder; and

(f) means for disengageably connecting the other end of said threaded drive shaft to said motor output shaft whereby upon a rotation thereof said threaded drive shaft is advanced a distance through said block means thereby pulling said motor a distance along said base.

3. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) a base having planar surfaces;

(b) means for firmly attaching said syringe to said base;

(c) a motor slidably mounted on said base, said motor having an output shaft being adapted for rotation;

(d) a block means stationarily mounted on said base and having a threaded passageway extending therethrough;

(e) a threaded drive shaft having a length thereof being in threadable engagement with said threaded passageway and having one end thereof positioned against the exposed end of said piston, said threaded drive shaft upon the rotation thereof being adapted to force said piston into said cylinder; and

(f) a coupling disengageably connecting the other end of said threaded drive shaft with said end of said motor output shaft, said coupling being comprised of a shoulder mounted on one selected end, said shoulder having a lock pin rigidly attached thereto and a collar mounted on the other end having a slot in the wall thereof, said collar adapted to internally receive said shoulder and said slot to receive said lock pin whereby upon a rotation of said motor drive shaft said threaded drive is advanced a distance through said block means thereby pulling said motor a distance along said base.

4. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) an elongated base plate having planar surfaces and having a pair of disposed guide rails mounted on a surface thereof, said guide rails and said surface cooperating to form a track;

(b) means for firmly attaching said syringe to a surface of said base;

(c) a motor having slide bearings fixed thereto, said bearings being received by said guide rails thereby adapting said motor to slide along said track, said motor having an output shaft adapted for rotation:

(d) a block means stationarily mounted on said base and having a threaded passgeway extending therethrough;

(e) a threaded drive shaft having a length thereof being in threadable engagement with said threaded passageway and having one end thereof positioned against the exposed end of said piston, said threaded drive shaft upon the rotation thereof being adapted to force said piston into said cylinder; and

(f) a coupling disengageably connecting the other end of said threaded drive shaft with said end of said motor output shaft, said coupling being comprised of a shoulder mounted on one selected end, said shoulder having a lock pin rigidly attached thereto and a collar mounted on the other end having a slot in the wall thereof, said collar adapted to internally re-receive said shoulder and said slot to receive said lock pin whereby upon a rotation of said motor drive shaft said threaded drive shaft is advanced a distance through said block means thereby pulling said motor a distance along said base.

5. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) a base having planar surfaces;

(b) means for firmly attaching said syringe to said base;

(c) a motor slidably mounted on said base, said motor having a drive shaft being adapted for rotation;

(d) a block means stationarily mounted on said base and having a threaded passageway extending therethrough;

(e) a threaded drive shaft having a drive shaft head at one end positioned against the exposed end of said piston, a power receiving end and a shaft, said shaft having a smooth portion extending a distance from said power receiving end being greater than the length of said threaded passageway in said block means and a threaded portion extending from said smooth portion and having an inner diameter being greater than the diameter of said smooth portion,

said threaded drive shaft being adapted for rotation and advancement when said threaded portion is threadably received by said threaded passageway and being adapted for rotation only when said smooth portion resides in said threaded passageway; and

(f) means for disengageably connecting the other end of said threaded drive shaft to said motor output shaft whereby upon a rotation thereof said threaded drive shaft is advanced a distance through said block means thereby pulling said motor a distance along said base.

6. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) a base having planar surfaces;

(b) means for firmly attaching said syringe to said base;

(c) a motor slidably mounted on said base, said motor having a drive shaft being adapted for rotation;

(d) a block stationarily mounted on said base, said block having a threaded passageway and a smooth passageway extending therethrough, said passageways being axially parallel and being connected by an opening extending the length thereof, said smooth passageway having a diameter being greater than the outer diameter of said threaded passageway;

(e) a threaded drive shaft having a drive shaft head at one end positioned against the exposed end of said piston, a power receiving end and a shaft, said shaft having a first smooth portion extending a distance from said power receiving end being greater than the length of said passageway in said block means, a second smooth portion extending a distance from said drive shaft head being greater than the length of said threaded passageway and a threaded portion linking said first and said second smooth portions and having an inner diameter being greater than the diameter of each smooth portion, said piston drive shaft being adapted for rotation and advancement when said threaded portion is threadably received by said threaded passageway; and

(f) means for disengageably connecting the other end of said threaded drive shaft to said motor output shaft whereby upon a rotation thereof said threaded drive shaft is advanced a distance through said block means thereby pulling said motor a distance along said base.

7. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) an elongated base plate having planar surfaces and having a pair of disposed guide rails mounted on a surface thereof, said guide rails and said surface cooperating to form a track;

(b) means for firmly attaching said syringe to a surface of said base;

(c) a motor having slide bearings fixed thereto, said bearings being received by said guide rails thereby adapting said motor to slide along said track, said motor having an output shaft being adapted for rotation;

(d) a block means stationarily mounted on said base and having a threaded passageway extending therethrough;

(e) a threaded drive shaft having a drive shaft head at one end positioned against the exposed end of said piston, a power receiving end and a shaft, said shaft having a smooth portion extending a distance from said power receiving end being greater than the length of said threaded passageway in said block means and a threaded portion extending from said smooth portion and having an inner diameter being greater than the diameter of said smooth portion, said threaded drive shaft being adapted for rotation and advancement when said threaded portion is

threadably received by said threaded passageway and being adapted for rotation and advancement when said threaded portion is threadably received by said threaded passageway and being adapted for rotation only when said smooth portion resides in said threaded passageway; and

(f) a coupling disengageably connecting the other end of said threaded drive shaft with said end of said motor output shaft, said coupling being comprised of a shoulder mounted on one selected end, said shoulder having a lock pin rigidly attached thereto and a collar mounted on the other end having a slot in the walls thereof, said collar adapted to internally receive said shoulder and said slot to receive said lock pin thereby upon a rotation of said motor drive shaft said threaded drive shaft is advanced a distance along said block means thereby pulling said motor a distance along said base.

8. An apparatus for automatically ejecting a therapeutic fluid from a medical syringe of the cylinder and piston type at a controlled rate comprising:

(a) an elongated base plate having planar surfaces and having a pair of disposed guide rails mounted on a surface thereof, said guide rails and said surface cooperating to form a track;

(b) means for firmly attaching said syringe to a surface of said base;

(c) a motor having slide bearings fixed thereto, said bearings being received by said guide rails thereby adapting said motor to slide along said track, said motor having an output shaft adapted for rotation;

(d) a block stationarily mounted on said base, said block having a threaded passageway and a smooth passageway extending therethrough, said passageways being axially parallel and being connected by an opening extending the length thereof, said smooth passageway having a diameter being greater than the outer diameter of said threaded passageway;

(e) a threaded drive shaft having a drive shaft head position against the exposed end of said piston, a power receiving end and a shaft, said shaft having a first smooth portion extending a distance from said

power receiving end being greater than the length of said threaded passageway in said block means, a second smooth portion extending a distance from said piston pushing end and being greater than the length of said threaded passageway and a threaded portion linking said first and second smooth portions and having an inner diameter being greater than the diameter of each smooth portion, said piston drive shaft being adapted for rotation and advancement when said threaded portion is threadably received by said threaded passageway; and

(f) a coupling disengageably connecting the other end of said threaded drive shaft with said end of said motor output shaft, said coupling being comprised of a shoulder mounted on one selected end, said shoulder having a lock pin rigidly attached thereto and a collar mounted on the other end having a slot in the walls thereof, said collar adapted to internally receive said shoulder and said slot to receive said lock pin whereby upon a rotation of said motor drive shaft said threaded drive shaft is advanced a distance through said block means thereby pulling said motor a distance along said base.

9. The apparatus of claim 8 wherein said means for firmly attaching said syringe to said base is comprised of a shaft being integral with and perpendicular to said base, a turntable rotatably mounted on said shaft, and a plurality of pairs of clamps, each pair being rigidly mounted on said turntable and axially aligned whereby each pair of said clamps is adapted to receive a syringe.

References Cited

UNITED STATES PATENTS

1,320,582	11/1919	Sperling	64—6
2,498,672	2/1950	Glass	128—218
3,156,236	11/1964	Williamson	128—218

FOREIGN PATENTS

4,718	2/1912	Great Britain.

RICHARD A. GAUDET, *Primary Examiner.*

D. L. BAKER, *Assistant Examiner.*