Jan. 16, 1940. W. B. ELLWOOD 2,187,114

PNEUMATIC DEVICE

Filed March 31, 1938

FIG. 1

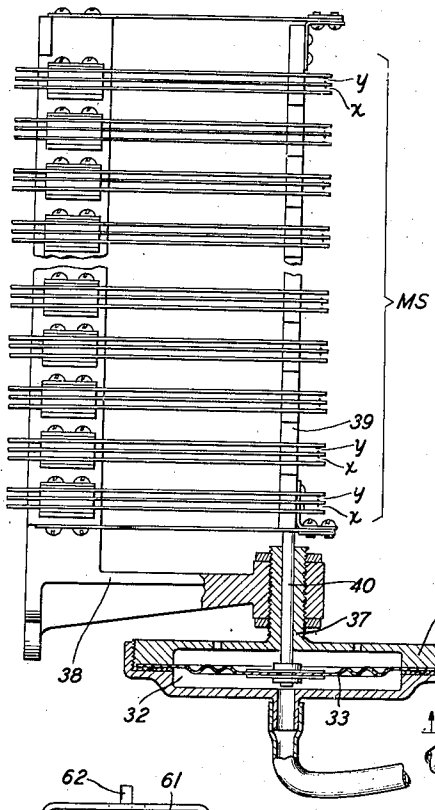


FIG. 2

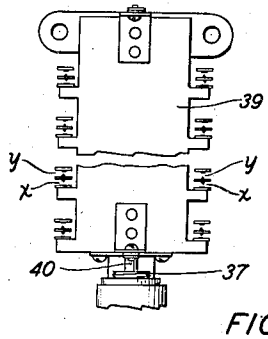


FIG. 3

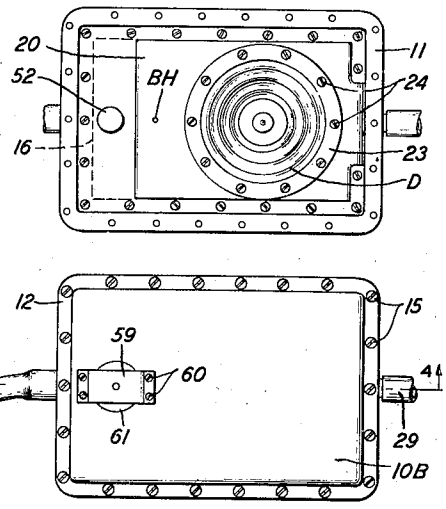
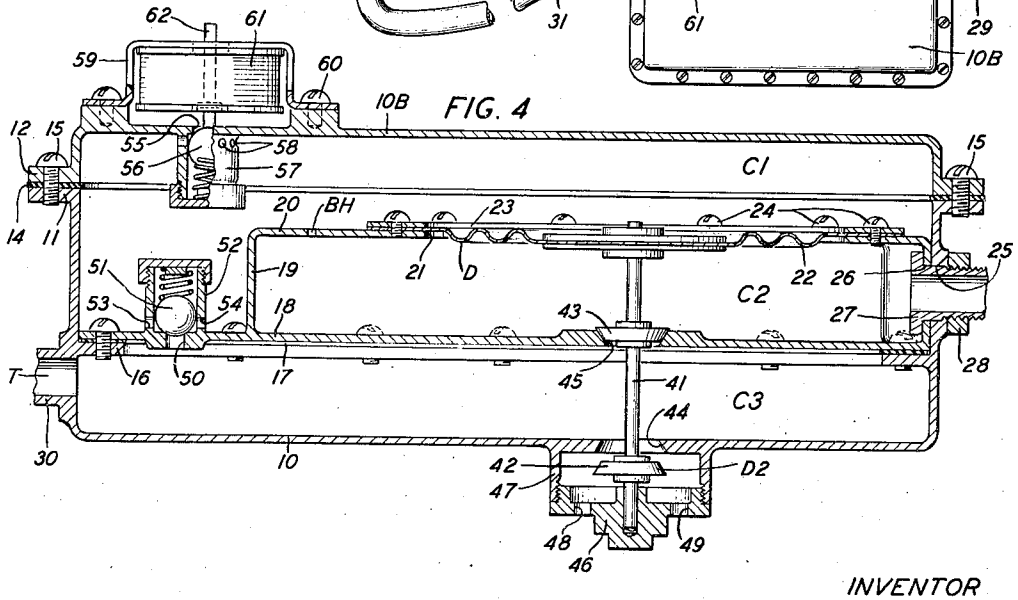


FIG. 4



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2,187,114

PNEUMATIC DEVICE

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Application March 31, 1938, Serial No. 199,311

1 Claim. (Cl. 121—46.5)

This invention relates to pneumatic devices and more particularly to a pneumatic trigger amplifier for use, for example, for operating a multiplicity of switching elements simultaneously at a point remote from the power generating source.

The object of the invention is the provision of a pneumatic trigger amplifier device of the type above referred to which will be simple, positive in operation, and in which the force required for its operation is a small fraction of the air pressure required for the operation of the switching elements actuated thereby.

In telephone systems, for example, there are conditions which require the operation of a multiplicity of switching devices simultaneously but where the space required for the mounting of a sufficiently high power motor element is not available. The present invention contemplates the use of a remotely placed source of power which is operatively connected to an actuating element disposed at the point of the applied force so as to avoid the damaging effects of vibrations inherent to the use of a high power motor mechanism at the point of the applied force and the consequent improper operation of the switching devices actuated thereby, the source of motive power being, for example, controlled by a comparatively small electromagnet which may itself be controlled by a switching device placed at a remote point from the switching devices it is desired to operate.

In the drawing Fig. 1 is a side elevation view of a switching device assembly operatively connected to the trigger device of the invention, the operable element of such a device being shown in section.

Fig. 2 is a partial front view of Fig. 1;

Fig. 3 is a top view of the trigger device shown with its cover removed, and

Fig. 4 is an enlarged longitudinal sectional view taken on line 4—4 of Fig. 1.

As shown in the drawing, a casing is formed of two parts 10 and 10B (Fig. 4) each provided with a peripherally disposed rim 11 and 12 for clamping a gasket 14 therebetween through the tightening of a plurality of screws 15 so as to form an air-tight joint between these casing portions.

The casing portion 10 is provided with an inwardly extending peripheral rim 16 shown in Fig. 4 for receiving a gasket 17 of relatively soft material to be clamped between the rim portion 16 and a partition 18 to form an air-tight closure therebetween, a portion of this partition cooperating with integrally formed side walls 19 and top wall 20 to form a chamber C2, while forming in cooperation with casing portions 10 and 10B a second and a third air chambers C1 and C3, respectively.

The wall 20 of chamber C2 is provided with a so-called bleeder hole BH and an opening 21 closed by a corrugated diaphragm 22 clamped between the wall 20 and a ring 23 by a plurality of screws 24. The casing portion 10 and one of the side walls 19 of chamber C2 are provided at similar disposed ends with openings 25 and 26 respectively for receiving a bushing 27 secured thereto by a nut screw 28. This bushing serves for securing one end of a tubing 29 shown in Fig. 1 which connects the chamber C2 to a suitable air compressor device, not shown, while the casing portion 10 is provided at its other end with a sleeve portion 30 for securing one end of a tubing 31 shown in Fig. 1 connecting a remotely disposed air chamber 32, this chamber being formed of a circular casing 35 having a yieldable wall in the form of a diaphragm 33 clamped therein by a ring 36 engaging the interiorly screw-threaded portion of casing 35.

The ring 36 is formed with a cylindrical portion 37 which is screw threaded for engaging the arm 38 of a multi-switching device MS having an operating bar 39 disposed in operative relation with one end of a plunger 40 slidably mounted in the cylindrical portion 37 of ring 36 and having its other end secured to the diaphragm 33 for operation as will be hereinafter described in detail.

In the position shown in Fig. 1, the contacts x of each set are normally closed and the contacts y of these sets open so that the movement of diaphragm 33 and that of plunger 40 actuated thereby is imparted to the bar 39 for opening the contacts x of each set and closing the contacts y of these sets.

To the center portion of diaphragm 22 as shown in Fig. 4 is securely mounted a plunger 41 formed with valves 42 and 43 for engaging, as the case may be, the valve seats 44 and 45 respectively in the partition 18 and in the casing portion 10, the plunger 41 being guided at its free end by a plug 46 having air exhaust openings 48 and 49 and threadedly engaging the cylindrical extension 47 formed with casing portion 10.

The partition 18 at the point between the side wall 19 of air chamber C2 and the adjacent end wall of casing portion 10 is provided with an opening 50 normally closed by a spring pressed

ball 51 disposed in a tubular extension 52 itself having openings 53 and 54 connecting the air chamber C1 formed by the casing portion 10B with the air chamber C3 formed by the casing portion 10 and partition 18 upon the automatic operation of ball 51 in a manner which will be hereinafter described in detail.

The casing portion 10B is provided with an opening 55 normally closed by a spring pressed ball 56 in a cylindrical extension 57, this extension being provided with a plurality of openings 58 connecting the air chamber C1 to the atmosphere. On the casing portion 10B, as shown in Figs. 1 and 4 is mounted a bracket 59 secured thereto by screws 60 and on this bracket is mounted a relatively small electromagnet 61 provided for actuating a plunger 62 for operating the ball 56 upon the energization of this magnet to cause the operation of the trigger device in the following manner.

With the operating parts of the device in the position as shown in Figs. 1 and 4 supposing that a compressor connected to bushing 27 supplies the chamber C2 with air at a pressure sufficient for operating the bar 39 of the switching device MS, the air from chamber C2 passes into chamber C1 through the bleeder hole BH in wall 20 until the pressure becomes equal in these chambers so that the diaphragm 22 does not operate since the balls 51 and 56 close the openings 50 and 55, respectively and the opening 45 is closed by valve 43. Upon the energization of electromagnet 61, however, as effected by a remotely disposed controlling switching device (not shown), the operation of plunger 62 and thereby the movement of ball 56 from its seat 55 permits the air from chamber C1 to exhaust to the atmosphere through the holes 58 and seat 55 of ball 56. Under this condition the air pressure in chambers C1 and C2 becomes unbalanced and the air pressure in chamber C2 acts on the diaphragm 22 and forces it to bulge toward the chamber C1 thus operating the plunger 41 for lifting the valve 43 from its seat 45 and closing the valve 42. The air from chamber C2 now flows into chamber C3 through valve 43 and hence to chamber 32 through tubing 31 to cause the bulging operation of diaphragm 33 for operating the plunger 40 and thereby the bar 39 of the switching device for opening the contact x and closing the contact y of each set. Under this condition the ball 51 is lifted from its seat 50 due to the difference in pressure in chambers C1 and C3.

Upon the deenergization of magnet 61 and the consequent closure of opening 55 by spring pressed ball 56, the ball 51 which is still raised due to the higher air pressure in chamber C3 permits the air to flow in chamber C1 until the air pressure becomes equal in these two chambers. This condition permits the return of diaphragm 22 to normal for closing the valve 43 and reopening the valve 42 to permit the air to exhaust to the atmosphere by the openings 48 and 49 in plug 46 when the diaphragm 33 returns to normal to close the contact x and open contact y of each set and the device is now ready for a subsequent switching operation which is effected as above mentioned by the closing of the contact used for controlling the energization of magnet 61 and the consequent operation of the ball 56 controlled thereby. The function of the valve formed by ball 51 and seat 50 is to provide an air path in addition to bleeder hole BH so as to permit the quick balancing of the pressure in chambers C1 and C3 and thereby the return of the diaphragm 22 to normal in a minimum of time, thus reducing the amount of air escaping from the valve 42 to a minimum following the closure of opening 55 by ball 56.

In this device the time of operation depends (1) upon the air pressure, (2) the relative sizes of valve seats 44 and 45, (3) the openings 50 and 55 and BH, (4) the capacity of chambers C1, C2 and C3 and (5) the capacity of chamber 32. High speed is obtained, however, by making the capacity of chamber C1 as small as possible and making the ratio of the area of opening 55 as large as the operating force of magnet 61 will permit. The area of diaphragm 22 should be, however, several times that of openings 44 and 45 which in turn should be at least as large as the cross-section of tube 31 which should be in turn equal to that of the input air tubing connecting with bushing 27.

The device of the invention is particularly useful for operating power driven switches involving large numbers of contacts or for heavy current contacts. The intrinsic sensitivity of the device allows it to be used as a substitute for an electrical contact in connection with an electromagnetic relay and since the forces exerted by diaphragm 33 are unlimited in magnitude, it may be used to control heavy current switches or gangs of contacts, while permitting the casing 35 to be removed from the rest of the apparatus at a distance limited only by the tubing connection between the casing and the point of the applied force.

What is claimed is:

A trigger amplifier comprising three air-tight chambers, one of said chambers having means for connection with an air pressure source, another of said air chambers having means for connection with a power applying device and the third of said chambers having a valve operable for controlling the operation of a diaphragm in one of the walls of the first-mentioned chamber, a system of valves actuated by the movement of said diaphragm to cause the air to flow to the chamber of said power applying device and a valve connecting the second and the third-mentioned chambers operable automatically upon a difference of air pressure in these chambers to cause the return movement of said diaphragm to normal following the closure of said first valve.

WALTER B. ELLWOOD.