April 4, 1950 H. C. GRAVES, JR 2,503,154

ESCAPEMENT TYPE TIME DELAY FOR CIRCUIT BREAKER TRIP MECHANISMS

Original Filed Feb. 17, 1944 2 Sheets-Sheet 1

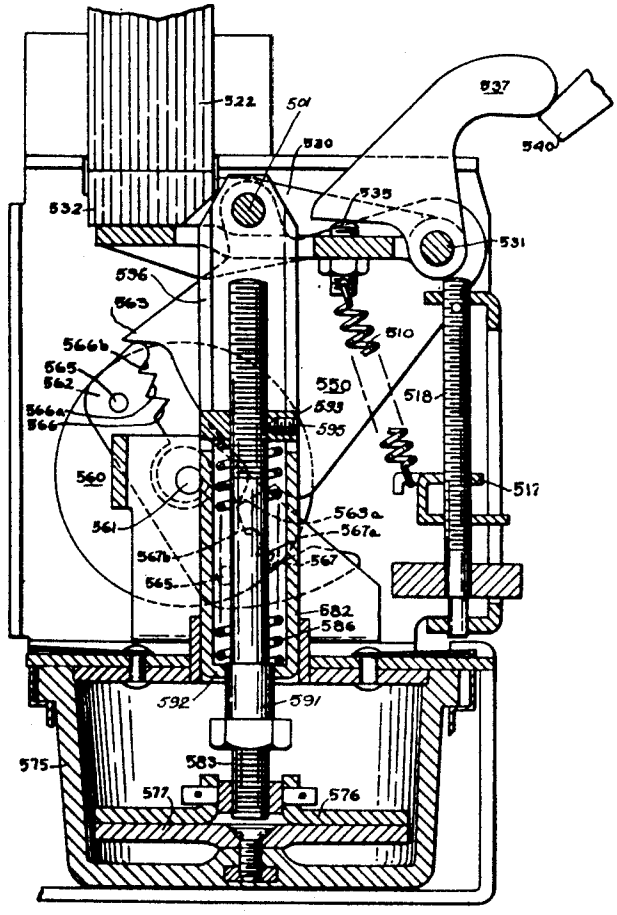

Fig. 1.

INVENTOR
HERBERT C. GRAVES, JR.
BY
Ostrolenk and Faber
ATTORNEYS

April 4, 1950 H. C. GRAVES, JR 2,503,154

ESCAPEMENT TYPE TIME DELAY FOR CIRCUIT BREAKER TRIP MECHANISMS

Original Filed Feb. 17, 1944 2 Sheets-Sheet 2

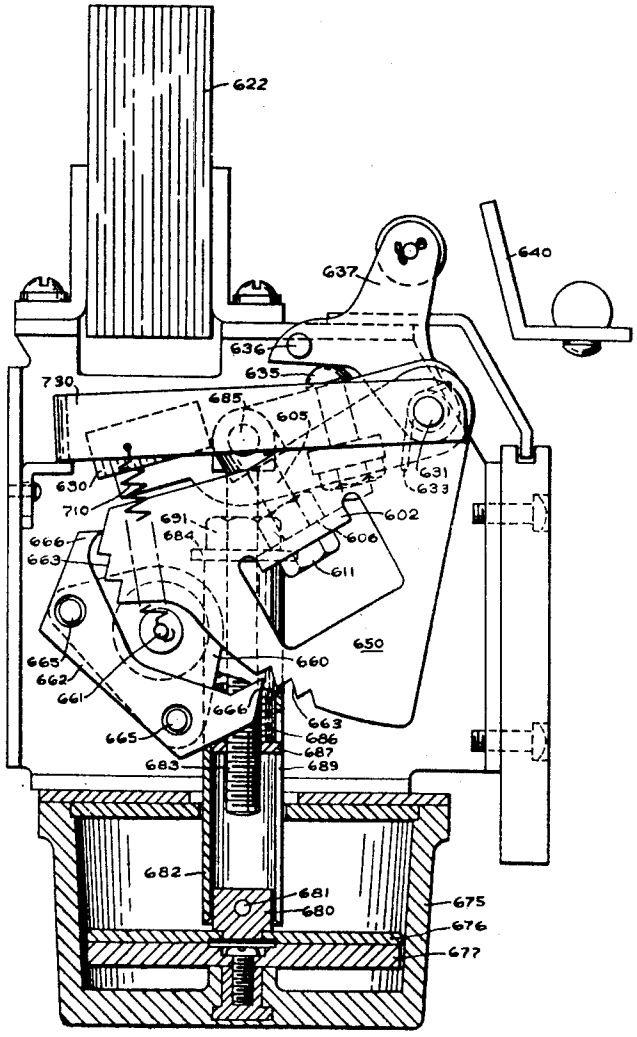

Fig. 2.

INVENTOR.

HERBERT C. GRAVES, JR

BY Ostrolenk and Faber

Attorneys

Patented Apr. 4, 1950

2,503,154

UNITED STATES PATENT OFFICE

2,503,154

ESCAPEMENT TYPE TIME DELAY FOR CIRCUIT BREAKER TRIP MECHANISMS

Herbert C. Graves, Jr., West Chester, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Original application February 17, 1944, Serial No. 522,725. Divided and this application May 23, 1945, Serial No. 595,459

1 Claim. (Cl. 175—372)

1

My invention relates to a novel time delay mechanism used in connection with the fault responsive magnet of a circuit breaker and more particularly relates to a short mass-type time delay, a long sucker-disc time delay, and an instantaneous mechanism.

Figure 1 is a view of a form of momentum absorbing device for use in connection with the present invention.

Figure 2 is a view showing a somewhat modified form of the construction of Figure 1.

In Figure 1 I have shown a construction wherein the device is intended primarily for use in connection with the attainment of appropriate sequential tripping operations in a system which is not cascaded. In Figure 1 the device is shown with the quick trip in operation and the ordinary time delay unit mechanically shunted aside. The quick trip has proceeded to a full tripping operation, thus showing that the fault condition which initiated the operation was not cleared during the momentary time delay obtained by the momentary absorption of the energy of the moving armature.

The dashpot **575**, its sucker discs **576** and **577**, the rod **583**, the sleeve **582** and the compression spring **586** all are constructed so that when the armature is attracted by sufficient force, spring **586** is compressed and the armature is free of the time delay afforded by dashpot **575**. The armature **530** is connected by pin **501** to the upper end of sleeve **582**. Sleeve **582** surrounds rod **583** connected to the movable sucker disc **576** of dashpot **575**. Nut **591** on rod **583** determines the upward limit of movement of rod **583** and movable sucker disc **576**. Sleeve **582** is flanged at **592**. Adjusting nut **593** is threaded on the upper end of rod **583** and its adjustment is fixed by set-screw **595**. Spring **586** is compressed between nut **593** and flange **592**. Slots **596** are provided in sleeve **582** to make adjustment of nut **593** possible. The value at which spring **486** is compressed determines the value at which the armature will move free of the dashpot. The calibration spring **510**, the adjusting nut **517**, the adjusting rod **518** also are arranged for adjustment of the armature for different types of protection. The armature **530**, the striking member **537**, the abutment **535** and the latch trip **540** are arranged so that on movement of the armature to close the gap, the circuit breaker will be tripped. The quick trip lever **550** is secured to the armature and operates therewith, rising when the armature rises.

The abutment **562** which is secured to the weight **560** by means of the bolts **565** is struck

2

by the quick trip lever **550** as it rises with the armature and may rotate on the pin **561**. Members **550** and **562** are so shaped and arranged as to provide a species of escapement mechanism with an increased time delay period on the quick trip. That is, the extension **563** on the quick trip lever **550**, when the armature and lever **550** rise, first moves into engagement with the surface **566** on the abutment **562**. This moves the abutment **562** counterclockwise and correspondingly rotates the mass **560** in the same direction. The extension **563***a* on the opposite end of the quick trip lever **550** then moves into engagement with the notch **567** on the opposite side of the abutment now resulting in a clockwise movement of the abutment **562** and the weight **560**.

The extension **563** of the quick trip lever **550**, on continued movement of the armature **530**, now is brought into the notch **566***a* of the abutment **562** resulting once more in a counterclockwise rotation of the abutment **562** and weight **560**; whereupon the extension **563***a* of the lever **550** moves in engagement with the notch **567***a* of the abutment **562** again resulting in clockwise rotation of the abutment **562** and weight **560**. Thereupon the abutment **563** now moves into engagement with the notch **566***b* in the abutment resulting once more in counterclockwise rotation of the abutment and weight, whereupon the extension **563***a* of the lever **550** moves into contact with the surface **567***b* of the abutment resulting in clockwise rotation of the abutment and weight while the extension **563** of the lever **550** moves clear of the abutment.

By this means it will be seen that during the rise of the armature **530** an extended time delay on the quick trip is achieved by the escapement type operation of the abutment and weight wherein the abutment and weight must reverse their direction of movement several times during the movement of the armature and the initial energy of movement of the armature is successively absorbed so that rather than a time delay of the order of 1 to 12 cycles, an increased time delay which depends on the number of reversals of movement of the abutment and weight is obtained.

This time delay, depending on the number of reversals of movement (and thus depending on the number of notches on each side) may extend for as much as 20 cycles and even more. As above pointed out, the unit shown in Figure 1 is not equipped with an instantaneous trip device and is therefore to be used preferably in a system which is not cascaded, that is, in a system where every

circuit breaker in the system has capacity to clear any fault which may occur. However, this type of quick trip time delay may be of particular value when combined with other forms of time delay. Thus for instance in a system which is not cascaded, the main circuit breaker which controls many of the feeders may be provided with a quick trip time delay of the type shown in Figure 1. Moreover it will be obvious that it may be provided with an instantaneous quick trip device where desired.

In Figure 2 I have shown a slightly modified form of inertia mass time delay which follows substantially the principles above described.

The armature 630 is pivoted on the pin 631 and carries the abutment 635 which engages the striking member 637 to operate the latch trip 640.

The armature 630 may be provided with a hold-down spring similar to those shown in the previous figures.

The adjustable abutment 635 is directly mounted on the armature 630 so that when the armature 630 rises, the abutment 635 rotates the striking member 637 to effect a tripping operation. Torsion spring 633 restores the striking member 637 to its normal position when the armature has been released by magnet 622.

The adjustable abutment 635 is thus mounted because an additional armature 730 is also provided pivotal on the pin 631, which armature 730 must also be effective independently as hereinafter described, to trip the circuit breaker.

The armature 630 has secured thereto in any suitable manner and rotatable therewith the quick trip lever 650. Quick trip lever 650 is provided with a flange 602 through which a bolt 605 passes and which is secured to the flange 602 by the nuts 606 and 611. The opposite end of the bolt is pivotally secured to the pin 685 on the armature 630. The armature 630 and the quick trip lever 650 are thus integrated.

A weight 660 is rotatably mounted on the pin 661 and has secured thereto in any suitable manner, as for instance, by the rivets 665, 665, the abutment 662.

The notches 663 on the quick trip lever 650 engage alternately with the hooked extensions 666 on the abutment 662 as the quick trip lever 650 is rotated.

Thus, a species of escapment mechanism corresponding exactly to that shown in Figure 1 but reversed as to the parts, is achieved.

As the armature 630 is attracted by an excessive force exerted by the magnet 622, the successive engagement of the notches 663 and the hooks 666 causes a series of successive reversals of movements of the abutment 662 and the weight 660.

Consequently, when the armature 630 is attracted under an excessive overcurrent or short circuit condition, the said armature and the quick trip lever 650 are delayed in their movement toward the magnet by the necessity for bringing the mass 660 into movement, stopping it, reversing it, stopping it again, and so forth. The extent of the time delay is determined, of course, by the size of the mass 660 and by the number of notches 663. As will be noted from the shape of the gear teeth 663, and the shape of the verge teeth 666, the angle between the plane of any gear tooth and the plane perpendicular to the line from the verge pivot to the point of engagement of a verge tooth and gear tooth is greater than the non-slip angle. This will provide self-starting and inverse time starting for this time delay mechanism.

Accordingly, if, while the armature 630 is moving toward the magnet 622, another circuit breaker in the system clears the fault before the escapement-type mechanism 650—662 has permitted the armature to escape, the inertia mass of the weight 660 then, on the reduction of the attraction of the magnet 622, will stop armature 30 so that its spring may restore it before the tripping position is reached.

In the device of Figure 2, the armature 630 is under the influence only of the mass 660 and its hold-down spring and is designed to act on only excessive conditions with a relatively very small time delay.

The dashpot 675 is connected to the armature 630 in substantially the manner previously described in connection with other figures, that is, a threaded rod 683 is pivotally secured to the pin 685 on the armature 630 and passes downwardly into the sleeve 682.

Sleeve 682 is secured by means of the cross-pin 681 to the upwardly extending lug 680 of the upper sucker disc 676 of the dashpot 675.

Sucker disc 676 is in engagement with the lower sucker disc 677.

A nut 691, threaded on the portion of the threaded rod 683 which emerges from the top of the sleeve 682, restricts the movement of the rod 683 downwardly into the sleeve 682. The nut 69 bears against the upper plate 684 through the ce ıter of which the rod 683 passes.

A nut 687 on the rod 683 is adjustable upwardly or downwardly through the slot 689 in the side of the sleeve 682.

A compression spring 686 is captured between the nut 687 and the top plate 684.

At currents below a predetermined amount (two to ten times normal), the spring 686 is substantially incompressible, and the armature 630 is subjected to the time delay influence of the dash-pot.

At predetermined value (for instance, more than ten times normal), the spring 686 becomes compressible so that the armature 630 may rise regardless of the fact that discs 676, 677 stay together, and the quick trip time delay, resulting from engagement of members 650 and 662, comes into play. This, therefore, corresponds substantially in all respects to the devices previously described.

In addition, an additional armature 730 is pivotally mounted on the pin 631 and is held down by the fixed spring 710. The additional armature 730 is so formed that it will be attracted by the magnet only under excessive short circuit conditions and thus is a U-shaped member, the major portion of which lies only within the outer boundaries of the magnetic field of the magnet 622.

The armature 730 is in addition held down by the powerful spring 710 which is connected to the pin 661. The spring 710 is arranged so that the armature 730 will be attracted only under excessive short circuit conditions approaching the interrupting capacity of the circuit breaker. When the armature 730 has been attracted by the magnet 622, due to an excessive short circuit condition, it cooperates with the striking pin 636 in the striking member 637 to rotate the striking member in a clockwise direction so as to effect a tripping operation.

Consequently the dual overload condition is provided so that should it be necessary to by-pass

even the quick time delay of members **650** and **662**, an additional armature **730** performs the function of ensuring an instantaneous trip.

Thus, in the construction of Figure 2 the dashpot time delay ensures appropriate inverse time delay elements for current surges of from two to ten times normal. The quick trip time delay ensures a momentary time delay at current values between, say ten times normal and those somewhat below the interrupting capacity of the circuit breaker. The instantaneous trip is provided by armature **730** as values just below the interrupting capacity of the circuit breaker. The instantaneous armature **730** may, of course, be so arranged that it will operate at values just below the interrupting capacity of the next smaller circuit breaker below it in a cascaded system.

In the foregoing I have described my invention and the method achieved thereby in connection only with specific preferred embodiments and in connection with specific operative examples of the system and the method. Many variations and modifications of the physical embodiments of my invention and of the systems and methods which are the essence thereof should now be obvious to those skilled in the art. Accordingly, I prefer to be bound not by the specific disclosures herein, but only by the appended claims.

This application is a division of my application Ser. No. 522,725, filed February 17, 1944, now Patent No. 2,439,165, and a continuation-in-part of my application, Ser. No. 488,841, filed May 28, 1943, now Patent No. 2,491,657.

I claim:

In a time delay mechanism for a circuit breaker having trip mechanism, an electromagnet having an armature mechanism for engaging and operating said trip mechanism, calibrated adjustable biasing means for biasing said armature mechanism away from said electromagnet, said electromagnet when energized by a first predetermined overload current determined by the adjustment of said calibrated biasing means exerting a force on said armature mechanism to pull said armature mechanism toward said electromagnet and said electromagnet when energized by a second predetermined fault current exerting a force on said armature mechanism to pull said armature mechanism toward said electromagnet, said time delay mechanism including an oil dash pot connected to said armature mechanism for retarding the movement of said armature mechanism by said electromagnet for long periods of time of the order of seconds in response to said first predetermined overload current energization of said electromagnet, said time delay mechanism also including an oscillable mass, a connection from said mass to said armature mechanism, said connection including a gear having teeth, said mass including a verge having a pair of teeth engageable with the teeth of said gear, the angle between the plane of any gear tooth, and the plane perpendicular to the line from the verge pivot to the point of engagement of a verge tooth and gear tooth being greater than the non-slip angle, said mass retarding the movement of said armature mechanism by said electromagnet for short periods of time of the order of cycles in response to said second predetermined fault current energization of said electromagnet, a pivotal mounting for said verge for permitting oscillation of said verge to effect alternate engagement of said verge teeth with said gear teeth for controlling through said connection the rate of movement of said armature mechanism to retard said movement of said trip operating mechanism to cycles of time in a sixty cycle system.

HERBERT C. GRAVES, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,123,288	Hellmund	Jan. 5, 1915
1,154,359	Basch	Sept. 21, 1915
1,622,044	Miller	Mar. 22, 1927
1,702,204	Dudley	Feb. 12, 1929
1,738,461	Stevens	Dec. 3, 1929
1,764,382	Ashbaugh	June 17, 1930
1,768,452	Jones	June 24, 1930
2,393,736	Bennett et al.	Jan. 29, 1946
2,419,892	Graves	Apr. 29, 1947
2,439,165	Graves	Apr. 6, 1948
2,486,595	Graves	Nov. 1, 1949