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Weissinger

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[54] **MEDICAL INFUSION APPARATUS**

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[52] **U.S. Cl.**.. **128/214 E;** 128/214 A; 128/DIG. 13; 222/173; 222/185

[51] **Int. Cl.**[2]..... **A61M 05/14**

[58] **Field of Search**..... 128/214 R, 214 A, 214 E, 128/214 F, 214 Z, 215, 218 NV, 221, 2 F, DIG. 12, DIG. 13; 222/173, 180–182, 185

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[57] **ABSTRACT**

A medical infusion apparatus has an infusion flask an infusion tube fastened to the flask and lying in a two part casing provided with an electrical control system and a drip valve or infusion pump, the flask being exchangeably fastened to the casing and the valve or pump being exchangeably disposed at the bottom of the casing. Heating means is provided to heat the liquid being infused.

6 Claims, 8 Drawing Figures

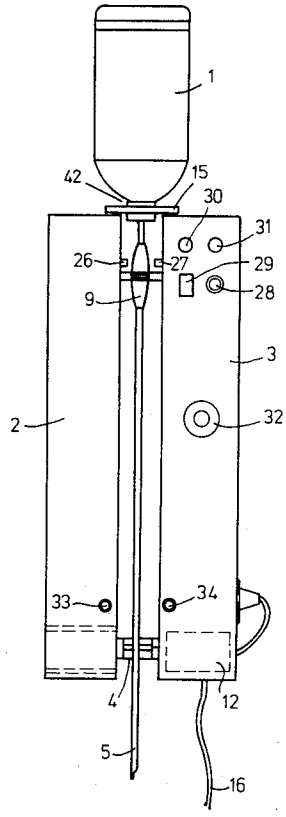


Fig. 1

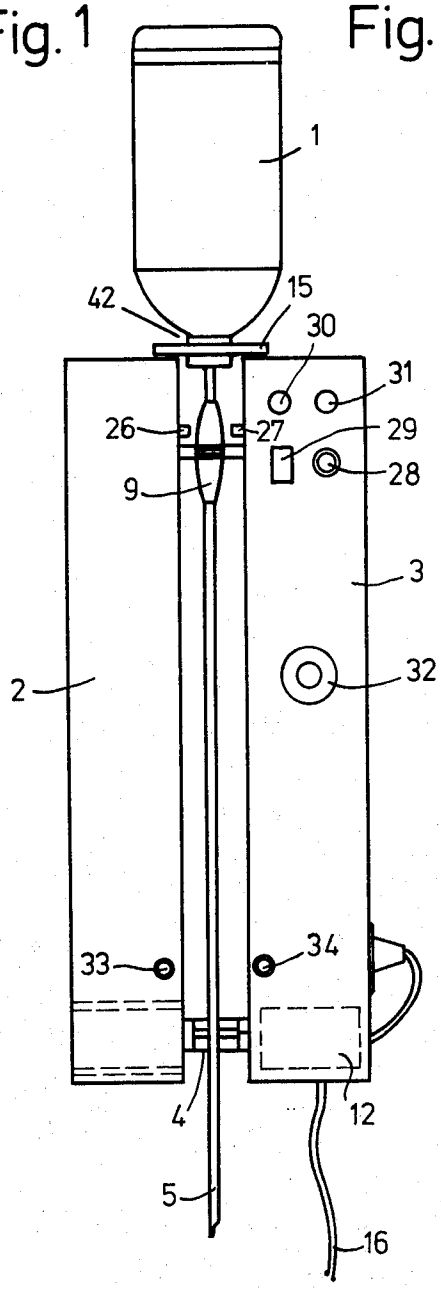


Fig. 2

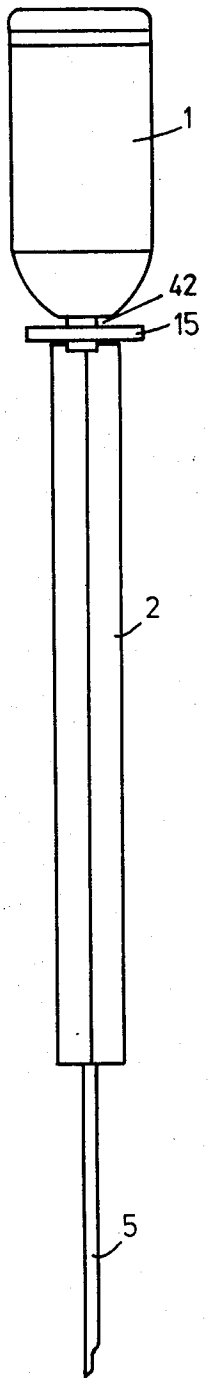


Fig. 3

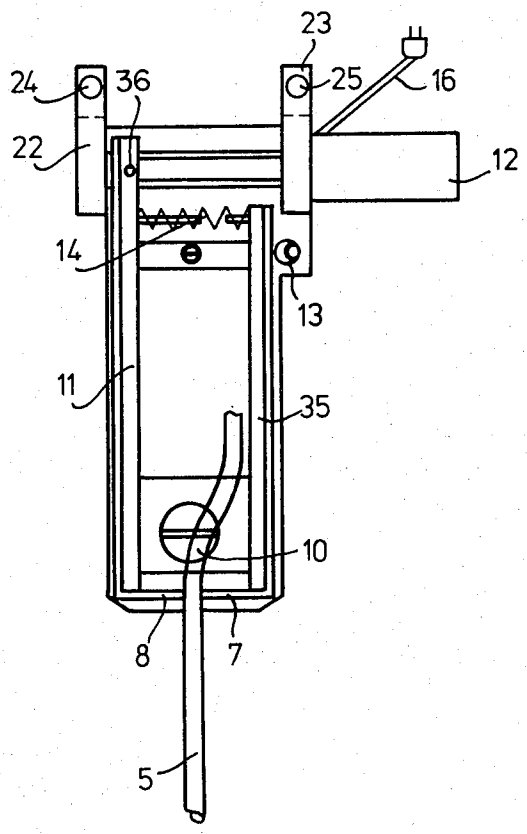
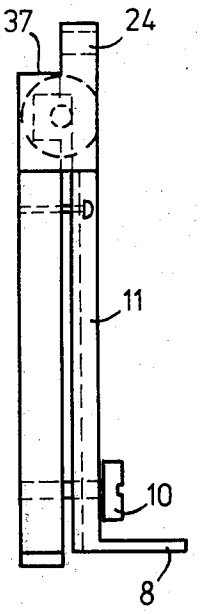


Fig. 4



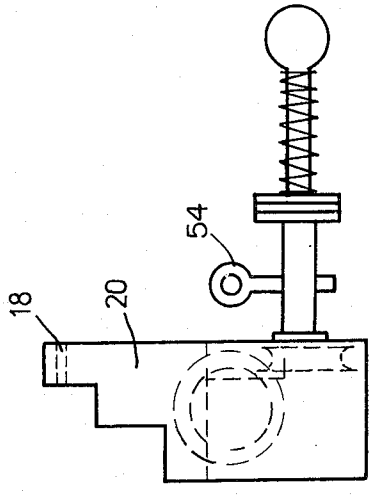


Fig. 6

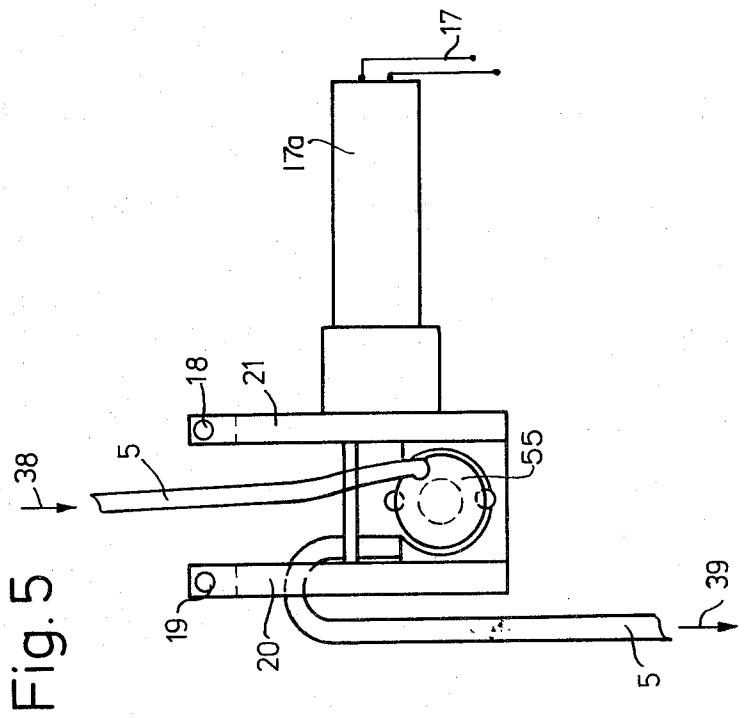


Fig. 5

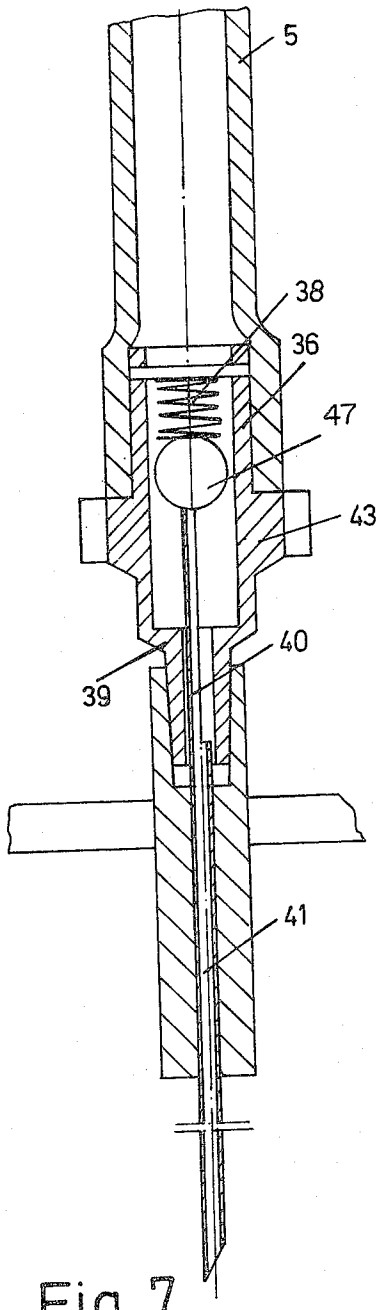


Fig. 7

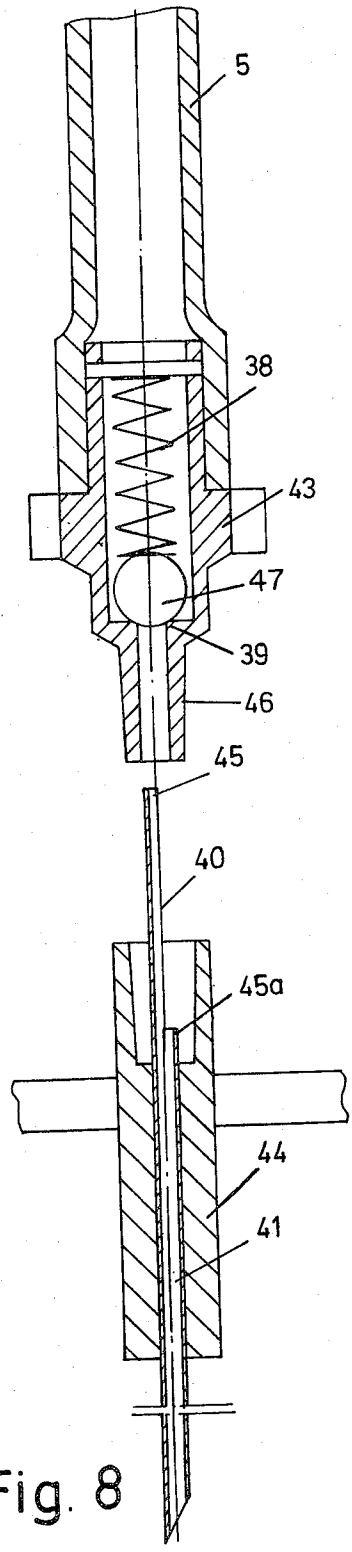


Fig. 8

MEDICAL INFUSION APPARATUS

BACKGROUND OF THE INVENTION

The invention relates to infusion apparatus, particularly electrically monitored, having an infusion flask, an infusion tube fastened thereto and provided with a drip chamber, a casing for receiving the electrical control system, and a drip valve or an infusion pump.

Infusion devices of this kind are already known — see for example applicable trade literature. In these devices gravity flow of an infusion solution is automatically controlled at a preselected rate of flow.

Through automatic self-control the known apparatus takes over the function of tube valves and clips. Infusion tubes of any desired thickness can be used, and the rate of flow is adjustable and is automatically maintained constant.

These devices however have the great disadvantage that the infusion flask is separate from an electronic control device, so that a drop sensor must be suspended on the infusion flask and kept separate from the device. Furthermore, various separate devices are required, depending on whether an infusion pump or a magnetic clip release device for flexible tubes is to be used.

Finally, the disadvantage also exists that when ordinary commercially available infusion tubes and complete infusion sets are used the flexibility of some tubes is so slight that a very large magnet is required for the known drip valves. Generally such commercially available tubes can not be used at all.

SUMMARY OF THE INVENTION

The problem underlying the invention therefore consists in so improving the apparatus of the kind first mentioned above that it can be used as universal apparatus. This means that the apparatus should permit in a simple manner the insertion of a complete commercially available infusion set, in such a way that it can work both with a drip valve and with an infusion pump without it being necessary, for example, to clip the drop sensor to the drip chamber.

According to the invention this problem is solved by exchangeably fastening the infusion flask on the top of the casing and exchangeably disposing the drip valve or infusion pump at the bottom of the casing.

In this way the separate clipping of the drop sensor to the drip chamber is not necessary, since the invention provides for the apparatus and the infusion flask to form a unit, so that after the flask has been disposed on the apparatus and the tube clamped in position no further installation work is necessary. Furthermore, the apparatus is capable of universal use because the drip valve can be replaced by a pump, so that the same apparatus can be adapted to various requirements.

As a further development of the invention provision is made for the casing to be composed of two parts and for the infusion tube to be disposed between the two parts. In this way maximum integration of the casing and infusion set is achieved, and the casing serves at the same time to receive the flask, so that the flask does not need to be separately suspended. For this purpose the infusion flask may also be provided with a mounting flange for the purpose of secure support on the casing.

Another feature of the invention consists in that the drip valve has two clamp jaws, of which at least one is connected to a lever which is movable about a fulcrum and the longer arm of which is acted on by the control

magnet. In this way a relatively small control magnet is sufficient to supply the necessary force in all cases so that the universal nature of the apparatus is further increased, since the most diverse tubes can be used without disadvantage. For this purpose it may also be very helpful for the second clamp jaw to be stationary but adjustable in position by means of an eccentric adjusting pin.

By means of this adjusting pin, adjustment to the most diverse thicknesses of tube can be achieved easily and simply.

The invention provides an infusion apparatus having an infusion flask, an infusion tube fastened thereon and provided with a drip chamber, a casing to receive an electrical control system, and a drip valve or an infusion pump, said infusion flask being exchangeably fastened to the casing and that the drip valve or the infusion pump being exchangeably disposed at the bottom of the casing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatical front view of an apparatus in accordance with the invention,

FIG. **2** a side view of the apparatus shown in FIG. **1**,

FIG. **3** a front view of a replacement part for use with the apparatus shown in FIGS. **1** and **2**,

FIG. **4** a side view of the replacement part shown in FIG. **3**,

FIG. **5** a front view of another replacement part for use on the apparatus shown in FIGS. **1** and **2**, and

FIG. **6** a side view of the replacement part shown in FIG. **5**.

FIG. **7** is a longitudinal section, on a much larger scale, through the end of the infusion tube, and

FIG. **8** shows the same as FIG. **7**, but before fastening of the infusion tube.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows the completely assembled apparatus, comprising an infusion set consisting of an infusion flask **1**, a drip chamber **9** and an infusion tube **5**, this set being incorporated in an apparatus comprising essentially two casing parts **2** and **3** together with a mounting flange **15**. The mounting flange **15** can, for example, be opened by means of a hinge in order to insert the infusion set. The drip chamber **9** thus always lies in the region of a transmitter **26** and a receiver **27** of known construction, without it being necessary for these components to be clipped to the drip chamber.

As indicated in FIG. **1**, no contact at all is made between these parts. In the lower region of the casing is indicated the drip valve **4**, which is operated by an electromagnet **12** the electric lead of which is designated **16**. This drip valve unit can be replaced by an infusion pump, as will be explained below more fully.

A number of switches, namely a starting switch **28**, a mains switch **29**, and a drip pre-selector switch **32**, are also provided on the casing. Furthermore, a mains pilot lamp **30** and an alarm lamp **31** are also indicated here.

Two screws **33** and **34** allow the drip valve unit to be replaced by a motor-driven infusion pump, as will be explained later on.

FIG. **3** shows the drip valve unit **4** in greater detail. This Figure shows two mounting lugs **22** and **23** with fastening holes **24** and **25**, by means of which the unit

can be replaced as a whole with the aid of the screw **33** and **34** shown in FIG. **1.**

The infusion tube **5** is clamped between clamp jaws **7** and **8,** which are rotatable about the screw **10.**

The clamp jaw **7** is generally made stationary, but can be adjusted by the action of an eccentric adjusting pin **13** on a long lever arm **35.**

The other adjusting jaw **8,** on the other hand, is adapted to be continuously moved by means of a magnet **12,** which acts on the switch pin **36** on the long lever arm **11.** The return movement is effected by means of the spring **14.**

Owing to the fact that, as can clearly be seen in the drawing, the long lever arm **11** has a length which is a multiple of that of the short lever arm between the clamp jaw **8** and the screw **10,** the magnet **12** can be of relatively small dimensions, while it is nevertheless possible for the most diverse tubes **5** to be used with the infusion set.

FIG. **4** shows a side view of the fastening hole **24** behind which is provided a recess **37** suitably adapted to the casing **2, 3,** so that the element can be fastened to the casing only by the two screws **33** and **34.**

Exactly the same purpose is served by two fastening holes **18** and **19** in FIGS. **5** and **6,** which are provided in a motor-driven infusion pump **55** shown there. These continuous action infusion pumps are known per se and need not be described in detail. The arrows **38** and **39** above and below the infusion tube **5** indicate the direction of flow. The motor **17***a* with its electric leads **17** is provided as drive means and is coupled by means of a coupling pin **54** through a worm drive, as can be seen in FIG. **6.** Mounting lugs **20** and **21** correspond to the mounting lugs **22** and **23** shown in FIG. **3.**

As already mentioned, it is of great importance that by means of the two screws **33** and **34** the unit consisting of the drive motor **17***a* and the infusion pump can also be easily and simply mounted on the casing **2, 3.** In addition, another important feature of the invention is that provision may also be made for electronic elements or components in the casing **2, 3,** to be replaced by other elements or components for different functions, so that the apparatus is suitable for the most diverse purposes, in accordance with a module principle.

FIG. **7** shows the end of the infusion tube **5,** in which in a further embodiment of the invention a ball valve having the valve casing **43** is disposed, the valve casing containing a valve ball **47** loaded by a spring **38.** In FIG. **7** the ball **47** has been lifted off its valve seat **39** by an extension **40** of the injection needle **41,** so that the flow in the direction of the needle **41** is permitted.

FIG. **8** on the other hand shows the situation when the needle holder **44** has been pulled off the valve casing **43** in the downward direction, so that the valve ball **47** loaded by the spring **38** is pressed onto its seat **39** and the infusion liquid can no longer flow out.

The lower part of FIG. **8** shows clearly that the injection needle **41** is provided with the previously mentioned extension **40.** The latter may also be formed by the use of a slightly longer needle, the inlet **45***a* of which however lies, at least in part, slightly lower than the end **45.** The dimensions are here shown greatly exaggerated, and in practice the distance may amount to only a few millimetres.

In another embodiment which is not illustrated, an intermediate part may be disposed between the needle **41** and the mounting **46** of the valve casing **43,** the latter being provided with an extension of this kind, namely the extension **40,** in order to enable a conventional needle **41** to be used, in which case this needle need not have the extra length. This will be immediately understandable to the specialist, so that this arrangement need not be illustrated.

In all cases the attachment or extension **40** ensures that the valve is closed immediately when the needle is pulled off.

In this way the apparatus provides the advantage that accidental flow is reliably prevented and in addition the apparatus can be arranged in this case to give an alarm signal.

Because of the spring-loaded ball **47** the infusion tube is continuously closed when not in use and only when the doctor or nurse fastens the needle or the previously mentioned intermediate part to the valve will the valve ball be lifted off its seat and allow the infusion liquid to flow through.

If the connection between the tube and the needle or the abovementioned intermediate part should now be broken by the patient, the ball is pressed back onto its valve seat by the spring, and the tube is immediately closed, so that no further infusion liquid can flow out. The tube, is thus immediately filled with liquid and an alarm signal may be operated by an electrical device, whereby staff can be summoned.

Another problem arises in heating an infusion liquid, for example blood, before the infusion. It is already known for the blood to be brought to the temperature of about 37° before being introduced into the infusion flask. This however entails the disadvantage that a certain cooling occurs during the filling of the flask. Since the infusion is known to take a long time, the blood will in the meantime cool further.

Through the incorporation of heat radiation source **42** as shown in FIGS. **1** and **2** there is the advantage that the infusion liquid does not need to be heated before commencement of the infusion but on the contrary the infusion can commence immediately. The blood is heated on its path from the flask **1** to the tube **5.** The heat radiation source may also act over other regions of the flask **1** and/or of the tube **5,** and also of the drip chamber **9.** It is thus possible for the radiator to be disposed in other positions than those shown in FIGS. **1** and **2.** It is also within the scope of the invention for the entire infusion flask to be heated.

I claim:

1. Infusion apparatus comprising:

a. a pair of laterally spaced, hollow casing sections having top and bottom ends and defining a space between them,

b. an infusion flask mounting flange at the top end of the casing sections spanning the space between them,

c. an infusion flask mounted on the mounting flange in inverted position,

d. drop sensor means mounted on the casing sections adjacent the top end thereof and operatively spanning the space between the casing sections,

e. a drip chamber communicating with the infusion flask and positioned freely in the space between the casing sections for sensing by the drop sensor means,

f. infusion outfeed control means mounted on the casing sections adjacent the bottom end thereof

and operatively spanning the space between the casing sections, and

g. an infusion tube communicating with the drip chamber and extending downward therefrom freely through the space between the casing sections and operatively connected to the outfeed control means.

2. The infusion apparatus of claim **1** wherein the infusion tube is provided at its outfeed end with a valve body housing a spring-loaded ball valve, an injection needle adapted for removable attachment to the valve body, and valve operator means operatively associated with the needle independently of the infeed end of the needle for engaging and unseating the ball valve when the needle is attached to the valve body, for the unobstructed flow of infusion liquid into the infeed end of the needle.

3. The infusion apparatus of claim **2** wherein the valve operator means comprises an arcuate segment extension of the wall of the injection needle.

4. The infusion apparatus of claim **1** wherein the infusion outfeed control means comprises a drip valve including two clamp jaws of which at least one is connected to one end of an elongated lever provided with a pivot adjacent said end, and a control electro magnet engages the lever adjacent the opposite end thereof for pivoting the lever.

5. The infusion apparatus of claim **4** wherein the other of said two clamp jaws is connected to one end of a second elongated lever provided adjacent said end with the same pivot as the first named lever, and an eccentric adjusting pin engages the second lever adjacent the opposite end thereof for adjusting the position of the second jaw.

6. The infusion apparatus of claim **4** including spring means engaging the lever for returning the associated clamp jaw to unclamping position.

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