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MASTER ADJUSTER FOR SENSING RANGE

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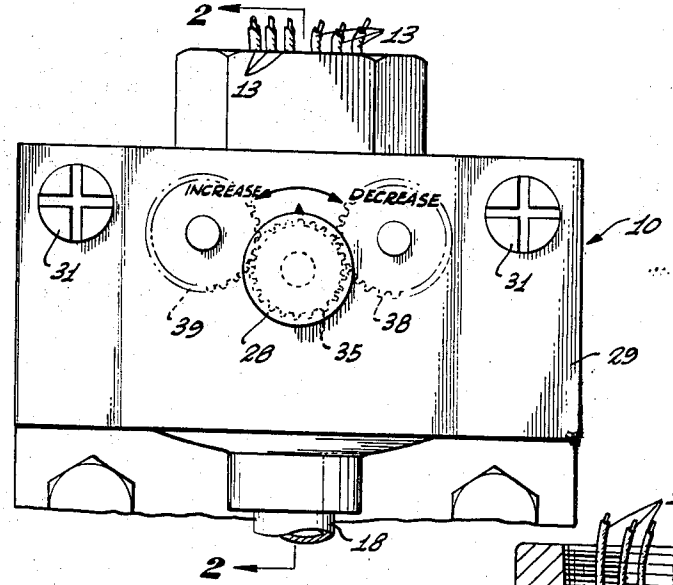


Fig. 1

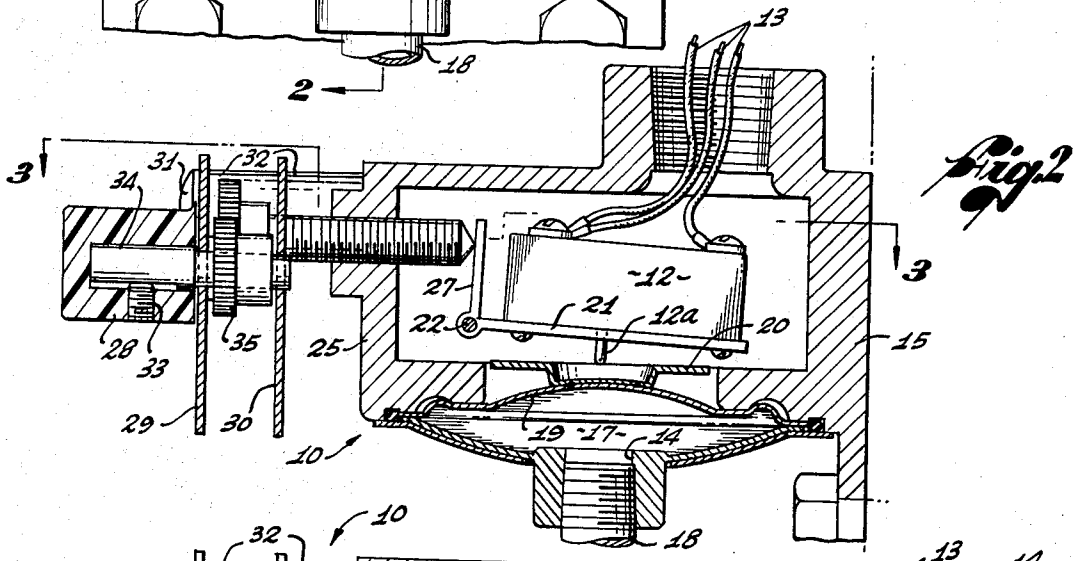


Fig. 2

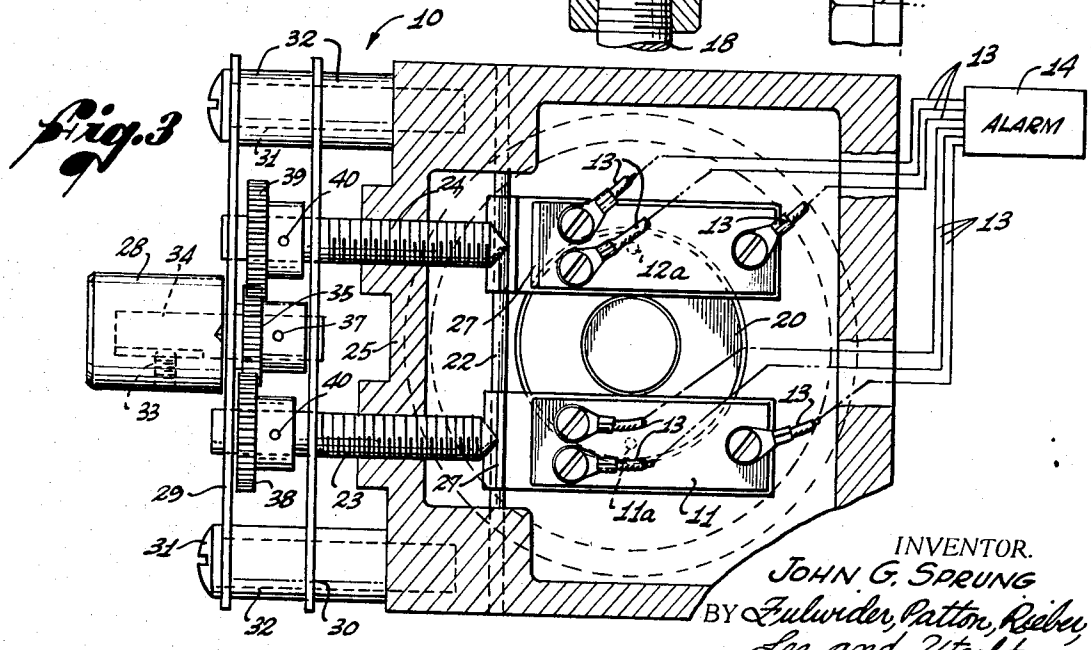


Fig. 3

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MASTER ADJUSTER FOR SENSING RANGE

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ABSTRACT OF THE DISCLOSURE

A device for sensing and signaling pressure variations above and below a selected, adjustable range, and including a diaphragm engaging the actuators of two switches, each of which is supported for swinging toward and away from the diaphragm in response to rotation of an associated adjusting screw. A master adjusting mechanism is provided for varying the pressure range, and includes a driving gear meshing with two driven gears on the adjusting screws to turn the screws simultaneously, thereby to adjust the actuating points of the switches upwardly and downwardly in unison and by equal amounts, the gears being sandwiched between two plates with clearance for limited axial movement of the driven gears with the adjusting screws.

BACKGROUND OF THE INVENTION

This invention relates to the sensing and signaling of variations in a monitored condition, and relates more specifically to a sensing and signaling device having an output element movable in accordance with the variations, and also having a pair of signaling elements that are individually adjustable relative to the output element so as to vary the values of the condition at which high and low signals are produced.

One such device is a pressure monitor for the blood pressure in one of the lines in a hemodialysis system, or artificial kidney. In such a system, the blood of a patient flows out of his body through one line or tube, through the dialyzer for the passage of substances in the blood through a semipermeable membrane into a dialysate liquid, and then back to the patient's body through another tube. The blood-pressure monitoring typically takes place at a drip bulb attached to one of the tubes, although the sensing and signaling device may be remotely located.

This device signals both high and low pressures so as to indicate a departure in either direction from a selected range generally centered on the initial pressure level found to exist at the beginning of the treatment. Subsequent variations in pressure are indications of variations in blood flow, and can indicate excessive blood flow caused, for example, by an accidental opening of the tubing, or a low blood flow resulting, for example, from a clot.

SUMMARY OF THE INVENTION

The present invention resides in a master adjustment mechanism for changing the high and low limits of the selected pressure range simultaneously and in equal amounts, either up or down, so as to center the range quickly and easily on the actual pressure at the beginning of treatment and also at any other time adjustment becomes necessary or desirable. More specifically, the mast adjustment mechanism includes a single master adjusting element that is geared to both signal devices to adjust them simultaneously in corresponding directions.

Other objects and advantages of the invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a sensing and signaling device equipped with a master adjustment mechanism embodying the novel features of the present invention;

FIG. 2 is a fragmentary cross-sectional view taken substantially along the line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary cross-sectional view taken substantially along the line 3—3 of FIG. 2.

DETAILED DESCRIPTION

As shown in the drawings for purposes of illustration, the invention is embodied in a device **10** for sensing the blood pressure in a tube (not shown) carrying blood between a patient and an artificial kidney, and producing a signal if the blood pressure departs from a selected range, for example, plus or minus 20% of the initial pressure. The signal may be audible, visual, or preferably both audible and visual, and also indicates whether the pressure has gone above or below the range.

For these purposes, the device **10** has two signaling elements **11** and **12** in the form of switches connected by wiring **13** to an alarm device **14** (FIG. 3) for producing the desired signals. The basic pressure-sensing arrangement is conventional, the device **10** having a hollow housing **15** with a sealed pressure chamber **17** (FIG. 2) mounted on its underside and connected to a tube **18** through which pressure is applied to the chamber.

The upper wall of the pressure chamber **17** is a flexible diaphragm **19** which rises with increases in the chamber pressure and falls with reductions in pressure, thus constituting a movable output element of the sensing means. An actuating ring **20** is mounted on top of the diaphragm to move back and forth vertically within the housing in response to pressure changes.

Directly above the actuating ring **20** are the two signaling switches **11** and **12**, each having an operator **11***a*, **12***a* that extends downwardly into engagement with the actuating ring to be moved by the ring in accordance with the movements of the diaphragm **19**. As shown most clearly in FIGS. 2 and 3, each switch is mounted on a generally horizontal plate **21** that is pivoted at one end about a shaft **22** extending across one side of the interior of the housing **15**, the left side as viewed in FIGS. 2 and 3. Mounted in this manner, the plates **21**, and thus the switches, are rockable individually toward and away from the diaphragm to adjust the actuating points of the switches.

The device **10** also includes means for adjusting the actuating point of each switch **11**, **12**. For this purpose, two screws **23** and **24** are threaded through the left wall **25** (FIGS. 2 and 3) of the housing, parallel to each other, and engage flanges **27** upstanding from the left ends of the plates **21**, above the pivot shaft **22**. Thus, each plate and its upstanding flange forms, in effect, a bell crank supporting the associated switch, and the angular position of the bell crank about the pivot shaft is determined by the axial position of one of the screws **23**, **24** relative to the wall **25** of the housing.

By turning one of the screws **23**, **24** in a selected direction, the associated switch **11**, **12** may be moved either closer to or farther from the diaphragm **19**, and this correspondingly adjusts the chamber pressure at which the switch is actuated to produce the selected signal. Herein, the switch **11** is actuated at the higher level to signal a pressure exceeding the selected range, and the switch **12** is actuated at the lower level to signal a reduction in pressure below the range. While this arrangement is one suitable sensing and signaling arrangement, it will be evident to those skilled in the art that the invention is not to be limited to this specific form of sensing device.

In accordance with the invention, a master adjustment mechanism is provided, with an adjusting element **28** accessible from outside the housing **15**, to adjust both adjusting elements **23**, **24** simultaneously and equally in corresponding directions in order to maintain a uniform spread or range between the actuation points of the two switches **11**, **12**. Accordingly, the user simply adjusts the single master adjusting element until the desired pressure level is centered between the upper and lower limits, and this eliminates not only the difficulty of making two separate adjustments, but also the possibility of changing the spread of the preselected range during adjustment.

In the present instance, the master adjusting mechanism is mounted between two parallel plates **29** and **30** supported outside the left wall **25** on screws **31** and spacer sleeves **32**, the master adjusting element **28** being a knob held by set screw **33** on a shaft **34** that is journaled on the two plates. The shaft supports a driving gear **35** that is sandwiched between the plates and also is disposed between the outer end portions of the two adjusting screws **23** and **24**, as shown in FIG. 3. A pin **37** (FIG. 3) holds the driving gear on the shaft **34**.

The driving gear **35** meshes on opposite sides with two driven gears **38** and **39** that also are disposed between the plates **29** and **30** and are fastened by pins **40** to the adjusting screws **23** and **24**. The total thickness of the driven gears, including their hubs, is substantially less than the spacing between the plates **29** and **30** to accommodate the range of back and forth motion of the gears necessary for the range of axial adjustment of the screws and the resulting vertical adjustment of the signaling switches. The plates **29** and **30** thus form limiting stops for the adjustment mechanism.

It will be seen in FIG. 3 that the driven gears **38** and **39** are free to move axially relative to the driving gear **35**, within the limits of the clearance between the plates **29**, **30**, without moving out of engagement with the driving gear. Thus, rotation of the knob **28** in one direction or the other simultaneously rotates the driven gears **38** and **39** and the associated adjusting screws **23** and **24** equally in corresponding directions. This shifts the screws axially by equal amounts to raise or lower the upper and lower actuating points together by equal amounts.

From the foregoing, it will be seen that the present invention provides a novel, and very simple, master adjusting mechanism for selectively raising and lowering the acceptable range of pressure variation with a single and simple motion. It also will be evident that, while a specific embodiment has been illustrated and described, various changes may be made without departing from the spirit and scope of the invention.

I claim as my invention:

1. In combination with a sensing and signaling device having a housing, a diaphragm in said housing movable back and forth in accordance with changes in the pressure applied to said diaphragm, first and second signal elements actuated by said diaphragm and adjustably positioned relative thereto so as to change the position of the diaphragm at which each signal element is actuated, and a pair of parallel adjusting screws threadedly supported in a wall of said housing and each positioning one of said signal elements according to the axial position of the

screw relative to said wall, the improvement comprising: a pair of driven gears fast on said screws outside said wall for rotary and axial movement with said screws; motion-limiting surfaces disposed on opposite sides of said gears with clearance accommodating a range of axial motion of the gears sufficient for a selected amount of adjustment of each of said signal elements; a driving gear rotatably supported between said surfaces and meshing on opposite sides with said driven gears to turn the latter equally in response to turning of the driving gear; and an adjusting knob connected to said driving gear and accessible from outside said housing to adjust both driven gears, and thus both signal devices, simultaneously and equally in either direction.

2. The combination defined in claim **1** in which said gears are sandwiched between two spaced plates outside said wall, said driving gear being carried on a shaft journaled on said plates, and said screws extending through said plates with said driven gears fast on the portions of the screws between the plates.

3. In combination with a sensing and signaling device having a housing, means in said housing for sensing variations in a monitored condition and including an output element movable back and forth in accordance with such variations, first and second signal elements actuatable by said output element and adjustable relative thereto in order to change the position of the output element and the value of said condition at which each signal element is actuated, and first and second individual adjusting elements operable separately to adjust the positions of the respective signal elements, the improvement comprising: a master-adjusting element accessible from outside said housing and movably mounted thereon, and means connecting said master adjusting element to said individual adjusting elements and operable to shift the same simultaneously and equally in corresponding directions relative to said output element thereby to maintain a uniform range between the values of actuation of said signal elements while changing the level of the range.

4. The improvement defined in claim **3** in which said individual adjusting elements comprise screws threadedly supported in parallel relation on said housing, and said master adjusting element is a knob disposed outside said housing, and said connecting means include a shaft extending into said housing from said knob and carrying a driving gear rotatable with said shaft, and a pair of driven gears mounted on said screws and each meshing with said driving gear to be turned thereby, and thus to turn said screws for movement thereof simultaneously in corresponding directions.

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