

June 25, 1957

H. D. DORFMAN ET AL

2,797,277

CIRCUIT BREAKER

Filed Sept. 24, 1954

2 Sheets-Sheet 2

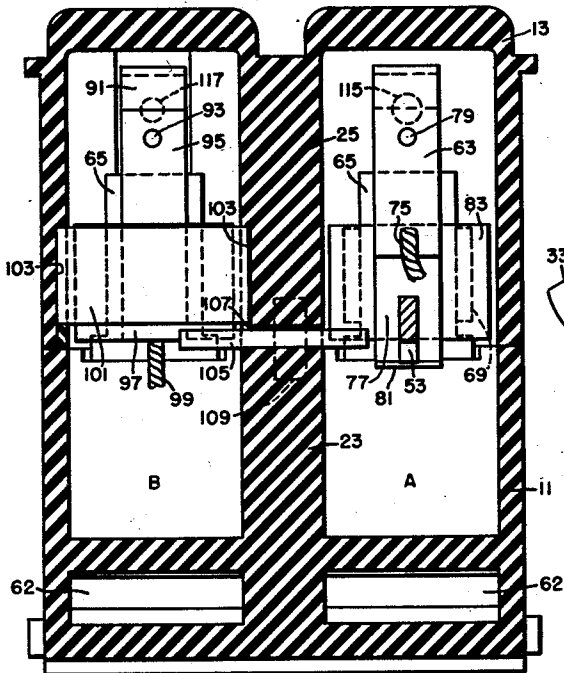


Fig. 3.

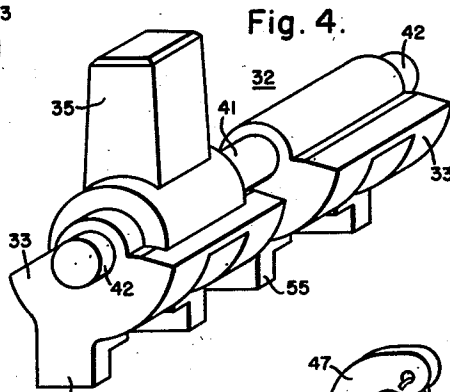


Fig. 4.

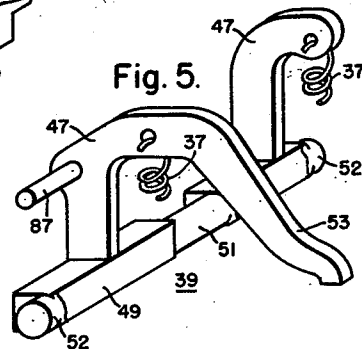


Fig. 5.

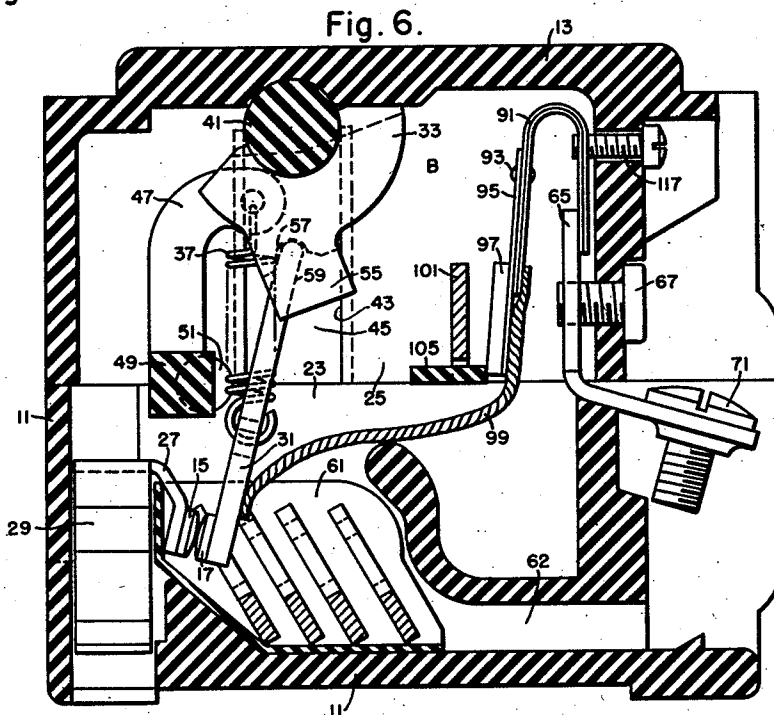


Fig. 6.

1

2,797,277

CIRCUIT BREAKER

Hiller D. Dorfman and Robert H. Flick, Beaver, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 24, 1954, Serial No. 458,215

10 Claims. (Cl. 200-116)

This invention relates to circuit breakers, and more particularly to multi-pole circuit breakers which are manually opened and closed by a single handle, and all poles of which are opened automatically upon the occurrence of an overload current in any pole of the breaker.

An object of the invention is to provide a multi-pole circuit breaker having an insulating housing comprising a base and cover in which the movable parts are mounted in individual compartments in the cover and held in place when the base is placed in position.

Another object of the invention is to provide a multi-pole circuit breaker embodying a novel trip mechanism.

Another object of the invention is to provide a multi-pole circuit breaker embodying a trip device in which the trip elements move in opposite directions to trip the breaker.

Another object of the invention is to provide a multi-pole circuit breaker having an insulating housing comprising a base and a cover each divided into separate compartments with a trip device in each compartment and a single member operated by the trip device in one compartment for operating the trip device in another compartment to effect opening of the circuit breaker.

Another object of the invention is to provide a multi-pole circuit breaker having an insulating housing comprising a base and cover divided into separate compartments and a trip device in each compartment, the trip devices moving in opposite directions to trip the breaker and a member for transmitting the tripping movement of the trip device in one compartment to move the trip device in another compartment to effect tripping of the breaker.

The invention both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description when read in conjunction with the accompanying drawings.

In said drawings:

Figure 1 is a top plan view, partly in section, of a circuit breaker embodying the principles of the invention.

Fig. 2 is a vertical sectional view taken on line II—II of Fig. 1 and looking in the direction indicated by the arrows.

Fig. 3 is a vertical transverse sectional view taken along line III—III of Fig. 2 and looking in the direction indicated by the arrows.

Fig. 4 is a perspective view of the operating handle.

Fig. 5 is a perspective view of the common releasable member.

Fig. 6 is a vertical sectional view taken substantially on line VI—VI of Fig. 1 and looking in the direction indicated by the arrows.

Fig. 7 is a top plan view in reduced scale of the trip mechanism adapted for use in a three-pole circuit breaker.

Referring to Fig. 2 of the drawings, the circuit breaker generally comprises a two-piece housing of molded in-

2

ulating material including a base 11 and a cover 13, a stationary contact 15 and movable contact 17 for each pole of the breaker, an operating mechanism 19 and a trip device 21. The housing is divided into two separate compartments by means of matching barriers 23 and 25 molded integral respectively with the base 11 and the cover 13. While a two-pole circuit breaker indicated generally as poles A and B is specifically described hereinafter, the invention may readily be adapted for use in a three-pole circuit breaker by merely adding another outer compartment and the parts therein indicated in Fig. 7 as pole C.

The stationary contacts 15 for each of the two compartments are mounted on the inner ends of conducting members 27 integral with a plug-in or other connector 29 supported in the base 11 of the housing. The moving contact 17 for each pole is rigidly secured to a U-shaped switch or contact arm 31. Both of the contact arms 31 (Figs. 2 and 6) are operated to open and closed positions by the single operating mechanism 19 (Fig. 2) to open and close the contacts.

The operating mechanism 19 comprises an operating member 32 having an operating lever 33 for each pole of the breaker and a single operating handle 35, an over-center spring 37 and a releasable trip member 39. The operating member 32 including the handle 35 and the operating lever 33 for both poles A and B comprises a single member of molded insulating material so that operation of the handle simultaneously moves both of the levers 33. Molded on the operating member 32 is a central bearing surface 41 for pivotally supporting the member in the barrier 25 and end bearing surfaces 42 for pivotally supporting the ends of the members in suitable openings in the side walls of the cover 13. The barrier 25 and the side walls of the cover 13 are provided with a slot 43 having a semi-circular bearing portion at its upper end for receiving and positioning the operating member 32. After the operating member is inserted into the slots 43, support and closure members 45 of insulating material are inserted in the slots and suitably secured therein. The upper ends of the members 45 have semi-circular bearing notches engaging and supporting the bearing portions 41 and 42 of the member 32.

The releasable trip member 39 (Fig. 5) comprises a spring support lever or trip arm 47 for each of the poles of the breaker, each of the spring supports or trip levers being secured adjacent its pivot axis to a tie rod or cross bar 49 of molded insulating material for unitary pivotal movement. The tie rod 49 is provided with a central bearing portion 51 for supporting the releasable trip member 39 in the central barrier 25 and end bearing portions 52 for supporting the ends of the releasable trip member 39 in bearing portions (not shown) in the side walls of the cover 13. The spring support or trip lever 47 for pole A of the breaker extends toward the right (Figs. 1 and 2) and has a latch end 53 which is normally engaged and releasably held by a single latch of the trip device (to be later described) to releasably hold both of the trip arms 47 of the releasable trip member 39 in operative position.

Each of the levers 33 (Figs. 2, 4 and 6) is bifurcated and the spaced legs 55 thereof are provided with notches 57 in which are seated the legs 59 of the U-shaped switch members 31. The switch members 31 are held in place by the overcenter springs 37 which are connected under tension between the switch members 31 and the corresponding spring supports 47 of the releasable trip member 39 (Fig. 5). In the position shown in Figs. 2 and 6, the springs 37 bias the switch members 31 to the closed position.

The circuit breaker is opened manually by moving the

3

operating member 32 (Fig. 2) by the handle 35 clockwise from the "on" position to the "off" position. During this movement, the inner ends of the switch arms 31 are carried over to the left of the line of action of the overcenter springs 37 whereupon the springs move the switch arms 31 to the open position with a snap action. The contacts are closed by reverse movement of the operating members 32, that is, from the "off" to the "on" position. During this movement, the inner ends of the switch members 31 are moved over to the right of the line of action of the overcenter springs which then move the switch members to the closed position with a snap action.

An arc extinguisher 61 (Figs. 2 and 6) may be disposed in a recess or arc chamber in the base 11 for each pole of the breaker for quickly extinguishing the arc drawn when the circuit is interrupted. The arc extinguisher may be of any suitable type, the one illustrated comprising a series of spaced magnetic plates into which the arc is drawn and quickly extinguished. The arc gasses are drawn into a passage 62 along the bottom of the base 11 and vented out the end of the housing opposite the stationary contacts.

The circuit breaker is tripped open automatically in response to overload currents by operation of the trip device 21. Since the trip devices for poles A and B are somewhat different they will be described separately. Referring to Fig. 2 of the drawing, the trip device for pole A comprises a bimetal element 63 having a reverse loop therein and having one end rigidly mounted on the inner end of a conducting strip 65. The high expansion side of the bimetal element 63 is on the outside of the loop. The conducting strip 65 is secured to the end wall of the cover 13 by means of a screw 67 which also serves to mount a U-shaped magnet yoke 69. The conducting strip 65 extends out through an opening in the base 11 below the cover 13 and has a terminal connector 71 at its outer end.

The free end 73 of the U-shaped bimetal element 63 is electrically connected to the switch members 31 by means of a flexible conductor 75. The upper end of a spring 77 is secured by means of a rivet 79 to the bimetal element 63 at a point just below the loop and extends downwardly along the inside of the bimetal element. The lower end of the spring 77 has latch means 81 thereon which engages the latch end 53 of the trip arm 47 for this pole of the breaker and releasably restrains the trip member 49 for both poles in operative position. An armature 83 of magnetic material is rigidly secured to the spring 77 by suitable means, such as riveting or welding, for cooperating with the magnet yoke 69. The magnet yoke 69 is mounted by means of the screw 67 between the conductor 65 and the end wall of the cover 13 and embraces three sides of the conductor as shown in Figs. 1 and 2.

Upon the occurrence of an overload current in the associated pole of the breaker of, for example, up to 1000% of normal rated current, the bimetal element 63 bends rearwardly in a direction to close the loop, since the high expansion side is on the outside of the loop, and moves the free end thereof toward the right and disengages the latch means 81 from the releasable trip arm 47 thus releasing the entire trip member 39 (Fig. 5). As soon as the releasable trip member 39 is released, the springs 37 for both poles of the breaker rotate the releasable structure 39 including the spring support or trip member 47 for each pole in a clockwise direction (Figs. 2 and 6). This action carries the line of action of the springs 37 for both poles of the breaker over to the right of the associated switch members 31 and the springs 37 then move the switch members to the open position with a snap action. The clockwise movement of the releasable trip member 39 is arrested by engagement of the latch end 53 of the spring support or trip arms 47 with a projection 85 on the base 11 of the breaker housing. When the springs 37 move over center, they bias the operating

4

member 32 and the handle 35 to an indicating position (not shown) between the "off" and "on" positions, giving a single indication that both poles have been opened.

Upon the occurrence of a heavy overload current of, for example, 1000% or more of normal rated current or a short circuit current, the armature 83 is attracted to the magnet yoke 69. This flexes the relative light spring 77 and disengages the latch 81 to instantaneously trip the breaker without bending the stiffer bimetal element 63.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and re-latch the mechanism. This is accomplished by moving the handle 35 and the operating member 32 to a position slightly beyond the "off" position. During this movement the legs 55 of the levers 33 engage a pin 87 in the member 47 and restore the entire releasable structure 39 for both poles (Figs. 2, 4 and 6) to the latched position. The contacts are then closed in the previously described manner by movement of the handle 35 and the levers 33 to the "on" position.

Referring now to Fig. 6 of the drawing, it will be seen that the trip device for pole B of the breaker is somewhat different in structure and operation from that shown in Fig. 2. A bimetal element 91 is rigidly secured, for instance, by welding, to the inner end of the conducting strip 65 for this pole of the breaker. The bimetal element 91 has a reverse bend therein and differs from the bimetal for pole A shown in Fig. 2 in that the high expansion side of the bimetal element 91 is on the inside of the loop. Secured by means of a rivet 93 to the bimetal element 91 for pole B at a point just below the outside of the loop is a spring 95 which extends downwardly along the low expansion side of the bimetal element and has an armature 97 rigidly secured to the lower end thereof. The free end of the bimetal element 91 is electrically connected by a flexible conductor 99 to the switch arm 31 for this pole of the breaker. A magnet yoke 101 for pole B is rigidly supported in recesses 103 (Fig. 1) in the side wall of the cover 13 and in the barrier 25 in the cover. A trip actuator lever 105 of insulating material (Figs. 1, 2, 3 and 6) is disposed horizontally in an opening 107 in the barrier 25 in the cover 13 and is mounted on top of the barrier 23 for pivotal movement by means of a pin 109 having its opposite ends merely laid into recesses in the opposed barriers 23 and 25. One arm 111 of the lever 105 bears against the armature 97 for pole B and the other arm 113 of the lever 105 bears against the armature 83 for pole A.

Since the high expansion side of the bimetal element 91 (Fig. 6) for pole B is on the inside of the loop the free end of the bimetal element will deflect toward the left when heated in response to overload currents of, for instance, up to 1000% of normal rated current. This moves the spring 95 and armature 97 toward the left as viewed in Figs. 1 and 6, and causes the armature 97 to rotate the lever 105 counterclockwise about its pivot 109. Due to the engagement of the arm 113 of the lever 105 with the armature 83 (Figs. 1 and 2) for pole A, the counterclockwise movement of the lever 105 will move the armature 83 toward the right (Fig. 2) bending the spring 77 and causing the latch 81 to release the trip member 47. This results in automatic opening of the breaker in the manner previously described.

Upon the occurrence of a heavy overload current of, for instance, 1000% or more of rated current or a short circuit current, the electromagnet 97-101 is energized sufficiently to attract the armature 97 (Fig. 6) bending the spring 95 and operating the lever 105 to instantaneously trip the breaker.

The latch overlap and, hence, the thermal tripping time of the trip device for pole A (Figs. 1 and 2) is adjusted by means of a screw 115 which threadedly engages the end wall of the cover 13. The rounded inner end of the screw 115 applies a pressure to the supported

5

leg of the bimetal element 63 at a point adjacent the loop of the bimetal. Turning the screw 115 clockwise increases the pressure applied to and moves the bimetal element to thus reduce the amount of latch overlap and cause the breaker to trip at a lower value of current in pole A.

The bimetal element 91 of pole B is similarly adjusted by means of a screw 117 (Figs. 1 and 6) which is threaded into an opening in the supported leg of the bimetal 91 adjacent the loop and has its head engaging the end wall of the cover 13 in a counterbore in the end wall to apply a pressure to the bimetal 91. Rotation of the screw 117 clockwise pulls back the upper end of the bimetal 91 and causes its lower end to move to the left. This varies the relation of the armature 97 to the end 111 of the trip actuator 105 and reduces the amount of play between the parts and reduces thermal tripping time of the bimetal element 91. Thus rotation of the screws 115 and 117 in a given direction has the same effect in calibrating the respective poles even though the two bimetals move in opposite directions to trip the breaker.

As illustrated in Fig. 7, a three-pole breaker is provided by adding a pole C on the opposite side of pole A from pole B and providing a second trip actuator lever 105. The operating member 32 (Fig. 4) is extended to provide an operating lever 33 for pole C and the releasable trip member 39 (Fig. 5) is also extended to provide a trip arm 47 for pole C like the trip arm 47 for pole B.

There is provided a multi-pole circuit breaker in which the manual operating lever extends into each compartment for supporting and actuating the several switch members. The releasable structure extends into each compartment to support and, when released, to actuate the overcenter springs and effect automatic opening movement of the several switch members. The trip device in one compartment operates in one direction to operate the latch and effect release of the releasable structure while the trip device in another compartment operates in the opposite direction to actuate an intermediate member which, in turn, actuates the latch in the one compartment to release the releasable structure.

While the invention has been disclosed in accordance with the provisions of the patent statutes it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from the spirit of the invention.

We claim as our invention:

1. A multi-pole circuit breaker having an insulating housing comprising a base and a cover, said base and cover having one or more matching barriers forming a plurality of compartments, separable contact means in each of said compartments, operating means comprising a single releasable member releasable to effect automatic separation of said contact means in all of said compartments, a trip device in one of said compartments operable in response to overload currents to effect release of said releasable operating means, said trip device comprising a bimetal element having resilient latch means mounted thereon for normally restraining said releasable operating means, thermal bending of said bimetal element causing said resilient latch means to release said releasable operating means, a second trip device in another of said compartments, said second trip device comprising a second bimetal element having non-latching spring means mounted thereon, a separate member pivotally mounted between said compartments disposed to be engaged and actuated by said spring means of said second bimetal element, thermal bending of the bimetal element of said second trip device causing said spring means to engage and move said separate member to thereby cause said separate member to engage and bend said resilient latch means in said one compartment and effect release of said single releasable member.

6

2. A multi-pole circuit breaker having an insulating housing comprising a base and cover divided into a plurality of compartments, separable contact means in each of said compartments, operating means releasable to effect separation of said contact means, a trip device in one of said compartments operable in response to overload currents to effect release of said releasable operating means, said trip device comprising a bimetal element having a reverse bend therein forming a loop, the high expansion side of said bimetal element being on the outside of said loop, biased latch means mounted on the low expansion side of said bimetal element, said biased latch means being movable to release said releasable operating means while said bimetal element remains substantially undisturbed, a second trip device in another of said compartments comprising a bimetal element having a reverse bend forming a loop with the high expansion side of said bimetal on the inside of the loop, spring means mounted on the bimetal element of said second trip device on the outside of said loop, a separate member pivotally mounted between said compartments, and thermal bending of the bimetal element of said second trip device causing said spring means to engage and actuate said separate member to thereby cause said separate member to engage and bend said resilient latch means and effect release of said releasable operating means.

3. A multi-pole circuit breaker having an insulating housing comprising a base and a cover divided into separate compartments, separable contact means in each compartment, operating means releasable to effect automatic separation of said contact means, a first trip device in one of said compartments operable in response to overload currents to release said releasable operating means, said trip device comprising a bimetal element having resilient latch means mounted thereon for normally restraining said releasable operating means, thermal bending of said bimetal element causing said resilient latch means to release said releasable operating means, electroresponsive means comprising a fixed magnet yoke, an armature mounted on said resilient latch means, said armature upon energization of said electroresponsive means in response to overload currents of certain value bending said resilient latch means to effect instantaneous release of said operating means, a second trip device in another of said compartments comprising a bimetal element, a biased member having one end supported on the bimetal element of said second trip device, electroresponsive means in said other compartment comprising a fixed magnet yoke supported in said cover and an armature mounted on said biased member, a member pivoted between said compartments having one end disposed adjacent to said resilient latch means and the other end disposed adjacent the armature in said other compartment, thermal bending of the bimetal element of said second trip device operating said pivoted member to cause said pivoted member to engage and bend said resilient latch means and effect release of said releasable operating means, and operation of said electroresponsive means in said other compartment bending said biased member to cause the latter to operate said pivoted member and effect instantaneous release of said releasable operating means.

4. A multi-pole circuit breaker having relatively movable contacts for each pole, means comprising a single member releasable to effect simultaneous opening of said contacts in all of said poles, a trip device for each pole of the breaker, biased latch means mounted on the trip device for one only of said poles and operable by said one trip device to release said releasable means, a lever pivoted between said trip devices operable by another of said trip devices to engage and operate said biased latch means on said one trip device to thereby effect release of said releasable means.

5. A multi-pole circuit breaker having relatively movable contacts for each pole, means releasable to effect

7

automatic opening of said contacts, a trip device for each pole of the breaker, one of said trip devices comprising a bimetal element having a reverse bend therein forming a loop, the high expansion side of said bimetal element being on the outside of said loop, biased latch means mounted on the inside of said loop and operable by said bimetal element to effect release of said releasable means, another of said trip devices comprising a bimetal element having a reverse bend therein forming a loop with the high expansion side of said bimetal element on the inside of said loop, biased means mounted on the outside of the loop on the bimetal element of said other trip device, and a lever pivoted between its ends and operable by the bimetal element of said other trip device for engaging and bending said biased latch means to effect release of said releasable means.

6. A multi-pole circuit breaker comprising a center pole and two outer poles having relatively movable contacts for each pole, means releasable to effect automatic opening of said contacts, a circuit responsive trip device for each pole, biased latch means mounted on the trip device for the center pole only, said biased latch means being operable by said center pole trip device to effect release of said releasable means, a separate member pivotally mounted between the center pole trip device and each of the outer pole trip devices, said separate members being actuated by the trip device for the associated outer pole to operate the biased latch means on the center pole trip device to thereby effect release of said releasable means.

7. A multi-pole circuit breaker having relatively movable contacts for each pole, means releasable to effect automatic opening of said contacts, a trip device for each pole of the breaker, biased latch means mounted on one only of said trip devices, said one trip device when energized in response to overload currents moving in a direction to cause said biased latch means to release said releasable means, another of said trip devices being constructed and arranged so that when energized in response to overload currents it moves in a direction opposite to said one trip device, and a single member pivoted between its ends and operable by said other trip device to engage and bend said biased latch means on said one trip device and effect release of said releasable means.

8

8. A multi-pole circuit breaker having relatively movable contacts for each pole, means releasable to effect automatic opening of said contacts, a trip device for each pole of the breaker, said trip devices each having a magnetic element and a thermal element movable to effect release of said releasable means, said magnetic element and said thermal element for one pole being constructed and arranged to move in the opposite direction from the magnetic element and thermal element of the other pole to effect said release.

9. A multi-pole circuit breaker having relatively movable contacts for each pole, means comprising a single member releasable to effect automatic opening of said contacts for all of said poles, a trip device for each pole of the breaker, said trip devices each having a trip portion movable to effect release of said releasable means, said trip portion for one pole being constructed and arranged to move in the opposite direction from the trip portion for the other pole to effect release of said releasable member, and a trip lever extending between the poles, said trip lever being pivoted at a point between its ends on a fixed pivot and transmitting movement of said trip portion of one pole to the trip portion of the other pole to cause opening of the movable contacts of all poles.

10. A multi-pole circuit breaker having relatively movable contacts for each pole, means releasable to effect automatic opening of said contacts, a trip device for each pole of the breaker, said trip devices each including a bimetal element movable to effect release of said releasable means, a calibrating screw for each bimetal element and said calibrating screws being disposed and arranged relative to said bimetal elements so that when said screws are turned in the same direction they move said bimetal elements in opposite directions.

References Cited in the file of this patent

UNITED STATES PATENTS

1,869,563	Jennings	Aug. 2, 1932
1,966,286	Dorfman	July 10, 1934
2,279,737	Jennings	Apr. 14, 1942
2,638,519	Jackson	May 12, 1953