(13)

'Twin-Needle Synchronized Type Single-Gauge Aneroid Sphygmomanometer'

THIS INVENTION relates to a single gauge aneroid sphygmomanometer, particularly of the twin-needle synchronized type.

The conventional aneroid sphygmomanometer comprises a single gauge having a single needle. In measuring the blood pressure, the operator must carefully watch the needle movement and memorize the systolic and diastolic pressures as the needle drops. A person unskilled in the art is apt to misread and to make mistakes in memorizing the resulting blood pressure.

It is an object of this invention to enable the provision of a twin needle synchronized type single gauge aneroid sphygmomanometer which may exactly indicate both the systolic and diastolic blood pressure readings, respectively, in one measuring procedure.

According to the present invention, there is provided a sphygmomanometer, comprising: a pressure cuff adapted to be worn by a patient, an air pump for pressurising the cuff, means for controlling the flow of air to and from the cuff, and a gauge for indicating the pressure in the cuff, the gauge comprising: a diaphragm responsive to the pressure in the cuff; a first, diastolic needle; a second, systolic needle; drive means for moving the first and second needles in response to movement of the diaphragm, the drive means comprising a drive spindle rotatably mounted in a first fixture plate and passing through a second fixture plate, the spindle having at one end a gear means drivable by a transmission gear responsive to movement of diaphragm and at the other end a first needle sleeve on which the first needle is mounted, a first needle brake disc mounted on the spindle, a second needle inner sleeve mounted on the second fixture plate, a second needle intermediate sleeve placed over the second needle inner sleeve having mounted thereon a second needle brake disc, the intermediate sleeve

being provided with a flange on which is mounted a second needle outer sleeve and biasing means for biasing the first and second needles against rotation in a first direction in response to increasing pressure in the cuff; and control means for stopping rotation of the second needle brake disc upon detection of Korotkov sounds and for stopping rotation of the first needle brake disc when the Korotkov sounds cease to prevent further rotation of the respective needles so that, in use, the first needle indicates the distolic blood pressure and the second needle indicates the systolic blood pressure.

In order that the invention may be more readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a flow diagram depicting the measurement of arterial blood pressure with the electronic twin-needle synchronized aneroid sphygmomanometer according to the present invention;

FIGURE 2 is a partial cross-sectional side view of the twin-needle synchronized aneroid sphygmomanometer according to the present invention;

FIGURE 3 is a partial cross-sectional front view the sphygmomanometer shown in Figure 2, with the needles and dial removed; and

FIGURE 4 is a cross-sectional view, on enlarged scale, of the twin-needle measuring mechanisms.

Referring now to Figure 1, there is shown a twin-needle synchronized aneroid sphygmomanometer according to the present invention. The measuring mechanism includes an air pump 1, a check valve 2, a flexible tube 3, an air release valve 4, a twin-needle pressure gauge 5 and a cuff 6, whereas the indicating mechanism includes a sensor 7, a leadline 8, an electronic circuit assembly 9, a buzzer 10 and a signal light 11.

The twin-needle pressure gauge 5, which is best shown in Figures 2 and 3, comprises four compartments, namely, a first compartment 12 containing the electronic circuit assembly 9 and buzzer 10, a second

compartment 13 accomodating a battery 16 as a power source, a third compartment 14 containing the measuring mechanism and a fourth compartment 15 in which is mounted a diaphragm set 17. The gauge 5 has a nipple 18 for connection to the flexible tube 3 (see Fig. 1). The third compartment 14 is provided with a transparent cover 19. The signal light 11 is located at any suitable position. The electronic circuit assembly 9 and all electric connections among the parts are substantially the same as illustrated in Figure 5 of the co-pending UK Patent Application No. 8131267 published under Publication No. 2,107,189A and will not be described further herein. The gauge 5 is also provided with a power switch 20, a sensor socket 21 for the insertion of a plug of the sensor 7, and another socket 22 for an AC/DC adaptor (not shown). A low voltage light 23 is optionally provided.

One end of a pushing rod 24 is operatively connected to the diaphragm 17 while the other end of the rod 24 is pivotably and eccentrically connected to a main transmission gear 25. On a wall 26 are mounted two columns 27 which carry a lower fixture plate 28 and an upper fixture plate 29, and a support 30 to support the lower fixture plate 28 for enhancing the stability of the whole measuring mechanism. A main gear spindle 31 is secured between the plates 28 and 29. Lower and upper needle control relays 32 and 33, respectively, are provided angularly spaced-apart around a pinion gear spindle 34 which is secured to the lower fixture plate 28. At the lower end of the spindle 34 is formed a pinion gear 35 which meshs with and is driven by the main transmission gear 25.

Referring now to Figure 4, a lower section of the spindle 34 carries an upper needle brake disc 36 above the pinion 35. The lower section of the spindle 34 also carries an upper needle spring bushing 37 about which an upper needle spring coil 38 is provided. A lower needle spindle inner sleeve 39 extends around an intermediate section of the spindle 34, and is secured on the upper fixture plate 29. A lower needle spindle middle sleeve 40 with an intermediate peripheral flange is fitted over the inner sleeve 39. On a lower portion beneath the flange of the middle sleeve 40 is mounted a lower needle brake disc 41 and a lower needle spring bushing 42 about which a lower needle spring coil 43 is provided. On an upper portion above the flange of the middle sleeve 40 is fitted a lower needle spindle outer sleeve 44 on which a lower needle 45 is placed. An upper needle sleeve 46, on

which the upper needle 47 is placed, is mounted on an upper section of the spindle 34. As illustrated, the outer end of the lower needle 45 is bent upwardly beyond and behind the upper needle 47 for pushing the upper needle to cause it to move in a counter-clockwise direction (Figure 4).

The lower needle control relay 32 and the upper needle control relay 33 are identical and each comprise (as illustrated by Figure 4 in which only the upper needle control relay 33 is shown), respectively, a brake piece 48, a brake spring 49, a Si-steel piece 50, a magnet core 51, a relay coil 52, a relay fixture 53 and a relay case 54.

In operation, the air pump 1 pumps pressurized air through the check valve 2, the flexible tube 3 and the air release valve 4. The pressurized air flows into the twin-needle pressure gauge 5 and the cuff 6 which is wrapped around the arm of the patient or of the operator himself.

As the cuff 6 is inflated, the air in the system increases the pressure therein. Simultaneously, air flows through the air inlet 18 into the diaphragm assembly 17 of the gauge 5. Upon expansion due to increase of the air pressure, the upper surface of diaphragm 17 will push the pushing rod 24 up which in turn rotates the main transmission gear 25 and drives the meshed pinion gear 35 to move the upper needle 47, and therefore the lower needle 45, clockwise synchronously. When the pressure reading by the indication of the needles on the dial (not shown) reaches approximately 20 to 30 mm Hg higer than the patient's usual systolic value, then the pumping operation is stopped and therefore both needles also stop moving and indicate the same blood pressure reading value.

Next, the air release valve 4 is opened to deflate the cuff 6 at a rate of about 2 to 3 mm Hg reading per heart beat. Meanwhile, the diaphragm 17 retracts upon decrease of the air pressure, which causes the driving force of the pinion gear 35 to decrease gradually. As the air pressure decreases the torque applied to the upper needle 47 (which is secured at the upper section of the pinion gear spindle 34) by the upper needle spring 38 causes the upper needle 47 to move in an anti-clockwise direction in Figure 4 so that the upper needle 47 moves out of contact with the lower needle 45. However, the twisting torque applied to the lower needle 45 by the lower needle spring

43 similarly causes the lower needle to move in the anti clockwise direction in Figure 4. Because the bent end of the lower needle 45 is restrained by the upper needle 47, the lower needle cannot pass the upper needle and therefore the needles 45 and 47 move in synchronism in the anti-clockwise direction. As the pressure reduces to the level at which the sensor 7 detects the first Korotkov sounds, the needles indicate the maximum or systolic blood pressure. This signal is converted into an alarm from the buzzer 10 and flashing of the light 11 via the electronic circuit 9 to alert the operator. Meanwhile, the sensor actuates the relay 32 to cause the magnet core 51 to attract the Si-steel piece 50 which pushes the brake piece 48 attached to the brake disc 41 (Figure 2) to stop movement of the lower needle 45. Since the lower needle brake disc 41 closely fits on the lower needle spindle middle sleeve 40, and its frictional brake force predominates over the twisting torque of the lower needle spring 43, further rotation of the lower needle spindle outer sleeve 44 is prevented and the lower needle 45 is retained at the systolic pressure indication. Further, since the lower needle spindle inner sleeve 39 is interposed between the pinion gear spindle 34 which supports the upper needle 47 at the upper end thereof and the lower needle spindle middle sleeve 40 which secures the lower needle brake disc 41, the upper needle 47 will not be stopped by the braking action of the lower needle control relay 32 but moves further in the anti-clockwise direction in Figure 4 with the decrease of pressure to indicate the reduction of the blood pressure value.

The upper needle 47 continues to move until the alarm from buzzer 10 stops and flashing of the light 11 ceases, i.e. until the Korotkov sounds disappear; this represents the minimum or diastolic blood pressure. At this time, the upper needle control relay 33 acts in a manner similar to the lower needle control relay 32 to cause the magnet core 51 to attract the Si-steel piece 50 which pushes the brake piece 48 attached to the brake disc 36 (Figure 4) to stop further movement of the upper needle 47. Because the upper needle brake disc 36 closely fits on the pinion gear spindle, and its frictional brake force predominates over the twisting torque of the upper needle spring 38, further movement of the pinion gear spindle 34 is prevented and the upper needle 47 stays at the diastolic pressure indication.

When the power switch 20 is turned off, the control relays 32 and 33

will be inoperative and the restoring action of the brake spring 54 will cause the brake piece 48 to detach from the brake discs 41 and 36, respectively, freeing the same. In this case, the twisting torque of the lower needle spring 43 causes the lower needle spindle middle sleeve 40 carrying the outer sleeve 44 to move in the counter-clockwise direction in Figure 4, so that the lower needle 45 which is secured on the outer sleeve 44 also moves in the counter-clockwise direction until the bent end of the lower needle 45 is prevented from further movement by the upper needle 47 which stays at the lower blood pressure valve. Therefore, the position of the lower needle 45 coincides with the upper needle 47 again. If pressure still exists in the diaphragm assembly 17, then both needles will stop at a certain pressure value higher than zero, otherwise both needles return to the zero position and the gauge 5 is ready for operation again.

The present twin-needle synchronized type single-gauge aneroid sphygmomanometer may be used as a stethoscopic sphygmomanometer. In this arrangement, a set of conventional stethoscope head, Y tube and stethoscope eartips (not shown) will be provided and on the gauge 5 lower and upper needle brake buttons will be necessary, the electronic circuit 9 no longer being required. In operation of the stethoscopic sphygmomanometer, when the first Korotkov sounds are heard, the lower needle brake button should be pressed to actuate the lower needle control relay 32 whereas, when the Korotkov sounds disappear, the upper needle brake button must be pressed to actuate the upper needle control relay 33.

CLAIMS

1. A sphygmomanometer, comprising: a pressure cuff adapted to be worn by a patient, an air pump for pressurising the cuff, means for controlling the flow of air to and from the cuff, and a gauge for indicating the pressure in the cuff, the gauge comprising: a diaphragm responsive to the pressure in the cuff; a first, diastolic needle; a second, systolic needle; drive means for moving the first and second needles in response to movement of the diaphragm, the drive means comprising a drive spindle rotatably mounted in a first fixture plate and passing through a second fixture plate, the spindle having at one end a gear means drivable by a transmission gear responsive to movement of diaphragm and at the other end a first needle sleeve on which the first needle is mounted, a first needle brake disc mounted on the spindle, a second needle inner sleeve mounted on the second fixture plate, a second needle intermediate sleeve placed over the second needle inner sleeve having mounted thereon a second needle brake disc, the intermediate sleeve being provided with a flange on which is mounted a second needle outer sleeve and biasing means for biasing the first and second needles against rotation in a first direction in response to increasing pressure in the cuff; and control means for stopping rotation of the second needle brake disc upon detection of Korotkov sounds and for stopping rotation of the first needle brake disc when the Korotkov sounds cease to prevent further rotation of the respective needles so that, in use, the first needle indicates the distolic blood pressure and the second needle indicates the systolic blood pressure.

2. A spygmomanometer according to Claim 1, wherein the control means comprises a respective control relay for each of the first and second needle brake discs, each relay comprising a brake piece for contacting the associated disc upon actuation of the relay, a brake spring, an Si-steel piece, a magnet core and a relay coil.

3. A sphygmomanometer according to Claim 1 or 2, wherein the free end of the second needle is bent so as to be in front of the first needle in the direction opposide to the first direction.

* C L M S *

4. A sphygmomanometer substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

---

* C L M S *