Dec. 19, 1967 S. T. WILLIAMS 3,358,563

AIR CYLINDER CYCLING APPARATUS

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Fig. 1.

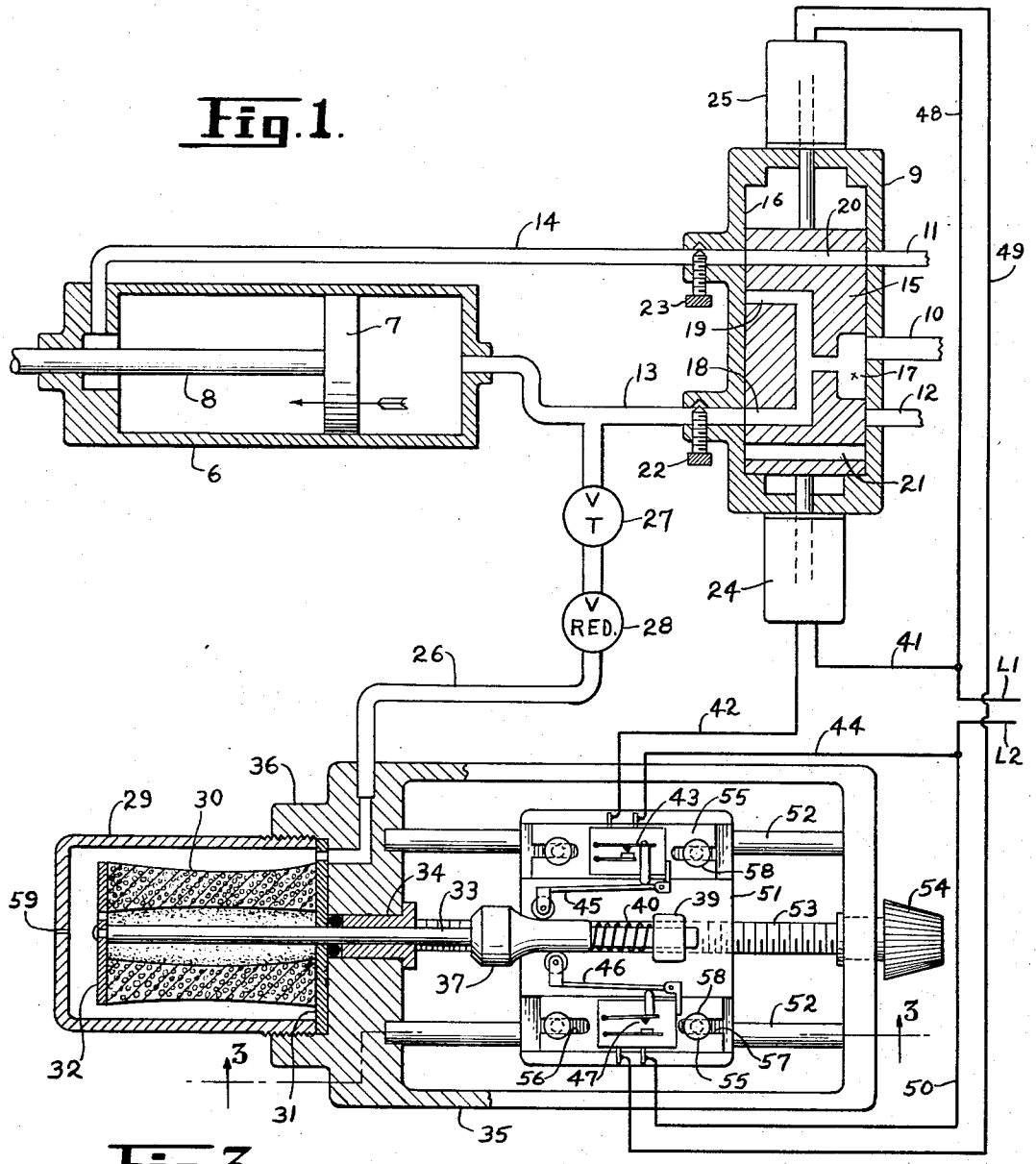
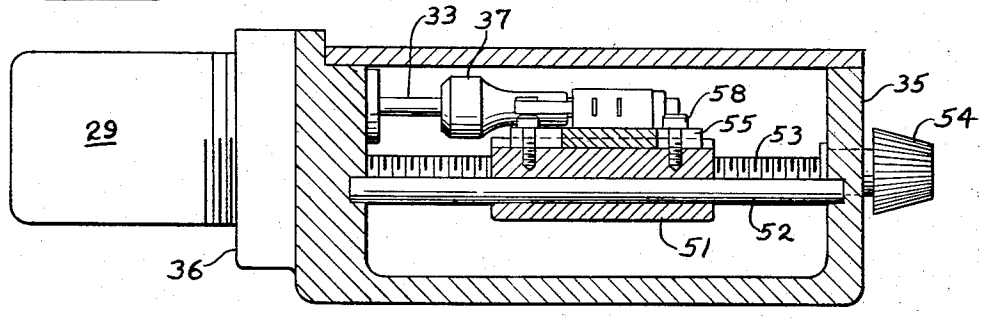


Fig. 3.

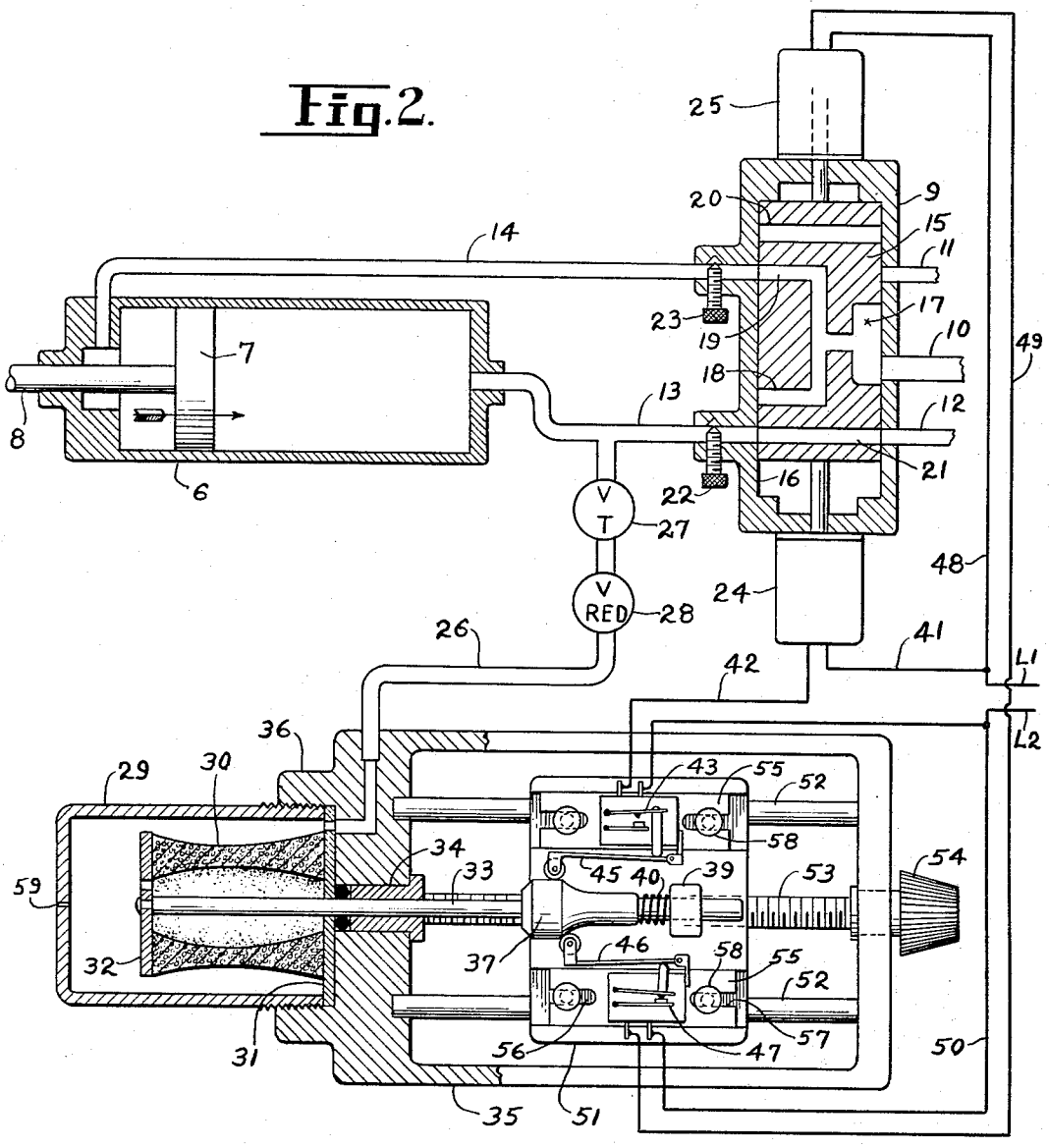


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Fig. 2.



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AIR CYLINDER CYCLING APPARATUS

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This invention relates to air cylinder cycling apparatus to control the automatic reciprocation of a piston for repetitive motive applications. It is intended to operate continuously as long as connected to a supply of air under pressure.

Devices of this general class are in common use where the cycling of the piston through its operating stroke and return are governed by devices which respond to the movement of the piston to a certain position. Devices of this type will shift the valve which controls admission of air to opposite ends of the cylinder mechanically upon movement of the piston a certain distance regardless of the time element involved. The timing of the stroke can, of course, be regulated to some extent by throttling the supply of air to the cylinder. Other known devices involve the use of motorized cams or direct mechanical connection between the valve and a machine being controlled.

My invention, as distinguished from these prior devices is controlled by pneumatic means supplied by air when the valve is in one or the other of its positions, preferably during the working stroke of the piston. It is thus not dependent on any mechanical connection with the piston or with the machine being controlled. Therefore, I am able to control not only the rate of travel of the piston by throttling its supply, but I am also able to vary the timing of the cycling of the piston independently. This is accomplished by additionally regulating the flow to the pneumatic control device, by adjustments in that device itself, or by a combination of the two. Thus, I can provide for very rapid cycling, even reversing the piston before it travels all the way to the end of the cylinder, or I can provide for any desired dwell time at the completion of the working stroke of the piston.

Other objects and advantages of the invention will hereinafter more fully appear.

In the accompanying drawings, I have shown for purpose of illustration, one embodiment which the invention may assume in practice. In these drawings:

FIG. 1 is a diagrammatic view of my improved cycling apparatus with the various parts in their positions during the working stroke;

FIG. 2 is a similar view but showing the parts in their positions during the return stroke; and

FIG. 3 is a section on line 3—3 of FIG. 1.

The cycling apparatus is shown as connected to a cylinder **6** containing a piston **7** with an operating rod **8** extending through one end of the cylinder. For controlling the admission and exhaust of air from opposite ends of the cylinder, there is provided a valve casing **9** connected at **10** to a source of air under pressure and having exhaust ports **11** and **12** on opposite sides of the inlet connection. Air is supplied to and exhausted from that end of the cylinder opposite the operating rod **8** through a suitable connection **13**, and another connection **14** leads from the valve casing to the opposite end of the cylinder for controlling admission of air to that end for the return stroke and for exhausting air on the working stroke.

The valve **15** may be of the cylindrical type operating in a cylinder bore **16** of the valve casing **9**. It has the space **17** in constant communication with the supply line **10** and from this space leads the passage **18** which supplies air under pressure to the connection **13** in the position of FIG. 1. The passage **19** supplies air under pressure

to the connection **14** when the parts are in the position shown in FIG. 2.

In the FIG. 1 position, an exhaust passage **20** in the valve establishes communication between the connection **14** and the exhaust port **11** while in FIG. 2, a similar passage **21** opens the connection **13** to the exhaust port **12**.

The needle valves **22** and **23** are provided at convenient places in the valve casing to throttle the flow of air to and from opposite ends of the cylinder. The valve is shifted to and held in the FIG. 1 position by a solenoid **24** and to the reverse position by a solenoid **25** after de-energization of the solenoid **24**. The solenoids are activated for shifting the valves at the desired times by means of a pneumatically controlled device supplied with air under pressure when the valve is in its working stroke position through a connecting line **26**. In this line, there is an adjustable regulating valve **27** effective to throttle the air flowing from the valve to a reservoir or compartment **29** and if desired, there may also be employed a one-way pressure reducing valve **28**.

The line **26** leads to the reservoir **29** which may house a suitable form of pressure responsive element. For this purpose, I prefer to use a body **30** consisting of foam material made from rubber or plastic and having closed cells. This body can be either a single hollow cylindrical piece or a plurality of doughnut-shaped pieces cemented together. It is anchored to the end wall **31** of the reservoir **29** by adhesive and its other end to a movable plate **32**. An operating rod **33** extends through a suitable packing **34** extending through a hole in the frame **35**.

The cylindrical reservoir **29** can be threaded into a boss **36** of the frame member **35**. The rod **33** which is moved outwardly on increase in pressure in the reservoir **29** carries a switch operating cam **37** and the free end of the rod is supported in a boss **39**. A spring **40** may be placed between the boss and cam **37** to assist in the return movement of the rod **33**.

Solenoid **24** is energized from power line L_1 through wires **41** and **42**, normally closed switch **43** and wire **44** back to L_2.

During the working stroke as seen in FIG. 1, the foam material body **30** will decrease in length at a rate dependent on the adjustment of the valves **22** and **27**, and upon lapse of the desired time, the cam **37** will move to the right enough to lift the switch operating arm **45** to open switch **43** and de-energize solenoid **24**. Upon a slight further predetermined movement, the cam **37** will push the switch operating arm **46** downwardly to close switch **47**. This will energize the solenoid **25** from L_1 through wires **48** and **49**, switch **47** and wire **50** so as to cause the valve **15** to shift to the FIG. 2 position which, of course, will effect the return stroke of the piston **7**. At the same time, the air in reservoir **29** will flow freely through the line **26** to the exhaust port **12** and allow the switch operating cam **37** to return quickly to a starting position. As soon as the cam **37** moves far enough to open switch **47**, solenoid **25** will be de-energized and shortly thereafter on the return movement of the switch operating rod **33**, the arm **45** will drop and allow switch **43** to close so as again to energize solenoid **25** to complete the cycle.

The switches and their operating arms are carried on a block **51** slidably mounted on rods **52** in the frame **35** and a long threaded rod **53** can be manipulated by a knob **54** to adjust the switch-carrying block **51** relative to the cam **37**. The switches **43** and **47** together with their operating arms, are adjustable relative to the cam **37** and relative to each other. For this purpose, each switch and its operating arm are fixed to a plate **55** having slots **56** and **57** at opposite ends. By loosening the hold-down screws **58**, these plates can be adjusted to the exact position de-

sired. The block **51** also carries the boss **39** previously mentioned.

By the adjustments provided for the switches, the time required for their operation is changed because the length of the operating rod movement depends on the pressure build-up in the compartment or reservoir **29**. For example, the switches can be adjusted so that they will operate after only a slight movement of the pressure responsive element; or if the time interval desired for the piston cycle is greater, then the switches can be adjusted to require maximum build-up of pressure in the reservoir **29**.

The speed of the piston stroke is controlled by the needle valves **22** and **23** which will also regulate to some extent, the rate of the return stroke. Besides the throttling accomplished by valve **22**, the regulating valve **27** can also be adjusted to vary the time required for the pressure build-up in reservoir **29**. A very small bleed opening **59** is for the purpose of preventing build-up of heat in the reservoir, which might result from the continuous flexing of the foam material body **30**.

It will accordingly be seen that I have utilized a pressure responsive switch actuating means governed by the air pressure between the valve and the cylinder during the operating stroke which is capable of regulation over a very wide range to provide the desired time cycle of the piston independent of mechanical devices actuated by the piston itself. Such a device is capable of being set up at a remote station rather than being stationed directly to the machine to be controlled.

What I claim is:

In combination with an air cylinder, a piston in the cylinder having an operating rod extending through one end of the cylinder;

(a) a valve casing having separate connections to opposite ends of said cylinder;

(b) a valve in said casing movable between a first position which admits air to one end of the cylinder while opening the other end to exhaust, and a second position to admit air to said other end while exhausting the first end of said cylinder;

(c) means for shifting said valve from the first position to the second position;

(d) a pneumatically controlled device supplied by air from said valve in said first position for activating said shifting means;

(e) additional means for regulating the flow of air to said pneumatically controlled device, said pneumatically controlled device comprising a compartment in communication with said valve, a pressure responsive element in said compartment, a switch actuator connected to said element, a switch actuated thereby and a solenoid connected to said valve and whose energizing circuit is controlled by said switch;

(f) means for manually adjusting the position of said switch relative to said actuator to vary the time of cycling by said valve;

(g) a second solenoid connected to the valve for returning it from its second position to its first position, and a second switch controlled by said switch actuator, said second switch being in the energizing circuit of said second solenoid; and

(h) means for manually adjusting the position of one of said switches relative to the other.

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