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[54] **COUPLING AND POWER CONTROL DEVICE**
16 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **91/428,**
91/448, 91/457; 137/596.2, 137/614.21
[51] **Int. Cl.** **F15b 13/04**
[50] **Field of Search** 91/378,
446; 91/428, 448, 457; 137/(Inquired), 614.11,
614.21; 285/(Inquired); 287/(Inquired);
137/596.2

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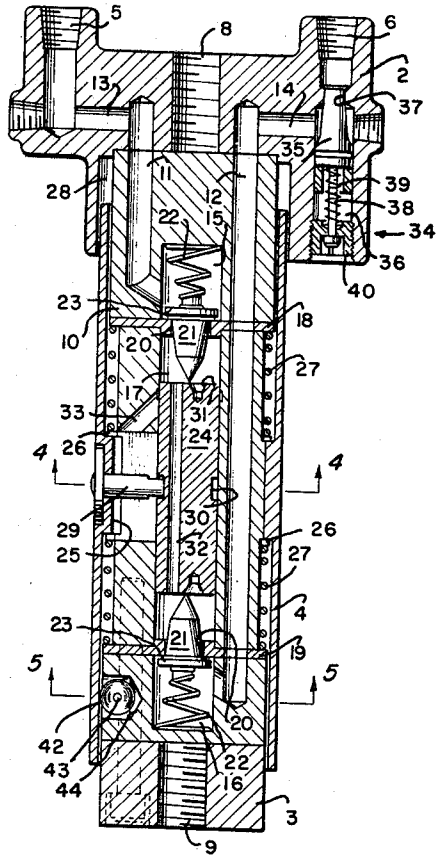
ABSTRACT: An elongate coupling member having means for attaching at either ends thereof a hook block and a hoist cable adapter. Within the coupling member are fluid passageways and valves, the valves being operated by means coupled to a slidable sleeve which envelopes the coupling member. The valves and passageways communicate pressured fluid with the hoist, or prohibit the communication, in response to sleeve movement, to power the hoist to raise or lower an attached hook block.



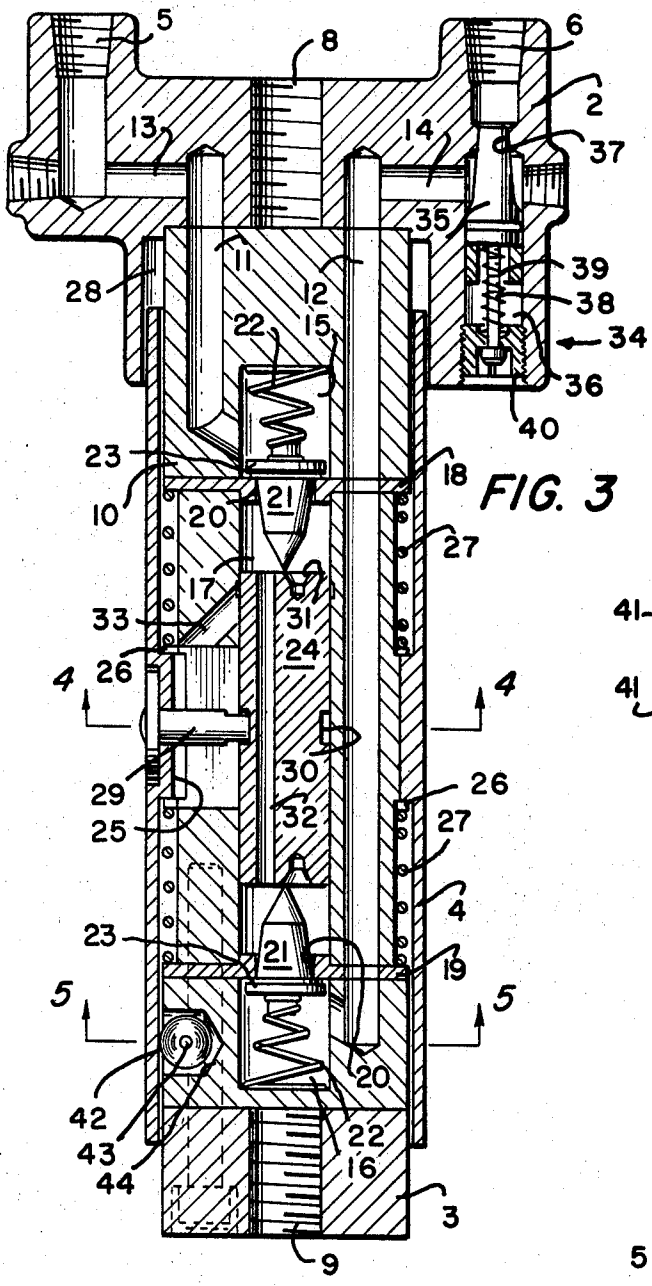


FIG. 3

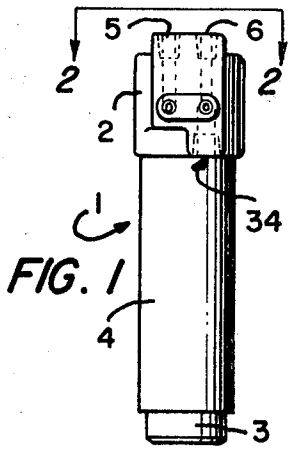
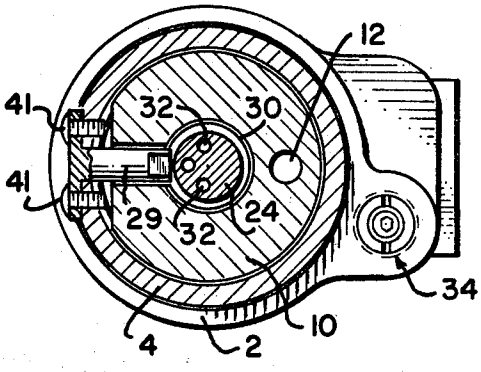


FIG. 1

FIG. 4



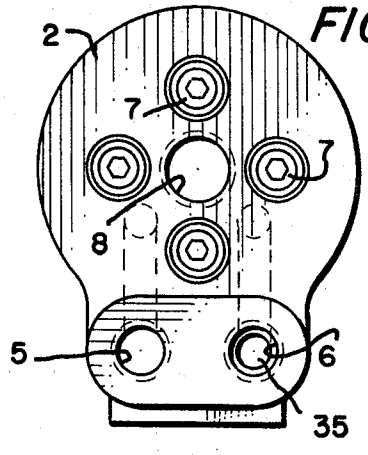


FIG. 2

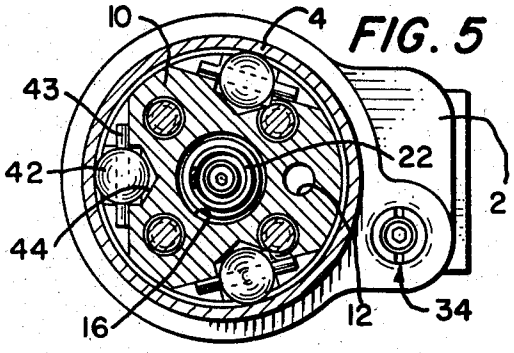


FIG. 5

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COUPLING AND POWER CONTROL DEVICE

This invention pertains to means for mechanically coupling a prime mover and a workload, and to means for controlling the enabling power communicated to a prime mover which is coupled to a workload, and in particular to a device in the novel structure of which are met the faculties of both such coupling and power control.

Heretofore, in the prior art concerned with the matters to which our invention pertains, it has been customary to provision an independent mechanical coupling between the workload and the prime mover, and an independent power control for operation of the prime mover.

Where the prime mover is electrical, it is known, for instance, to employ a remote and independent wall switch for controlling the admittance of the power medium thereto. Where the prime mover is fluid-responsive, such as in air-powered hoists, it is common to use a suspended pendant, which is functionally interposed in the supply line of the fluid medium, to regulate the prime mover.

There is an inherent lack of immediacy or feel in such remote operation of workload-handling prime movers. A more intimate sensing of prime mover functioning and workload response could be realized if the workload coupling and the power control were joined in a self-same unit. Moreover, the more immediate sensing would be enhanced if such a unit were responsive to manual pressure exerted in a given direction to effect workload handling by prime mover-induced motion in said given direction. This would provide a linear work response to a manual pressure having a given corresponding orientation. Equally or more useful would it be to have such a unit providing a linear work response of a given rate to manual pressure of a given degree and a response of a different rate to manual pressure of a different degree, these responses manifested at the location of workload coupling.

Accordingly, it is an object of this invention to provide a coupling and power control device having means for attaching thereto workload-handling means and motive power output means together with means operable to communicate the medium of a given power source with the prime mover, to power the prime mover, to effect workload handling.

Another object of this invention is to provide a device of the type noted in which the operable, medium-communicating means are further operable for prohibiting such communication.

Another object of our invention is to provide in such a device, power medium communicating means effective for power-operating the prime mover at variable rates of response.

Still another object of our invention is to provide such power medium communicating means with cooperative actuator means, the two being cooperative to effect a prime mover response in an orientation which corresponds to the orientation given to said actuator means, this to produce a linear work response of the prime mover.

Yet another object of our invention is to provide a coupling and power control device having means for attaching thereto means for mechanically coupling said device to a workload-handling prime mover, with prime mover operating means and actuator means slidable along an axis, relative said attaching means, in response to manual pressure, to cause said operating means to enable and to halt said prime mover.

A feature of this invention comprises the provisioning of an elongate coupling member having means for attaching workload-handling means and motive power output means of a prime mover thereto. The coupling member has means and controls therewithin operable for communicating the medium of a power source with a prime mover, and operable for prohibiting said communication, to operate and to halt said prime mover, respectively.

Further objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying FIGS., in which:

FIG. 1 is a vertical illustration of a preferred embodiment of a coupling and power control device according to the invention;

FIG. 2 is a top view of the embodiment of FIG. 1;

FIG. 3 is an unreal, or a contrived, vertical cross section of the device of FIGS. 1 and 2. This illustration, as is more fully explained in the following text, is a development of the significant vertical cross sections of the device; it was composed, and is presented herewith, the more readily to facilitate an understanding of the invention, and to show every feature thereof specified in the claims, in a manner which several true vertical cross sections could not equal in simplicity;

FIG. 4 is a true horizontal cross section of the device taken along section 4–4 of FIG. 3; and

FIG. 5 is another true horizontal cross section of the device taken along section 5–5 of FIG. 3.

Considering FIG. 1, the coupling and power control device 1 of our invention comprises header blocks 2 and 3 shown at the top and bottom, respectively, of the device.

It is to be understood that the given vertical orientation of the device 1 is arbitrarily chosen for illustrative purposes. In this disposition, the device will cooperate with an overhead hoist. Clearly, though, the device 1 will function equally well in a horizontal attitude to cooperate with a winch to handle a workload. So also, the device 1 can be inverted or angularly inclined, from the FIG. 1 disposition, to cooperate with a linear actuator, or a hydraulic or air cylinder as the prime mover. The types of prime movers with which our device 1 will cooperate, are of no particular consequence. For purposes of illustration, we show an embodiment of our invention usable with a fluid-powered prime mover. Yet this is not in any way intended to suggest that our invention is limited to this embodiment any more than it is limited to a use in a vertical orientation.

To continue with a description of the device 1, header blocks 2 and 3 are rigidly fixed to a member (not shown in FIG. 1) about which member there is carried a slidable sleeve 4. Header block 2 has formed therein bored and tapped holes, input means 5 and output means 6, respectively, the two shown in dashed-line outline in FIG. 1.

Input and output means 5 and 6 are seen to better advantage in FIG. 2 where a top view of header block 2 is shown. In addition there is shown socket-headed machine screws 7, four in number, which fasten header block 2 to an elongate member (not shown in FIG. 2).

By reference to FIG. 3 it is seen that header blocks 2 and 3 have tapped bores 8 and 9, respectively, for attaching thereto motive power output means of a prime mover, and workload-handling means, respectively. Now, by such output means we contemplate no specific, limited means. The output means can be a threaded adapter depending from a hoist cable, or a threaded movable rod extending from a linear actuator or other fluid cylinder, or the like. So also, the workload-handling means can be a hook block, or a hammer or tamper, or whatever.

FIG. 3 appears to suggest that header block 2 carries the input and output means on opposite sides of an axial centerline. This is not so; the configuration of header block 2 is actually as represented in FIGS. 1, 2, and 4. However, as discussed in the ensuing text, header blocks 2 and 3 are fixed to either ends of an elongate member 10, which member, as a principal vehicle for the novel features of the invention, maintains passageways, chambers, and valving elements cooperative to power, or to silence, the prime mover. It is believed more useful, towards explaining the structure and functioning of the device, to present a composite cross section. Thus, in FIG. 3 inlet and outlet passageways 11 and 12, which are actually aligned in proximate side-by-side relationship, with input and output means 5 and 6, as shown in FIG. 1, are presented as if superimposed with a cross section portion of one overlying a cross section portion of the other.

Inlet and outlet passageways 11 and 12, formed in member 10, are joined with input and output means 5 and 6, by means

of input and output passageways 13 nd 14. Inlet passageway 11 opens on an inlet chamber 15 formed within member 10. Outlet passageway 12 communicates with an outlet chamber 16 which is also formed within member 10. An intermediate control chamber 17 subsists between chamber 15 and 16 and is separated therefrom by walls, inlet wall 18 and outlet wall 19, at either ends thereof.

Walls 18 and 19 each have an aperture 20 therein which apertures receive the tapered, valving ends of poppet-type valving elements 21. Springs 22 disposed in chambers 15 and 16 bear against both the terminations of said chambers, and against large-diameter, flattop portions 23 of said valving elements, normally to cause said elements to maintain penetration of walls 18 and 19 to close said apertures 20.

Control chamber 17 slidably confines therewithin a spool 24 which is in sealing engagement with the walls of control chamber 17. Sleeve 4 has a smaller inside diameter area 25 which occurs about midway along the sleeve length. Area 25 receives thrust rings 26 at either ends thereof. The rings 26 are provisioned as bearing surface elements for a pair of compression springs 27 constrained between said rings and said walls 18 and 19. Springs 27 are resiliently and dimensionally equal, to assure a normal "Centering" of sleeve 4 relative elongate member 10. However, sleeve 4 is responsive to manual pressure, i.e., manual manipulation, to overcome the resilience of springs 27, and will move along its axis, relative member 10, both toward and away from header block 2. An annular recess 28 is formed in header block 2 to provide for the manipulated incursions of sleeve 4.

Sleeve 4, at one place in its outer surface, about midway along the length thereof, presents a relieved area which is drilled through to receive therethrough the shank portion of a headed pin-actuator 29. Said shank portion has an end thereof which is in keying engagement with an annular, relieved girth portion 30 of spool 24. Portion 30 is formed about midway along the length of spool 24, and is provisioned to cooperate with pin-actuator 29 to effect axial movement of spool 24 in response to movement of sleeve 4.

Movement of spool 24, as a consequence of the movement of sleeve 4, is arranged for to cause an unseating of valving elements 21; that is to say, spool 24 is provided for sliding movement in control chamber 17 to move valving elements 21 so as to open apertures 20. The tapered ends of elements 21 are disposed inline with the axial center of spool 24; a said ends are so arranged to mate with complementary conical holes 31 formed in either ends of spool 24. Yet, it is to be noted that holes 31 are formed in the ends of spool 24 offset from the spool axial center; only peripheral portions of holes 31 are disposed for initial engagement with elements 21. Thus, movement of spool 24 against either one of said elements 21 causes said element to tilt relative aperture 20 before wholly proceeding to remove therefrom. Elements 21 must tilt as the ends thereof seek out the center of holes 31. This deliberate malalignment of holes 31 and elements 21, to cause an initial tilting of elements 21, is for a purpose to be noted in following text.

Spool 24, as clearly evidenced in FIGS. 3 and 4, has a plurality of bores 32—and in this embodiment three—fully therethrough. Accordingly, as spool 24 is moved to open aperture 20 of wall 18, inlet passageway 11 and inlet chamber 15 are thereby communicated with bores 32. Conversely, as wall 19 is opened, passageway 12 and outlet chamber 16 are communicated with bores 32. Further, the broaching of wall 19 is occasioned by the movement of spool 24 toward header block 3. This movement also opens one end of a borehole 33 formed through the wall of member 10. The other end of borehole 33 communicates with the atmosphere by way of interstitial spaces occurring between sleeve 4 and recess 28, and pin-actuator 29 and the hole in the relieved area of sleeve 4 which said pin-actuator penetrates. Accordingly, the latter movement of spool 24 communicates passageway 12, outlet chamber 16, bores 32, and borehole 33. Such movement, then, has the effect of venting passageway 12 to the atmosphere.

Fluid regulator means 34 (FIG. 3) are interposed between output means 6 and output passageway 14. Regulator means 34 comprise a taper-ended valve poppet 35 which is slidably disposed in a valve chamber 36 formed in header block 2; the tapered end of poppet 35 is nested in a correspondingly tapered metering orifice 37 which is contiguous with chamber 36. Orifice 37 is interposed between output passageway 14 and output means 6. Poppet 35 is internally threaded and receives a headed follower screw 38 which serves the function of a guide rod. A biasing spring 39 envelopes the shank of screw 38. One end of spring 39 bears against an inner bore of poppet 35; the other end of spring 39 bears against an adjusting screwplug 40 which is threaded into the external termination of valve chamber 36. Spring 39 controls the bias with which the tapered end of poppet 35 nests with orifice 37; by adjustment of screwplug 40, that bias is variable.

Remaining features of our novel device's structure are evident in FIGS. 4 and 5 where, in FIG. 4, it is seen that screws 41 secure pin-actuator 29 to sleeve 4. Finally, as shown in FIG. 5, ball rollers 42, rotatably carried on shafts 43 set in elongate member 10, provide for a friction-less interface between sleeve 4 and elongate member 10. Radial bores or cylindrical recesses 44 are formed in the outer surface of member 10 in which rollers 42 revolve to carry sleeve 4 thereon. Three such assemblies of rollers 42 are shown in FIG. 5, however, there are six assemblies in all three of each under opposite ends of sleeve 4.

Considering the embodiment illustrated, our device is well suited to operation with a fluid-operated prime mover which, for purposes of explanation, will be assumed to be a hoist.

In operation, the pressured fluid medium for the hoist will be communicated with input means 5, and the pressured-medium actuating chamber of the hoist will be communicated with output means 6. A hook block, or the like, would be threadedly coupled to tapped bore 9 and the hoist cable threadedly coupled, via an appropriate adapter, to tapped bore 8. To lower the hoist cable, an operator will move sleeve 4 on rollers 42 toward header block 3. Pin-actuator 29 will move spool 24 to open wall 19 by initially tilting valving element 21 therein, and then by axially displacing element 21 relative the aperture 20. The movement of spool 24 opens borehole 33; thus, the pressured-medium actuating chamber of the hoist is vented to the atmosphere. Accordingly, the hoist depressurizes and pays out cable, and device 1 descends bringing the hook block down therewith. The operator then releases sleeve 4, and it "centers" relative elongate member 10. Cable payout then halts.

After attaching a hook, or such other workload-handling means, to a workload, an operator will move sleeve 4 toward header block 2. This movement halts the venting of output means 6. The closure of wall 19 by element 21 retains the actuating chamber of the hoist at its given level of pressure until such time as a medium of greater pressure can open wall 19 and displace poppet 35.

Movement of sleeve 4 toward header block 2 axially displaces element 21 which penetrates wall 18. The pressured medium is communicated through bores 32 and subsequently unseats (axially moves) the other element 21 relative wall 19, and proceeds, via passageways 12 and 14, past poppet 35 and through orifice 37. In this manner, then, the pressurized medium is communicated with the actuating chamber of the hoist, and the hoist proceeds to receive cable as a consequence thereof; the workload is raised until the operator releases sleeve 4.

It is to be noted that poppet 35 is not intended completely to close orifice 37 at any time. Its function is simply one of metering a fluid medium. The metering, against the bias of spring 39, serves a sage safety function. It is not desired to raise a light workload too quickly. So, where there is a light load, there will be a relatively light pressure of the medium in the actuating chamber of the hoist. This light pressure, then, is addressed to the nose of poppet 37 and is effective only to move poppet 35 a small amount against the bias of spring 39. Accordingly, the orifice 37 will admit little of the more highly

pressured fluid medium, and the workload will rise at a sage rate of speed. Of course, where there is a heavy workload, a greater actuating chamber pressure will greatly displace poppet 35. The orifice 37 will be considerably opened and the still higher pressure fluid medium of the source will cause the heavier workload to rise. This automatically controlled, safety feature operates he the lowering of a workload as well.

When the sleeve 4 is moved toward header block 3, the pressure of the fluid medium in the hoist-actuating chamber, being less than that of the supply pressure addressed to input means 5, cannot "unseat" the element 21 in penetration of wall 18. Thus, it can only vent to the atmosphere via borehole 33. Yet, when the full supply of pressured fluid is passed through wall 18, by raising sleeve 4 (i.e., moving it toward header block 2), as the pressure thereof is greater than that in the actuating chamber of the hoist—which holds element 21 in closure of wall 19—said element is moved relative wall 19 to admit the pressured medium through the aperture 20 thereof. Release of sleeve 4, of course, results in an instantaneous closure of wall 18, the supply pressure immediately causing element 21 therein to close aperture 20 thereof. Thus, the elevation of a workload by our device 1 is immediately halted when sleeve 4 is released; springs 27 cooperate to center the sleeve 4 relative elongate member 10.

The element 21 in penetration of wall 19 operates as a safety check valve. If sleeve 4 is moved toward header block 2 too small a distance, it will admit too small a volume of pressured medium to balance a heavy workload much less to raise it. Of course, the inadvertent descent of a heavy workload must be avoided. Thus, element 21 in wall 19 guards against any such occasion of damage or injury. Should the movement of sleeve 4 dispose pressured medium at X p.s.i. before the inner face of wall 19 and its element 21, and if X+Y p.s.i. is necessary to hold the workload at balance, wall 19 will not be opened. A pressure of X+Y p.s.i. is borne by the outer face of wall 19 and portion 23 of element 21 thereat, said pressure proceeding from the hoist actuating chamber. Thus, the load is checked. Aperture 20 of wall 19 will not be exposed unless sleeve 4 is moved sufficiently to present the medium at a pressure which will overcome the actuating chamber pressure of X+Y P.S.I. Whenever sleeve 4 is released, then, aperture 20 of wall 19 is closed by its element 21; the load is fully checked and held at halt.

The deliberate malalignment of holes 31 and elements 21 causes said elements to tilt before fully proceeding to remove from walls 18 and 19. This novel malalignment makes it easier to open the apertures 20; it requires less force to first "crack" the apertures, against high fluid pressures, by initially tilting elements 21 than it would require initially to move a full element 21 axially against such force.

From the foregoing, and study of the FIGS., it will be clear that our device 1 provides for variable rates of response. For one, regulating means 34, in the adjustability provided therefor of poppet 35, offer a static response-rate control. For another, the degree of measure of movement of sleeve 4, which has direct relationship to the degree of opening of apertures 20, offers a dynamic response-rate control. Additionally, this novel device 1 of our invention produces a response in the prime mover, and effective therefor on the workload, which is linearly, or complementarily related to the manual manipulation which causes its manifestation. That is to say, that, with our device 1 disposed vertically, per FIGS. 1 and 3, an upward movement of sleeve 4 will be translatable into enabling power for a prime mover to move the workload upward. Conversely, a downward movement of sleeve 4 will effe In a horizontal disposition, our device 1 being operated by movement of sleeve 4 in a left-hand or right-hand direction will cause workload movement in said left-hand or right-hand directions. Now, we speak here of workload movement, but only for explanatory purposes. Practically, of course, we intend to embrace other applications of our device: workload impacting, tamping, and the like.

As will be evident to those skilled in the art to which it pertains, the teaching of our invention is not limited to a fluid-powered coupling and power control device usable with a fluid-powered prime mover. In an alternate embodiment of our device, within the spirit of our teaching, it is readily feasible to structure a device operable with an electrically powered prime mover. In such an embodiment, passageways 11, 12, 13, and 14 would, as though conduits, confine an electrical power line for an electrical prime mover. Elements 21 would be supplanted by limit switches, or the like, one thereof to control enabling of the prime mover in a given direction, and the other to control enabling of the prime mover in an alternate direction. A component similar to spool 24 would be employed alternately to actuate either of said switches.

Our device is most useful for employment with a hoist in moving workloads from a ground or floor level to an elevated platform, bench, truck bed, or the like, and vice verse. However, its use is not limited to such applications. It will happen, for instance, that a workload of great girth or circumference will have a load point of suspension which frustrates the operator's horizontal reach. Also, it will occur that a workload requires elevation to a height beyond the operator's vertical reach. In such circumstances our device is used in a manner which facilitates such operations. That is, the device 1 is not placed in series with the prime mover in and the workload-handling means. Rather, as in a hoist-enabling application, our device is suspended, i.e., mechanically coupled, as by a flexible cable or wire rope from the hoist. The flexible cable is coupled to a threaded adapter, and the adapter is fastened in tapped bore 8 (FIG. 3). Finally, the pressured fluid medium for the hoist is shunted, via input and output means 5 and 6 of he device. The workload-handling means, such as a hook, is suspended, in the customary way, from the hoist drum to receive the workload. Then, by manipulation of sleeve 4, in accordance with the operations priorly explained, the hoist is caused to raise and lower the workload. This adaptation of our device disposes it for usages as wide in application as that of the conventional pendant, yet it offers the novel correspondence of prime mover actuation and workload handling in same directions, and with variable response rates, as cited in connection with the priorly-described usage of the invention. That is to say that even this more universal adaptation of our device, with the device but shunting the motive medium, offers substantially the same immediacy or feel in operation.

We claim:

1. A coupling and power control device for controlling operation of a fluid-actuated device, comprising:
- an elongate member having a longitudinal axis;
- header blocks at opposite axial ends of said member;
- means for securing said header blocks to said elongate member;
- one of said header blocks having means for attaching thereto power output means of a fluid-actuated device;
- the other of said header blocks having:
  - means for attaching thereto working-handling means;
  - porting means in said one of said header blocks for admitting fluid; and
  - porting means in said one header block for exhausting fluid to the fluid-actuated device;
- said elongate member having communicating inlet and outlet passageways formed therewithin for conducting fluid therethrough;
- valving means, including a plurality of separate relatively movable valving elements interposed between said inlet and outlet passageways, operative for controlling the conduct of fluid through said elongate member; and externally operated actuator means independent of said power output means, carried by said elongate member, directly operative of said valving elements, said actuator means being detached from said valving elements for abutting actuation thereof;
- said passageways each having a given terminal end in communication with one of said porting means, opposite ter-

minal ends of said passageways each terminating within said elongate member and opening on said valving elements; and

said actuator means being axially movable, relative to said member, in both axial directions and effective, upon being moved in one axial direction, directly to cause operation of only one of said valving elements, and directly to cause operation of only one other of said valving elements upon movement thereof in the opposite axial direction.

2. The invention, according to claim 1, wherein:

said valving means further includes inlet and outlet fluid chambers formed within said elongate member;

said inlet and outlet passageways open into said inlet and outlet chambers, respectively;

said elongate member further having an axial-extending control chamber formed therewithin, between said inlet and outlet chambers, with walls at either ends thereof separating said control chamber from said inlet and outlet chambers;

said walls each having a single aperture formed therein; and wherein

said one and another valving elements are displacable, and are normally constrained in sealing penetration of said respective single apertures by resilient means.

3. The invention, according to claim 2, wherein said actuator means comprises a spool, slidable confined within said control chamber, having opposite ends disposed for abutting engagement with said valving elements.

4. The invention, according to claim 3, wherein said spool has at least one axially extending borehole formed therein, opening on said opposite ends, for communicating between said either ends of said control chamber.

5. The invention, according to claim 3, wherein said elongate member further includes means for venting fluid from said control chamber.

6. The invention, according to claim 2, wherein:

said elongate member further has a borehole formed therein for venting fluid from said control chamber; and

said actuator means comprises means for closing off and opening said borehole.

7. The invention, according to claim 6, wherein:

said actuator means further comprises a spool, slidably confined within said control chamber;

said spool having opposite ends disposed for abutting engagement with said valving elements to displace said valving elements from constrained sealing of said apertures; and

said spool is effective for opening said borehole coincident with displacement of one of said valving elements.

8. The invention, according to claim 7, wherein said actuator means further comprises:

a sleeve slidably disposed about said elongate member; and

a pin-actuator carried by said sleeve and having a portion thereof in engagement with said spool for effecting movement of said spool coincident with movement of said sleeve.

9. A device, according to claim 8, further comprising antifriction means disposed between said sleeve and said elongate member.

10. The invention, according to claim 8, further including means disposed between said sleeve and said elongate member to constrain said sleeve in a given position relative to said elongate member, and to constrain said spool in a prescribed disposition which accommodates the normally constrained sealing of said apertures by said valving elements.

11. The invention according to claim 8, wherein said sleeve and pin-actuator are cooperative to cause said spool to displace the valving element in the wall which is adjacent to said inlet chamber, upon said sleeve being moved toward said one header block.

12. The invention according to claim 6, wherein said actuator means further comprises:

a spool, slidably confined within said control chamber, having opposite ends thereof disposed for abutting engagement with said valving elements to displace said valving elements from constrained sealing of said apertures; and

said spool is effective for opening said borehole coincident with displacement of the valving element in the wall wall which is adjacent to said outlet chamber, upon said spool being moved toward said other header block.

13. The invention, according to claim 2, wherein said valving elements are of a poppet-type.

14. The invention, according to claim 2, further comprising means interposed between said outlet passageway and said porting means for exhausting fluid for regulating the conduct of fluid therebetween.

15. The invention, according to claim 14, wherein said regulating means is automatically responsive to variations in the force of fluid subsisting in said porting means for exhausting fluid for effecting regulation of fluid conduct therethrough.

16. A device, according to claim 15, wherein said regulating means have means for adjusting the amount of automatic response thereof to said force.