Jan. 26, 1960 W. F. PAWLOWSKI 2,922,594

CONTROL APPARATUS FOR AIR-OPERATED DEVICES

Filed March 25, 1957

FIG. 1

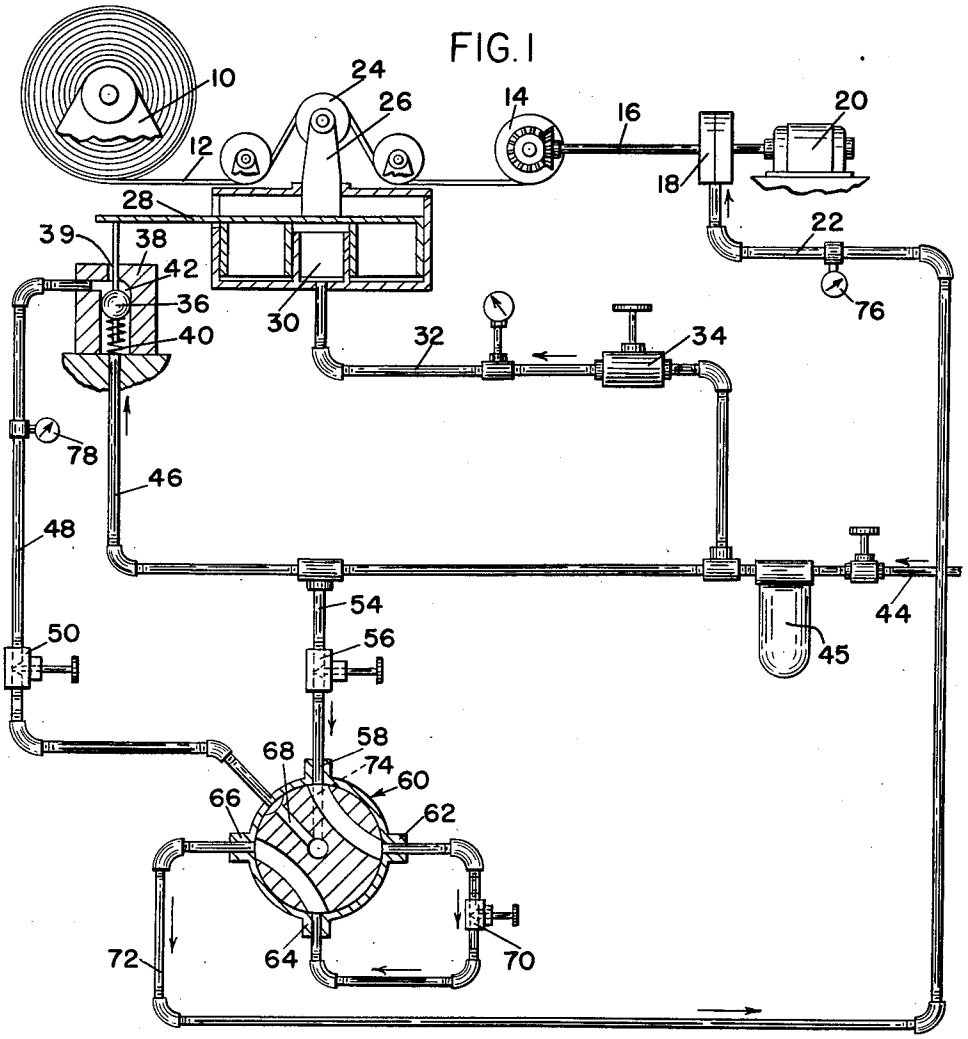
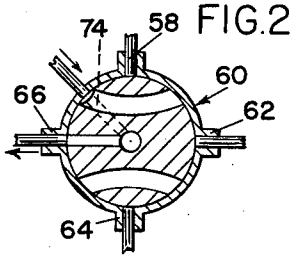


FIG. 2



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CONTROL APPARATUS FOR AIR-OPERATED DEVICES

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2 Claims. (Cl. 242—75.53)

This invention relates to control apparatus and reference is made herein to my copending application Serial No. 582,193, filed May 2, 1956. This invention represents a modification of the structure of the automatic control means as described in said application.

The principal object of the present invention resides in the provision of means providing an air control, as for instance for an air clutch which is adapted to be driven by a motor to drive a winding or reeling roll or pump, or any other device, and including means providing a pneumatic impulse signal to apply a variation of air pressure to the clutch, said means comprising a device which is movable according to the variation of a load imposed thereon and directly controlling the action of an air relay valve for opening and closing or varying the opening thereof, whereby an automatic signal from the source of air pressure going directly to the clutch is variably applied so as to increase or decrease the torque applied to the driven device by means of the clutch; and the provision of a control device as above described including a novel valve arrangement for the purpose of introducing a manual control of the clutch as well as an automatic control, it merely being necessary to selectively change the opernation of the device between manual control position and automatic control position as described above; and the provision of means bleeding the air supply pressure providing that under manual operation the system is stabilized at a fixed value for each different setting of a needle valve restriction inserted in the air circuit.

Other objects and advantages of the invention will appear hereinafter.

Rerference is to be had to the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of an entire control system and illustrating the same in condition for manual operation thereof; and

Fig. 2 is a view illustrating the valve in condition for automatic operation.

This invention has been illustrated as applied to a winding and reeling apparatus, and the novel control system is particularly adapted for textile operations. However, the invention is not limited to such an adaptation and may be used particularly in any relationship wherein the speeds are of a relatively low order but wherein it is desired to provide an automatic control of a high order of sensitivity and action.

There is illustrated at **10** a stand for reeling or unreeling a web **12** and another stand is illustrated at **14**, the roll **14** being driven as for instance by a shaft **16** by means of a variable pneumatic clutch **18** of commerical design, in turn driven by a motor **20**. A line, as for instance at **22**, applies air to the clutch in order to control the torque being applied. Although a clutch is here referred to, any other air-operated control device may be used.

The web **12** proceeds over a load-sensing roll **24**

which is mounted on a block **26**, the block in turn being mounted upon an element **28** which may be referred to as the "force" lever. This element is maintained on an air cushion, as for instance in the cylinder **30** by means of an air supply **32**. If the air supply **32** is maintained constant, as for instance by an adjusting regulating valve at **34**, when the load rises and falls the element **28** will rise and fall in proportion therewith and will operate a valve element **36** in the air relay valve **38** against the action of a spring **40** therein in order to variably open and close a valve diagrammatically shown at **42**. The air-relay valve **38** is vented at **39**.

Any source of air may be applied through the conduit at **44** and filter **45** for supplying the entire system, and a conduit **46** supplies the valve **36**, and therefore it will be seen that the air pressure in the conduit **48** leading from the valve will vary according to the load imposed upon the roller or load-sensing signal device **24**.

A needle valve **50** is inserted in the conduit **48** which leads to a novel valve generally indicated at **60**. As shown in Fig. 1, the valve **60** is closed with respect to the conduit **48**, so that automatic operation of the load-sensing device, above described, is out of operation.

Instead, a conduit **54** is provided leading from the air supply. This conduit is provided with an adjustable needle valve **56** leading to a port **58** in the valve **60**. This valve has ports **58**, **62**, **64**, **66** and **68**. In the manual position of the device illustrated in Fig. 1, the air supply passes through the needle valve **56** into port **58** and out the port **62** whence it passes by a venting device **70** and re-enters at port **64**, passing to port **66** and thence out through a conduit **72** to conduit **22** to the clutch or other air-operated device **18**.

However, if the valve **60** be turned to the position shown in Fig. 2, the automatic signal enters a passage **74** and out through the port **66** to conduit **72** and thence to the clutch **18**, as before, and thus it is seen that a simple re-positioning of the valve provides for a fixed manual operation of the device or for the automatic operation of the device, and when in the automatic position, ports **58**, **62** and **64** are each selectively blocked such that there is no wasteful loss of air from the system to atmosphere. The passage **74** is out-of-line of port **58**, and is closed in Fig. 1.

In the automatic operation of the device, the variation of pressure on the clutch is obtained simply through the source of air **44** passing through the valve **38**, and is controlled thereby; but under manual operation, the valve **56** may be manipulated to provide for changes in torque if such is desired.

In manual control position, adjustment of the needle valve restriction **56** permits the feeding of any required pressure signal to the clutch, and this value can be read on the output gauge **76**. If adjusted for the desired web tension while the machine is operating, automatic control may be obtained in two succeeding steps. In the first place, adjustment of pressure in conduit **32** is made by loading the piston in the cylinder **30** to locate a point of balance with respect to the load pressure on the piston. At the balance point, the air relay valve at **38** will change position and this is indicated by an air pressure change at the control point indicator gauge **78**. When this condition is obtained, changing the valve **60** from manual and to automatic places the control on the automatic control.

This invention permits the operator to record the manual output pressure for certain conditions on winding or unwinding operation and the control points for the particular material being processed so as to duplicate conditions at other times when running identical goods. When an operation is completed, manipulation of the

control valve 60 to manual position will immediately restore correct output pressure to the clutch for the next roll of goods, etc. As soon as the next roll of goods has been placed in motion, valve 60 may then be turned to automatic position. This reduces operative actuation and progresses to a simple two-step manipulation of the valve 60 for each roll of goods processed.

Control action is initiated as a function of a variable deviating from a fixed value which it is desired be maintained. The variable is indicated as a force and is balanced by an opposing force which is independently controlled at a regulated value. Thus the control point is a fixed standard of comparison. As the variable measurement deviates about the desired control point, a signal device illustrated as the air valve 38 is actuated by a direct mechanical connection. The signal from this device thus travels between two values, zero or maximum as the variable load deviates above or below the required value. Since the remainder of the automatic control circuit functions from this basic concept of balancing of a variable measurement against a fixed standard force, the primary feature gained thereby is the fact that over-all accuracy of the system is not a percentage function of any span of operation, but merely the mechanical error introduced by resistance to movement of members incorporated in the design of the load-sensing-signal-device assembly combination. Thus, regardless of minimum or maximum value or setting of the control point, accuracy is a constant factor and thus error is minute, particularly at the upper limits of operation.

The second feature of this control mechanism is a result of the adjustable resistance introduced in the line from the air relay valve. This restriction modulates the air signal which is initiated as a direct result of deviations of the controlled variable from the desired standard of comparison or control point. A correcting signal is thus fed as an output directly to the final control element of the control loop. The extreme

sensitivity of the load-sensing device leads to an extremely high order of control accuracy.

It is to be understood that the present invention may have many different applications but it is particularly adaptable to relatively slow speed operations. The clutch 18 may be utilized as a brake if desired and many other changes in the invention in specific applications may be made without departing from the scope of the invention.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:

1. Automatic control mechanism comprising a source of air under pressure, a load detecting device, means to pre-set the latter including an air cylinder and a regulator valve therefor, an air relay valve, an air-operated device actuated by the source of air pressure, the air relay valve being located in the air line between the air pressure source and the device, means in the relay valve for varying the air pressure passed thereby, means associated with the load detecting device to actuate the second named means according to the load impressed on the air cylinder of the load detecting device, means to transfer the air pressure directly to the air operated device by-passing the air relay valve, and manually-operated means to control the air pressure in the air transfer means.

2. The control mechanism of claim 1 including a metering means comprising a needle valve located in the line between the air relay valve and the air-operated device.

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