

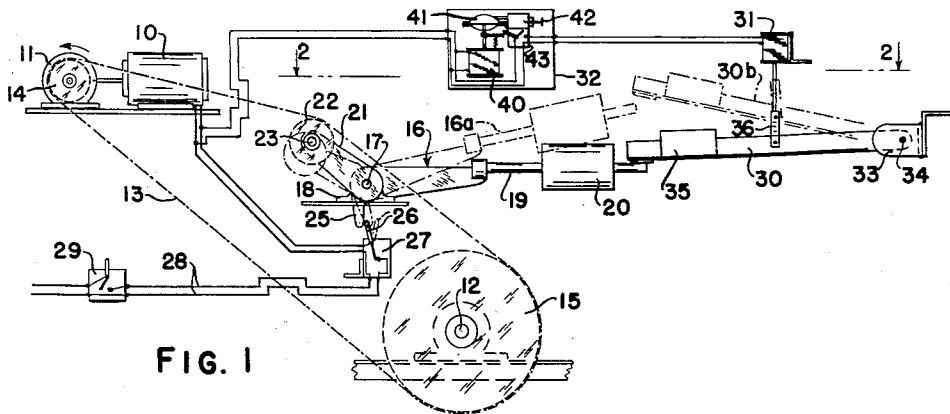
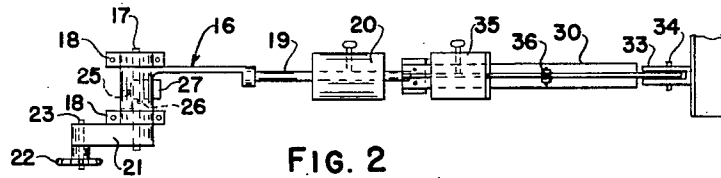
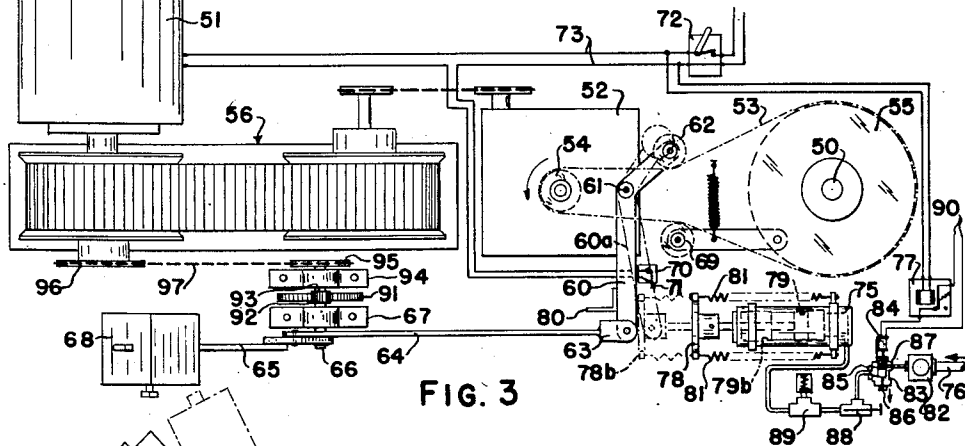
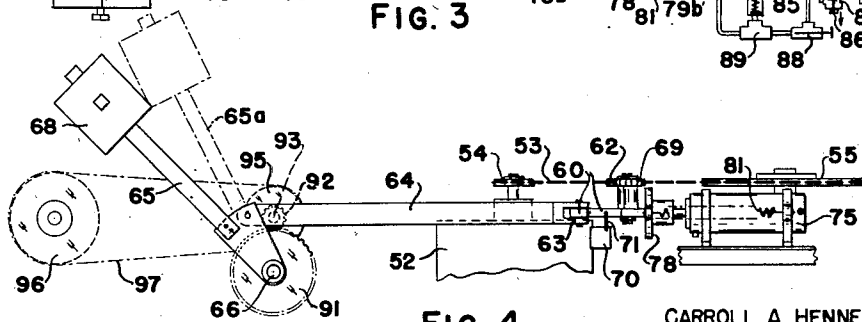
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AUTOMATIC STARTING REGULATOR FOR OVERLOAD RELEASE DEVICES

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AUTOMATIC STARTING REGULATOR FOR
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This invention relates to an automatic starting regulator for overload release devices in connection with machine drives, and more particularly to a regulator which compensates for the starting inertia of the driven machine and also provides for automatic release of the machine upon an initial overload.

Certain machines, conveyors in particular, require an overload release device to shut off the power or to decrease the speed of the machine when the machine becomes jammed or otherwise overloaded. In many cases, the starting inertia of the machine is as great, or greater than, the permissible load on the machine under operating conditions. Long conveyors in particular have a starting inertia greater, in many cases, than the permissible overload while the conveyor is moving. Materials, such as cartons and light articles, carried by the conveyor, are frequently easily damaged should they become jammed in some way in the conveyor. This necessitates setting the overload release device so that the conveyor is stopped when only a slight overload on the drive of the machine occurs.

Some long conveyors require several driving units along their length, and the speed of the several drives must be synchronized so that each driving unit bears its proportionate share of the load. Such conditions make it difficult to start such a conveyor safely, since the overload release device or devices should be set to stop the driving motors upon a comparatively small overload.

The present invention is designed and has for its principal object to automatically regulate the overload release devices of such machines so that they may be easily started without manually resetting the overload release device each time the machine is started.

A further object is to provide overload release means to stop the machine should it become jammed or more than usually overloaded during starting.

Another object is to provide easily installed and synchronized starting regulators for machines with multiple drives and multiple overload release devices.

Other objects and advantages will more fully appear from the following description, taken in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatical side elevation of a machine drive, overload release device, and starting regulator, together with control means;

Figure 2 is a plan view of the overload release

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device and starting regulator of Figure 1, partly in section on the line 2-2 thereof;

Figure 3 is a diagrammatical plan view of a single drive unit of a multiple drive machine, together with an overload release and drive-synchronizing device, a modified form of starting regulator and control means; and

Figure 4 is a fragmentary side elevation of the mechanism shown in Figure 3.

Referring more particularly to Figures 1 and 2, the drive and overload release device, more fully described in United States Patent 1,949,119 to William J. Gibbs, comprises an electric motor 10, driving a reducer 11, which, in turn, drives the shaft 12 of a conveyor or other machine, by means of an endless driving member 13, such as a belt or chain, and drive elements, such as pulleys or sprockets 14 and 15. The overload release device includes a bell-crank 16 secured to a shaft 17 which is pivotally supported by pillow block bearings 18-18. Arm 19 of the bell-crank 16 has a sliding weight 20 adjustably secured thereto. Arm 21 carries a rotary idler member 22, such as a pulley or a sprocket, adapted to contact the driving side of the endless drive member 13 and rotatably secured to arm 21 by shaft 23. Bell-crank 16 has a contact arm 25 projecting therefrom and adapted to contact lever 26 of limit switch 27 as the bell-crank is turned. Switch 27 is connected in series in the electric supply wiring 28 to motor 10. A control switch is indicated at 29 in Figure 1.

The starting regulator mechanism comprises a supplementary weighted lever 30, a solenoid 31 and a pneumatic timing relay 32 wired in parallel with switch 27. Lever 30 is a lever of the third order pivotally supported at one end by the clevis 33 and pin 34 to swing in a substantially vertical plane. A sliding weight 35 is adjustably secured to the lever 30, and the free end of the lever is adapted to overhang and rest on the free end of arm 19 of bell-crank 16. Intermediate the ends of lever 30, a link 36 joins the lever to the plunger of the solenoid 31, which is shown as of the pull type.

The solenoid 31 is energized by the pneumatic timing relay 32, which is shown as including a solenoid 40 operatively connected to diaphragm bellows 41. One side of the diaphragm is connected to an adjustable bleeder valve 42, and movement of the solenoid plunger operates a limit switch 43. The timing relay 32 is of a commercially well-known type, but it will be apparent that it may be replaced by any combination of timing device and electrical relay which is

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adapted to energize the solenoid 31 a suitable number of seconds after the turning on of current to motor 10.

The operation of the overload release device depends on the tension on the endless driving member 13. As the load on the machine driven by shaft 12 increases, the increased tension on the drive member 13 moves the rotary idler member 22 and bell-crank 16 toward the position shown in broken lines at 16a, lifting the weighted arm 19. When the load reaches an amount for which the device has been set by adjustment of weight 20 on arm 19, the contact arm 25 breaks the circuit through switch 27, shutting off power to the motor 10.

It will be apparent that, in many machines such as conveyors, it will be necessary to set this overload release device so that a very slight overload will stop the conveyor. This is necessary to prevent damage to the material or packages, carried by the conveyor, when they become jammed in some manner. In long conveyors, the starting inertia of the conveyor parts will exceed the amount of permissible overload.

To start such a machine, the starting regulator lever 30 is weighted by sliding and securing weight 35 in such a position as to compensate for the starting inertia of the machine. Lever 30 is then allowed to rest upon arm 19. Assuming that control switch 29 is open and switch 27 has been manually closed, switch 29 is now closed, causing motor 10 to be energized. The additional weight of lever 30 compensates for the starting inertia of the machine and the overload release device is prevented from shutting off the power to the motor while it is starting. Any more than usual load on the machine during starting, caused by jamming or otherwise, will be added to the normal starting inertia and will cause arm 19 to rise, pushing lever 30 before it, and switch 27 will be turned off in the usual manner.

When no overload occurs in starting, motor 10 is started and reaches its normal running speed usually in an interval on the order of 3 to 5 seconds. The pneumatic timing relay 32 is therefore set for this interval by adjustment of the bleeder valve 42. When the circuit to motor 10 is closed, solenoid 40, being in parallel with the motor, is also energized. The plunger of solenoid 40 pushes against the diaphragm 41 and rises as air is bled from the valve 42. At the end of this 3 to 5 second interval, the plunger has risen sufficiently to close switch 43, thus energizing solenoid 31. When solenoid 31 is energized, it pulls the lever 30 upward away from arm 19 to the position shown in broken lines at 30b, leaving the overload release device free to operate in normal manner.

When the machine is turned off, by reason of the operation of either switch 27 or switch 29, current to the motor and hence to solenoid 31 is shut off. Arm 19 swings down, and, as it is always under lever 30, lever 30 drops upon it. Gravity, or preferably a return spring, resets the pneumatic timing relay 32.

It will now be apparent that the starting inertia of the machine may be thus automatically compensated for, without disturbing the normal operation of the overload release device, and with provision being made for overload release during starting.

Figures 3 and 4 illustrate a modified form of automatic starting regulator. A conveyor, or other machine, may be driven in a conventional manner by shaft 50, by means of motor 51, re-

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ducer 52 and an endless drive member 53, such as a chain or belt, connecting the sprockets or pulleys 54 and 55 on reducer 52 and shaft 50, respectively. A variator 56, or speed-changing device, such as the variable diameter pulley device described in United States Patent 583,402 to M. O. Reeves, may be interposed between motor 51 and reducer 52 in the conventional manner.

An overload release device, similar to the one described above, includes the bell-crank 60 pivotally supported at 61 on the reducer or the supporting frame of the machine. One arm of bell-crank 60 carries the rotary idler member 62, such as a sprocket or pulley, adapted to contact the driving side of the endless drive member 53. The other arm of bell-crank 60 is pivotally connected to a clevis 63 at one end of a connecting rod 64. The other end of rod 64 is pivoted to a weighted lever 65 intermediate the ends thereof. One end of lever 65 is secured to a shaft 66 rotatably supported by a pillow block bearing 67. The other end of lever 65 bears a weight 68 slidable thereon and adjustably secured thereto. Bell-crank 60 and lever 65 are thus linked together to move toward the positions shown in broken lines at 60a and 65a, respectively, as the tension on the endless drive member 53 is increased, and bell-crank 60 is weighted by the action of weight 68 on lever 65. A spring-pressed idler sprocket or pulley 69 may contact the other side of the endless member 53 to keep it taut.

A limit switch 70 is supported by the frame of the machine so that its operating lever 71 is in the path of bell-crank 60, and the circuit through the switch is broken when the bell-crank reaches the position indicated at 60a. Switch 70 is connected in series with the control switch 72 in the electric supply wiring 73 to motor 51.

The starting regulator comprises an air-operated piston and cylinder 75, an air supply line 76, certain valves connected thereto as hereinafter described, and an electrical relay 77 wired in parallel with the electric supply line 73 to the motor.

The air cylinder 75 is supported by the frame of the machine in such a position that the contact plate 78 borne by the piston rod of its piston 79, when fully extended by air introduced into the cylinder as indicated at 78b and 79b, will oppose and obstruct the movement of bell-crank 60 away from the normal running position shown in full lines. A stop 80 may be secured to the frame of the machine to limit the movement of bell-crank 60 as shown. Return springs 81—81 extend from plate 78 to cylinder 75.

Air is supplied to the cylinder 75, behind the piston, through appropriate piping from the supply line 76. Air from the supply line passes first through a conventional low pressure regulator valve 82 and then through a standard in-line, direct, solenoid-operated, 3-way valve 83. This valve is spring operated, when its solenoid 84 is not energized, to allow free passage of air from its entrance port 87 to its exit port 85, and the exhaust port 86 is blocked. When solenoid 84 is energized, the entrance port 87 is blocked and free passage of air from the exit port 85 is allowed to the exhaust port 86. The exit port 85, which is always open, is connected to the conventional needle valve 88, which is connected to a conventional safety, or pop, valve 89, which, in turn, is connected to cylinder 75.

Solenoid 84 is energized from an electrical supply line 90, preferably of lower voltage than the line 73, by means of the relay 77 as shown.

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The overload release device shown in Figures 3 and 4 may also be used to regulate the speed of the machine drive shown. Certain large machines, such as long overhead conveyors, require several motors and drives at intervals along their length so that the whole driven load will not be borne by the whole length of chain or belt which runs the length of the conveyor. By having multiple drive units each section of the conveyor bears only a portion of the load. When multiple drives are used, the speed of each drive unit must be regulated, the speed of each drive being decreased, when the load on that unit becomes unduly great, so that the other drive units may take up their share of the load.

The drive unit shown in Figure 3 may be used as one of a number of such multiple drives, the variator 56 being used in well-known manner to control the speed of the drive. The end of shaft 66, opposite the end to which is secured the swinging lever 65, has secured thereto the spur gear 91. A smaller gear 92 is in mesh with gear 91, as shown in Figure 4, gear 92 being secured to a shaft 93 which is journaled in the pillow-block bearing 94 and to which is also secured the sprocket 95. Sprocket 95 drives the sprocket 96 by means of chain 97, the latter sprocket controlling the speed ratio of the pulleys of variator 56 in well-known manner.

The overload release device of Figures 3 and 4 operates like the one previously described in connection with Figures 1 and 2. As the load on the conveyor or other machine increases, the tension on the driving side of the endless drive member 53, increases, moving the idler 62 and bell-crank 60 toward the position shown at 60a. Should the load become so great that the position 60a is reached, the limit switch 70 is operated by reason of bell-crank 60 striking the switch lever 71. Current to the motor 51 is thereby cut off.

Should the load on the drive move bell-crank 60 only slightly, and not all the way to the position shown at 60a, lever 65 is raised toward the position shown in broken lines at 65a and gear 91 is rotated. Gear 92 is also rotated, causing the sprockets 95 and 96 to turn and reducing the speed of the drive. This allows the other drive units of the conveyor, or other machine, to pick up more of the total load and lessen the load on the drive unit here shown. Stop 80 is positioned to hold lever 60 and the weighted lever 65 in such position as to maintain the maximum desired speed.

When switch 70, or control switch 72, is turned off, the current to motor 51 is interrupted, as is the current to relay 77, which is in parallel with motor 51. Relay 77 being de-energized, the circuit to solenoid 84 is interrupted, and valve 83 allows air to flow from the supply line 76, through regulator valve 82 and the entrance port 87 and exit port 85 to the needle valve 88. Exhaust port 86 is closed. Air passes through the needle valve 88, through valve 89, into cylinder 75 and pushes the piston 79, without shock, to its extended position at 79b. Contact plate 78 is pushed into the path of, and immediately adjacent, bell-crank 60 at 78b, lever 60 resting against stop 80 by reason of the pull of the weighted lever 65. Air remains under pressure in cylinder 75 as long as motor 51 is turned off.

Switch 70 being manually reset, if necessary, the motor 51 is started by turning switch 72 on. Switch 72 may control the motors of all the drives, if multiple drives are used. As motor 51 starts, the load on the conveyor, or other machine,

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including the inertia of starting, puts tension on the drive side of the endless drive member 53, tending to move bell-crank 60 toward the position 60a. Movement of bell-crank 60 is blocked during the starting of motor 51, however, by the plate 78 at 78b.

With the closing of switch 72, however, relay 77 is energized, closing the circuit to solenoid 84 of valve 83. The plunger of valve 83 is thereby moved to cut off the entrance of air through port 87 and the exit port 85 is connected to the exhaust port 86. Air under pressure in cylinder 75 may then bleed out through the needle valve 88 and through the ports 85 and 86 of valve 83. As the air bleeds out of cylinder 75, the plate 78 is moved away from lever 60 by the return springs 81—81. Needle valve 88 may be adjusted so that plate 78 may be withdrawn during the 3 to 5 second interval during which motor 51 is reaching its normal rate of speed, the inertia of starting being compensated for only during this period of starting.

Any unusual overload during starting may still cut out motor 51 by opening switch 70, by reason of the action of pop valve 89. This valve is set to open and release air to atmosphere should the pressure in cylinder 75 increase over the pressure of normal starting caused by pressure of bell-crank 60 on plate 78.

When plate 78 has been withdrawn after the interval of starting, the overload release mechanism again assumes its normal role of regulating the speed of the drive by adjustment of the variator 56 and of acting as a safety cut-out when bell-crank 60 trips the switch 70.

When the current to motor 51 is cut off by switch 72 or switch 70, relay 77 is again de-energized and current to solenoid 84 is again cut off. Valve 83 thereupon connects ports 85 and 87 and blocks the exhaust port 86. Air is again allowed to flow into cylinder 75, and plate 78 is extended to 78b immediately adjacent bell-crank 60, ready for restarting motor 51.

When the drive unit shown in Figures 3 and 4 is used as one of a number of similar drives in a multiple drive machine, the starting regulators of all the drive units may be synchronized by the adjustment of their respective needle valves 88. Each valve 88 may be adjusted so that the time interval for the exhausting air from cylinders 75 is approximately equal. As air is exhausted from the cylinders 75 during the starting of the motors, the plates 78 of each unit will be gradually withdrawn allowing the speed regulating devices 56 to be increasingly effective in distributing the load as the starting interval elapses.

It will be apparent to those skilled in the art that the starting regulator 75—77—78—83—88—89 of Figures 3 and 4 may be substituted for the regulator 30—31—32 of Figures 1 and 2 by positioning the air cylinder so that plate 78 is directed downward to contact the free end of arm 19. The regulator 30—31—32 may also be substituted in Figures 3 and 4 by positioning the lever 30 so that it falls downward into the path of the weighted lever 65. The device shown in Figures 1 and 2, however, has been found particularly satisfactory for vertical conveyors, while that of Figures 3 and 4 is particularly satisfactory for substantially horizontal conveyors such as overhead conveyors.

In all the figures of the drawing, the supporting framework has not been shown, fragmentary portions only being shown to indicate the fact of such support. It will also be apparent that the

figures of the drawing show the drives and overload release devices in diagrammatical fashion and that different arrangements of parts may equally well be made. Spring-loaded levers, for instance, may be substituted for the gravity-loaded levers of the drawing, and the starting regulators may equally well be used with different arrangements of the levers and linkages.

While there is herein described, and in the drawing shown, illustrative embodiments of the invention, it is to be understood that the invention is not limited thereto, but may comprehend other constructions, arrangement of parts, details and features without departing from the spirit of the invention. I desire to be limited, therefore only by the scope of the appended claims.

I claim:

1. The combination with a machine drive, including a motor and an endless driving member, and an overload release device having a loaded bell-crank rotatable in response to the tension on said endless driving member and operably connected to control said motor responsive to said tension, of supplementary means for additionally resisting the turning of said bell-crank when the motor is started, said supplementary means being removable from the path of said bell-crank at a predetermined tension on said endless driving member, and timed means for removing said supplementary means from the path of said bell-crank after a predetermined time from the starting of said motor.

2. The combination with driving means, including a motor, a driven machine, an endless driving member connecting said driving means and said machine, and an overload release device including a loaded bell-crank, a rotary idler contacting said endless driving member and mounted on an arm of said bell-crank, whereby the movement of said bell-crank is responsive to the tension on said endless driving member, the movement of said bell-crank controlling said driving means, of an automatic starting regulator comprising supplementary means for additionally resisting the movement of said loaded bell-crank, means for yieldingly interposing said supplementary means in the path of said bell-crank upon the stopping of the motor to compensate for the succeeding starting inertia of said driven machine, means for withdrawing said supplementary means from the path of said bell-crank, and timing means for initiating the withdrawal of said supplementary means at a predetermined time after the starting of the motor.

3. An automatic starting regulator for machine-drive overload-release devices having a loaded lever moving in response to the load on said machine and thereby controlling said drive, comprising a second loaded lever guided to fall upon, and augment the load on, said first loaded lever when the machine-drive is stopped, means for lifting said second lever from the path of said first lever, and timed means for initiating the lifting of said second lever from the path of the first after a predetermined time from the starting of said machine-drive, said second lever being loaded to substantially compensate for the starting inertia of said machine whereby said second lever may be lifted by said first lever upon any initial overloading of said machine.

4. An automatic starting regulator for machine-drive overload-release devices having a loaded lever moving in response to the load on the machine and thereby controlling said drive,

comprising a second loaded lever guided to normally rest upon said overload-release lever and to augment the load thereon to substantially compensate for the starting inertia of said machine, a solenoid energized by the starting of said machine-drive and operably connected to said second lever to lift it from the first lever, and timing means for delaying the energizing of said solenoid for a predetermined time after the starting of said machine-drive.

5. An automatic starting regulator for machine-drive overload-release devices having a loaded lever moving in response to the load on said machine and thereby controlling said drive, comprising a contact plate, fluid-operated means for extending said plate against and opposed to the movement of said overload-release lever, a source of fluid under pressure, valve means for normally supplying fluid under pressure to said fluid-operated means, spring means opposed to said fluid-operated means for withdrawing said contact plate from the path of said lever, valve means operated coincidentally with the starting of said machine drive for cutting off the supply of fluid and for the timed escape of fluid from said fluid-operated means, whereby said contact plate is withdrawn from the path of the overload release lever after the starting inertia of the machine has been overcome, and a safety valve connected to said fluid-operated means for the immediate escape of fluid therefrom upon any initial overload exceeding the normal starting inertia of the machine.

6. An automatic starting regulator for machine-drive overload-release devices having a loaded lever moving in response to the load on said machine and thereby controlling said drive, comprising an air-operated piston and cylinder, a source of air under pressure, valve means for normally supplying air under pressure to said cylinder, means operated coincidentally with the starting of said machine-drive for cutting off said supply and allowing the timed escape of air from said cylinder, a contact plate extensible by the operation of said piston to oppose the movement of said loaded lever, resilient means for withdrawing said plate, and a safety valve connected to said cylinder, whereby the starting inertia of said machine is compensated for by the opposition of said plate during the starting of said machine-drive.

7. An automatic starting regulator for machine-drive overload-release devices having a loaded lever moving in response to the load on said machine and thereby controlling said drive, comprising an air-operated piston and cylinder, a contact plate operable by said piston and cylinder to extend into the path of said lever to prevent the normal operation of said overload-release caused by the starting inertia of said machine, resilient means for withdrawing said contact plate from the path of the lever, a source of air under pressure, valve means for normally supplying air under pressure to said cylinder, means operated by the starting of said machine-drive for operating said valve means to cut off the supply of air to the cylinder, an adjustable bleeder valve for the timed exhausting of air from the cylinder whereby the air may be exhausted during the interval in which starting inertia is present, and a pop valve connected to said cylinder for the immediate exhausting of air therefrom upon an initial overload on said machine.

8. An automatic starting regulator for machine-drive overload-release devices having a

loaded lever moving in response to the load on the machine and thereby controlling the machine drive, comprising an air-operated piston and cylinder, a source of air under pressure, a three-way valve, a needle valve and a pop valve, said source of air being connected to said cylinder through said valves, said three-way valve normally allowing air to flow to the cylinder through said needle valve, a solenoid energized upon the starting of said machine drive and operably connected to said three-way valve to shut off the supply of air and to allow air to bleed from the cylinder through said needle valve when the solenoid is energized, said needle valve being adjustable whereby the air may be exhausted from the cylinder at a predetermined elapsed time from the starting of the machine drive, a contact plate operated by said piston to oppose the movement of said loaded lever when the piston is extended

by air under pressure in the cylinder, spring means for withdrawing said contact plate from the path of the lever when air is exhausted from the cylinder, and said pop valve being adapted to immediately exhaust air from the cylinder upon an initial overload in excess of the normal starting inertia of the machine.

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