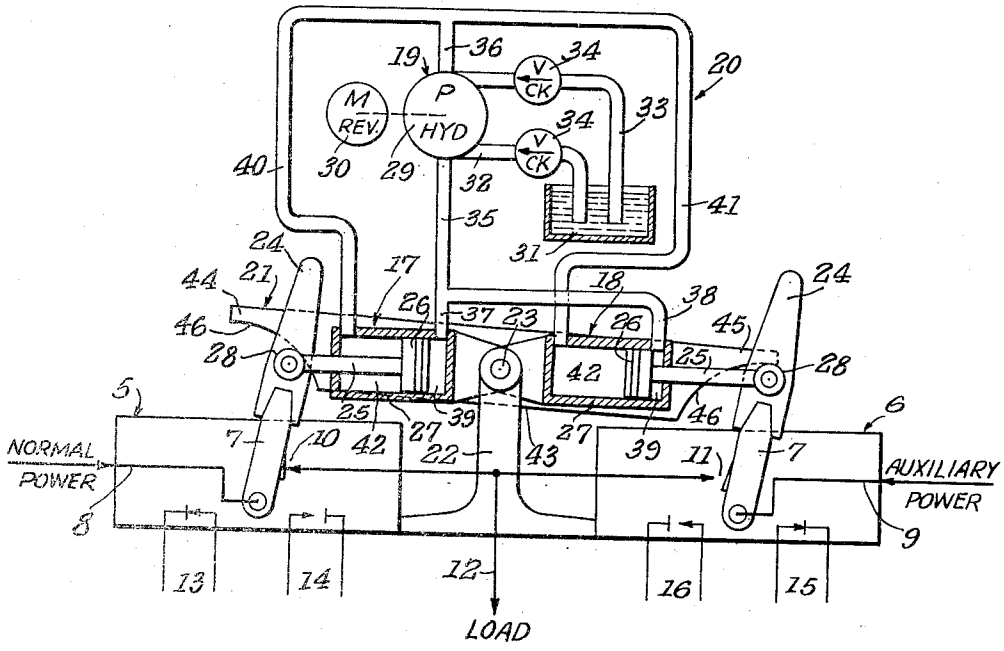
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AUTOMATIC TRANSFER SWITCH

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AUTOMATIC TRANSFER SWITCH

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This invention relates to a transfer switch means and has for an object to provide simple and positive means for automatically cutting in auxiliary or emergency power to maintain a load circuit in the event of failure of the normal power supply for said circuit.

Another object of the invention is to provide an hydraulically-operated transfer switch that by controlling two circuit breakers—one in a normal power operating circuit and the other in an emergency power operating circuit—effects a change to the emergency power operating circuit upon failure of the normal power and a return back to normal power upon restoration thereof.

A further object of the invention is to provide reversing means responsive to a relay in the device being controlled, for instituting automatic transfer between normal and emergency power serving said means.

A still further object of the invention is to provide a transfer switch of the character referred to that cannot effect connecting of both normal and emergency power sources simultaneously.

A yet further object of the invention is to provide means insuring moving one of the power switches from "on" to "off" position before a switch that is "off" is moved to "on" position.

The invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawing merely shows and the following description merely describes, one embodiment of the present invention, which is given by way of illustration or example only.

In the drawing, like reference characters designate similar parts in the several views.

The figure is a semi-diagrammatic view of an automatic transfer switch according to the present invention.

The present mechanism is based on two circuit breakers or comparable switch devices 5 and 6, each being provided with a switch arm 7. The arm of breaker 5 is connected to a normal power line 8 and the arm of the breaker 6 to an auxiliary or emergency power line 9. The former arm controls a switch 10 and the latter a switch 11. Line 8, through switch 10, when closed, provides normal power to a load line 12, and line 9, through switch 11, when closed, provides emergency power to said load line. It will be clear that the power or current to a load is maintained by that circuit breaker 5 or 6 that has its switch arm 7 in switch-closing position. In addition, and in a conventional manner, circuit breaker 5 is provided with auxiliary switches 14 and 13, the former normally open and the latter closed when switch 10 is closed. Similarly, circuit breaker 6 is provided with a normally open switch 15 and a normally closed switch 16.

The above-described circuit breakers are controlled by the present automatic means, the same comprising, generally, an hydraulic actuator 17 for circuit breaker 5 and a similar actuator 18 for circuit breaker 6; pump means 19 to operate the actuators 17 and 18; a controlling hydraulic circuit 20 interconnecting said pump means 19 and said actuators 17 and 18; and interlocking means 21 preventing operation to switch-closed position of one arm 7 before the other arm has moved from its closed position to an open position.

As shown in the drawing, the actuators 17 and 18 are mounted on a standard or pedestal 22 that is preferably located between the circuit breakers 5 and 6 and which is provided with a bearing 23 on which is pivotally mounted said actuators 17 and 18, the same being individually pivotal so that one may be actuated independently of the other.

Each actuator 17 and 18 comprises an extension 24 on the switch arm 7 of each respective circuit breaker, a piston rod 25 pivotally connected to said extension and provided with a piston 26, and a cylinder 27 in which each respective piston is slidingly fitted and which, as above indicated, is pivotally carried by the pedestal 22. It will be clear that the arcuate movement of arms 7 between switch-closed and switch-open positions causes arcuate oscillation of the actuators around the bearings 23. The rods 25, at their pivotal connections to the arm extensions 24, are each provided with a boss or like lateral projection 28.

The pump means 19 is shown as an hydraulic pump 29 that is operated by a reversing motor 30, the same thereby pumping in either direction depending on the direction of drive rotation of said motor. The mentioned auxiliary switches 14 and 15 are connected in the circuit of the reversing motor 30 in the usual way, switch 14, when closed, causing rotation of said motor and the pump 19 in one direction—counter-clockwise in this case—and switch 15, when closed, causing reverse rotation of said motor and pump.

The hydraulic circuit 20 is shown as a reservoir 31 for fluid, flow connections 32 and 33 constituting inlets to the pump from said reservoir, each said inlet being provided with a check valve 34 to prevent back flow to the reservoir. Said pump has outlets 35 and 36, the former, by branch connections 37 and 38, supplying pressure fluid to the chambers 39 in cylinders 27; and the latter, by branch connections 40 and 41, supplying pressure fluid to the chambers 42 at the opposite ends of the cylinders 27.

It will be noted that the circuit 20 is a closed circuit in that chambers 39 and 42, as the case may be, are evacuated as the other is being supplied with fluid. Thus, connection 35 or 36 becomes an inlet only when the pump rotation is such as to provide the same with pressure. The reservoir supplies such additional fluid as may be needed to keep the circuit full of liquid.

The present pump 29 is designed to bleed itself after an operation so as to equalize the pressures in all of the chambers 39 and 42. The pressures in the mentioned chambers are affected by the fact that chamber 39 of actuator 18 has the total pressure effective on piston 26 reduced because of the piston rod 25 with relation to the pressure in chamber 39 of actuator 17 wherein there is no piston rod. Thus, pressure in outlet 35 will act first to move the arm of circuit breaker 5 and the switch 10 to open position, and then move the arm of circuit breaker 6 and the switch 11 to closed position. The reverse of the above holds true when the outlet 36 is provided with pressure. Switch 11 will open before switch 10 will close.

The interlocking means 21 is shown as a bar 43 that is mounted on the mentioned bearing or pivot 23. The

same is in the form of a walking beam having opposite ends 44 and 45 directed toward the respective switch arms of the two circuit breakers. Each end 44 and 45 is provided with a cam face 46 that has engagement with the mentioned bosses 28 of said respective arms. The engagement is of such nature that the boss of one arm must move in a direction away from its related cam face before the beam is enabled to tilt or teeter in a direction to allow the boss of the other arm freedom to move in the same direction that the first arm moved.

The auxiliary switches 13 and 16 may control signals, such as tell-tale lights, to indicate which power source 8 or 9 is connected to the load.

The apparatus is shown in its normal power position with circuit breaker 5 holding switch 10 closed to provide a normal supply of power to the load 12. Since the directions of rotation of the motor 29 may be controlled by relays that are retained in actuated position by the incoming power source, the same causes that power source to be connected to the load. Also, since switches 14 and 15 are limit switches in the reversing wiring of the motor, when the latter is operating in a clockwise direction, the wiring is connected so that switch 15 opens at the limit of travel of the circuit breaker 6, thereby limiting rotation of the motor, accordingly. When the motor is operating in a counter-clockwise direction, the motor wiring is reversed so that switch 14 opens at the limit of travel of circuit breaker 5 and limiting rotation of the motor accordingly.

It will be seen that, when the normal power fails or is in some way interrupted, the pump 29 will operate in a clockwise direction to supply pressure fluid to chambers 39, largely drawing the fluid from chambers 42. The piston 26 of actuator 17 will move toward the left since there is no obstruction to boss 28 of arm 7 of said actuator. Piston 26 of actuator 18 will also seek to move toward the left but will be unable to do so because the boss 28 of the arm 7 of the latter actuator is engaged with the cam face 46. Only after the left arm 7 has moved to allow adjusting teeter of the beam 43, can the right arm move in the same direction under pressure against the piston in the right actuator 18.

Thus, the arms 7 do not move in unison, but rather alternately, the arm opening switch 10 controlling movement of the arm closing switch 11 by means of the mentioned interlock. Since, at the limit of movement of the right arm 7, the switch 15 opens, the motor 39 stops operating. Now the load is being supplied by auxiliary or emergency power through closed switch 11. Thereafter, the pump bleeds itself so that the arms of the circuit breakers may be manually moved. While both arms may be moved to switch-open positions opening both switches 10 and 11, they cannot both be moved to switch-closed positions because of the mechanical interlock 21.

It will be noted that the circuit breakers require a greater total force or pressure to throw "on" than "off." Reference to the differential pressures above described is made in this connection. The areas of the pistons are so designed as to provide an hydraulic force that is greater against the piston controlling the breaker being moved to "off" position than against the piston controlling the breaker being moved to "on" position. Thus, as explained, the breaker which is "on" will always be moved to "off" first. Since at the end of the travel of the latter piston, the pressure in the system 20 will increase to increase the force on the piston that had not yet been moved, the initially-open switch 10 or 11, as the case may be, will close. Thus, a sequential operation is provided to insure a full open circuit before power is provided on the load.

While the foregoing has illustrated and described what I now contemplate to be the best mode of carrying out my invention, the construction is, of course, subject to modification without departing from the spirit and scope

of my invention. Therefore, I do not desire to restrict the invention to the particular form of construction illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. Transfer switching means comprising two circuit breakers connected to a common load and each breaker connecting said load to a separate current source, a piston-cylinder unit connected to each circuit breaker to open and close the same, a reversible hydraulic pump, and pressure-fluid connections between said pump and the opposite ends of the cylinders of said units to actuate the latter to open one circuit breaker while closing the other.

2. Transfer switching means comprising two circuit breakers connected to a common load and each breaker connecting said load to a separate current source, a piston-cylinder unit connected to each circuit breaker to open and close the same, a reversible hydraulic pump, pressure-fluid connections between said pump and the opposite ends of the cylinders of said units to actuate the latter to open one circuit breaker while closing the other, and means provided in said connections to produce a greater hydraulic force in the piston-cylinder unit that is connected to actuate the circuit breaker that is closed.

3. Transfer switching means comprising two circuit breakers connected to a common load and each breaker connecting said load to a separate current source, a piston-cylinder unit connected to each circuit breaker to open and close the same, a reversible hydraulic pump, pressure-fluid connections between said pump and the opposite ends of the cylinders of said units to actuate the latter to open one circuit breaker while closing the other, and means to control the actuation of the piston-cylinder units to first open the closed circuit breaker and then close the open one.

4. Transfer switching means comprising two circuit breakers connected to a common load and each breaker connecting said load to a separate current source, a piston-cylinder unit connected to each circuit breaker to open and close the same, a reversible hydraulic pump, pressure-fluid connections between said pump and the opposite ends of the cylinders of said units to actuate the latter to open one circuit breaker while closing the other, means to control the actuation of the piston-cylinder units to first open the closed circuit breaker and then close the open one, and means provided in said connections to produce a greater hydraulic force in the piston-cylinder unit that is connected to actuate the circuit breaker that is closed.

5. In transfer switching means having two circuit breakers connected to a common load and each breaker connecting said load to a separate current source, the improvement that comprises a piston-cylinder unit connected to each circuit breaker to open and close the same, a reversible hydraulic pump, and means interconnecting said pump and the opposite ends of the cylinder of each said unit to extend and contract each unit according to the direction of rotation of the pump and flow of pressure fluid from the pump, whereby the circuit breakers are opened and closed and one is opened during closing of the other.

6. In transfer switching means according to claim 5, means being provided to produce a greater total operating pressure in the unit that controls the circuit breaker that is being opened than in the circuit breaker that is being closed.

7. In a transfer switching means according to claim 5, interlocking means to control the retraction of one piston-cylinder unit in response to extension of the other and thereby cause sequential actuation of the circuit breakers.

8. In a transfer switching means according to claim 7, means being provided to produce a greater total operating pressure in the unit that controls the circuit

breaker that is being opened than in the circuit breaker that is being closed.

9. In a transfer switching means according to claim 5, interlocking means to control the retraction of one piston-cylinder unit in response to extension of the other and thereby cause sequential actuation of the circuit breakers, the retracting unit being connected to the circuit breaker that is being closed and thereby closing after actuation of the circuit breaker that is being opened.

10. Transfer switching means comprising first and second circuit breakers connected to a common load and each breaker connecting said load to a separate current source, a first piston cylinder unit connected to the first circuit breaker to open and close the same, a second piston cylinder unit connected to the second circuit breaker to close and open the same, each piston cylinder unit including a piston having greater effective area on the side against which pressure is effective for opening the circuit breaker than on the opposite side, a reversible hydraulic pump, pressure-fluid connections between said pump and the opposite ends of the cylinders of said units to actuate the latter to open one circuit breaker while closing the other whereby greater hydraulic force acts to open either circuit breaker than to close the other and simultaneous connection of the load to both current sources is avoided.

11. Transfer switching means comprising, first and second circuit breakers connected to a common load and each breaker connecting said load to a separate current source, first and second piston cylinder units connected to the first and second circuit breakers respectively to open and close the same, a reversible hydraulic pump having first and second output connections at which fluid is delivered according to the direction of rotation of the pump, branch lines from the first outlet connected to the breaker closing end of the first piston cylinder unit and to the breaker opening end of the second piston cylinder unit, the second outlet connection having branch

lines to the circuit opening end of the first piston cylinder unit and the breaker closing end of the second piston cylinder unit, each piston cylinder unit including a piston having greater effective area on the breaker opening side than on the breaker closing side, whereby the fluid pressure causes the breaker opening piston cylinder unit to act first for disconnecting one source of power from the load before connecting the other.

12. Transfer switching means comprising two circuit breakers connected to a common load and each circuit breaker connecting said load to a separate current source, a piston cylinder unit connected to each circuit breaker to open and close the same, the units being pivoted to a common pivot and extending in opposite directions from the common pivot, an interlock walking beam pivotally connected to said common pivot having opposite ends with cam faces thereon, each breaker having an operating arm carrying a boss for cooperation with one of said cam faces, the cam faces being so spaced that when one breaker is in the closed position, its boss moves against the cooperating cam face to tilt the interlocking walking beam to a position in which the opposite cam face prevents movement of the other breaker boss to the breaker closed position, a reversible hydraulic pump, pressure fluid connections between said pump and the opposite ends of the cylinders of said units to actuate the latter to open one said circuit breaker while closing the other, whereby the closing of either breaker is delayed until opening of the other has been effected.

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