June 20, 1944. J. C. MARSH 2,351,828

SURGICAL PUMP

Filed Jan. 8, 1942

Fig. 1.

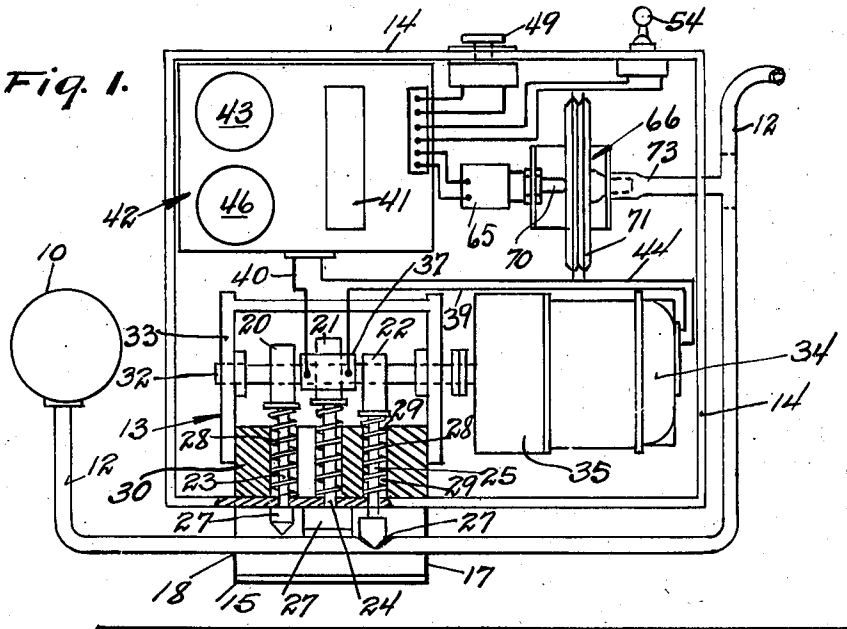
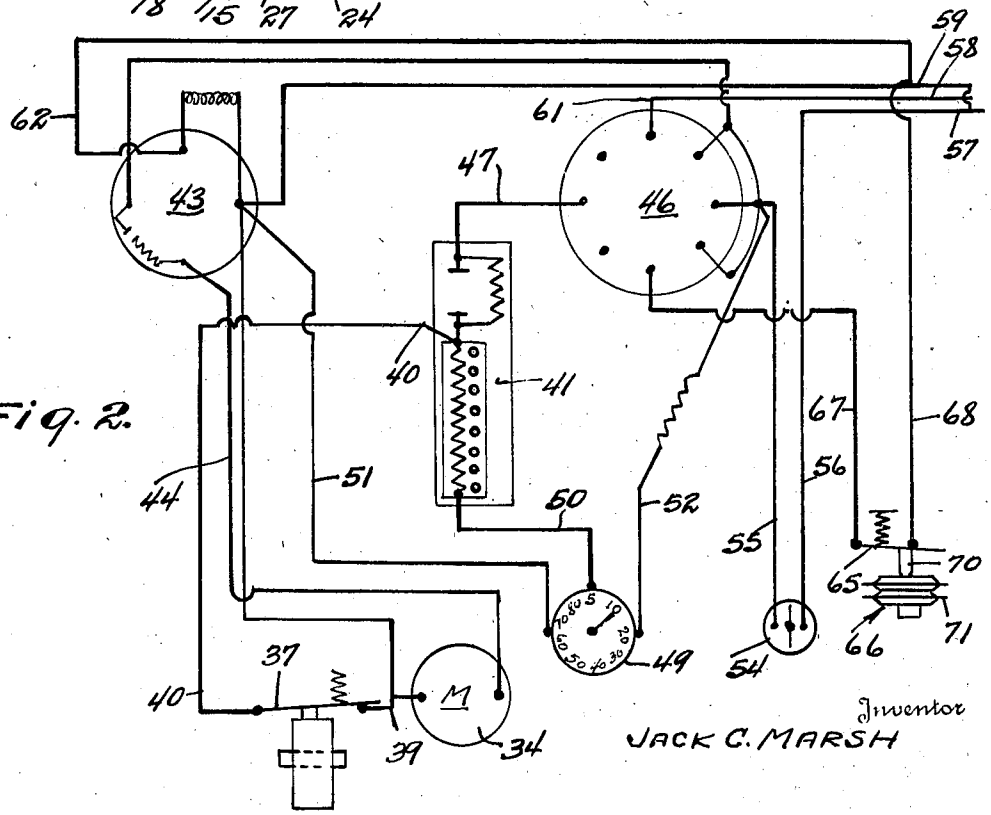


Fig. 2.



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SURGICAL PUMP

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5 Claims. (Cl. 103—148)

This invention relates to continuous drip apparatus and it has particular relation to a surgical pump suitable for the gradual administration of liquid compositions in the treatment of ailments, such as peptic ulcer, or the removal of fluid from the tubular organs.

One of the objects of the invention is to provide a surgical pump in which the delivery rate of the liquid is positive and the rate accurately maintained.

Another object of the invention is to provide a surgical pump in which an automatically controlled unit regulates the flow of liquid to the patient. Other objects may be inferred from the nature of the invention.

Heretofore the apparatus employed has depended on suction obtained by allowing water to flow from a bottle suspended above the patient through a tube to a bottle placed below the patient. When the rate of flow of water is changed the air pressure in the chamber also changes. As the air regulates the flow of liquid to the patient the rate of flow would necessarily fluctuate and which in an apparatus of this type cannot be adjusted accurately. Pumping apparatus have heretofore been employed to overcome the above objections but they have been unsatisfactory due either to lack of control of the suction formed in the operation of the apparatus or failure of accurately controlling the delivery rate of the pump, particularly in the smaller quantities, i. e. amounts of from five to fifteen drops a minute.

In the use of a surgical pump constructed in accordance with my invention, the pump is positioned beside the patient. The pump is formed with a constant speed motor provided to drive a plurality of cam elements, which engage fingers adapted to contact a tube, the tube extending from a source of supply to a patient. A time control device connected to the motor through a microswitch is provided to regulate the action of the pump. The time control permits the pump to deliver a single stroke of the pump, five drops of fluid, after which the pump stops for a time. This stop or "wait" may be adjusted from less than a second to more than sixty seconds by means of a control knob operatively connected to the timer control. As soon as the pump has created a suction more than equal to a column of water two feet six inches high, a vacuum control operatively connected to the tube shuts off the pump, while maintaining the vacuum. As soon as the vacuum is broken the pump is automatically turned on again and operates until such time as more than the designated suction is acquired.

For a better understanding of the invention, reference may now be had to the accompanying drawing forming a part of the specification in which:

Fig. 1 is a plan view of the invention, with certain portions in section for the sake of clearness.

Fig. 2 is a diagrammatic view of an electrical circuit employed in the invention.

In practicing my invention, the fluid is placed in a container 10, at substantially the same level as the patient, with the tube 12, formed of rubber or other elastic material, extending from the container to the patient. A pumping apparatus 13, contained in a casing 14, having a bracket 15, formed with a member 17 adapted to engage the tube 12, as indicated at 18, is provided to feed fluid to or from the patient as desired.

The pumping apparatus is provided with a plurality of cams 20, 21, and 22 adapted to engage fingers 23, 24, and 25 respectively. Each of the fingers, formed with end members 27 adapted to compress the tube 12, is provided with springs 28 positioned in openings 29 of a block 30. The member 27 of the fingers 23 and 25 have edge portions which engage the tube 12. These fingers are provided to entrap the fluid in the tube between the two points of engagement. The finger 24 is provided to act as a piston, for forcing the liquid to the patient and is formed with the edge portion of the member 27 extending longitudinally of the tube 12. The springs maintain the fingers in contact with the cams. The cams are mounted on a shaft 32 supported in a housing 33, with the shaft being driven by a motor 34 through reduction gearing 35 integral with the motor.

A microswitch element 37 mounted on the housing 33 and actuated by the cam 21 is provided with a lead 39 connected to the motor 34 together with a lead 40 connected to a condenser 41 of a time control device 42. The time control 42 is also provided with a relay 43, having connected thereto a lead 44 extending to the motor and a vacuum or rectifier tube 46, having a lead 47 connected to one side of the condenser 41. Extending from the condenser to a time control dial 49 mounted on the casing 14 is a lead 50, operately connected to the condenser. Leads 51 and 52 extending from the control dial are connected to the relay 43 and to the vacuum tube 46 respectively. A toggle switch 54 mounted on the casing 14 is provided with a lead 55, connected to

the tube 46 and a lead 56 extending to a power lead 57. A power lead 58 is provided with lead 61 connected to the vacuum or rectifier tube 46. A resistance cord 59 is connected at one end to the lead 57 and at the other end to the relay 43. A switch 65, of a control device 66 is provided with a lead 67 connected to a vacuum or rectifier tube 46, and a lead 68 connected to the relay 43. The switch 65 is provided with a contact element 70 normally held in engagement with bellows 71, formed of rubber or other elastic material. Connected to the bellows on the side opposite the switch is a tube 73 connecting to the bellows and the tube 12, intermediate the fingers and the patient.

In operation, the cams 20, 21 and 22 are driven by the motor 34, so that at least one finger is always compressing the tube 12; for example, as shown in Fig. 1, with the finger 25 closed against the tube. In starting the pump a suction is created by compressing and expanding the tube 12, for example when finger 24 compresses the tube. As the cams rotate, the finger 24 moves back and finger 25 closes. When finger 24 moves back, it releases the tube 12, which expands and fills from the supply container 10. With finger 24 back and the outlet end closed by finger 25, the finger 23 moves forward closing the inlet end of the tube and remains in such position until finger 25 moves back from the tube, with finger 24 moving forward driving over the required amount of fluid. As one finger is always closed, there is a closed system maintained at all times. At the end of each stroke of the pump, the cam 21 actuates the switch 37 which stops the pump for a time. This stop or wait can be adjusted from less than a second to more than sixty seconds, depending on the dial setting 49, before making another stroke. The operation of the time control depends upon the principle that the time required to discharge an electrical condenser through a resistance depends upon the charging potential applied to the condenser.

As soon as the pump has created a suction more than equal to a column of water two feet six inches high, the vacuum control shuts off the motor. As shown in Fig. 1, the contact element 70, of the switch 65, engages a side of the bellows 71 which normally maintain the switch in closed position. When more than the desired suction is exerted, the bellows contract, thus opening the switch and stopping motor, while maintaining a vacuum. This is particularly important in the removal of fluid and gas from the duodenum. As soon as the vacuum is broken by the removal of the fluid and gas from the duodenum, the pump is automatically started and operates until two feet six inches of negative pressure is again obtained.

From the foregoing description it is apparent that I have provided a surgical pump having electrically controlled means which provides intermittent operation of the pump, together with a structure which permits wide variation of the quantities of fluid delivered to or removed from the patient. Moreover it is apparent that I have provided a structure that is simple in operation, accurate in the function thereof and which, when once set, may be operated by a novice of the medical profession.

It is to be understood that the form of the invention herewith shown and described is merely illustrative of a preferred embodiment and that such changes as fall within the purview of one skilled in the art may be made without departing from the spirit of the invention and the scope of the appended claims.

I claim:

1. A pumping apparatus for medical treatments comprising a constant speed motor, a plurality of cam elements operated by the motor, a plurality of fingers actuated by the cams, in a predetermined sequence, an elastic tube adapted to be compressed by the fingers, an electrical time control for controlling the action of the pump and means connected with the time control for regulating the delivery rate of the pump.

2. A pumping apparatus for medical treatments comprising a constant speed motor, a plurality of cam elements operated by the motor, a plurality of fingers actuated by the cams, in a predetermined sequence, an elastic tube adapted to be compressed by the fingers, an electrical time control for controlling the action of the pump, a switch element operatively connected with one of the cams, for actuating the time control and means connected to the time control for regulating said time control.

3. A pumping apparatus for medical treatments comprising a constant speed motor, a plurality of cams operated by the motor, a plurality of fingers actuated by the cams, in a predetermined sequence, an elastic tube adapted to be compressed by the fingers, an electrical time control including a condenser for controlling the action of the pump, a switch element operatively connected with one of the cams for actuating the time control and means connected with the condenser for regulating the time control.

4. A pumping apparatus for medical treatments comprising a constant speed motor, a plurality of cam elements operated by the motor, a plurality of fingers actuated by the cams, in a predetermined sequence, an elastic tube adapted to be compressed by the fingers, for creating a suction, means secured to the tube for stopping the pump upon creation of a suction above a predetermined point, an electrical time control for controlling the intermittent operation of the pump and means operatively connected to the time control for regulating said time control.

5. A pumping apparatus for medical treatments comprising a constant speed motor, a plurality of cam elements operated by the motor, a plurality of fingers actuated by the cams, in a predetermined sequence, an elastic tube adapted to be compressed by the fingers, for creating a suction, a vacuum control element secured to the tube for stopping the pump upon creation of a suction above a predetermined point and electrical means for intermittently operating the pump.

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