Jan. 9, 1940. E. H. LAABS 2,186,113

SYSTEM OF CONTROL FOR PRINTING PRESSES AND OTHER MACHINERY

Filed Feb. 9, 1939 2 Sheets-Sheet 1

Fig. 1

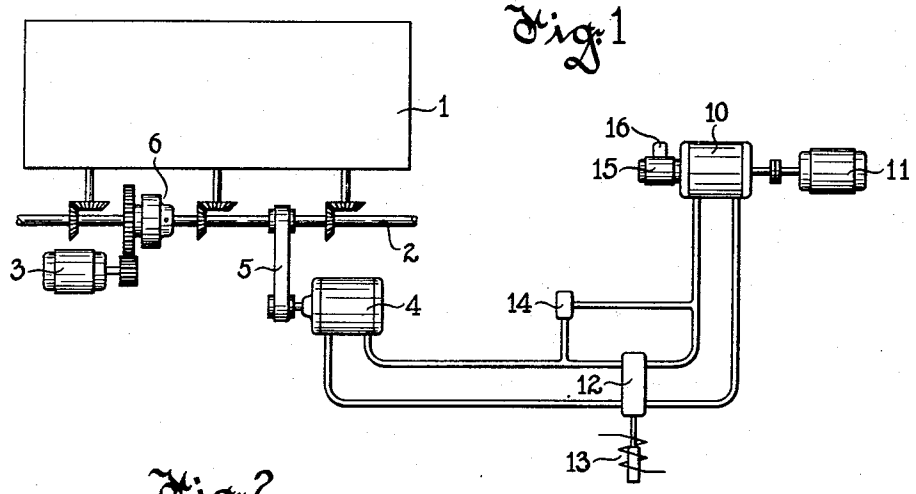


Fig. 2

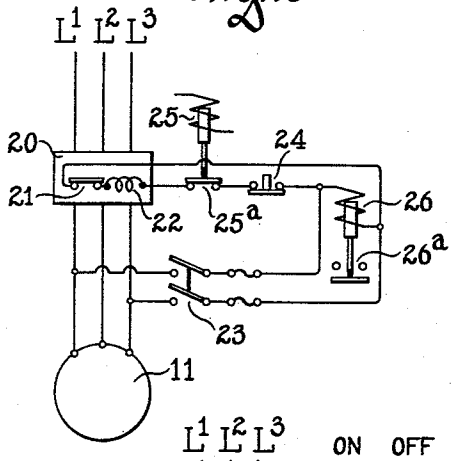


Fig. 3

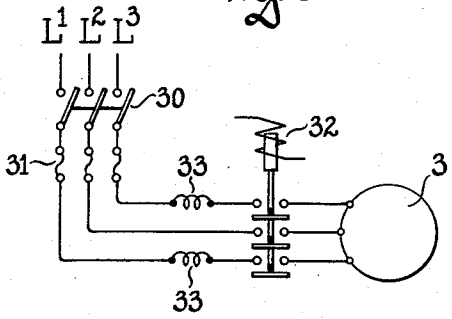
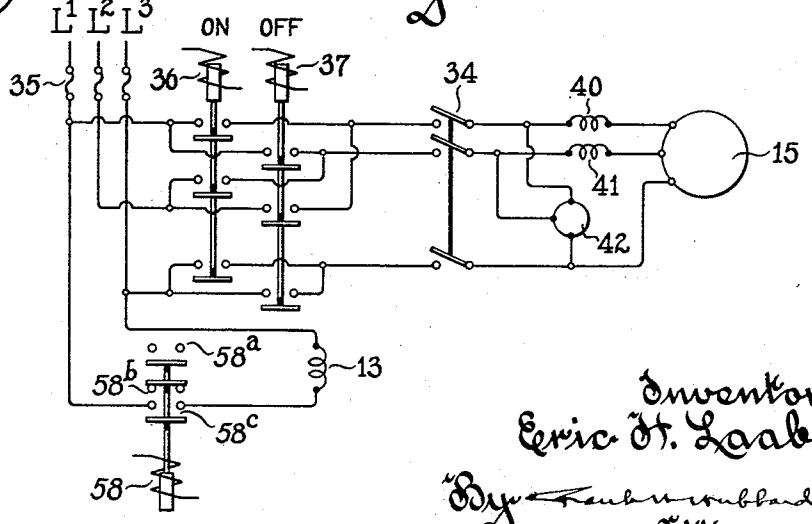


Fig. 4

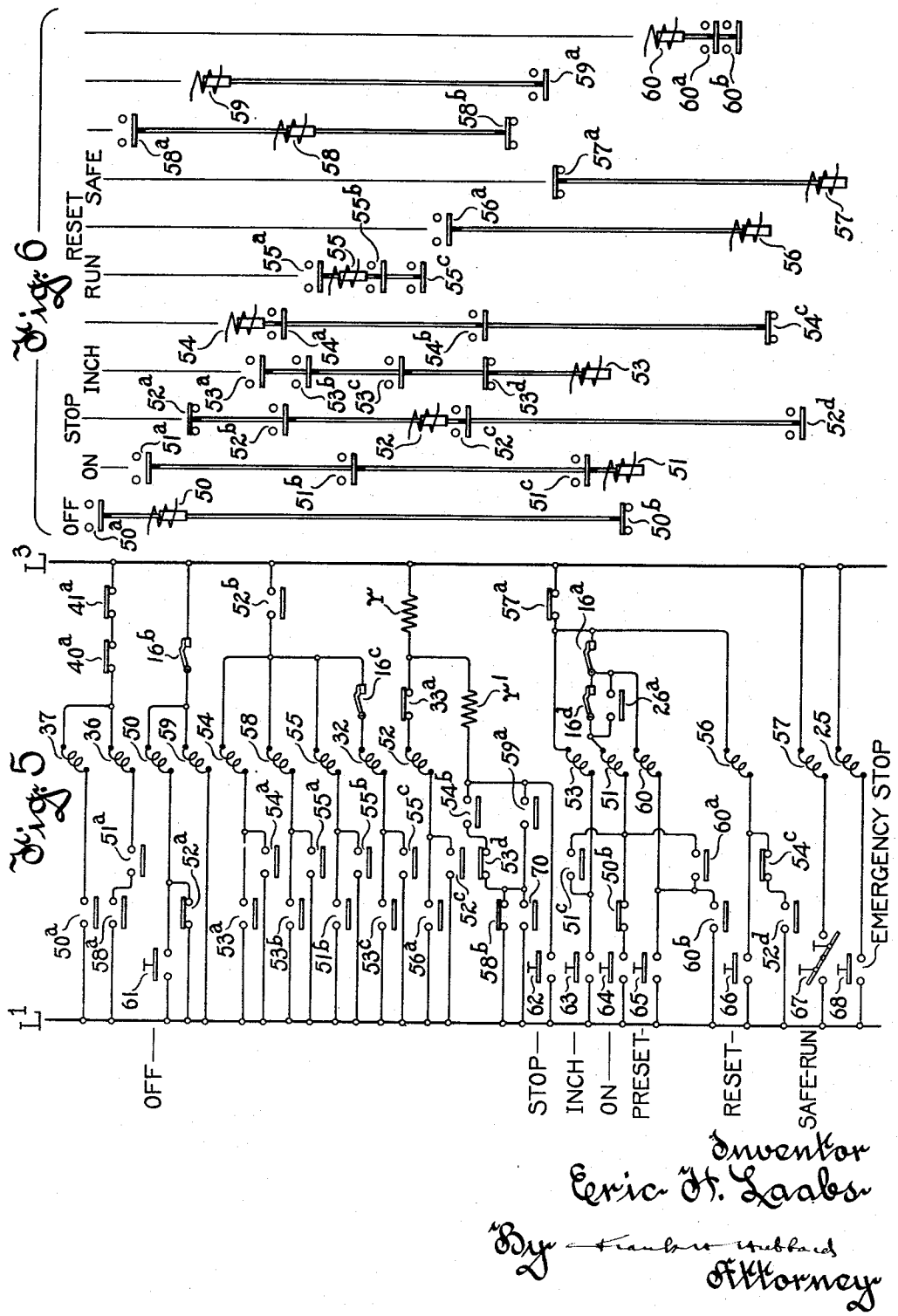


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SYSTEM OF CONTROL FOR PRINTING PRESSES AND OTHER MACHINERY

Filed Feb. 9, 1939 2 Sheets-Sheet 2



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Patented Jan. 9, 1940 2,186,113

UNITED STATES PATENT OFFICE

2,186,113

SYSTEM OF CONTROL FOR PRINTING PRESSES AND OTHER MACHINERY

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Application February 9, 1939, Serial No. 255,555

20 Claims. (Cl. 60—6)

This invention relates to systems of control for printing presses and other machinery.

Newspaper presses commonly have been provided with all electric drives comprising a small motor for starting, inching and threading speed and a large motor for printing speeds. Such drives have proven very successful for printing presses and other machines. On the other hand, a more recently developed hydraulic drive comprising an electrically driven hydraulic generator supplying a hydraulic motor has been used for printing press drive with some degree of success, the single hydraulic motor being used for starting, inching and running. However, the only outstanding operating advantage of the hydraulic motor drive over the two-motor electric drive lies in the intermediate speeds obtainable with the former, certain of the commonly employed types of electric motors presenting difficulties in obtaining the desired intermediate speeds. As against this advantage the hydraulic motor drive has numerous disadvantages, especially when used in connection with printing presses. As is well known, the starting torque of such a press is very much greater than its running torque, and thus the hydraulic motor to be successful must be much larger than it need be for driving the press at speed. Again there is a delay involved in starting the hydraulic motor, and this is undesirable particularly in inching where it should be possible to gauge the motion of the press from the length of time the inching button is held depressed, beginning the calculation at the moment the button is depressed. Furthermore, the period of preparation of the press during which only inching and threading operations are required may run into hours, and where the hydraulic motor drive is used for inching and threading the motor operating the hydraulic generator must be always in operation to avoid further delays in starting, and this involves a great waste of electrical energy.

The present invention has among its objects to provide a system enabling use of the hydraulic type of drive free from the aforementioned and other disadvantages.

Another object is to provide a system which in part is hydraulic and in part electric to obtain the aforementioned and other advantages of both hereinbefore discussed types of drives.

Another object is to provide such a composite system which will afford control of the press or other driven machine in substantially the same manner as that afforded by an all electric system.

Other objects and advantages of the invention will hereinafter appear.

One embodiment of the invention is illustrated in the accompanying drawings which will now be described, it being understood that the embodiment selected for illustration is susceptible of various modifications without departing from the scope of the appended claims.

In the drawings,

Figure 1 is a schematic view showing the driven and driving elements of the system.

Fig. 2 shows power connections for the electric motor driving the hydraulic generator employed.

Fig. 3 shows the power circuits for a separate electric motor which is employed.

Fig. 4 shows the power connections for the electric pilot motor of the hydraulic generator unit.

Fig. 5 shows the control instrumentalities and the control circuits in an across-the-line form, and

Fig. 6 is a chart showing the windings and contacts of the various switches or relays of Fig. 5 coordinated by vertical alignment and aligned horizontally with Fig. 5 to indicate their respective positions therein.

Referring to Fig. 1, there is schematically shown a press 1 having a drive shaft 2 to which is connected an electric motor 3 and a hydraulic motor 4. In practice the motor 4 preferably is connected to the shaft 2 by a V-belt or silent chain 5, although any other suitable connections might be employed. It is contemplated to employ the hydraulic motor 4 only for printing speeds and to utilize the electric motor 3 for starting, inching and threading. Thus it may be assumed that the motor 3 is of the type and size usually employed for starting, inching and threading, said motor preferably being connected to shaft 3 through an over-running clutch 6, provided for freeing the shaft 2 from the electric motor drive when the hydraulic motor takes over the drive. The overrunning clutch 6 could of course be replaced by a suitably controlled electromagnetic clutch. As shown the overrunning clutch 6 is mounted on shaft 2 and may be connected to motor 3 by gearing as shown or by a V-belt or by a silent chain.

For supplying the hydraulic motor there is shown schematically a commercial form of unit comprising hydraulic generator 10 driven by an electric motor 11 and suitably piped to the hydraulic motor through a valve 12 having an operating solenoid 13. The piping also includes a relief valve 14. This unit provides for regulation

of the speed of the motor 4 through regulation at the generator 10, this regulation being accomplished through the medium of a pilot motor 15 having a suitably operated limit switch 16. As will be understood, the limit switch 16 stops the pilot motor when the generator regulator has been driven to either of two extreme limits. In addition to the contacts required for such limits the limit switch 16 is provided with contacts hereinafter set forth to be operated in intermediate positions of said switch. Also as will be understood, the valve 12 is to be operated by its solenoid whenever the press is set in motion. The system illustrated being as aforestated of a well known type and its specific form being immaterial to the present invention further description thereof appears needless.

Referring to Fig. 2, the motor 11 employed to drive the hydraulic generator is shown as of the three phase alternating current type connected to supply lines L^1, L^2, L^3 through a suitable panel 20 which preferably includes an overload device comprising contacts 21 and a trip winding 22. This trip winding 22 is shown as connected in series with its contacts 21 across supply lines L^1—L^3 through a double pole knife switch 23, a normally closed "stop" switch 24 and normally closed contacts 25^a of a relay 25. Thus opening of the "stop" switch 24 or relay 25 will have the same effect as response of the overload, and as will be understood operation of any one of these instrumentalities would be utilized in one of the well known ways to effect disconnection of motor 11. A relay 26 has its winding connected across the leads from lines L^1 and L^3, said relay having normally open contacts 26^a and serving a purpose hereinafter explained. The relay 26, as will be apparent, is energized to close its contacts 26^a while motor 11 is running and to release said contacts when said motor is disconnected from circuit.

Referring to Fig. 3, the starting and inching motor 3 is shown as comprising a 3 phase alternating current motor supplied from lines L^1, L^2, L^3 through a triple pole knife switch 30, fuses 31 and an electromagnetic main switch 32 having normally open contacts in each phase of the circuit. Two phases of the motor circuit include overload windings 33. Assuming the knife switch 30 to be closed the motor 3 may be started and stopped for inching the press by energizing and deenergizing the electromagnetic main switch 32.

Referring to Fig. 4, the pilot motor 15 for the hydraulic generator is shown as comprising a 3 phase alternating current motor supplied from lines L^1, L^2 and L^3 through fuses 35, a triple pole knife switch 34 and "on" and "off" electromagnetic switches 36 and 37, respectively. Each of switches 36 and 37 is of the triple pole type having normally open contacts in each of the three phases of the motor circuit, and these switches have different line connections whereby they afford operation of the motor 15 in reverse directions, selectively. As will be understood, when it is desired to operate the pilot motor for increasing the speed of the hydraulic motor the "on" switch is energized until the desired speed has been obtained, whereupon it is deenergized, the speed change being governed by the duration of the pilot motor. On the other hand, when it is desired to decrease the speed of the hydraulic motor the "off" switch is energized to effect operation of the pilot motor in a reverse direction until the desired speed change has been effected whereupon the "off" switch is to be deenergized. Two phases of the pilot motor circuit are preferably provided with overload coils 40 and 41, respectively, and preferably the pilot motor is provided with an electrically controlled brake 42 shown as connected to all three phases of the motor circuit.

Further referring to Fig. 4, the same also shows the power connections for the solenoid 13 of the valve 12. More specifically it shows this solenoid connected across lines L^1 and L^3 through normally open contacts 58^c of an electroresponsive relay 58.

Referring now to Fig. 5, the same shows at the bottom thereof the winding of relay 25 of Fig. 2, and near the middle the winding of switch 32 of Fig. 3. Also at the top of this figure are shown the windings of electromagnetic "on" and "off" switches 36 and 37 of Fig. 4, and below these the winding of relay 58 of Fig. 4. The windings 36 and 37 have in circuit therewith contacts 40^a and 41^a to be actuated by the overload coils 40 and 41 of Fig. 4.

The additional relays shown in Fig. 5 will best be understood by first referring to Fig. 6. These relays include an "off" relay 50 having normally open contacts 50^a and normally closed contacts 50^b, and an "on" relay 51 having normally open contacts 51^a, 51^b and 51^c. These relays control the windings of the "off" and "on" switches 36 and 37, respectively. The relays also include a "stop" relay 52 having normally closed contacts 52^a and normally open contacts 52^b, 52^c and 52^d, an "inch" relay 53 having normally open contacts 53^a, 53^b and 53^c and normally closed contacts 53^d, a "safe after inch" relay 54 having normally open contacts 54^a and 54^b and normally closed contacts 54^c, a "run" relay 55 having normally open contacts 55^a, 55^b and 55^c, a "reset" relay 56 having normally open contacts 56^a and a "safe" relay 57 having normally closed contacts 57^a. Relay 58 is here shown as having normally open contacts 58^a and normally closed contacts 58^b, whereas as shown in Fig. 4 it additionally has normally open contacts 58^c. A relay 59 having normally open contacts 59^a and a relay 60 having normally open contacts 60^a and 60^b are also included.

Fig. 5 additionally shows an "off" push button switch 61, a "stop" push button switch 62, an "inch" push button switch 63, an "on" push button switch 64, a "preset" push button switch 65, a "reset" push button switch 66, a "safe-run" push button switch 67 and an "emergency stop" push button switch 68.

Fig. 5 additionally shows contacts 16^a and 16^b of limit switch 16 (Fig. 1) to be opened in extreme positions respectively of said limit switch, 16^a being the "on" limit contacts in circuit with relay windings 51 and 60, and 16^b being the "off" limit contacts in circuit with relay windings 50 and 59. Also it shows contacts 16^c of said limit switch connected in circuit with relay winding 32, said contacts being arranged to be opened shortly after the pilot motor 15, Fig. 1, starts the limit switch 16 away from "off" position. Further Fig. 5 shows contacts 16^d of limit switch 16 connected in circuit with relay winding 51, these contacts being arranged for opening slightly in advance of contacts 16^c and to be short-circuited by contacts 26^a of relay 26 (Fig. 2) upon energization of said relay. The contacts 33^a shown in circuit with relay winding 52 are adapted to be operated by either of the overload windings 33 (Fig. 3).

The control is such that before the press or other driven machine may be started by pressing

either the "inch" or the "on" buttons the "reset" push button switch 66 must first be depressed. When push button switch 66 is depressed the winding of relay 56 is connected across lines L^1, L^3, through said push button switch and normally closed contacts 57^a of relay 57. Relay 56 thereupon responds to connect through its contacts 56^a the winding of relay 52, across lines L^1 and L^3 through the overload switch 33^a and resistance r. Relay 52 then responds and through its contacts 52^c establishes a maintaining circuit for itself and through its contacts 52^b establishes a connection between line L^3 and certain of the relay windings. Furthermore relay 52 in responding completes through its contacts 52^d a maintaining circuit for the winding of relay 56, said maintaining circuit including normally closed contacts 54^c of relay 54 and shunting push button switch 66.

With relays 52 and 56 energized the usually employed signal system would indicate and depression of the "inch" push button switch 63 then is effective for inching. Depression of this push button switch connects the winding of "inch" relay 53 across lines L^1, L^3 through the normally closed contacts 57^a of relay 57, subject to disconnection upon release of said push button switch. Relay 53 in responding establishes a connection from line L^1 through its contacts 53^c to and through the winding of the starting switch 32 of the inching motor, to and through limit switch 16^c to and through the now closed contacts 52^b to line L^3. Switch 32 thus responds to start the small motor 3 for inching subject to termination of the inching operation by release of the push button switch 63 to deenergize the inching relay 53 which in turn deenergizes the switch 32. In the meantime during the inching operation the solenoid operated valve 12, Fig. 1, is energized. The inching relay 53 upon responding acts through its contacts 53^b to establish a connection from line L^1 to and through the winding of relay 58 to and through the now closed contacts 52^b to line L^3. This relay completes the circuit of the solenoid 13 shown in Fig. 4. When the "inch" push button is released then the relay 58 is deenergized through deenergization of the inching relay to disconnect the valve solenoid from circuit.

During the inching operation the relay 54 also is energized and this effects restoration of circuits following release of the "inch" push button switch, such as to necessitate repeating of the reset cycle first described above prior to a further inching operation or to starting through operation of the "on" button. The energizing circuit of relay 54 is completed by contacts 53^a of the "inch" relay and relay 54 in responding establishes through its contacts 54^a a maintaining circuit shunting the contacts 53^a. Also relay 54 in responding closes its contacts 54^b connected in a shunt around the winding of relay 52. This shunt includes a resistance r^1, and normally closed contacts 53^d and 58^b of relays 53 and 58. Thus when relays 53 and 58 are deenergized following release of the "inch" push button switch the relay 52 is deenergized by shunting of its winding, and releases to disengage its contacts 52^b, restoring the circuits to the condition shown.

Assuming repetition of the resetting cycle followed by depression of the "on" push button switch instead of the "inch" push button switch the "on" relay 51 is energized. The circuit of the "on" relay may be traced from line L^1 through "on" push buton switch 64 and normally closed contacts 58^b of the "off" relay to and through winding 51 to and through limit switches 16^d and 16^a in series to and through normally closed contacts 57^a of relay 57 to line L^3. The "on" relay remains energized only so long as the "on" push button switch is held depressed. The "on" relay 51 upon responding connects in parallel with its winding through its contacts 51^c the winding of the "inch" relay 53. Hence the switches aforedescribed as responding to closure of the "inch" relay again respond, causing the small motor to start and the solenoid 13 to operate the valve 12 through response of relay 58. Relay 58 and the "on" relay 51 through their respective contacts 58^a and 51^a complete the energizing circuit of the "on" switch 36 of Fig. 4. This, assuming that the hydraulic generator is in operation, provides for starting and accelerating the hydraulic motor to take over the press drive, the degree of acceleration being determined by the length of time the "on" push button is held depressed. As will be understood, when the "on" push button is released the pilot motor 15 controlling the hydraulic generator is arrested for continued operation of the press at the selected speed until stopping or a speed change is directed. A further increase in speed may of course be obtained by again depressing the "on" push button switch 64. If, on the other hand, a speed reduction is desired, then the "off" push button switch 61 is depressed to connect across lines L^1 and L^3 the winding of "off" relay 50. "Off" relay 50 in responding acts through its contacts 50^a to energize the "off" switch 37 of Fig. 4 to operate the pilot motor in a reverse direction subject to arrest when the "off" push button switch is released.

If when the "on" relay 51 is energized to start the pilot motor away from "off" limit the hydraulic system is not in operation then shortly the limit switch contacts 16^d open to deenergize "on" relay 51 to stop the pilot motor. The slow speed drive continues and when the hydraulic system is started relay 26 responds to short-circuit limit switch contacts 16^d for reenergization of the "on" relay when the "on" push button switch is closed. When the drive is taken over by the hydraulic motor the limit switch contacts 16^c open to deenergize relay 32 for disconnection of the electric starting motor 3.

With the press in operation as the result of depression of the "on" push button switch stopping may be effected by depressing the "stop" push button switch 62. The push button switch 62 when depressed alone shunts the winding of "stop" relay 52 through resistance r^1, causing deenergization of said "stop" relay with consequent restoration of circuit connections, such as to necessitate repetition of the first described reset cycle before the press can be restarted.

Stopping automatically is provided for by a paper break switch 70 which when closing while the press is in operation establishes a shunt for the winding of "stop" switch 52 which extends through said paper break switch, the normally closed contacts 53^d of the "inch" relay and the contacts 54^b of relay 54 which is closed during running operation.

Throughout the time that "off" limit switch 16^b is closed the winding of relay 59 is connected across lines L^1 and L^3, and this relay in responding parallels through its contacts 59^a the circuit including contacts 53^d and 54^b of relays 53 and 54, respectively. Thus prior to restarting while the paper break switch is closed the pilot motor must be operated to "off" position to open con-

tacts 16b for deenergization of relay 59, thereby confining operation to a threading speed until the paper break is repaired to restore the paper break switch to open position.

In some instances it is desirable to bring the press to a preset speed by momentary depression of a push button, and this can be accomplished by so depressing push button switch 65. This establishes circuit from line L^1 to and through the winding of relay 60, to and through the limit switch 16a, to and through contacts 57a of relay 57 to line L^3. Relay 60 upon responding completes through its contacts 60b a maintaining circuit for itself and through said contacts and contacts 60a in series a circuit for the "on" relay 51. Accordingly response of relay 60 provides for continued energization of "on" relay 51 until it is deenergized by operation of the limit switch 16a when the desired speed has been attained.

The safe run switch 67 when closed provides for connection across lines L^1 and L^3 of the winding of relay 57 which upon responding opens its contacts 57a, thus disconnecting from line L^3 the windings of the relays controlled by the various push button switches other than the "off" push button switch.

Depression of the emergency push button 68 connects across line L^3 the winding of relay 25 of Fig. 2, thus providing for shut-down of the motor operated generator set.

What I claim as new and desire to secure by Letters Patent is:

1. For printing presses and other machines, the combination with an hydraulic type drive comprising a generator and motor supplied thereby, of an electric drive comprising a motor capable of starting the driven machine, and control means for said drives insuring starting of the driven machine always by said electric drive and affording thereafter transfer of drive to said hydraulic drive.

2. For printing presses and other machines, the combination with an hydraulic type drive comprising a generator and motor supplied thereby, of an electric drive comprising a motor capable of starting the driven machine, and control means for said drives insuring starting of the driven machine always by said electric drive, affording slow speed operation of the driven machine by said electric drive and affording transfer of drive to said hydraulic drive for higher speed operation of the driven machine.

3. For printing presses and other machines, the combination with an hydraulic drive comprising a generator and a motor supplied thereby, of an electric drive comprising a motor capable of starting the driven machine, and control means for said drives insuring starting of the driven machine always by said electric drive, affording slow speed operation of the driven machine by said electric drive and affording transfer of drive to said hydraulic drive for higher speed operation of the driven machine, said control means including means affording regulation at will and in small increments or decrements of the speed of the driven machine when operated by said hydraulic drive.

4. For printing presses and other machines, the combination with an hydraulic type drive comprising a generator and motor supplied thereby, of an electric drive comprising a motor capable of starting the driven machine, and control means for said drives insuring starting of the driven machine always by said electric drive and affording thereafter transfer of drive to said hydraulic drive and regulation of the speed of said hydraulic drive, said control means affording a speed of said hydraulic drive closely approximating that of said electric drive for such transfer.

5. For printing presses and other machines, the combination with an hydraulic type drive comprising a generator and motor supplied thereby, of an electric drive comprising a motor capable of starting the driven machine, and control means for said drives insuring starting of the driven machine always by said electric drive and affording thereafter transfer of drive to said hydraulic drive, said control means including means rendering such transfer of drive dependent upon establishment of certain operating conditions of said hydraulic drive.

6. For printing presses and other machines, the combination with an hydraulic type drive comprising a generator and motor supplied thereby, of an electric drive comprising a motor capable of starting the driven machine, and control means for said drives insuring starting of the driven machine always by said electric drive and affording thereafter transfer of drive to said hydraulic drive, said control means including means whereby if such transfer of drive is attempted when said hydraulic drive is not in operation said electric drive will be maintained effective until said hydraulic drive is started or until stopping of said electric drive is directed.

7. For printing presses and other machines, the combination with an electric drive comprising a motor capable of starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating the driven machine at a speed approximating the aforementioned slow speed and at higher speeds, and control means to start the first mentioned motor and thereafter start the second mentioned motor for transfer of drive from the electric drive to the hydraulic drive when the two drives have substantially like speeds, said control means after such transfer affording regulation of the speed of said hydraulic drive in small increments and decrements.

8. For printing presses and other machines, the combination with an electric drive comprising a motor capable of starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating the driven machine at a speed approximating the aforementioned slow speed and at higher speeds, and control means to start the first mentioned motor and thereafter start the second mentioned motor for transfer of drive from the electric drive to the hydraulic drive when the two drives have substantially like speeds, said control means after such transfer affording regulation of the speed of said hydraulic drive in small increments and decrements and said control means affording disconnection from circuit of said electric drive after transfer to the hydraulic drive.

9. For printing presses and other machines, the combination with an electric drive comprising a motor capable of starting the driven machine and of operating it at slow speed and an over-running clutch through which said motor drives, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating the driven machine at a speed approximating the aforementioned slow speed and at higher speeds, and control means to start the first mentioned motor and thereafter start the second mentioned

motor for transfer of drive from said electric drive to said hydraulic drive at a speed of the latter only slightly above that of the former, said control means following such transfer affording regulation of the speed of said hydraulic drive in small increments and decrements.

10. For printing presses and other machines, the combination with an electric drive comprising a motor capable of starting the driven machine and of operating it at slow speed and an over-running clutch through which said motor drives, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating the driven machine at a speed approximating the aforementioned slow speed and at higher speeds, and control means to start the first mentioned motor and thereafter start the second mentioned motor for transfer of drive from said electric drive to said hydraulic drive at a speed of the latter only slightly above that of the former, said control means following such transfer affording regulation of the speed of said hydraulic drive in small increments and decrements, and said control means insuring use of said electric drive in starting the driven machine for protection of said hydraulic drive against overloads incident to starting.

11. For printing presses and other machines, the combination with an electric drive comprising a motor capable of starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating said machine at a speed approximating the aforementioned slow speed and at higher speeds, and control means for said drives to start the same progressively for starting of the driven machine by said electric drive and for continued operation by said hydraulic drive or optionally to start only said electric drive for operation of the driven machine at slow speed only, said control means including means to guard against use of said hydraulic drive for starting.

12. For printing presses and other machines, the combination with an electric drive comprising a motor capable of starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating said machine at a speed approximating the aforementioned slow speed and at higher speeds, and control means for said drives to start the same progressively for starting of the driven machine by the electric drive and for continued operation by the hydraulic drive or optionally to start only the electric drive for operation of the driven machine at slow speed only, said control means including means to guard against use of the hydraulic drive for starting and preventing starting of the hydraulic drive except when the electric drive is operating.

13. For printing presses and other machines, an electric drive comprising a motor capable of starting the driven machine and operating it at slow speed and an over-running clutch through which said drive operates the driven machine, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating said machine at a speed only slightly above the aforementioned slow speed and at higher speeds, and control means for said drives to start said electric drive alone or to start both drives, said control means rendering starting of said hydraulic drive dependent upon prior starting and continued operation of said electric drive.

14. For printing presses and other machines, an electric drive comprising a motor capable of starting the driven machine and operating it at slow speed and an over-running clutch through which said drive operates the driven machine, of an hydraulic type drive comprising a generator and a motor supplied thereby capable of operating said machine at a speed only slightly above the aforementioned slow speed and at higher speds, and control means for said drives to start said electric drive alone or to start both drives, said control means rendering starting of said hydraulic drive dependent upon prior starting and continued operation of said electric drive and stopping said electric drive automatically after transfer from said electric drive to said hydraulic drive.

15. For printing presses and other machines, the combination with an electric motor drive for starting and for slow speed operation of the driven machine, of an hydraulic type motor drive for substantially like slow speed and also higher speed operation of the driven machine and control means for said drives to effect operation of said electric drive alone or operation of said hydraulic drive alone, said control means including means insuring against starting of said hydraulic drive except when said electric drive is operating and said control means having a cycle of operation for safety purposes and including means necessitating its operation through such cycle for restarting whenever the driven machine is stopped following operation by either of said drives.

16. For printing presses and other machines, the combination with an electric motor drive for starting and for slow speed operation of the driven machine, of an hydraulic type motor drive for substantially like slow speed and also higher speed operation of the driven machine and control means for said drives affording inching or continuous operation of the driven machine by said electric drive alone or continuous operation by said hydraulic drive alone, said control means including means insuring against starting of said hydraulic drive except when said electric drive is operating and said control means having a cycle of operation for safety purposes and including means necessitating its operation through such cycle for restarting after each inching operation and after continuous operation of the driven machine by either of said drives.

17. For printing presses and other machines, the combination with an electric motor drive for starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a power driven generator and a motor supplied thereby for operating the driven machine through an increased speed range, and control means for said drives including means to render the motor of said hydraulic drive idle while its generator operates and means to start said electric drive and thereafter start said hydraulic drive but only if operation of said electric drive is continued through the starting period of said hydraulic drive.

18. For printing presses and other machines, the combination with an electric motor drive for starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a power driven generator and a motor supplied thereby for operating the driven machine through an increased speed range, and control means for said drives including means to render the motor of said hydraulic drive idle

while its generator operates and to render starting of said hydraulic drive dependent upon prior starting of said electric drive and operation thereof at the time starting of said hydraulic drive is directed and said control means also including means tending to continue operation of said electric drive if the generator of said hydraulic drive is not in operation when starting of said motor to be supplied thereby is directed.

19. For printing presses and other machines, the combination with an electric motor drive for starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a power driven generator and a motor supplied thereby for operating the driven machine through an increased speed range, and control means for said drives including means to render the motor of said hydraulic drive idle while its generator operates, and means to start said electric drive and thereafter start and accelerate said hydraulic drive and means effective to restrict accelerating operation of the last mentioned means in the event starting of said hydraulic drive is directed while its generator is not in operation.

20. For printing presses and other machines, the combination with an electric motor drive for starting the driven machine and operating it at slow speed, of an hydraulic type drive comprising a power driven generator and a motor supplied thereby for operating the driven machine through an increased speed range, and control means for said drives including means to render the motor of said hydraulic drive idle while its generator operates, means to start said electric drive and thereafter start and accelerate said hydraulic drive, the last mentioned means having a motor driven device to effect a gradual increase in speed of said hydraulic drive, and means arresting the operation of said motor driven device when starting and acceleration of said hydraulic drive is directed at a time that its generator is not in operation.

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