July 11, 1961 H. FEHLING 2,992,308

HIGH SPEED SWITCH WITH IMPACT ARMATURE

Filed July 15, 1960

2 Sheets-Sheet 1

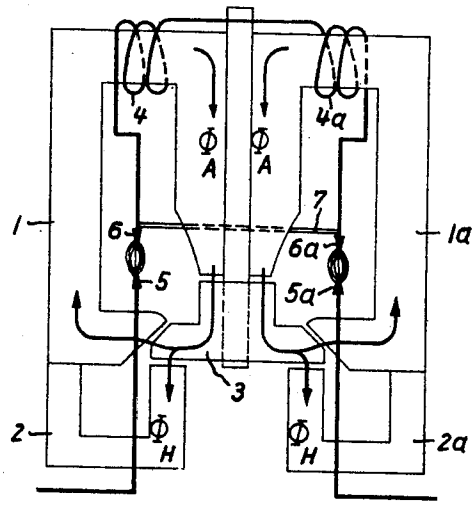


Fig. 1

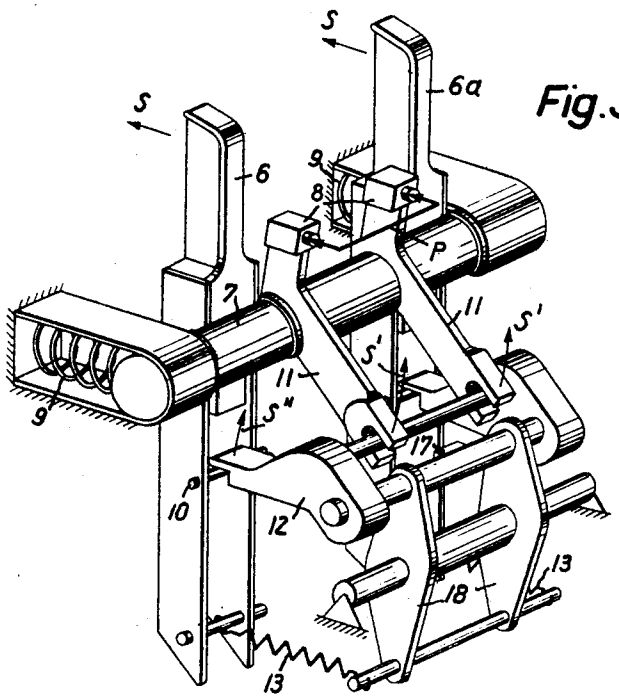


Fig. 3

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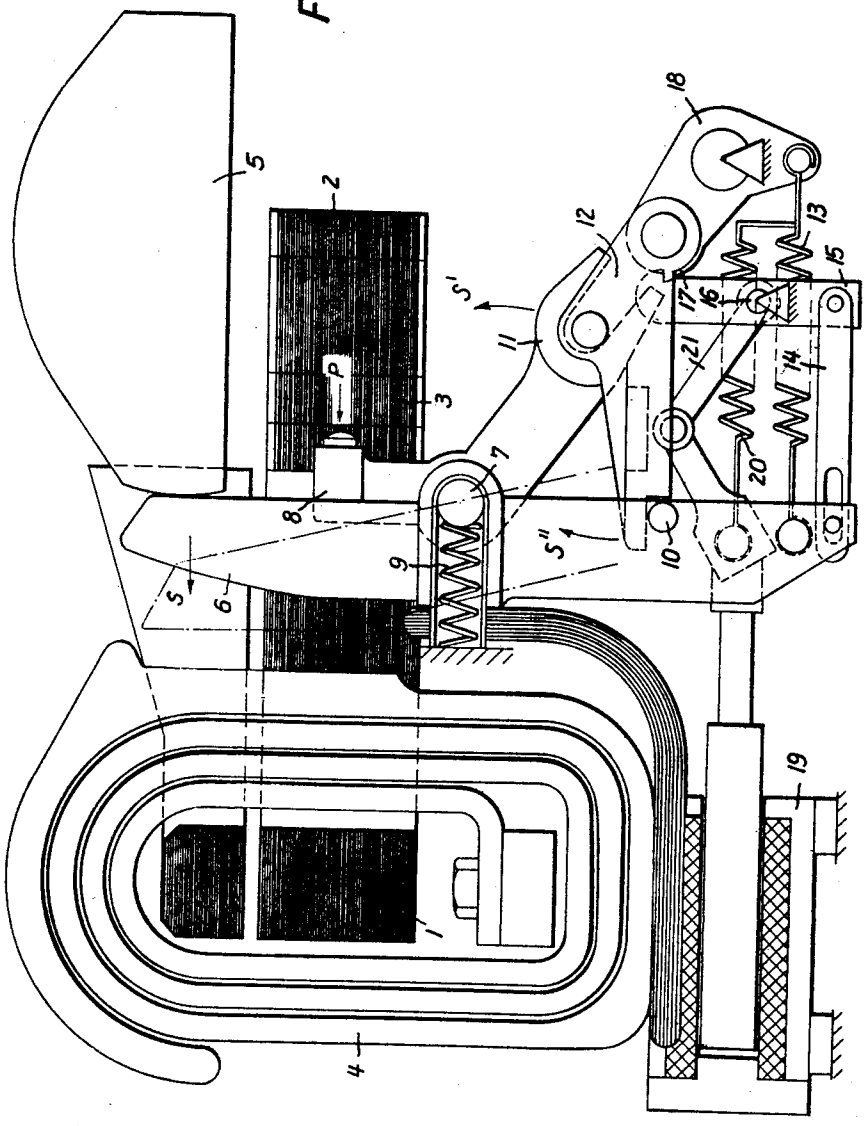
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Fig. 2



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HIGH SPEED SWITCH WITH IMPACT ARMATURE

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5 Claims. (Cl. 200—102)

The present invention relates to high speed circuit breakers of the type having a system for tripping the switch in case of overload or back current; more particularly, the invention relates to the manner of mounting the movable contact arms of such circuit breakers so as to increase the speed of tripping.

Circuit breakers have been previously devised which are electro-magnetic in operation in that energization of a magnetic system actuates an armature which causes movable contact arms to separate from the stationary contacts. This tripping of the contacts invariably produces an electric arc and structure must be provided to extinguish the arc. The disadvantages of providing sufficient structure to extinguish large electric arcs are clearly apparent, namely, they rapidly increase the size of the switching mechanism.

The main problem with regard to circuit breakers at the present time is a sufficiently high speed for the opening of the contacts. The arc drawn during the opening must become large as fast as possible in order to provide a high arc voltage drop so that a sufficient amount of energy can dissipate therein without providing excessive voltages in the inductances pertaining to the circuit to be opened.

The circuit breakers with impact armature according to the prior art usually operate in two steps; first the contacts are pushed open upon the impact of the armature and second the actual locking mechanism is opened. The second step usually follows the first step only after a relatively long delay such as 15 to 20 milliseconds during which delay period the arc drawn remained very small in length, but it passed a very high current, and the arc did not migrate into the arc extinguishing chamber even in case of a high blasting of gas. Such operation, of course, produces fast burning of the contacts and excessive voltages in the electrical circuit governed by the circuit breaker. The present invention is to remedy these deficiencies of the prior art.

One form of high speed switching mechanism which has been employed utilizes a pair of magnetic circuits which are arranged side by side in a single plane. The magnetic flux of both circuits operates simultaneously and uniformly to actuate an armature which engages a release lever to open the contact arms from the stationary contacts. Each magnetic circuit is so constructed with respect to the movable contact arms that each movable contact arm is at least partially surrounded by the iron forming the corresponding break or opening magnet.

The movable contacts are constructed as contact levers and are mounted for independent pivotal movement on a common shaft. The contact arms are insulated from each other. The common shaft is approximately in the center of the two ends of the contact lever. A release lever is also pivotally mounted on the common shaft. The release lever is engageable by the impact armature to effect an opening of the contacts.

The present invention resides in an improvement in the switching mechanism as described above. This improvement comprises in mounting the common shaft bearing the contact arms and release lever in such a way that the shaft is capable of both pivotable and lateral movement. Resilient means are provided to bias the common shaft in the direction from which the impact of the armature originates.

As the result of this invention, when the armature impacts the release lever, the release lever carries the common shaft a short distance laterally which lateral movement of the shaft brings about the initial opening of the contacts. The improvement also comprises structure to enable the contact arms to pivot about the common shaft after the lateral movement of the shaft has terminated. This structure is also actuated by the release lever.

By initially moving the contact arms in a straight line at the moment of impact of the armature the speed of opening of the contacts is increased since the movable contact arms move in a straight line away from the stationary contact.

The resilient means which biases the common shaft also serves to maintain the movable contact arms in engagement with the stationary contacts.

The present invention considerably simplifies the release lever over the release lever employed in the high speed switching mechanism as described above. The switching lever now comprises only two pairs of arms instead of the previously required three pairs of arms. The masses which are to be accelerated to cause the opening of the contacts are considerably lighter and the force exerted by the impact armature operates directly upon the movable contact arms.

It is therefore the principal object of this invention to provide a novel and improved high speed switching mechanism wherein the movable contacts are moved directly away from the stationary contacts during the initial stages of the opening of the contacts.

It is another object of this invention to provide a fast-acting high-speed switching mechanism which requires a considerably simplified structure.

Other objects and advantages of this invention will become apparent upon reference to the accompanying description when taken in conjunction with the following drawings, wherein:

FIG. 1 is a top plan view showing the magnetic circuits of the switching mechanism of this invention;

FIG. 2 is a side elevational view of the switching mechanism of this invention with several parts being omitted to clarify the illustration of the switching mechanism; and

FIG. 3 is a perspective view of the switching mechanism and showing the contact arms, the release levers and the structure necessary for the operation of the contact levers.

Returning now to the drawings a specific embodiment of the present invention will be described. With particular reference to FIG. 1 there is indicated at **1** and **1***a* two break or trip magnets which are positioned side by side in a single plane. The corresponding holding or close magnets are indicated at **2** and **2***a*. There is an impact armature **3** which is formed of two parts which are interconnected at opposite ends by a pair of nylon plates which are not shown. The coils of the trip magnets are indicated at **4** and **4***a*. During normal operation, in the closed position of the circuit breaker, the armature **3** is held by magnets **2** and **2***a* due to the flux indicated by ϕ_H. A normal current in coils **4** and **4***a* produces a flux ϕ_A, which is insufficient to attract armature **3**. In case of overload current, the flux ϕ_A prevails and attracts armature **3**. FIG. 1 illustrates the moment of this last mentioned attraction.

Proceeding next to FIGS. 2 and 3, the stationary contacts are indicated at **5** and **5***a*. The movable contact arms **6** and **6***a* are engageable with the stationary contacts and are pivotally mounted upon a shaft **7** for individual movement on the shaft. The contact arms are insulated from

each other. The shaft 7 is mounted for both pivotal and lateral movement.

There is a spring 9 which biases the shaft 7 against lateral movement within its mounting and also urges the movable contact arms 6 and 6a into engagement with the stationary contacts 5 and 5a.

A release lever 8 is also pivotally mounted on the shaft 7. The release lever 8 comprises a double bell crank lever having a short lever arm and a long lever arm 11 having forked ends. The ratio of the lever arms can be as great as 1:4.

Each of the contact arms 6 and 6a is provided with an auxiliary shaft 10 which together with the latch members 12 as shown in FIG. 3 forms a pivot mounting for the contact arms. The latch members 12 are interconnected by a rod which passes through the forks on the lever arms 11 of the release levers.

There is a spring 13 which is connected to the lower ends of the movable contact arms 6 and exerts a force to open the contacts in a manner to be described later.

Also interconnected by a lost motion connection to the bottom of the contact arms 6 is a bar 14 which is pivotally connected to a latch lever 15 which in turn is pivotally mounted on a stationary shaft 16. The upper end of the lever 15 has a notch therein which engages a projection 17 on the double levers 18. As one can see from FIG. 2 and FIG. 3, double lever 18 is L-shaped in FIG. 2, but straight in FIG. 3. This distinction is unimportant as far as the principle of operation is concerned, but might be important for purposes of a compact design, whether the arrangement is to extend primarily horizontally or vertically.

For actuation of the circuit breaker independent of any overload current in the power line in which coils 4 and 4a are inserted, there is a holding coil 19 which actuates an armature which is connected to the lower portions of the movable contact arms. When the coil 19 is deenergized either selectively by remote control or through a drop in the line voltage, a spring 20 will urge the lower end of the contact arm 6 toward the right as viewed in FIG. 2 and will cause the pivoted link 21 to engage the latch members 12 and to release the auxiliary shaft 10.

With the above description of the switching mechanism in mind the operation of the switching mechanism will next be explained.

Upon energization of the break or tripping magnets 1 the armature 3 will no longer be held by magnet 2 but will be attracted in such a direction as to hit the release lever 8 with a force indicated by P. The impact of the force of the armature is initially resiliently absorbed by the two springs 9. During this initial impact, the common shaft 7 moves laterally against the force exerted by the springs 9 and the contact arms 6 and 6a more in the direction S. The contact arms 6 and 6a will pivot about the auxiliary shaft 10 where it forms a pivot mounting with the latch member 12.

Simultaneously, with the engagement of the armature against the release lever and during the movement of the contact arms in the direction S, the release lever will be pivoted about the common shaft 7 so that the forked ends will move in the direction S' to lift the latch members 12 in the direction indicated by S''. The upward movement of the latch members 12 will cause an unblocking or release of the auxiliary shafts 10 and as a result the movable contact arms 6 and 6a will pivot around the shaft 7 into their final open positions.

It is pointed out that immediately upon the armature engaging the release lever the resiliently biased shaft 7 will be moved laterally and the contacts will be opened a distance of several millimeters. Before the contact arms can be returned into the closing position by the springs 9, the pening of the contacts is continued by the simultaneous unlocking of the auxiliary shafts 10 to bring about a pivoting of the movable contact arms about the shaft 7.

It is therefore apparent that the switching mechanism of this invention eliminates a principal disadvantage of older high speed switching mechanism. This disadvantage as mentioned above is that the movable contact arms are initially brought into a preliminary opening position in which position the arms remain for a short interval of time until a switching lock is actuated so as to move the open contacts into their final open position. It is this brief hesitation of the movable contacts after the initial impact of the armature which prolongs the formation of a small arc between the movable and stationary contacts, which small arc is hard to extinguish and does not dissipate sufficiently fast energy stored in the inductances of the circuit governed by the circuit breaker. This brief hesitation is avoided in the present invention and the arc drawn is made sufficiently large immediately after circuit breaking.

Just before the contact arms 6 and 6a reach their final open position the rods 14 are urged to the right as viewed in FIG. 2. This movement will bring about a release of the notch on the end of the lever 15 from the nose 17 in a manner previously described. This operation of these components 14 to 18 is not strictly necessary for the opening of the switch but is necessary for a subsequent closing of the switch.

When it is desired to close the switching mechanism the latch members 12 are positioned in engagement with auxiliary shafts 10 mounted on the movable contact arms 6 and 6a. The contact arms are then moved into a direction towards the fixed contacts 5 whereby engagement with the fixed contacts 5 closes the switch. During the closing operation of the switch the spring means 9 provides the force necessary for moving the movable contacts 6 into closing position with the stationary contacts. Independently therefrom, the armature 3 is already engaged again by holding magnet 2.

The switching mechanism of this invention can also be remotely controlled so as to open when the voltage drops to a predetermined low value. If the voltage drops below a certain value the pivoted lever 21 will lift the latches 12 in a manner as previously described and the switch will be moved in the open position by the spring 13.

Thus, it can be seen that the present invention comprises an improved high speed circuit breaker mechanism wherein the impact force supplied by a movable armature is applied directly against movable contacts to open these contacts from stationary contacts. Since the masses of the movable members of the circuit breaker mechanism are lighter, the action thereof is increased. Further, the simplified construction of this mechanism insures long trouble-free service.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. A high speed circuit breaker mechanism comprising a pair of magnetic circuits positioned side by side in the same plane, an impact armature actuated simultaneously by said two magnetic circuits, a shaft journalled for both pivotal movement and lateral movement, a pair of contact arms pivotally mounted on said shaft for independent movement thereon, a release lever pivotally mounted on said shaft and engageable by said impact armature, and means for resiliently biasing said shaft against said lateral movement and in the direction toward said release lever so that the impact of said impact armature upon said release lever will laterally move said shaft and the control arms therewith.

2. A high speed circuit breaker mechanism as claimed in claim 1 wherein said resilient means also maintains said contact arms in the closed position.

3. A high speed circuit breaker mechanism comprising a pair of magnetic circuits positioned side by side in

the same plane, an armature actuated simultaneously by said two magnetic circuits, a shaft journalled for both pivotal movement and lateral movement, a pair of contact arms pivotally mounted on said shaft for independent movement thereon, a release lever pivotally mounted on said shaft and engageable by said armature, means for resiliently biasing said shaft against said lateral movement and in the direction toward said release lever so that the impact of said armature upon said release lever will laterally move said shaft and the control arms therewith, auxiliary shaft means on said contact arms to provide a pivot mounting for said contact arms during the initial impact of said armature against said release lever, means forming a pivot support for said auxiliary shaft means, and a means operated by said release lever for disengaging said pivot support means from said auxiliary shaft means when said armature engaged said release lever whereby said contact arms will pivot on said shaft.

4. A high speed circuit breaker mechanism comprising a pair of magnetic circuits positioned side by side in the same plane, an armature actuated simultaneously by said two magnetic circuits, a shaft journalled for both pivotal movement and lateral movement, a pair of contact arms pivotally mounted on said shaft for independent movement thereon, a release lever pivotally mounted on said shaft and engageable by said armature, means for resiliently biasing said shaft against said lateral movement and in the direction toward said release lever will laterally

move said shaft and the control arms therewith, means forming a pivot mounting for said contact arms during the lateral movement of said shaft, and means actuated by said release lever for removing said pivot mounting during the impact of said armature on said release lever whereby said contact arms will pivot on said shaft.

5. A high speed circuit breaker mechanism comprising a pair of magnetic circuits positioned side by side in the same plane, an armature actuated simultaneously by said two magnetic circuits, a shaft journalled for both pivotal movement and lateral movement, a pair of contact arms pivotally mounted on said shaft for independent movement thereon, a release lever pivotally mounted on said shaft and engageable by said armature, said release lever comprising bell crank lever having a short lever arm and a long lever arm, said short lever arm engageable by said armature, means for resiliently biasing said shaft against said lateral movement and in the direction towards said release lever so that the impact of said armature upon said release lever will laterally move said shaft and the contact arms therewith, means forming a pivot mounting for said contact arms during the lateral movement of said shaft, said long lever arm being operatively connected to said pivot mounting means so as to remove said pivot mounting means during the impact of said armature on said short lever arm of the release lever whereby said contact arms will pivot on said shaft.

No references cited.