

Nov. 10, 1959

B. A. PITEO, JR., ET AL

2,912,544

CIRCUIT BREAKER WITH UNDERVOLTAGE TRIPPING MEANS

Filed Oct. 23, 1958

2 Sheets-Sheet 1

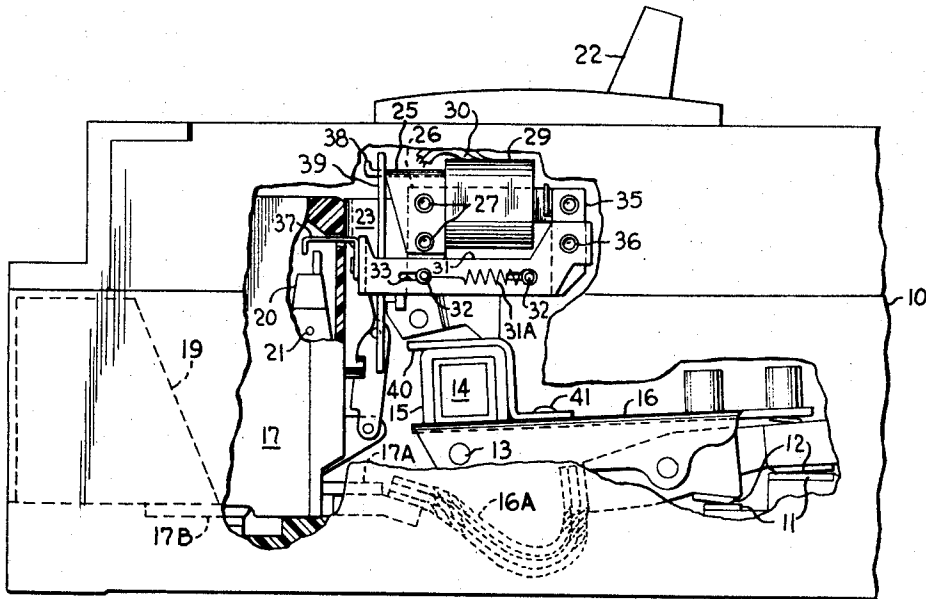


Fig. 1

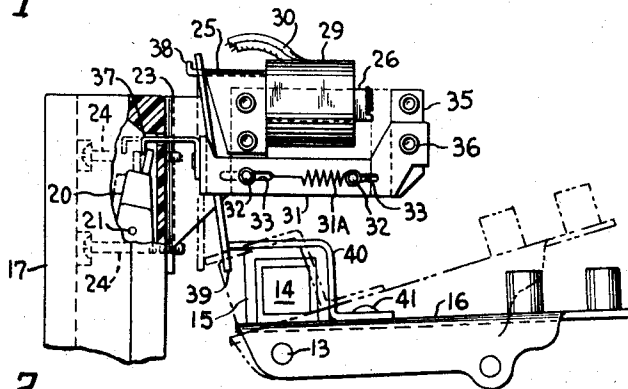


Fig. 2

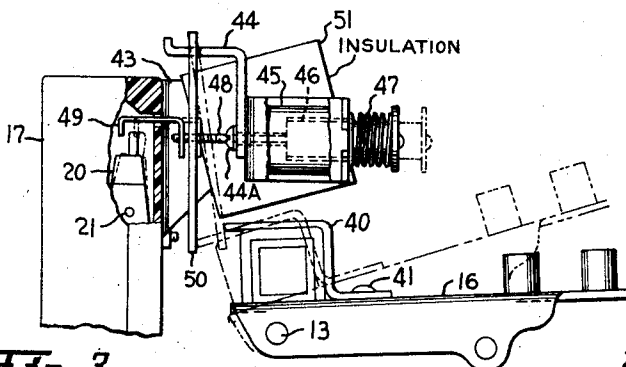


Fig. 3

INVENTORS
BENJAMIN A. PITEO JR.,
DAVID B. POWELL

BY *Robert D. Casey*
ATTORNEY

Nov. 10, 1959

B. A. PITEO, JR., ET AL

2,912,544

CIRCUIT BREAKER WITH UNDERVOLTAGE TRIPPING MEANS

Filed Oct. 23, 1958

2 Sheets-Sheet 2

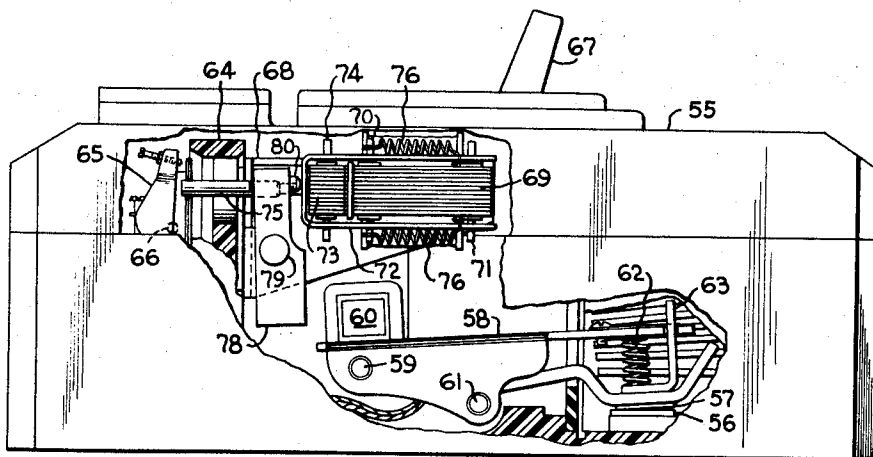


Fig. 4

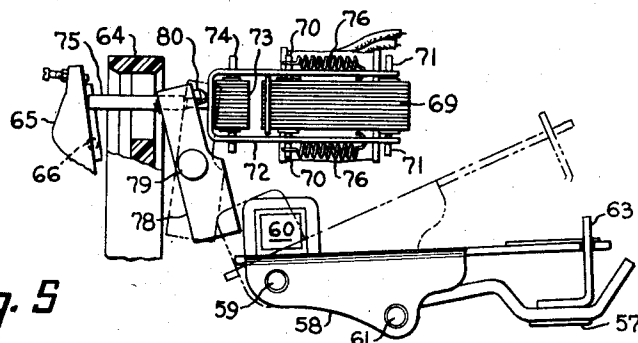


Fig. 5

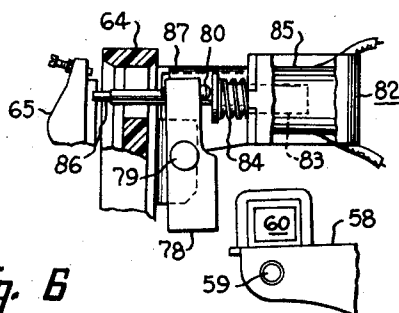


Fig. 6

INVENTORS
BENJAMIN A. PITEO JR.,
DAVID B. POWELL

BY *Robert D. Casey*
ATTORNEY

1

2,912,544

CIRCUIT BREAKER WITH UNDERVOLTAGE TRIPPING MEANS

Benjamin A. Piteo, Jr., Forestville, and David B. Powell, Bristol, Conn., assignors to General Electric Company, a corporation of New York

Application October 23, 1958, Serial No. 769,112

6 Claims. (Cl. 200—106)

Our invention relates to electric circuit breakers, and particularly to electric circuit breakers incorporating means for causing automatic opening of such circuit breaker upon the occurrence of low voltage or undervoltage conditions.

Electric circuit breakers of the type comprising a molded insulating casing, ordinarily incorporate means for causing the contacts of the circuit breaker to open automatically upon the occurrence of high or excessive current conditions in the circuit. Thus, operating mechanism is provided including a latch member and a trip member normally restraining the latch member and arranged so that upon movement of the trip member by a current responsive means, the latch member is released and the automatic circuit breaker mechanism opens the contacts. The trip member is ordinarily actuated by a current responsive member such as a bimetallic strip or a magnetic operating means. In addition, it is often desirable to provide in such circuit breakers auxiliary tripping means to cause the automatic opening of such circuit breaker not only upon the occurrence of excessive current conditions in the circuit, but also upon the occurrence of unusually low voltage conditions in the circuit. In accordance with the prior art, magnetic solenoid-type devices have been provided which are normally closed and which are released upon the occurrence of undervoltage conditions and moved by spring means to actuate the tripping device to cause tripping of the circuit breaker. Such devices have, however, been relatively large, bulky, and expensive. Such prior art devices have also not been suitable for installation by the user, but have required initial installation by the manufacturer of the basic circuit breaker because of the necessity for mounting different parts and adjusting them with relation to other parts of the breaker mechanism and to each other.

It is an object of the present invention to provide an electric circuit breaker incorporating an undervoltage tripping device which is small and inexpensive, and which can be readily added to a conventional circuit breaker construction by the user.

It is another object of the invention to provide a basic construction, the major parts of which are readily adaptable for use with circuit breakers having tripping devices of the push-type as well as of the pull-type.

In accordance with the invention, there is provided an electric circuit breaker comprising an insulating casing, at least two relatively movable contacts, operating means for operating the movable contacts between open and closed position and including a trip member movable to cause automatic opening of such contacts, and undervoltage trip means comprising a supporting bracket carrying a magnetic core member and mounted in relatively fixed relation within the housing. A movable armature is supported on the core member and is biased for movement away from the core member. The armature also has an extension engageable with the trip member to

2

cause tripping of the circuit breaker upon release of the armature on the occurrence of low voltage conditions. Means is also provided for subsequently reclosing the armature upon automatic opening movement of the contacts, to restore the initial impedance of the device and prevent its burning out. This means, in accordance with the invention, comprises an operating member carried by the main supporting bracket which is engaged and operated by a projection carried by the contact cross arm of the circuit breaker to reclose the armature. This operating projection, moreover, is relatively closely adjacent the pivot point of the contact arm of the circuit breaker, whereby a high amount of force is made available for resetting the armature, and the use of complicated interconnecting linkages is avoided.

The invention will be better understood by reference to the following detailed description, taken in conjunction with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawings:

Figure 1 is a side elevation view of a portion of an electric circuit breaker incorporating the invention, a portion of the side wall being broken away;

Figure 2 is a side elevation view of a portion of the mechanism of Figure 1 showing the parts in a different position;

Figure 3 is a view similar to Figure 2 but showing a different form of the invention, adapted for use with direct current;

Figure 4 is a view similar to Figure 1 but showing the invention as applied to a different type of circuit breaker requiring a pushing motion of the trip member rather than a pulling motion;

Figure 5 is a side elevation view of a portion of the mechanism of Figure 4 with the parts shown in a different position;

Figure 6 is a view of a modified form of the device of Figure 4 adapted for use with direct current.

In accordance with the invention as shown in Figure 1, an electric circuit breaker is provided comprising an insulating casing 10 containing a plurality of relatively stationary contact assemblies 11, only one of which is shown, and a plurality of relatively movable contact assemblies 12, only one of which is shown, pivotally supported in the casing 10 on a pivotal axle 13. The movable contact assemblies are ganged together, for movement in unison, by a contact cross arm member 14 rigidly attached to each of the contact arms by suitable means such as by inverted U-shaped brackets 15, the movable contacts are connected by suitable means, such as by a flexible braid 16A, to one terminal 17A of a trip unit 17 which has its other terminals 17B connected to relatively stationary terminal connecting lugs 19 for connection to incoming power lines.

The trip unit 17 includes a movable trip member 20 which is pivotally supported at 21 in the trip unit casing, and which is movable by suitable current responsive means, not shown, contained within the trip unit 17, to cause release of a mechanism retaining latch, not shown, and to cause automatic opening of the circuit breaker contact in conventional manner.

A manually engageable handle 22 is also provided for manually operating the mechanism to move the contacts between open and closed positions. The trip unit construction and the construction of the operating mechanism for the circuit breaker contacts may be of any suitable type. For convenience, the present invention has been shown in Figures 1-3 as incorporated in a circuit breaker of the type disclosed in applications Serial Number 679,606, Steven and Marshall, and 679,607, Judd and Young, filed August 22, 1957, and assigned to the same assignee as the present invention.

For the purpose of causing actuation of the trip member 20 upon the occurrence of predetermined low voltage conditions in the circuit or in any predetermined circuit, undervoltage trip means is provided, comprising, referring particularly to Figures 1 and 2, a stationary supporting bracket 23 rigidly attached to the insulating housing of the trip unit 17 by suitable means such as by screws 24. The bracket 23 includes a portion 25 which extends around and serves to support a generally U-shaped magnetic core lamination assembly 26, to which it is attached by suitable means such as by rivets 27. The U-shaped core portion 26 of the device also carries on one leg thereof the energizing coil 29 provided with leads 30 for connection to a suitable power source.

The form of the invention shown in Figure 1 is especially adapted for use with alternating current control power sources.

The magnetic core portion 26 carries a non-magnetic slidable bracket 31 on the leg thereof opposite the winding 29. The assembly 31 is slidably supported by means of pins 32 rigidly carried by the magnetic core portion 26 and extending through corresponding slots 33 in the bracket 31.

The sliding bracket 31 carries a movable armature member 35, which is pivotally supported thereon by means of pivot pin 36. The armature member 35 is adapted to bridge the pole portions of the U-shaped core assembly 26 when the device is in its energized condition.

Sliding bracket 31 is constantly biased toward the open position by means of a tension spring 31A which has one end anchored to the pin 32 at the right of the assembly and has the other end thereof hooked into the slot 33 at the other end of the assembly. A generally hook-shaped extension 37 is attached to the right portion of bracket 31 and is disposed and arranged to engage the trip member 20 when the bracket assembly 31 moves to the right, causing tripping of the circuit breaker mechanism.

In order to minimize the size and cost of the undervoltage trip assembly, it is desirable that the magnetic assembly be called upon only to retain the armature 35 in its closed position against the bias of the spring 36, and that it not be required to move the armature from its open position to its closed position. In order to make this possible, and also to prevent overheating of the coil if left in the open condition, there is provided, in accordance with the invention, means for automatically reclosing the armature 35 to the position indicated in Figure 1 upon movement of the contact arm 16 to its open circuit position.

For this purpose, the bracket 25 is provided with an extension 38 extending from the right portion thereof, and an operating lever 39 of insulation material is pivotally supported on the extension 38 and extends between the sides of the bracket member 31 adjacent the support of the hook portion 37. The contact arm 16 is also provided with an extension 40 attached to the contact arm by suitable means such as by rivet 41 and having its end portion disposed and arranged to engage the operating member 39 when the contact arm 16 moves to its open circuit position.

In Figure 2 there is illustrated the transient position which the parts assume immediately upon the occurrence of an undervoltage condition in the circuit to which the coil 29 is connected. As shown therein, the tension spring 31A causes the bracket 31 to move to the right causing the hook member 37 to engage and actuate the trip member 20. This releases the operating mechanism which immediately causes automatic opening of the contact arms 16 by the stored energy in springs of the operating mechanism, not shown. The contact arms thereupon move to the open circuit position as indicated in dotted lines in Figure 2, causing the extension 40 to engage the member 39 and return it to the position shown in dotted lines. Movement of the member 39 to its original, dotted line,

position, carries the bracket member 31 to the original or reclosed position.

It will be observed that the construction provided is extremely compact and simple to mount and assemble and all the moving parts necessary are carried by a common support, that is, frame member 23.

In the form of the invention shown in Figure 3, there is shown a form especially adapted for use with direct current circuits. In this form of the invention, a bracket 43 is provided for mounting on the trip unit housing 17 in a manner similar to the bracket 23 of the form of Figures 1 and 2. The bracket 43 has an insulating portion 51 which serves to support a solenoid comprising a stationary core portion 45 and a movable plunger portion 46 which is normally biased to the right as viewed in this figure by means of a compression spring 47. The plunger 46 has an extension shaft 48 which carries a hook-shaped member 49 similar to the member 37 of the form of Figures 1 and 2 and disposed to engage and actuate the trip member 20 in the manner similar to that described for the form of Figures 1 and 2. For the purpose of providing for resetting and reclosing of the solenoid in this form, an actuator 50 is provided similar to the actuator 39 of the form of Figures 1 and 2, pivotally supported on a bracket 44 mounted on the solenoid by screw 44A. The extension 40 attached to the contact arm 16 serves to engage the end of the operating member 50 upon tripping of the circuit breaker mechanism, and restores the solenoid to its normal position when the contact arm 16 moves to open position as illustrated in the dotted line position of the contact arm.

In both the forms of Figures 1 and 2 and that of Figure 3, the operating members 39 and 50, respectively, are preferably constructed of material which, while essentially rigid has a degree of flexibility to permit an amount of overtravel to ensure seating of the armature member in its proper location upon movement of the contact arm to open circuit position.

In Figures 4-6, the invention is shown as applied to circuit breakers incorporating a trip bar which moves in a direction away from the operating mechanism to cause tripping, as contrasted to the form of Figures 1-3 in which the trip member moves toward the operating member to cause tripping. In these forms it will be observed that the undervoltage trip device must operate to push the trip member, rather than to pull it.

In accordance with the form of the invention shown in Figure 4, there is provided a circuit breaker having a casing 55 including relatively stationary contacts 56, only one shown, and relatively movable contacts 57, only one shown, mounted on a movable contact arm 58 which is pivotally supported on a stationary pivotal support 59. The contact arms of each of the poles are ganged together by means of a common contact cross arm 60. The movable contact 57 is flexibly supported on the contact arm 58 on pivot point 61 and is normally biased away from the contact arm 58 by means of a compression spring 62, a retaining bracket 63 being provided to limit the movement of the contact member 57 away from the contact arm 58. The circuit breaker also includes a trip unit indicated generally at 64, which includes a trip member 65 pivotally supported at 66 and movable in a direction away from the operating mechanism to cause tripping of the circuit breaker.

The circuit breaker is also provided with suitable operating mechanism, not shown, which is operable by means of operating handle 67 for operating the movable contacts between open and closed circuit positions. The operating mechanism includes a releasable latch which is releasable upon movement of the trip bar 65 to cause automatic opening of the operating mechanism to move the contacts to open circuit position, upon the occurrence of predetermined over-current conditions in the circuit,

5

For the purpose of causing actuation of the trip member 65 upon the occurrence of predetermined low voltage conditions in the circuit, there is provided an electromagnetic device comprising a frame 68 which is rigidly attached to the trip unit insulating casing by suitable means, not shown, and which carries a relatively stationary, generally U-shaped magnetic core assembly 69. The core assembly 69 carries a pair of guide pins 70 and 71 mounted in fixed relation thereon and extending there-through with portions extending at each side of the core assembly 69. The pins 70 and 71 act as guide pins for a non-magnetic guide bracket 72 which has slots cut in the side walls thereof corresponding to the pins 70 and 71. The guide bracket 72 also carries the movable armature portion 73 which is pivotally mounted thereon by means of a pin 74, and includes an extension 75 for actuating the trip member 65. The bracket 72 and its movable armature 73 are constantly biased toward the left-hand position, that is, the open position, by the action of tension springs 76 which have one end thereof anchored on the pin 70 and have the other end thereof engaging with bracket 72 in the slots corresponding to the pins 71. It will be observed, therefore, that so long as the core of the magnetic assembly 69 remains energized and holds the armature member 73 in the position shown, the breaker will not be actuated. Upon the decrease of voltage in the energizing coil however, the armature is immediately released and the action of the springs 76 moves the armature and its carrier 72 to the left causing the extension 75 to engage the trip member 65 to cause tripping of the circuit breaker.

For the purpose of resetting the undervoltage trip device, a reset lever 78 is provided, which is pivotally mounted by means of a pivot pin 79 on an extension of the frame member 68. The lever member 78 carries a plunger 80 at one end thereof disposed adjacent a bight portion of the bracket 72. The plunger 80 is slidable in the end of the lever 78 and is spring biased to a normally projecting position as shown in Figure 4.

Upon decrease of voltage in the energizing coil of the magnetic member, the armature member 73 is released, as described above, and moves temporarily to the intermediate position indicated in Figure 5 in which the plunger member 75 engages the trip member 65 to cause tripping. Immediately upon the opening of the contacts, the contact arm 58 moves to the position indicated in dotted lines in Figure 5, causing the contact cross arm 60 to engage the lower portion of the lever 78, rotating the lever 78 clockwise. Clockwise rotation of the lever 78 causes the plunger 80 to engage the bight portion of the bracket 72 thereby sliding the bracket 72 and the movable armature 73 back to their reclosed or reset position.

The plunger 80 is slidably mounted and biased by a spring to a normally projecting position to allow a certain amount of travel of the lever 78 with respect to the armature 73 to ensure positive reclosing and holding of the armature in closed position until the circuit breaker is reclosed.

In Figure 6 there is shown a further embodiment of the invention along the lines of Figures 4 and 5 that is adapted to cause actuation of a trip member by a pushing action, but especially adapted for D.C. applications. In this form of the invention, a plunger-type solenoid is provided having a stationary magnetic portion 82 and a movable magnetic plunger portion 83 which is normally biased by a compression spring 84 toward projecting position with respect to the stationary portion 82. A suitable coil 85 is also provided for energizing the magnetic component. The plunger portion 83 also includes an extension rod 86 adapted to engage the trip member 65. The core and coil assembly is supported upon a suitable bracket 87 rigidly attached to the trip unit housing 64 by suitable means not shown.

6

Resetting of the magnetic armature or plunger portion is accomplished in this form in the same manner as indicated in Figure 5 by means of lever 78 which is pivotally mounted at 79 on the frame portion 87 and the plunger portion 80 of the lever 78 is disposed to engage the plunger portion 83 when the lever 78 is rotated clockwise by means of the cross arm 60 when the contact arm 58 moves toward open circuit position upon the occurrence of tripping of the circuit breaker.

It will be observed that while four different forms of the invention are shown, all such forms of the invention utilizes a portion of the contact cross arm engaging a pivotally supported lever member to cause resetting of the magnetic member upon the occurrence of tripping of the circuit breaker. All forms, also, include the provision, in such pivoted member, of resilient means for permitting a certain amount of overtravel of the actuating means with respect to the actuated means.

While only particular embodiments of the invention have been disclosed, it will be readily apparent that many modifications thereof may be made by those skilled in the art. It is therefore intended by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In an electric circuit breaker having a contact arm movable between open and closed circuit positions and a member movable to cause automatic opening movement of said contact arm, an undervoltage trip device comprising a relatively stationary magnetic core member, a relatively movable magnetic armature member, said armature being movable between a normal position in engagement with said core member and a released position out of engagement with said core member, means for returning said armature member from said released to said normal position upon the movement of said contact arm from closed to open position comprising an elongated lever pivotally mounted on a fixed pivot in said circuit breaker, means carried by said contact arm for engaging said lever to rotate said lever about said pivot, and means connecting said lever and said movable armature for causing reclosing movement of said armature upon contact opening movement of said contact arm.

2. The invention as set forth in claim 1 wherein said pivotal lever comprises resilient means for transmitting force from said contact arm to said movable armature whereby to permit a small amount of overtravel of said contact arm following engagement of said armature with said core member.

3. In an electric circuit breaker, a contact arm movable between open and closed circuit positions, a movable trip member movable to cause automatic opening movement of said contact arm, an undervoltage trip device comprising a relatively stationary magnetic core member, a relatively movable armature member, said core member being between said trip member and said armature, means carried by said armature for engaging said trip member upon movement of said armature in a direction away from said core member, means for returning said armature into engagement with said core member comprising an elongated lever pivotally supported on a pivot stationary relative to said core member, a projection carried by said contact arm adjacent said pivot, said lever having an end portion disposed in the path of movement of said projection, and a connection between an intermediate part of said lever and said movable armature to return said armature to reclosed position upon movement of said contact arm to contact open position.

4. The invention as set forth in claim 3 wherein said pivoted lever comprises a relatively wide, thin, flat strip of insulating material having a substantial amount of inherent resilience.

5. An electric circuit breaker comprising a contact

7

arm movable between open and closed circuit positions and a movable trip member movable to cause automatic opening movement of said contact arm, a relatively stationary magnetic core, a relatively movable magnetic armature member, said armature member being movable between a normal position in contact with said core member and a released position in which it is out of engagement with said core member, said armature member being on the same side of said core member as said trip member, and an elongated lever pivotally mounted on a fixed pivotal support, said lever having one end portion disposed in the path of movement of a portion of said contact arm and its other end portion disposed to engage said movable armature member to return said armature member into contact with said magnetic core

8

member upon movement of said first end by said contact arm.

6. An electric circuit breaker as set forth in claim 5 wherein said pivoted member also includes a projecting plunger actuator, said plunger being biased outwardly of said lever by compression spring means whereby to provide resilient means for transmitting force from said contact arm to said movable armature whereby said contact arm may overtravel a small amount after engagement of said armature with said core member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,154,703	Sandin	Apr. 18, 1939
2,697,148	Slebochnik	Dec. 14, 1954