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CIRCUIT BREAKER

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Fig. 1.

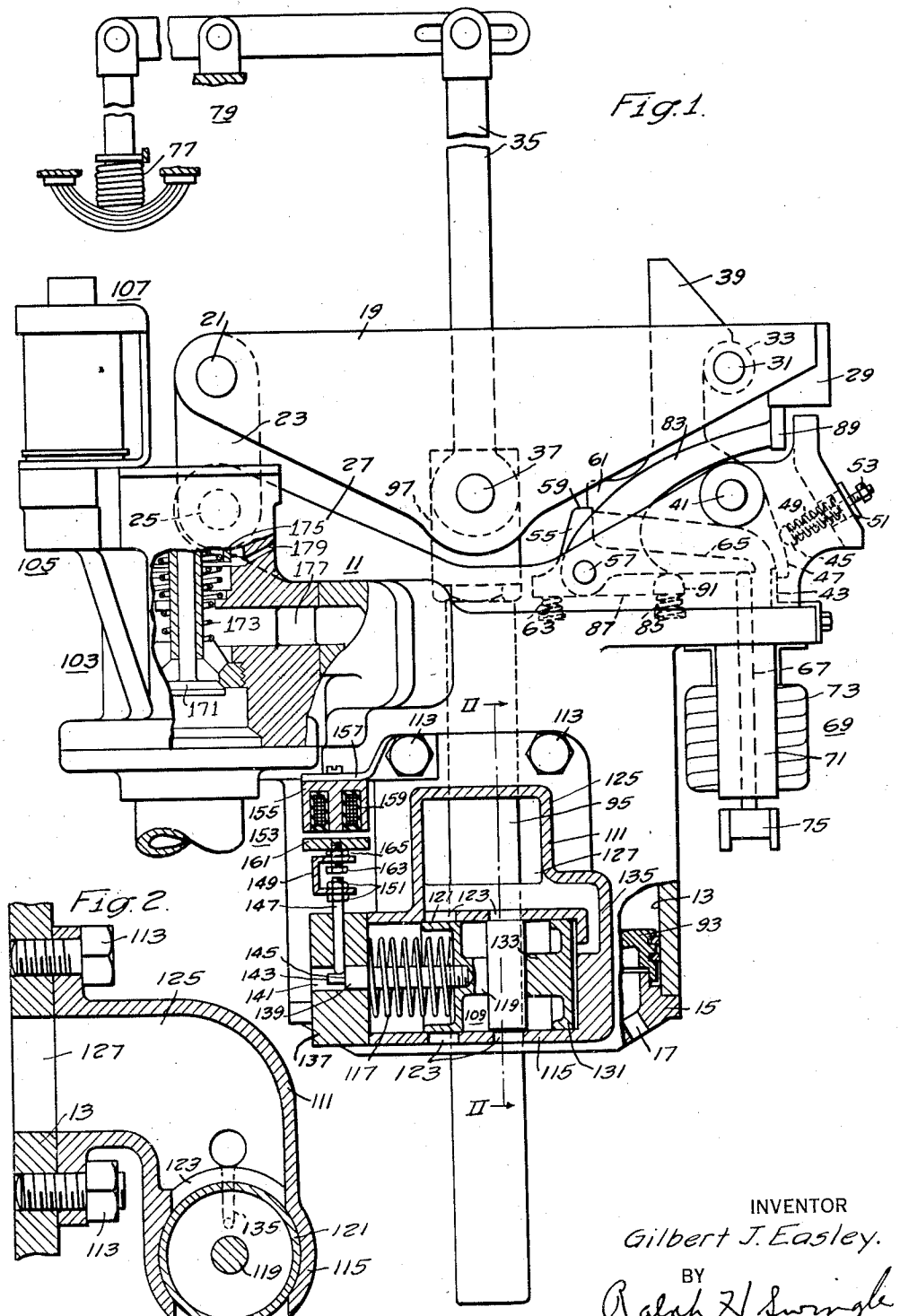

Fig. 2.

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CIRCUIT BREAKER

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11 Claims. (Cl. 200—82)

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This invention relates to circuit breakers, and more particularly to circuit breaker operating mechanisms of the fluid pressure operated type.

When a circuit breaker of the fluid motor operated type is closed in against a fault existing on the circuit controlled by the breaker, it is desired to quickly reverse the direction of movement of the mechanism and to quickly operate the breaker to open position. The compressed gas admitted to the fluid motor for closing the breaker is, at this time, at full closing pressure thereby preventing opening movement of the mechanism. This pressure may be dumped by opening a dump valve or exhaust valve which permits collapse of the fluid pressure on the working side of the motor directly to atmosphere. Such dump valves usually fall into two main classes, (1) those that are operated entirely by electromagnetic means, and (2) those that are operated by fluid pressure. The electromagnetically operated dump valves require an electromagnet of such size as to preclude high speed opening of the valve. Fluid pressure operated dump valves require a second valve for admitting fluid pressure to open the dump valve. Control valves for controlling the opening of pneumatically operated dump valves are energized near the end of the closing stroke of the breaker when the contacts touch and a certain amount of time is required to build up sufficient fluid pressure back of the dump valve to operate it.

It is therefore an object of the invention to provide a circuit breaker operating mechanism of the fluid motor operated type with an improved exhaust valve which is releasably restrained in closed position and when released is instantaneously moved to open position by fluid pressure previously provided.

Another object of the invention is to provide a circuit breaker operating mechanism of the fluid pressure operated type with an improved exhaust valve for quickly exhausting the working fluid pressure from the operating mechanism.

Another object of the invention is to provide a circuit breaker operating mechanism of the fluid pressure operated type with an improved high speed exhaust valve which is normally latched in closed position and which, when released, is operated at high speed to open position by the working fluid pressure of the operating mechanism.

Another object of the invention is to provide a circuit breaker operating mechanism of the fluid motor type with an improved exhaust valve which is releasably restrained in closed position by an electromagnetically operated latch, and which, when released, is operated to open position at high speed to quickly exhaust the working pressure from the fluid motor.

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The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof will be best understood from the following detailed description of one embodiment thereof when read in connection with the accompanying drawing in which:

Fig. 1 comprises an elevational view partly in section of a circuit breaker operating mechanism embodying the principles of the invention; and

Fig. 2 is a vertical sectional view taken on line II—II of Fig. 1.

Referring to the drawing, the operating mechanism includes a main casting 11 which is formed to provide a cylinder 13 closed at the upper end by an integral part of the casting. The lower end of the cylinder 13 is closed by means of a member 15 secured thereto and having a relatively large port 17 therein which is open to the atmosphere. An operating lever 19 is pivotally mounted at one end on the casting 11 and consists of a pair of spaced parallel levers pivotally connected at one end by means of a pivot pin 21 to the upper ends of a pair of parallel links 23 (only one being shown). The lower ends of the links 23 are pivoted by means of a pivot pin 25 on ears 27 (only one being shown) projecting from the main casting 11. The free ends of the operating levers 19 are rigidly connected by means of a cross member 29 and carry a short shaft 31 therebetween, on which is mounted a latch roller 33 disposed between the levers 19.

The circuit breaker shown schematically at 79 is biased to open circuit position by means of an accelerating spring 77 and is connected to the operating mechanism by means of an operating rod 35. The breaker operating rod 35 is pivotally connected by a pivot pin 37 to the operating lever 19.

In order to hold the breaker closed, the operating lever 19 is held in the closed position by means of a high speed latching mechanism including a main latch 39 pivotally supported on the main casting 11 by means of a pivot pin 41. The latch 39 is disposed between the levers 19 and is adapted to engage the roller 33 carried by the free ends of the breaker operating levers 19 to restrain the operating mechanism and the breaker in closed circuit position. The latch 39 is biased to latching position against a stop 43 by means of a spring pressed plunger 45 which engages a projection 47 of the latch. The plunger 45 is slidably mounted in an opening in a portion of the main casting 11 and is biased inwardly against the projection 47 of the latch 39 by means of a compression spring 49 surrounding the plunger 45 and disposed between a sleeve 51 threaded into the casting 11,

and the head of the plunger. An adjustable nut 53 is provided on the outer end of the plunger 45 to limit the inward movement of the plunger.

The construction of the latch face of the main latch 39 is such that this latch, by itself, will not serve to hold the breaker operating lever 19 in latching position. An auxiliary latch 55 is provided for engaging and holding the main latch 39 in latching position. The auxiliary latch 55 is pivotally mounted on the casting 11 by means of a pivot pin 57 and has a latch projection 59 which engages under a tail portion 61 of the main latch 39 in the latching position of the latching mechanism. The auxiliary latch 55 is biased to latching position by means of a compression spring 63 seated in a recess in the casting and engaging a projection of the latch 55. The auxiliary latch 55 is also provided with a projection 65 which extends directly over the upper end of a trip plunger 67 of an electromagnetic trip device 69. In addition to the trip plunger 67, the trip device comprises an E-shaped core 71 of magnetic material, an energizing coil 73 mounted on the center leg of the core 71, and a movable armature 75. The trip plunger 67 is secured to the center portion of the armature 75 and extends upwardly through a guide opening in the center portion of the core 71 and through an opening in the horizontal portion of the main casting 11.

When the trip device 69 is energized, the armature 75 is moved upwardly against the core 71 causing upward movement of the trip plunger 67. The upward movement of the trip plunger rotates the auxiliary latch 55 counterclockwise and disengages the projection 61 of the main latch 39, whereupon the accelerating spring 77 of the circuit breaker, shown schematically at 79, moves the breaker to the open circuit position, the operating lever 19 being rotated counterclockwise about its pivot 21 by the opening movement of the breaker. During the early part of the opening movement of the operating lever 19, the roller 33 forces the main latch 39 in a counterclockwise direction as it clears the latch. As soon as the roller 33 clears the main latch 19, the spring 49 acts to return the latch 39 to latching position.

Means is provided to prevent the restoration of the auxiliary latch 55 to its latching position until the operating lever 19 is returned to closed position. This means comprises a U-shaped holding lever 83, the legs of which are pivotally mounted on the pivot pin 57 on opposite sides of the auxiliary latch 55. The holding lever 83 is biased in a counterclockwise direction by a spring 85 compressed between a spring seat in the casting 11 and a projection 87 of the holding lever. The cross member 89 of the holding lever 83 is disposed directly beneath the free end of the operating lever 19 and thus is held in inoperative position when the operating lever is in closed position. When the operating lever is released and moves toward open position, the holding lever 83 is rotated counterclockwise at which time a lateral extension 91 of the holding lever 83 engages and holds the auxiliary latch 55 in unlatched position until the breaker operating arm 19 is returned to closed position and the roller 33 is reengaged by the latch face of the main latch 39. For this purpose, the biasing spring 85 of the holding lever 83 is of greater strength than the auxiliary latch biasing spring 63.

The breaker is adapted to be closed by compressed gas admitted to the cylinder 13 above an operating piston 93. The piston 93 is secured to a piston rod 95 slidable through an air-tight opening in the top wall of the cylinder 11. A connector 97 is threadedly connected to the piston rod 95 and pivotally connected to the pivot pin 37 carried by the operating lever 19, thus directly connecting the piston 93 to the breaker operating rod 35.

Compressed air is admitted from an auxiliary air reservoir or tank (not shown) to the upper end of the cylinder 13 through an inlet passage controlled by a main inlet valve indicated generally at 103 secured to the side of the casting 11. The opening operation of the main inlet valve 103 is, in turn, controlled by an electromagnetically operated pilot valve 105. The inlet valve 103 comprises a valve element 171 biased to closed position by means of a spring 173 and operable to open position by a piston 175 which is operated by compressed gas admitted thereto by operation of the pilot valve 105.

The pilot valve 105 is operated by an electromagnet 107 which, when energized, causes opening of the pilot valve 105 to admit compressed air from the tank (not shown) to the piston 175 to operate the main inlet valve 171. Actuation of the inlet valve admits compressed air through an inlet port 177 to the upper end of the operating cylinder 13 which drives the piston quickly downwardly to close the breaker.

When the mechanism is operated to closed position, the operating lever 19 rotates in a clockwise direction, and near the end of this clockwise travel, the roller 33 engages the inclined surface of the main latch 39. As the roller passes along this inclined surface, the latch 39 is rotated counterclockwise until the roller passes the nose of the latch whereupon the retrieving spring 49 restores the main latch 39 to latching position. As the roller 33 passes the nose of the main latch 39, the cross member 29 on the free end of the operating lever 19 engages the free end of the holding lever 83 and rotates the holding lever clockwise to its normal position permitting the spring 63 to restore the auxiliary latch 55 clockwise to latching position.

An exhaust port 179 is provided for venting the cylinder 13 to atmosphere through the inlet passage when the breaker is tripped open from a fully closed position and there is no closing air in the cylinder. This port, however, is inadequate to dump the charge of closing air to permit quick reversal of the piston and opening of the breaker when the breaker is closed in against a fault.

When the circuit breaker is closed in against a fault and it is desired to quickly reverse the movement of the mechanism so that the circuit breaker may be quickly opened, it is necessary to quickly vent the closing fluid pressure from the working side of the piston 93. This is accomplished by opening an exhaust valve 109.

The exhaust valve 109 is mounted for sliding movement in a housing 111 which is secured to the side of the operating cylinder 13 by means of bolts 113. The valve 109 is disposed in the cylindrical lower portion 115 of the housing 111 and is biased to closed position by means of a spring 117. The exhaust valve is of the piston-type and comprises a valve member 119 integral with two piston valves 121 which cooperate with exhaust ports 123 formed in the upper and lower walls of the cylinder 115. The exhaust ports 123 in the upper wall of the cylin-

der 115 communicate with a chamber 125 in the upper portion of the housing 111, and the chamber 125 communicates with the operating cylinder 13 by means of an exhaust port 127 in the wall of the cylinder. The ports 123 in the lower wall of the exhaust valve cylinder communicate directly to the atmosphere.

Disposed in the cylinder 115 to the right of the exhaust valve 109, but separable therefrom, is a pilot piston 131 having an integral stem stem 133 against which the exhaust valve 109 is biased by the spring 117. A passage 135 in the housing 111 connects the chamber 125 to the working end of the cylinder 115. The left-hand end of the cylinder 115 is closed by member 137 suitably secured thereto. The spring 117 is compressed between the member 137 and the left-hand end of the exhaust valve. A rod 139 having one end threaded and screwed into the left-hand end of the valve member 119 is slidably supported in an opening 141 in the member 137. The end of the rod 139 has a reduced portion 143 forming a shoulder 145 which is engaged by a latch rod 147 disposed for vertical sliding movement in an opening in the member 137. A U-shaped member 149 is adjustably secured to the upper end of the trip rod 147 by means of a pair of nuts 151 threaded onto the trip rod one above and one below the lower leg of the U-shaped member and tightened thereagainst. An electromagnet, indicated generally at 153, is provided for operating the latch 147 to release the dump valve. The electromagnet comprises an E-shaped core member 155 mounted on a bracket 157 secured to the housing 11 by means of one of the bolts 113, an energizing winding 159 surrounding the center leg of the core member and a movable armature 161. The armature 161 is mounted on the upper leg of the U-shaped member 149 by means of a headed bolt 163 and a nut 165 disposed between the armature and the U-shaped member. The head of the bolt 163 is spaced below the upper leg of the U-shaped member to provide a lost motion connection between the armature 161 and the latch rod 147. The purpose of the lost motion connection is to provide for high-speed operation of the latch rod 147.

During a closing movement of the operating piston 93 and before the contacts touch, the piston passes below the exhaust port whereupon compressed gas at full closing pressure is applied through the chamber 125 and passage 135 to the working side of the pilot piston 131. Neither the piston 131 nor the dump valve 109 can operate at this time since they are restrained by engagement of the latch rod 147 with the shoulder 145 on the rod 139. As the operating piston 93 continues its closing stroke, and just before the breaker arrives full closed position, the contacts touch. If, at this time, there is a fault on the line the trip device 69 is energized and operates the latch mechanism to permit opening movement of the breaker mechanism. At the same time the electromagnet 153 is energized and attracts the armature 161 upwardly to disengage the latch 147 from the shoulder 145, whereupon the previously built up pressure back of the pilot piston 131 drives the pilot piston and the exhaust valve 109 at high speed toward open position. As soon as the exhaust valves crack open the compressed gas rushing through the exhaust ports 123 and past the faces of the valves 121 assist in moving the dump valve to full open position momentarily separating the valve 109 from the end of the stem 133 of the pilot valve. When the gas pressure is decreased a certain amount, the spring 117 becomes effective to move the exhaust valve toward closed position, but since the compressed gas trapped back of the pilot piston 131 is vented relatively slowly, the piston 131 is held in a position to maintain the exhaust valve open until the trapped gas is vented to a point where the spring 117 moves the exhaust valve 109 and the pilot piston 131 to the position shown in the drawing. As soon as the exhaust valve reaches its closed position the latch rod 147 is moved downwardly by the force of gravity or by spring means (not shown) and reengages the latching shoulder 145 on the rod 139, the reduced portion 143 of the rod 139 acting as a limit stop for the downward movement of the trip rod.

From the foregoing description it will be apparent that there is provided a high speed exhaust valve mechanism for the fluid pressure operated mechanism wherein the exhaust valve is latched and full operating fluid pressure is applied to operate said valve before the valve is released thereby providing for substantially instantaneous opening of the valve upon release thereof.

Having described the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the structural details thereof without departing from some of the essential features of the invention, and that come within the scope of the appended claims.

I claim as my invention:

1. In a circuit breaker comprising relatively movable contacts, operating mechanism therefor comprising a fluid operated motor, means for admitting fluid under pressure to said motor to operate said contacts to closed position, trip means operable in response to abnormal circuit conditions to effect opening movement of said contacts, a valve operable to cause quick collapse of the fluid pressure on the working side of said motor, pneumatically operated means for moving said valve to open position, means releasably restraining said valve in closed postion, electroresponsive means operable when energized to operate said restraining means to release said valve, and means for applying fluid pressure to said pneumatic means before said electroresponsive means is energized.

2. In a circuit breaker comprising relatively movable contacts, operating mechanism therefor comprising a fluid motor operable to close said contacts, means for admitting fluid under pressure to operate said motor, trip means operable in response to abnormal circuit conditions to effect opening of said contacts, valve means operable to cause quick collapse of the fluid pressure on the working side of said motor, pneumatically operable means for operating said valve means to open position, latch means normally restraining said valve and said pneumatic means against operation, electroresponsive means operable when energized to operate said latch and release said valve, and means comprising a passage for admitting fluid pressure to said pneumatic means befose said valve is released, said pneumatic means maintaining said valve open until the fluid pressure in said motor has collapsed below a predetermined value.

3. An operating mechanism for a circuit breaker comprising a cylinder and a piston movable therein to close said breaker, means for ad-

mitting fluid pressure to said cylinder to operate said piston to close said breaker, means comprising a valve operable to an open position for causing quick collapse of pressure in the cylinder and thereby permit high speed reversal of movement of said piston, latch means releasably restraining said valve in closed position, pneumatically operated means for actuating said valve to open position, and means for operating said latch means to release said valve and permit said pneumatically operated means to actuate said valve to open position, fluid pressure being applied to pneumatically operated means before said valve is released.

4. An operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid under pressure to said motor for operating said breaker to closed position, means comprising a valve operable to an open position during a closing operation of said motor for causing quick collapse of the fluid pressure on the working side of said motor, actuating means operable by fluid pressure to actuate said valve to open position, latch means normally restraining said valve in closed position, electroresponsive means operable when energized to actuate said latch and release said valve, and means for applying fluid pressure to said actuating means before said valve is released.

5. In an operating mechanism for a circuit breaker, means comprising a fluid motor operable to close the breaker, an inlet valve operable to admit fluid pressure to said motor to effect closing of said breaker, means operable to cause opening of the breaker, a valve for collapsing the fluid pressure in said motor, fluid pressure operated actuating means for actuating said valve, and latch means for restraining said valve in closed position until after fluid pressure has been applied to said actuating means.

6. In an operating mechanism for a circuit breaker, means comprising a fluid motor operable to close the breaker, an inlet valve operable to admit fluid pressure to said motor to effect closing of said breaker, means operable to cause opening of the breaker, a valve for collapsing the fluid pressure in said motor, fluid pressure operated actuating means for actuating said valve, and latch means for releasably restraining said valve in closed position, and means operable after fluid pressure has been applied to said actuating means for operating said latch means to permit said actuating means to open said valve.

7. In an operating mechanism for a circuit breaker, means comprising a fluid motor operable to close the breaker, an inlet valve operable to admit fluid pressure to said motor to effect closing of said breaker, means operable to cause opening of the breaker, a valve for collapsing the fluid pressure in said motor, fluid pressure operated actuating means for actuating said valve to open position, latch means for restraining said valve in closed position, and means operable after fluid pressure has been applied to said actuating means for operating said latch to release said valve, said actuating means being maintained by trapped fluid pressure in a position to hold the valve open until after the fluid pressure in said motor has collapsed below a predetermined value.

8. In an operating mechanism for a circuit breaker, a fluid motor operable to close said breaker, means operable to admit fluid pressure

to said motor to effect closing of said breaker, means operable to cause opening of said breaker, a valve movable to an open position to cause quick collapse of fluid pressure in said motor, means engaging a part movable with said valve for releasably restraining said valve in closed position, pneumatic means for actuating said valve to open position, means effective during a closing stroke of said motor to admit fluid pressure to said pneumatic means, and electroresponsive means operable after fluid pressure is admitted to said pneumatic means to actuate said restraining means and release said valve.

9. In an operating mechanism for a circuit breaker comprising a fluid motor operable to close the breaker, an inlet valve operable to admit fluid pressure to said motor to effect closing of the breaker, means operable to cause opening of the breaker, an exhaust valve operable independently of said inlet valve to quickly collapse the fluid pressure in said motor to permit high speed reverse movement of said motor, fluid pressure actuating means for initiating opening movement of said exhaust valve, and latch means for releasably restraining said exhaust valve in closed position and operable after fluid pressure has been applied to said actuating means to release said exhaust valve.

10. In an operating mechanism for a circuit breaker comprising a fluid motor operable to close the breaker, an inlet valve operable to admit fluid pressure to said motor to effect closing of the breaker, means operable to cause opening of the breaker, an exhaust valve operable mechanically independently of said inlet valve to quickly collapse the fluid pressure in said motor to permit high speed reverse movement of said motor, fluid pressure actuating means for initiating opening movement of said exhaust valve, and latch means for releasably restraining said exhaust valve in closed position, said latch means being operable after fluid pressure has been applied to said actuating means to release said exhaust valve.

11. In an operating mechanism for a circuit breaker comprising a fluid motor operable to close the breaker, an inlet valve operable to admit fluid pressure to said motor to effect closing of the breaker, means operable to cause opening of the breaker, an exhaust valve operable independently of said inlet valve to quickly collapse the fluid pressure in said motor to permit high speed reverse movement of said motor, fluid pressure actuating means for initiating opening movement of said exhaust valve, said exhaust valve being moved to full open position independently of said actuating means, latch means for releasably restraining said exhaust valve and said actuating means in closed position, and means operable after fluid pressure has been applied to said actuating means to release said exhaust valve.

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