March 16, 1971 D. E. LEARMONT 3,570,323

MOTION-TRANSMITTING APPARATUS

Filed May 1, 1969 2 Sheets-Sheet 1

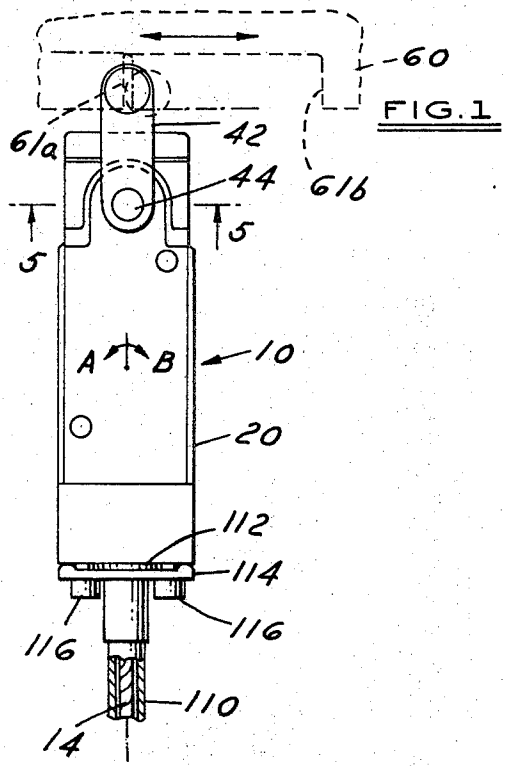
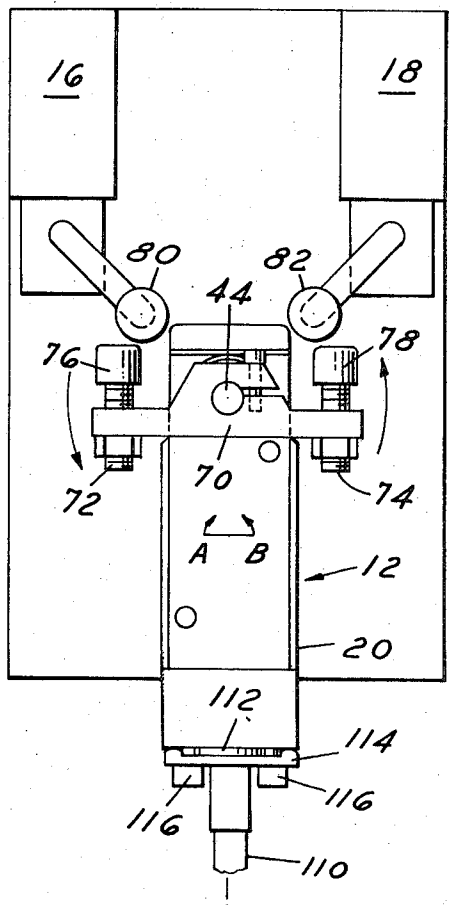


FIG. 1



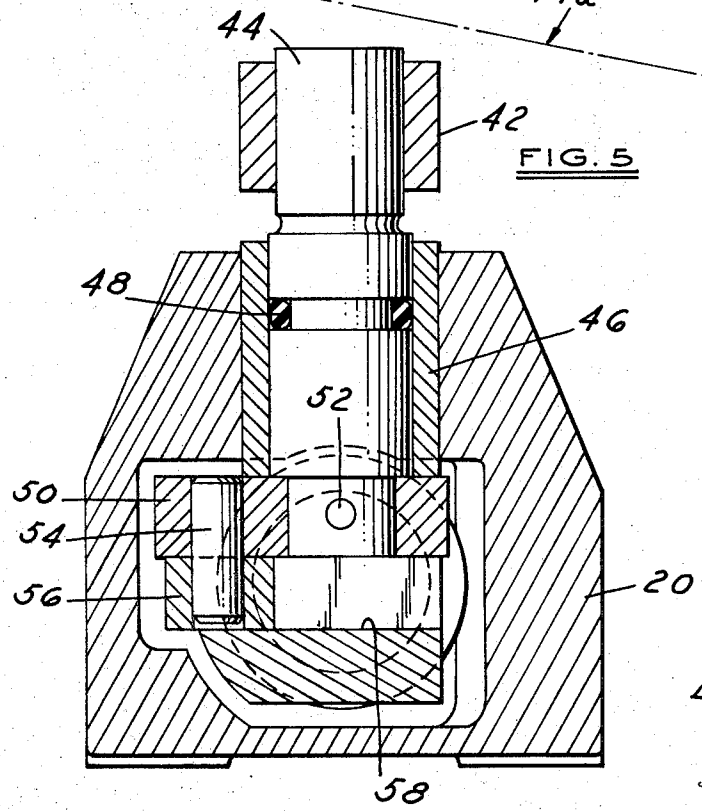


FIG. 5

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March 16, 1971 D. E. LEARMONT 3,570,323

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Filed May 1, 1969 2 Sheets-Sheet 2

FIG. 2

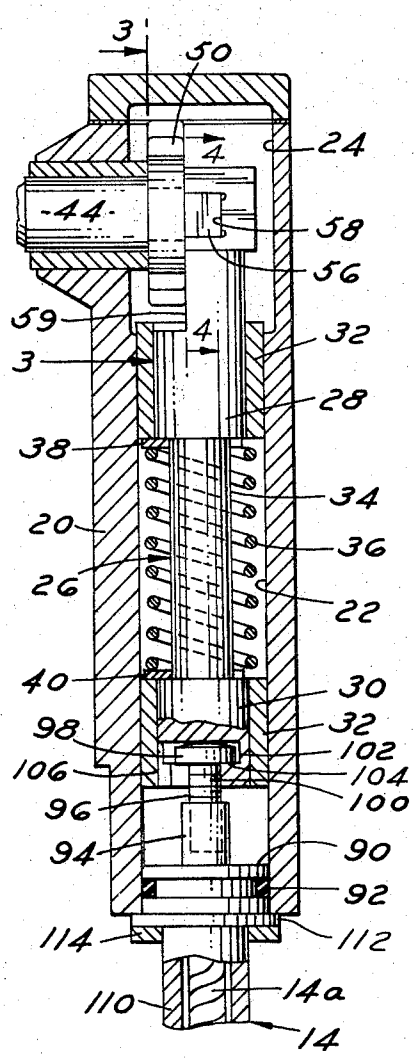


FIG. 3

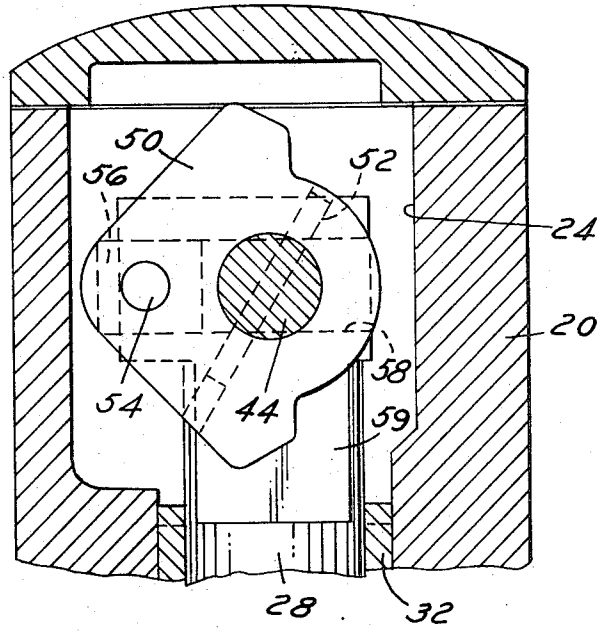
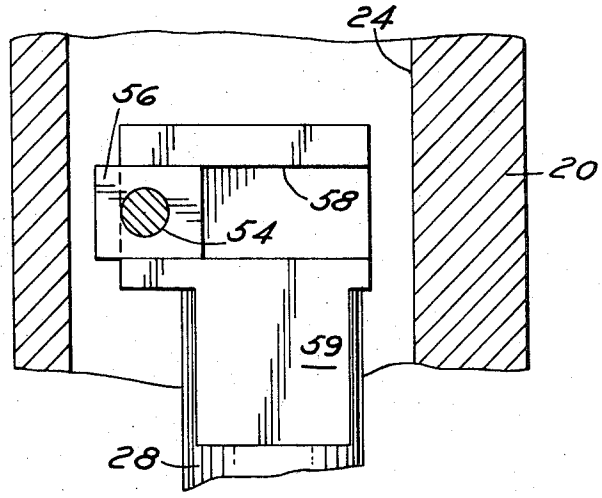


FIG. 4



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MOTION-TRANSMITTING APPARATUS

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Int. Cl. F16c 1/10
U.S. Cl. 74—501 4 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for operating one or the other of two limit switches in response to a mechanical movement at a remote point. A master unit has a first member movable in opposite directions from a neutral position in response to the mechanical movement, the direction of movement of the member depending upon the direction of the mechanical movement. A slave unit has a second member movable in opposite directions from neutral and adapted to effect the operation of one or the other of the switches depending upon the direction in which it is moved. A single push-pull linear member or cable transmits the movement of the first member to the second member in either direction.

SUMMARY OF THE INVENTION

It is a primary object of this invention to provide an improved motion-transmitting apparatus for operating limit switches or the like.

Another object is to provide a motion-transmitting apparatus responsive to signals in two directions, to trip either one of two limit switches.

Another object is to provide a system in which the switches are disposed in a readily accessible position in full view for easy adjustment.

Another object is to provide a push-pull cable connection between the units of the motion-transmitting apparatus which may be quickly coupled and uncoupled.

Another object is to provide a remote control system which is designed to utilize switches of various different constructions and/or brands.

Another object is to provide a system for the remote control of limit switches that utilizes a longer stroke to trip the switches than many other existing remote systems.

Another object is to provide a motion-transmitting apparatus having a master head for receiving the signals and a slave head for applying the signals to the switches, the heads being of substantially the same construction.

Another object is to provide an improved master and slave head construction.

Another object is to provide a remote control operator of improved construction making it possible to place the limit switches in a protected zone removed from the location where the signals are produced.

Another object is to provide a master and slave head construction adapted to transmit and receive signals in two different directions utilizing a single cable, whereby to operate one or the other of two limit switches depending upon the direction of the signal, the heads being normally spring centered to a neutral position.

Another object is to provide a master head construction having a centering spring for normally maintaining the trip arm in neutral position, the centering spring through the action of the push-pull cable also centering the trip arm of the slave head.

Another object is to make it possible to replace troublesome in-field switches by reason of the fact that the mounting dimensions of the master head are identical to many existing electrical switches.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is an elevational view with parts broken away and in section of remote control limit switch apparatus constructed in accordance with my invention.

FIG. 2 is a longitudinal sectional view of the master head which is a portion of the apparatus shown in FIG. 1.

FIG. 3 is a fragmentary sectional view taken on the line 3—3 in FIG. 2.

FIG. 4 is a fragmentary sectional view taken on the line 4—4 in FIG. 2.

FIG. 5 is a fragmentary sectional view taken on the line 5—5 in FIG. 1.

Referring now more particularly to the drawings and especially to FIG. 1, the apparatus there shown comprises a master head **10**, a slave head **12**, a flexible push-pull linear member or cable assembly **14** for transmitting motion from the master head to the slave head, and limit switches **16** and **18** adapted to be operated by the slave unit.

The important use of this invention is in connection with limit switch controlled machine operations where it is desired to remove the limit switches from the vicinity of the machine operation to be controlled in order to protect the switches from contaminants such as cutting fluids, abrasive dusts or lubricants which might adversely affect the operation of the switches. In the present instance, the master head **10** is placed near the member which applies the mechanical movement or signal, and the slave head **12** and limit switches are located in a safe place far enough removed from the signal to be unaffected by adverse conditions in the vicinity of the signal and also in a place where they may be readily accessible for service or adjustment.

The master head **10** comprises an elongated upright housing **20** having an internal chamber consisting essentially of an elongated cylinder **22** which opens through the bottom of the housing and an enlarged portion **24** communicating with the upper end of the cylinder. A piston or plunger **26** is reciprocable vertically in the cylinder **22** of the chamber, having heads **28** and **30** at the ends guided for vertical sliding movement in the fixed bearing sleeves **32** within the cylinder. The heads **28** and **30** are connected by an integral reduced contral portion **34** which is surrounded by a compression coil centering spring **36**. Free floating washers **38** and **40** at the ends of the spring are adapted to bear against the bearing sleeves **32** and against the heads **28, 30**. The piston **26** is thus held normally in the neutral position shown in FIG. 2 by the spring **36**, but the piston may be moved up or down from the neutral position compressing the centering spring by the pressure of one of the heads **28, 30** pushing on the associated washer **38, 40**.

The master head has a pivoted trip arm **42** which is secured upon a pivot pin **44** journaled for rotation in a bearing sleeve **46** in the upper portion of the housing **20**. An O-ring seal **48** in an annular groove of the pin **44** is provided to prevent the entry of contaminants into the master head housing.

A crank **50** which may be of the shape shown in FIG. 3 is secured to the pivot pin **44** by the pin **52** and carries a pin **54** upon which the slidable rectangular block **56** is pivoted. Block **56** is slidable in the horizontal groove **58** formed in a flat surface **59** of an enlarged upper end portion of piston head **28**. Accordingly, oscillation in one direction or the other of pivot pin **44** by trip arm **42** will through the action of the crank **50** and sliding pivot connection between the crank and piston **26** result in raising or lowering piston **26**.

The means for applying a signal to the master head is generally indicated as a machine member **60** reciprocable as indicated by the arrows which is capable of moving the trip arm **42** in either direction from the upright neutral position shown in FIG. 1 by engaging the roller **61** on the trip arm with either of the surfaces **61***a* or **61***b* of member **60**. Thus the master head is responsive to the mechanical movement of member **60** when member **60** is at the extreme left or right of its completed travel, and the trip arm will then be moved in one direction or the other depending upon which direction the member **60** is moved. Member **60** is shown at its extreme right in dotted lines and at its extreme left in dot-dash lines. (Switches indicate present status of movement.) Thus, referring to FIGS. 1 and 3, a clockwise movement of the trip arm **42** from the upright neutral position shown will cause the piston **26** to be raised, and counterclockwise movement of the trip arm **42** will cause the piston **26** to be lowered.

The mechanical force of the member **60** ceases to be applied when member **60** is in an intermediate position, at which time the trip arm **42** will be returned to the neutral position shown by the action of the centering spring **26**. The member **60** may, for example, be a machine part which moves back and forth within limits and its completed travel will be indicated by the signal of switches **16** or **18**.

The slave head **12** including all of its parts, is of the same construction as the master head **10** except for the design of the trip arm which instead of being like the element **42** of the master unit is of the construction shown and indicated at **70**. Accordingly, it will be unnecessary to refer to the interior construction of the slave head except to say that it is exactly as shown in FIGS. 2–5. Corresponding parts of the two units will be referred to by the same numbers. However, the piston in the slave unit, corresponding to the piston **26** of the master unit, may be centered by the centering spring **36** of the master unit through the operation of the push-pull cable, making it unnecessary to provide an individual centering spring **36** for the slave unit. In other words, the slave unit may omit the centering spring **36** since its piston will automatically follow the piston of the master unit and be centered by the centering spring of the master unit.

The trip arm **70** of the slave unit is secured midway between its ends upon the pivot pin **44** thereof and has switch operating elements **72** and **74**. These elements **72** and **74** are threaded members which thread into the opposite arms of the switch arm **70** for longitudinal or axial adjustment, and have heads **76, 78** for engaging the switch arms **80, 82** of the switches **16** and **18**. Hence rotation of the switch arm **70** in a clockwise direction for example from the neutral position shown will cause the head of element **72** to operate the switch arm **80** of switch **16**, and reverse rotation of the switch arm **70** from neutral will cause the head of element **74** to engage switch arm **82** and thereby operate switch **18**.

The motion of the piston in the slave head **12** will follow the motion of the piston **26** of the master head **10** from neutral by the operation of the connecting push-pull cable assembly **14**, although upward movement of piston **26** of the master head will result in downward movement of the piston in the slave head and vice versa, as will be apparent. Pivotal movement of trip arm **42** in direction A produces pivotal movement of trip arm **70** in direction A, and movement of trip arm **42** in direction B causes movement of trip arm **70** in the B direction. (See FIG. 1.) The cable assembly **14** includes a push-pull cable **14***a*. One end of the cable **14***a* has a pilot head **90** on the end which fits in the lower end of the cylinder **22** in housing **20** of master head **10**. An O-ring seal **92** in an annular groove in pilot head **90** excludes dirt and other foreign material from the housing. The cable has an end **94** which is threaded to accept a screw-type coupling member **96** having a head **98**. The lower end of the piston head **30** has a recess **100**

which is enlarged at its inner extremity shown at **102** so as to provide a shoulder **104** to engage the underside of the head **98** of the inserted coupling **96**. Thus the coupling **96** is firmly anchored to the head **30** of the piston and follows its reciprocatory movement. The side **106** of the recess **100, 102** is open however so that by manually withdrawing the piston **26** far enough to withdraw the recess **100, 102** beyond the lower end of sleeve **32**, the coupling member **96** may be laterally withdrawn from the open side **106** of the recess to break the connection. The parts may be just as easily assembled in a like manner.

The coupling or connection between the piston of the slave head **12** and the opposite end of the cable will be understood to be exactly the same as that described for the master head.

The push-pull cable **14***a* is sheathed in a flexible tubular cover **110** which protects it and yet permits the cable to move axially within the cover. Annular flange plates **112** are secured to opposite ends of the cover **110**. Mounting plates **114** slidable on the ends of the cover **110** are adapted to be bolted to the underside of the housing by fasteners **116** to clamp the flange plates **112** to the housing. It will of course be understood that before a coupling member **96** can be connected to or disconnected from the piston of the head **10** or **12**, the fitting **114** must be first detached from the housing.

It will thus be appreciated that movement of the piston **26** in the master head **10** from neutral in response to the movement of member **60** will be transmitted to the slave head **12** by the push-pull cable assembly **14** to effect a corresponding movement of the piston in the slave head, causing the trip arm or lever **70** to pivot one way or the other and operate one of the limit switches.

What I claim as my invention is:

1. The combination with two switches of motion transmitting apparatus for operating one or the other of said two switches in response to a mechanical movement at a point remote from said switches depending upon the direction of said mechanical movement, comprising a master unit disposed at said remote point and a slave unit disposed adjacent said switches, said master and slave units each including an elongated housing having a cylinder therein, a piston in each of said cylinders reciprocable in opposite directions from a neutral position, means for transmitting the movement of one piston to the other comprising a single push-pull linear member having the ends thereof respectively connected to said pistons, each unit having a pivotal trip arm on the housing thereof adapted to be pivoted in one direction or the other, means connecting the trip arm of each unit to the associated piston to transmit motion from one to the other, the trip arm of said master unit being adapted to be pivoted in one direction or the other by such mechanical movement and the trip arm of said slave unit having means respectively engageable with said switches depending on the direction of pivotal movement thereof, and yieldable means normally retaining said pistons in their neutral positions comprising a spring within one of said housings acting upon the piston therein.

2. The combination defined in claim **1**, wherein the piston upon which said spring acts is an elongated member having enlarged heads at the ends, bearing sleeves slidably supporting said heads, washers freely encircling said elongated piston member between said heads, said spring bearing against said washers and pressing said washers toward said heads, said washers normally abutting said heads and said bearing sleeves to hold said elongated piston member in its neutral position.

3. The combination defined in claim **2**, wherein said bearing sleeves are spaced apart the same distance as said heads.

4. The combination defined in claim **3**, wherein the connection means for the trip arm of each unit comprises a pin pivoted to said housing on which said trip arm is

mounted, a crank on said pin, and a sliding pivot connection between said crank and the associated piston.

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U.S. Cl. X.R.

200—153