

Feb. 24, 1970

J. W. KICE ETAL

3,496,834

AIR OPERATED TIMING MECHANISM

Filed Oct. 23, 1967

3 Sheets-Sheet 1

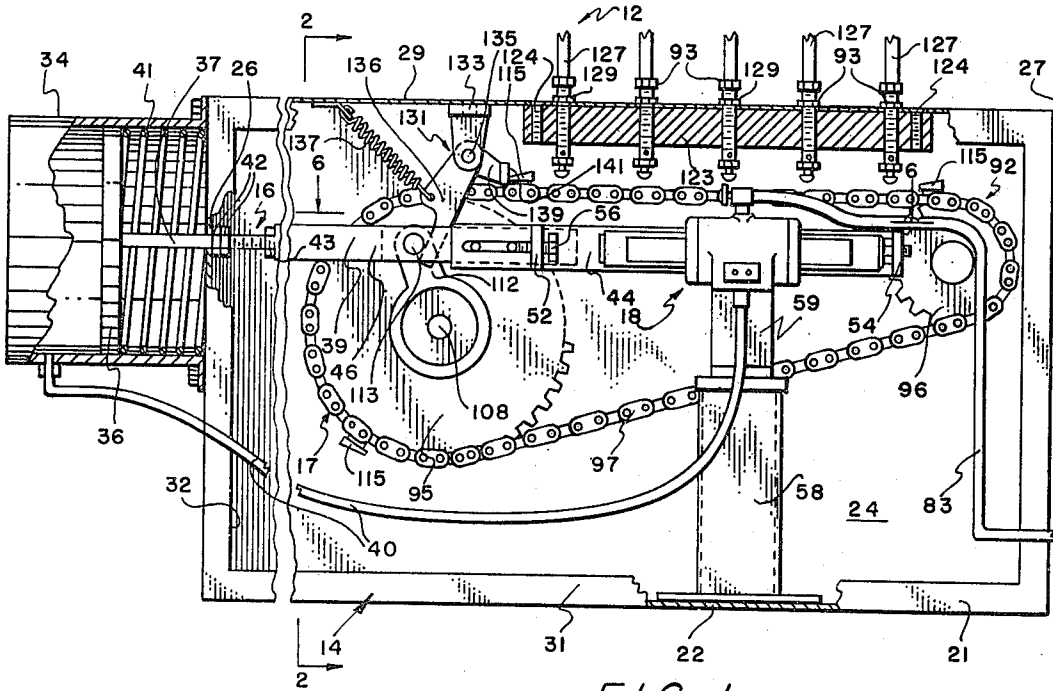


FIG. 1

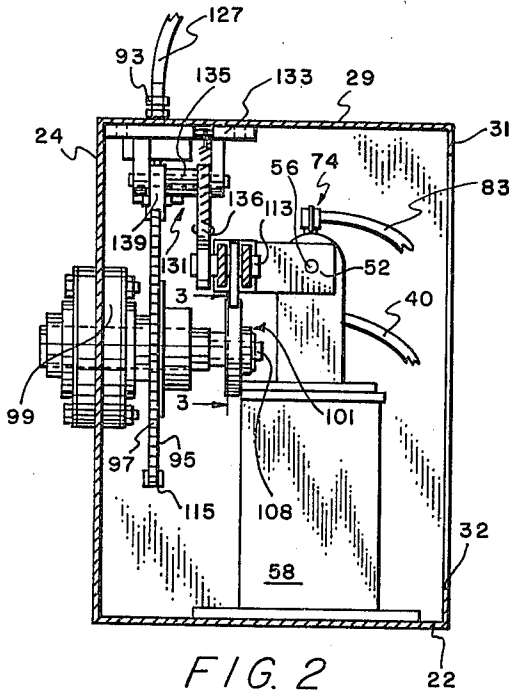


FIG. 2

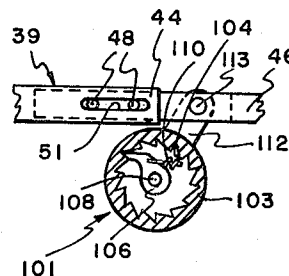


FIG. 3

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3 Sheets-Sheet 2

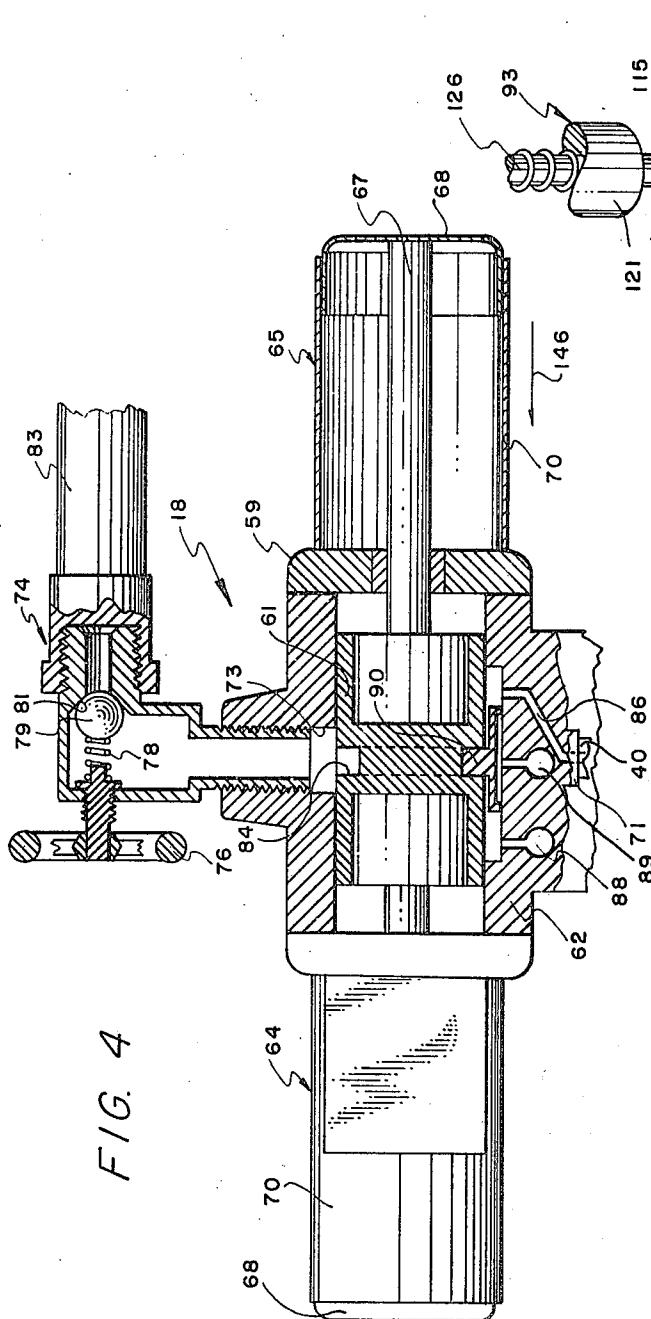


FIG. 4

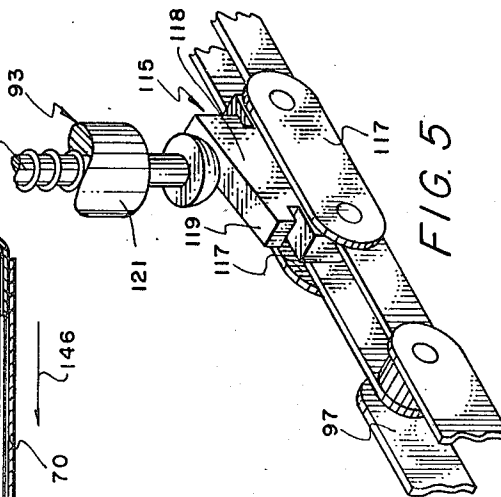


FIG. 5

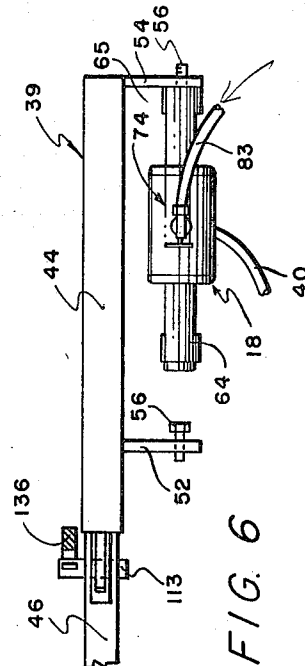


FIG. 6

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3 Sheets-Sheet 3

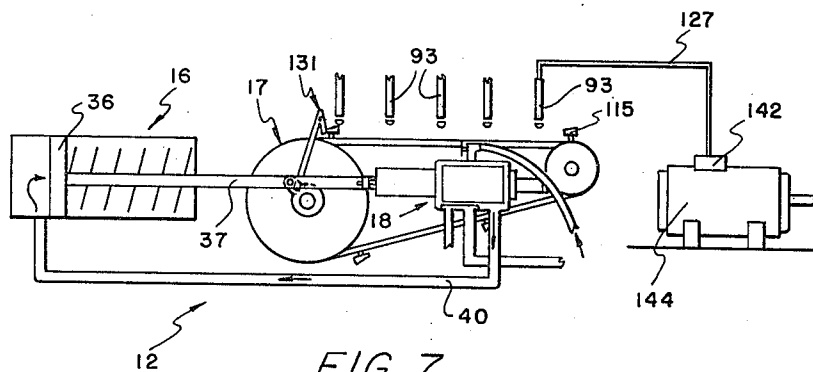


FIG. 7

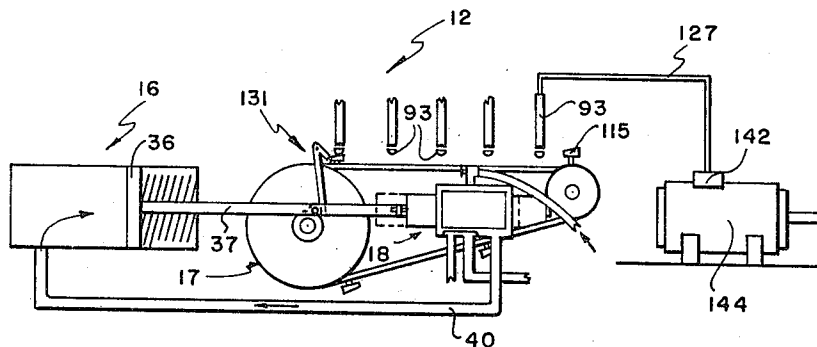


FIG. 8

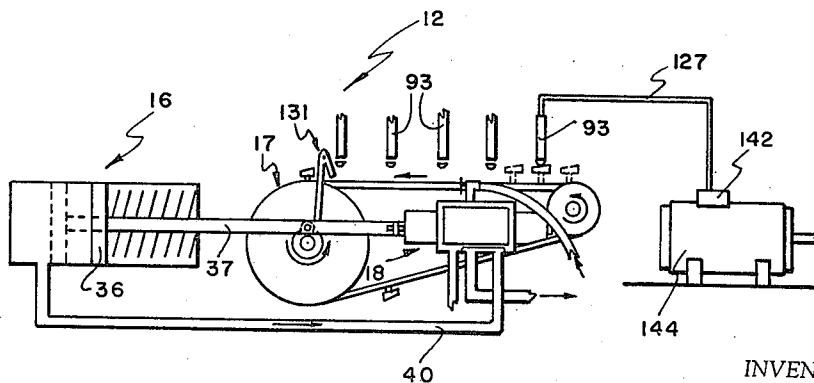


FIG. 9

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3,496,834

AIR OPERATED TIMING MECHANISM

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U.S. Cl. 91—218

4 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to an air operated timing mechanism and, more particularly, to a means for automatically and periodically controlling operation of a given device without the use of electrical or other spark producing methods thereby providing the utmost safety under explosive atmospheric conditions. Still, more specifically, this invention relates to an air operated timing mechanism operable to provide actuation selectively of a plurality switch means without the use of electrical energy or spark producing devices.

There are numerous types of timing devices known to the prior art; however, few if any of the prior art structures are satisfactory for usage in an explosive dust atmosphere as found in coal mining and grain milling applications. Additionally, the prior art devices are expensive to manufacture, costly to maintain, generally unreliable in operation, and limited in the possible applications thereof. It is noted that the use of fluid pressure as a timing medium is not shown nor taught in the prior art devices.

In accordance with present invention, a new timing mechanism operable entirely under fluid pressure is provided including a frame assembly; an actuator piston and cylinder assembly mounted on the frame assembly; a control valve secured to the frame assembly regulating the fluid flow through the actuator piston and cylinder assembly; and a sprocket and switch means mounted on the frame assembly and operably connected to the actuator piston and cylinder assembly to operate a plurality of switch members sequentially. The control valve is supplied with fluid under pressure and operable on reaching a pre-determined pressure reading to direct the same to the actuator piston and cylinder assembly. Thereupon, the actuator piston and cylinder assembly is operable in its fully extended position to contact the control valve and release pressure fluid from the actuator piston and cylinder assembly. This causes subsequent movement of the actuator piston and cylinder assembly to the retracted position and concurrently operates to move the sprocket and switch means to contact one of the switch members resulting in the control of a motor, an air valve, or the like.

In preferred specific embodiments of the invention, an air operated timing mechanism is provided to control operation of various devices and includes an actuator piston and cylinder assembly mounted on a housing or frame means and operably connected to a control means regulating pressure fluid flow thereto. The actuator piston and cylinder assembly includes a cylinder having a piston movable therein under fluid pressure and retracted as by spring means. An actuator arm is connected to the outer end of a piston rod which, in turn, is secured to the piston. The actuator arm is engageable with opposite ends of a slide valve which is part of the control means to regulate fluid flow to the actuator piston and cylinder assembly so as to achieve movement of the piston and actuator

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arm axially. A ratchet valve means connected to the frame means includes a pair of sprocket members interconnected by a chain member having a plurality of detent members mounted thereon engageable with switch members on rotation of the sprocket members. One of the sprocket members is connected as by a one-way ratchet means to the actuator arm whereby the retraction of the piston within the cylinder operates to rotate the sprocket members a partial turn to actuate one of the switch members. The slide valve is moved axially in one direction on contact by the actuator arm to control pressure fluid flow to the cylinder and, on the attainment of a given fluid pressure in the control means, for the extension thereof. The slide valve is moved in the opposite direction for retraction of the actuator arm by the spring means on contact of the actuator arm with the opposite end of the slide valve to release pressure fluid in the cylinder. The desired pressure buildup in the control means can be varied thereby providing a variable timing sequence of operations for actuation of the switch members to control a motor, air valve, or the like.

Accordingly, it is an object of this invention to provide a new timing mechanism overcoming the above-mentioned disadvantages of the prior art devices.

Another object of this invention is to provide an air operated timing mechanism readily usable in an explosive type atmosphere with the utmost safety and reliability.

A further object of this invention is to provide an air operated timing mechanism which can be readily programmed to provide a plurality of desired functions and readily regulated to operate at a desired time interval to energize motors, air valves, or the like.

One other object of this invention is to provide an air operated timing mechanism having a control valve operable to regulate fluid flow into a piston and cylinder assembly; an actuator arm member connected to the piston and cylinder assembly operable to contract and actuate the control valve; a ratchet means operably connected to the actuator arm operable to activate a plurality of switch members; and movement of the actuator arm through the piston and cylinder assembly operable to actuate the switch members thereby providing for the complete operation of the timing mechanism without the use or danger of electrical spark conditions.

One further object of this invention is to provide an air operated timing mechanism that is substantially maintenance free, economical to manufacture, simple in operation, and readily adaptable for a plurality of uses in explosive type atmospheres.

Various other objects, advantages and features of the invention will become apparent to those skilled in the art from the following discussion, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a fragmentary elevational view of the timing mechanism of this invention having portions thereof broken away for clarity;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is an enlarged elevational view of a control valve of the timing mechanism of this invention having portions thereof broken away for clarity;

FIG. 5 is a fragmentary enlarged perspective view of a detent member and a switch member of the timing mechanism of this invention;

FIG. 6 is a fragmentary top plan view taken along line 6—6 in FIG. 1; and

FIGS. 7, 8, and 9 are schematic diagrams illustrating the use and operation of the timing mechanism of this invention.

The following is a discussion and description of preferred specific embodiments of the new timing mechanism of this invention, such being made with reference to the drawings, whereupon the same reference numerals are used to indicate the same or similar parts and/or structure. It is to be understood that such discussion and description is not to unduly limit the scope of the invention.

Referring to the drawings in detail and in particular to FIG. 1, the timing mechanism of this invention, indicated generally at 12, includes a frame means 14; an actuator piston and cylinder assembly 16 secured to the frame means 14; ratchet and valve means 17 secured to the frame means 14 operably connected to the actuator piston and cylinder assembly 16 to regulate operation of a motor, an air valve, or the like; and control valve means 18 secured to the frame means 14 and operable to regulate fluid flow to and from the actuator piston and cylinder assembly 16.

The frame means 14 includes a housing 21 of generally rectangular box shape having a bottom base or wall 22 and a back wall 24 integral with upright end walls 26 and 7, all joined to a common top wall 29. A front wall 31 is provided with an enlarged rectangular opening 32 which can be closed with a cover plate (not shown) if desired.

As shown in FIG. 1, the actuator piston and cylinder assembly 16 includes a cylinder 34 secured as by welding or the like to the outer surface of the end wall 26, a piston 36 slidably mounted in the cylinder 34, an elongated piston rod 37 integral with the piston 36 extended transversely of the end wall 26 into the housing 21, and an elongated actuator arm 39 secured to the outer end of the piston rod 37. A conduit 40 is secured to the outer end portion of the cylinder 34 operable to supply and release pressure fluid against the piston 36 to control movement of the piston rod 37 and interconnected actuator arm 39 inwardly to extended and retracted positions. A compression spring member 41 is mounted in the cylinder 34 between the piston 36 and the end wall 26 operable to bias the piston 36 toward the retracted position for reasons to be explained.

More specifically, the outer end of the piston rod 37 is threaded having stop nuts 42 thereon engageable with the adjacent inner surface of the end wall 26 to prevent complete retraction thereof into the cylinder 34 by the spring member 41. The actuator arm 39 is of a substantially elongated bar shape having one end threaded into the outer end of the piston rod 37 and adjustably connected thereto as by a nut member 43. The arm 39 is provided with a tubular sleeve portion 44 mounted about a main body 46 with limited axial movement thereon regulated by pins 48 on the body 46 mounted within a slot 51 in the sleeve portion 44. As shown in FIG. 6, the sleeve portion 44 is provided with a pair of spaced, laterally extended projections 52 and 54, each having an adjustment bolt member 56 threaded therein. It is seen that the projections 52 and 54 are positioned on opposite sides of the control valve means 18 for reasons to become obvious.

As shown in FIGS. 1 and 4, the control valve means 18 includes an upright support pedestal 58 anchored to the bottom wall 22 of the housing 21 as by welding or the like having a slide valve 59 mounted on the top surface thereof. The slide valve 59 has a central control plunger 61 axially movable within a casing 62 on movement of piston assemblies 64 and 65, respectively. The piston assemblies 64 and 65 include shaft members 67 each having one end secured to the plunger 61 and the other end secured to cap members 68 slidably mounted in tube portions 70 secured to the casing 62. Additionally, the casing 62 is provided with an opening 71 in which is mounted the conduit 40 and an inlet opening 73 to which is threadedly mounted a pressure regulator valve 74. More specifically, the pressure regulator valve 74 is of a check valve type having a handle member 76 en-

gageable with a spring 78 against a ball 79 mounted in a seat 81 to regulate and adjust the pressure of the fluid admitted therethrough. The pressure regulator valve 74 is connected to a supply conduit 83 which, in turn, receives pressure fluid from a reservoir, pump, or the like (not shown).

The central plunger 61 is provided with a radial groove 84 adapted to convey pressure fluid therethrough for discharge through a channel 86 connected to the conduit 40 or through one of two pressure release discharge openings 88 and 89, depending on the axial position of the central plunger 61. The radial groove 84 is engageable with a U-shaped slide cup member 90 for axial movement with the plunger 61 to open and close the discharge openings 88, 89, and the channel 86 as will be explained.

The ratchet and valve means 17 includes a ratchet assembly 92 connected to the back wall 24 and a plurality of spaced switch members 93 secured to the top wall 29. More specifically, the ratchet assembly 92 includes a pair of spaced sprocket members 95 and 96 interconnected for conjoint rotational movement by a chain member 97 and rotatably mounted on the back wall 24 as by bearing assemblies 99 connected thereto. The large sprocket member 95 is provided with a one-way ratchet drive assembly 101 secured to the central portion thereof having an outer cylindrical housing 103 with integral internal ratchet teeth 104 thereon. Mounted within the housing 103 is a ratchet lug 106 mounted on a stub shaft 108 and biased into engagement with the ratchet teeth 104 by a tension spring 110 (FIG. 3). The outer surface of the housing 103 is integral with an arm member 112 pivotally connected as by a pin 113 to the main body 46 of the actuator arm 39. It is seen that the ratchet assembly 92 is operable on axial movement of the actuator arm 39 to the left as viewed in FIG. 1 to rotate the sprocket member 95 a given amount through the ratchet drive assembly 101.

As shown in FIG. 5, the chain member 97 is provided with a plurality of spaced detent members 115 each mounted between two opposed links 117 having an upper head portion 118 with an inclined actuator surface 119 adapted to engage a switch member 93, respectively. The switch members 93 are of a conventional air pressure type having a main body 121 extended through openings in the top wall 29 and mounted in a block member 123 secured thereto as by screws 124. A pressure plunger 126 is mounted in the main body 121 and axially movable therein to achieve a pressure response through tubes 127 connected thereto. The block 123 acts to give lateral stability to the switch members 93 and locking nuts 129 maintain the same in a given vertically adjusted position. The switch members 93 are connected by the tubes 127 to an air actuated motor switch, an air valve, or the like to provide for the operation thereof on depression on the plunger 126 by the head portions 118 of the detent members 115. It is obvious that the main body 121 can be adjusted vertically to achieve the proper distance from the head portion 118 for actuation of the plunger 126 on movement of detent members 115 thereunder.

As shown in FIGS. 1 and 2, a special rocker assembly 131 is secured to the housing 21 and operable to periodically maintain the detent members 115 on the chain member 97 in their proper rotational positions relative to the switch members 93. The rocker assembly 131 includes a support base 133 secured to the inner surface of the top wall 29 as by welding, bolts, or the like having a shaft 135 rotatably mounted therein. A finger member 136 is secured to the shaft 135 and engageable with the pin 113 of the ratchet assembly 92 so as to pivot the shaft 135 on forward movement of the pin 113. A spring member 137 having one end secured to the top wall 29 is connected to and maintains the finger member 136 in contact with the pin 113. A timing lug 139 secured to the shaft 135 is positioned approximately 90 degrees relative to the finger member 136 and has an abutment face 141 en-

engageable with the forward surface of the detent members 115. The rocker assembly 131 acts on movement of the actuator arm 39 and the pin 113 forwardly to rotate the timing lug 139 counterclockwise, as viewed in FIG. 1, to permit the detent members 115 to move thereunder. However, on subsequent counterclockwise rotation of the sprocket members 95 and 96, as viewed in FIG. 1, the timing lug 139 moves downwardly so as to be engageable with the head portions 118 of the detent members 115 thereby periodically assuring that the detent members 115 are properly spaced relative to the switch members 93.

In the use and operation of the timing mechanisms 12 of this invention as shown in FIGS. 7, 8, and 9, the fluid under pressure is supplied through the conduit 83 to the pressure regulator valve 74 whereupon the handle 76 is adjustable to regulate the pressure of the spring member 78 on the ball 79 to determine the fluid pressure required to open the ball 79 and permit flow of fluid to enter the casing 62 of the slide valve 59. It is obvious that the pressure regulator valve 74 can be readily adjusted to open as for example at 8 p.s.i., 15 p.s.i. or wherever desired with the variable period required to achieve this pre-set pressure providing the timing function of this invention. With the central plunger 61 of the slide valve 59 moved to the left from that shown in FIG. 1, the fluid pressure when admitted through the pressure regulator valve 74 moves through the channel 86 and the conduit 40 to the cylinder 34 to precede moving the piston 36, the rod 37, and the actuator arm 39 axially against the bias of the compression spring member 41. This results in a rotation of the arm member 112 and the housing 103 with movement of the ratchet teeth 104 over the lug 106. It is seen that the sprocket members 95 and 96 interconnected to the chain member 97 remain stationary due to the one-way ratchet drive assembly 101 (FIGS. 7 and 8).

After subsequent axial movement of the actuator arm 39, the adjustment bolt 56 on the projection 52 contacts the outer cap 68 to move the plunger 61 to the right from the position shown in FIG. 4. This acts to align the channel 86 and the discharge opening 89 by the slide cup member 90 to release the pressure through the conduit 40 from the cylinder 34 and, also, the inlet pressure is fed into the discharge opening 88 resulting in a closing of the pressure regulator valve 74. Obviously, the spring 41 acts to move the piston 36 to the retracted position with concurrent counterclockwise rotational movement, as viewed in FIGS. 1 and 9 of the ratchet assembly 101 thereby moving one of the detent members 115 under a respective switch member 93 to actuate the plunger 126 thereof. This operates as shown in FIG. 9 to energize a diaphragm type pressure switch 142 to start a motor 144 as may be required in an overall processing application.

In retraction of the piston 36 and actuator arm 39, it is seen that the adjustment bolt 56 on the projection 54 contacts the other cap 68 of the slide valve 59 to axially move the central plunger 61 as shown by the arrow 146 in FIG. 4. This operates to concurrently move the interconnected slide cup member 90 over the discharge openings 88 and 89 thereof to open the channel 86 and conduit 40 to available inlet pressure. After a given interval, the ball 79 of the pressure regulator valve 74 again opens under fluid pressure to permit fluid flow under pressure through conduit 40 to the cylinder 34 to repeat the aforementioned timing operation.

Although air pressure would commonly be used in the operation of the timing mechanism, it is obvious that nitrogen, water, oil, and other fluids may be used. The timing mechanism can be readily adapted to control numerous types of motors, valves, switches, etc. requiring a timing sequence where fluid pressure is available.

It is seen that the timing mechanism of this invention is operable without the necessity of electrical energy or spark producing contact between various metals so that the entire apparatus provides a timing means for use in an

explosive dust atmosphere as conventionally found in grain mills, flour mills, coal mining, and the like. Additionally, it is seen that the timing mechanism of this invention is economical to manufacture, substantially maintenance free, and simple to operate.

As will be apparent in the foregoing descriptions of the preferred embodiments of the applicant's timing mechanism, relatively simple and inexpensive means have been provided which are readily usable in numerous types of operations requiring the sequential operation of a motor or the like by a timing mechanism.

While the invention has been described in connection with preferred specific embodiments thereof, it will be understood that this description is intended to illustrate the invention which is defined by the following claims.

We claim:

1. A fluid operated timing mechanism, comprising;
 - (a) frame means,
 - (b) a piston and cylinder assembly secured to said frame means having a piston movable under fluid pressure within a cylinder, and a piston rod secured to said piston extended transversely of said cylinder,
 - (c) valve means secured to said frame means,
 - (d) means for supplying fluid under pressure connected to said valve means,
 - (e) conduit means connected to said valve means and said cylinder to selectively control fluid flow against said piston for the movement thereof,
 - (f) switch means secured to said frame means connected to a motor means to control the operation thereof,
 - (g) means connected to said frame means engageable with said switch means to selectively actuate same,
 - (h) an actuator arm secured to said piston rod engageable with said valve means,
 - (i) means connecting said arm to said switch actuating means to actuate said switch means on movement of said arm in one direction whereby said valve means directs fluid under pressure into said cylinder to move said arm into engagement with said valve means to release pressure fluid in said cylinder to move said switch actuating means to actuate said switch means,
 - (j) said switch actuating means having a pair of spaced sprocket members rotatably mounted on said frame means interconnected by a chain member,
 - (k) said chain member having a plurality of spaced detent members thereon engageable with said switch means on rotation of said sprocket members, and
 - (l) a rocker assembly secured to said frame means operably connected to said switch actuating means, said rocker assembly having a lug member engageable with said detent members for sequentially and periodically positioning the same relative to said switch members.
2. A timing mechanism as described in claim 1, wherein;
 - (a) said valve means having a control plunger movable through piston assemblies operable in one position to direct fluid under pressure into said cylinder and operable in a second position to release fluid pressure from said cylinder, and
 - (b) said arm engageable with said piston assemblies to move said control plunger to the first and second positions.
3. A timing mechanism as described in claim 1, wherein;
 - (a) said valve means having an adjustable pressure regulator valve connected to said fluid supply means operable to supply fluid to said conduit means on reaching a pre-determined pressure thereby regulating the time interval of actuating said piston and cylinder assembly.
4. A fluid operated timing mechanism, comprising;
 - (a) a frame means,

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- (b) a piston and cylinder assembly secured to said frame means having a piston movable by fluid pressure within a cylinder,
- (c) valve means secured to said frame means, said valve means having a control plunger movable through piston assemblies operable in one direction to direct fluid under pressure to said cylinder and operable in a second position to release fluid from said cylinder to cause movement of said piston,
- (d) means for supplying fluid under pressure connected to said piston and cylinder assembly and said valve means;
- (e) conduit means connected to said valve means and said cylinder to selectively control fluid flow against said piston for the movement thereof,
- (f) adjustable fluid pressure regulator means connected to said valve means to control the operation thereof at a predetermined rate,
- (g) said pressure regulator means and said piston and cylinder assembly interconnected and operable on axial movement of said plunger to control the operation thereof with passage of fluid through said pressure regulator means, said valve means, and to said piston and cylinder assembly,
- (h) an actuator arm secured to said piston engageable with said piston assemblies to move said control

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- plunger to said first and second positions for continuous controlled operation thereof,
- (i) switch means secured to said frame means,
- (j) actuating means having a plurality of spaced detent members thereon engageable with said switch means, and
- (k) a rocker assembly secured to said frame means having a lug member engageable with said detent members for sequentially and periodically positioning the same relative to said switch members.

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U.S. Cl. X.R.

74—567; 91—446