

March 13, 1951

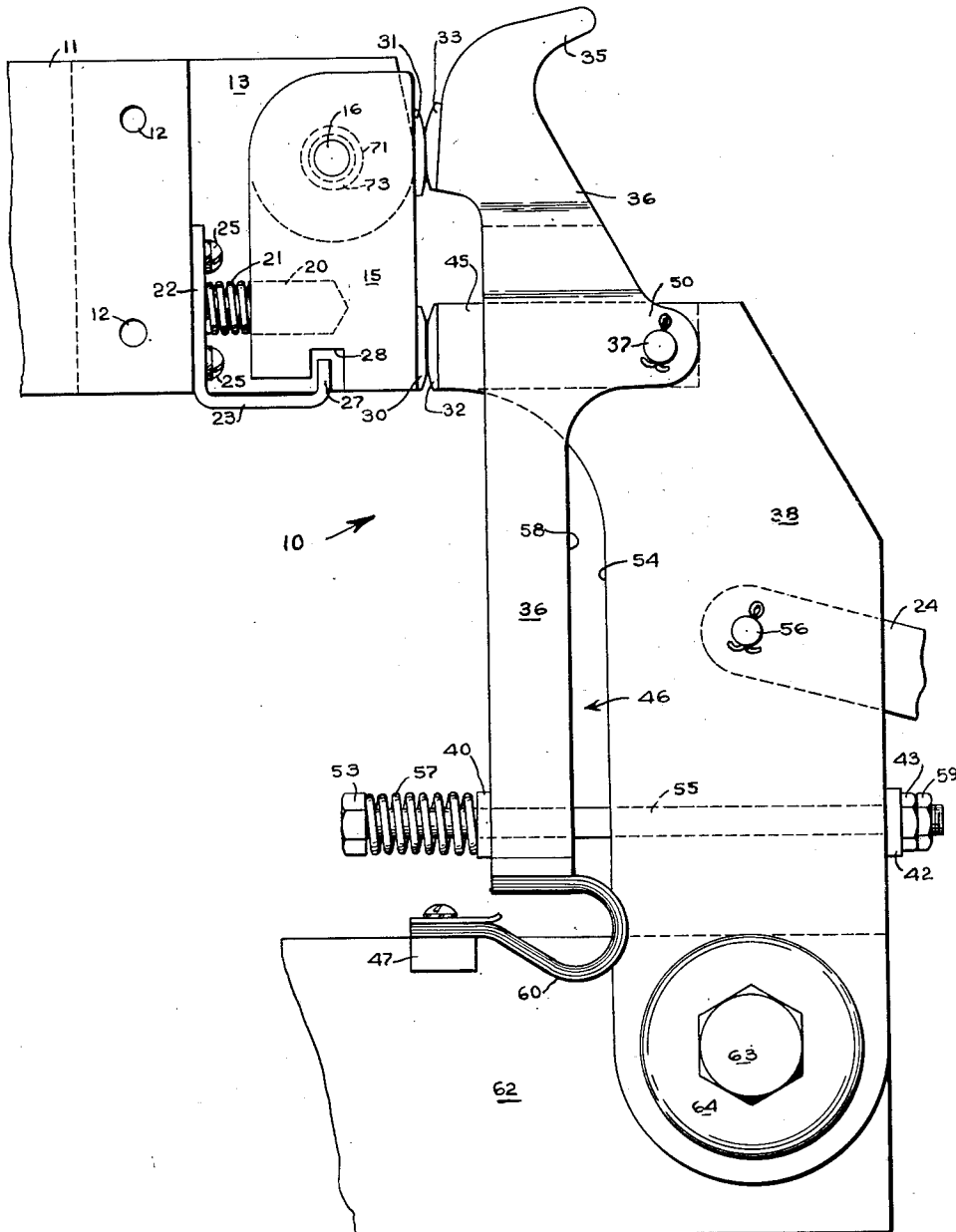
A. S. CASWELL

2,545,341

BLOW ON ARC TIP

Filed April 22, 1944

6 Sheets-Sheet 1



INVENTOR.

A. S. CASWELL

BY

Samuel O. Ostrander
ATTORNEY

Fig. 1

March 13, 1951

A. S. CASWELL

2,545,341

BLOW ON ARC TIP

Filed April 22, 1944

6 Sheets-Sheet 2

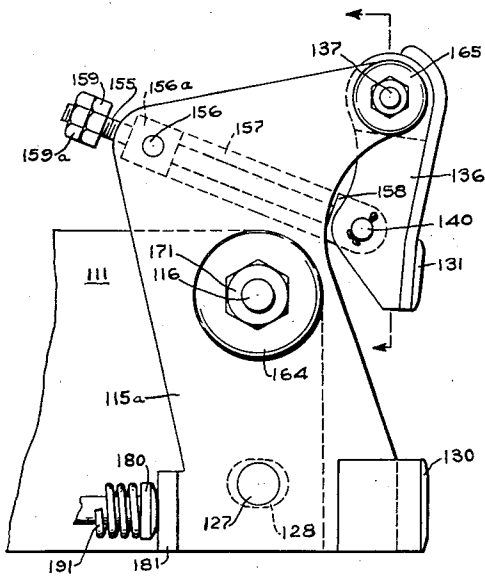


Fig. 4

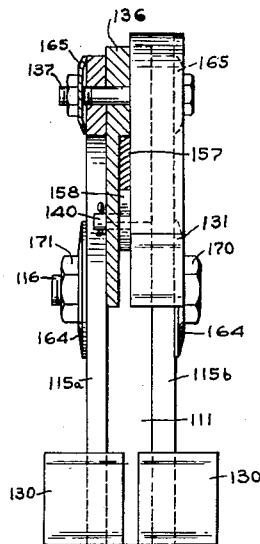


Fig. 5

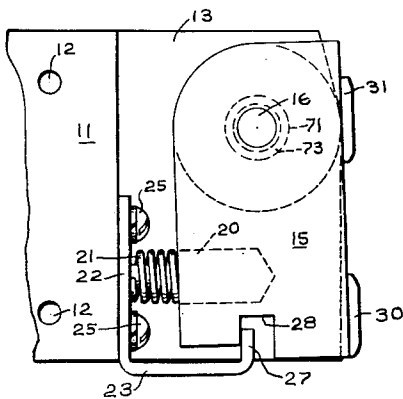


Fig. 1A

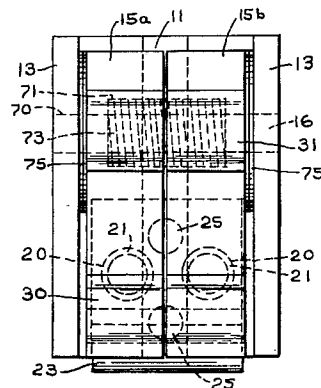


Fig. 2

INVENTOR.
A. S. CASWELL

BY

Samuel C. Holcomb
ATTORNEY

March 13, 1951

A. S. CASWELL

2,545,341

BLOW ON ARC TIP

Filed April 22, 1944

6 Sheets-Sheet 3

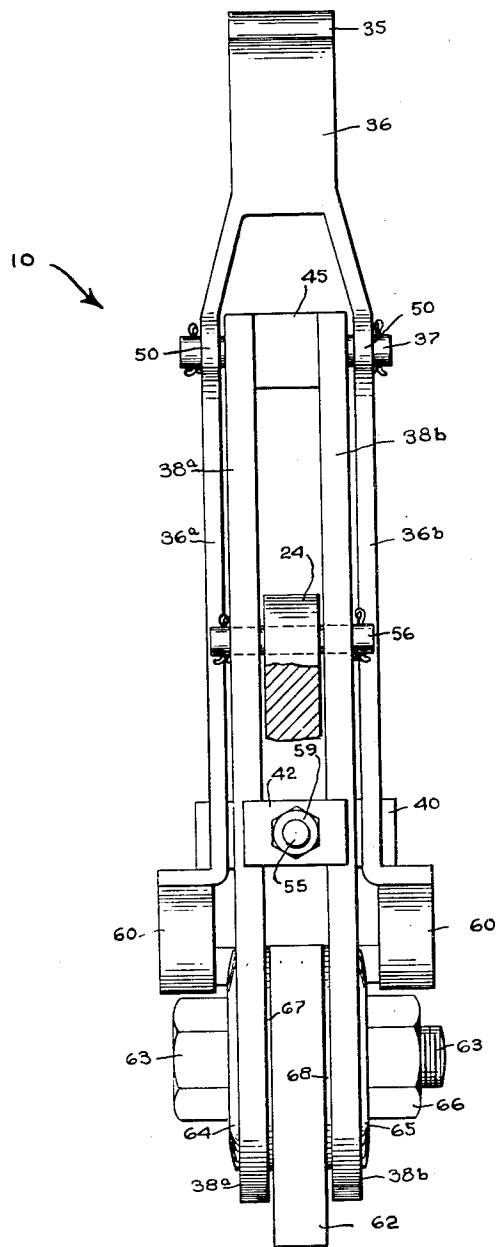


Fig. 3

BY

INVENTOR.
A.S. CASWELL

Samuel C. Peterson
ATTORNEY

March 13, 1951

A. S. CASWELL
BLOW ON ARC TIP

2,545,341

Filed April 22, 1944

6 Sheets-Sheet 4

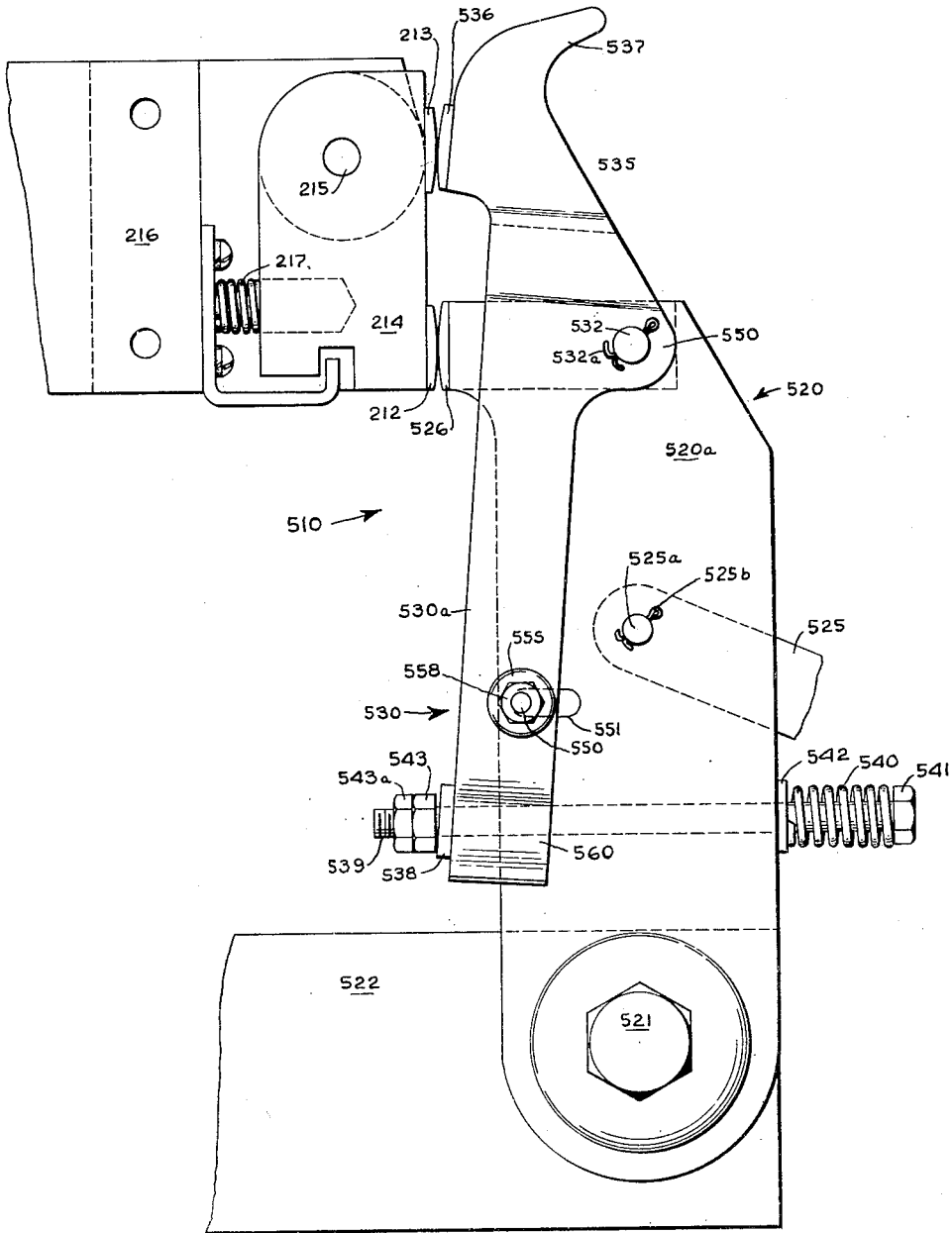


Fig. 6

INVENTOR.
A.S. CASWELL

BY

Samuel Ostrofsky
ATTORNEY

March 13, 1951

A. S. CASWELL

2,545,341

BLOW ON ARC TIP

Filed April 22, 1944

6 Sheets-Sheet 5

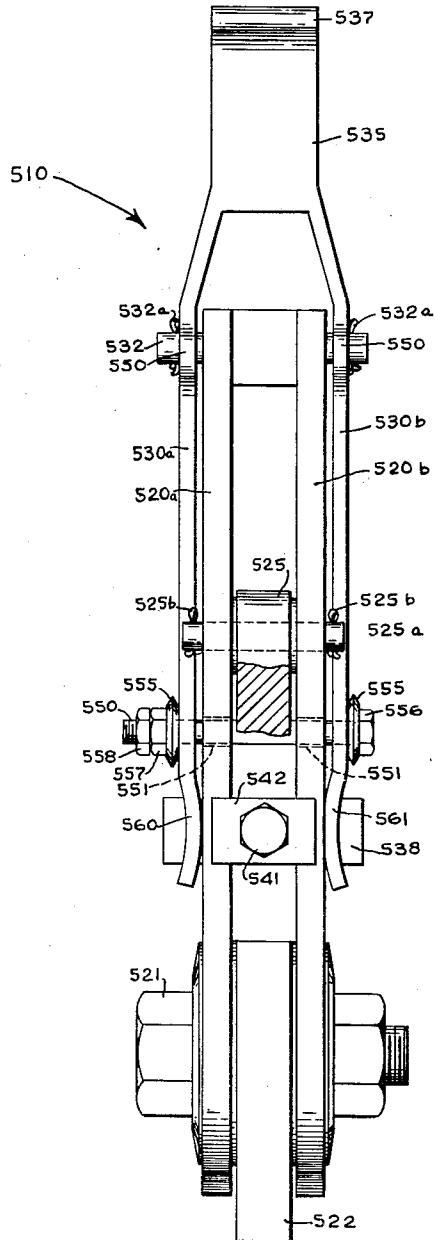


Fig. 7

BY

INVENTOR.
A. S. CASWELL

Samuel Ostrofsky
ATTORNEY

March 13, 1951

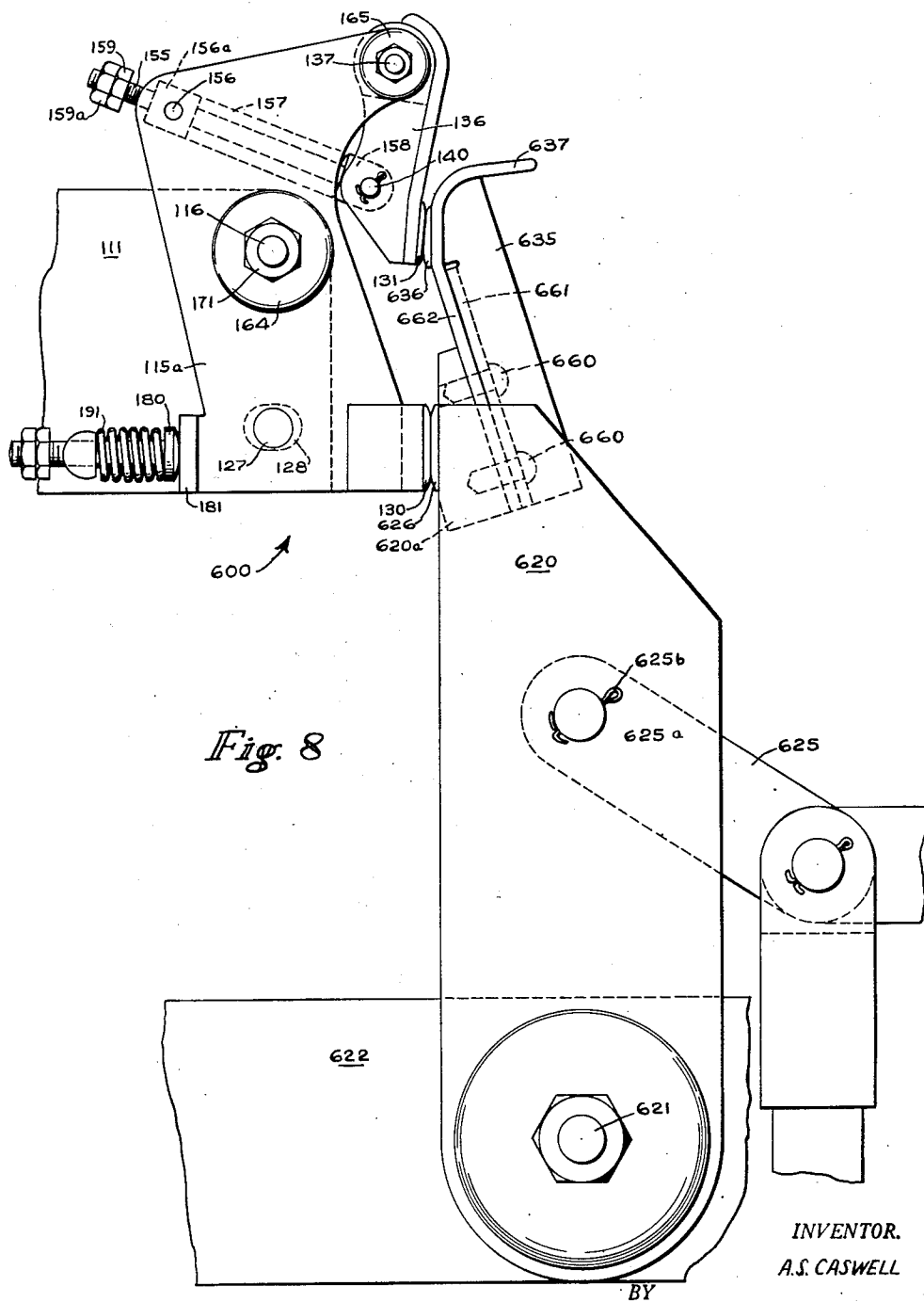
A. S. CASWELL

2,545,341

BLOW ON ARC TIP

Filed April 22, 1944

6 Sheets-Sheet 6



INVENTOR.
A.S. CASWELL

BY

Samuel C. C. C. C.
ATTORNEY

UNITED STATES PATENT OFFICE

2,545,341

BLOW ON ARC TIP

Arthur S. Caswell, Philadelphia, Pa., assignor to
I. T. E. Circuit Breaker Company, Philadelphia,
Pa., a corporation of Pennsylvania

Application April 22, 1944, Serial No. 532,269

3 Claims. (Cl. 200—87)

1

My present invention relates to circuit breaker contact structures and more particularly to a main stationary contact structure for circuit breakers which are constructed to provide a blow-on effect particularly of the arcing contacts; to magnetically blow the arc into the arc chute; and to substantially eliminate pigtailed conducting currents into moving members.

After the main contacts separate in response to a short circuit, it is desirable that the arcing contacts which carry the short circuit currents shall maintain good contact until the instant of separation.

In accordance with my invention, I have so arranged the contact arm that the normal blow off effect of the short circuit current becomes a "blow on" action on the arcing contacts to ensure good contact pressure until the arcing contacts separate.

Accordingly, an object of my invention is to provide a novel blow on effect on the arcing contacts.

In the operation of circuit breakers, it is of course necessary to obtain proper contact pressure between the stationary and the movable contacts. Since the movable contact carrying arm has a positive mechanical movement toward the stationary contact, an unpredetermined variation of even minute extent in the length of the stroke of the moving contact arm due to even slight wear will of course interfere with contact pressure.

Accordingly, it has become common to mount the movable contact on the contact carrying arm so that it may pivot or have some other movement with respect thereto and to spring bias the movable contact outwardly away from the contact carrying arm and toward the stationary contact. This spring bias ensures adequate contact pressure even though the length of the stroke of the movable contact carrying arm may vary slightly.

The pivotal mounting of the contact provides an inadequate current conductor from the contact to the contact carrying arm. Accordingly in the past, to ensure good current conduction, a pigtail connection from the contact to the contact carrying arm or from the contact directly to one of the terminals has been necessary.

Where the movable contact was made a rigid part of the contact carrying arm, it was necessary to make the stationary contact member pivotal or otherwise movable with respect to the stationary conductor and to spring bias the same outwardly from the end of the stationary conductor in order to obtain contact pressure. In this case the pigtail connection was required between the stationary contact member and the stationary conductor.

My invention contemplates the construction of a stationary contact member for a circuit

2

breaker which has a pivotal movement with respect to the stationary conductor and is spring biased outwardly away from the end of the stationary conductor but wherein no pigtail or other shunt connection is necessary in order to provide a current carrying path between the stationary contact and the stationary conductor.

Further, my invention contemplates as an object the provision of means in the mounting of the stationary contact on the stationary conductor for providing a current carrying path directly between the stationary contact and the stationary conductor.

A more specific object of my invention is the provision of means for creating a tight frictional current carrying engagement between the stationary contact and the stationary conductor of a circuit breaker so that a proper current carrying path is provided between them.

While my invention is directed more specifically to the construction and arrangement of a stationary contact member which may be pivotal with respect to the stationary conductor and in which the necessity for pigtail or other shunt connections between the stationary contact and the stationary conductor is eliminated, it will be clear that the structure of the stationary contact may, in appropriate cases, be incorporated in the movable contact structure to perform the same function and to obtain the same results.

My invention also contemplates the arrangement of the arcing contact arm and the mounting thereof in such a manner outside the main contact arm so that the skin effect of the assembly would help the arcing contacts take more current, and, therefore, increase the main contact protection.

A further object of my invention is the arrangement of the arcing contact in such a manner that the inertia thereof will assist in maintaining contact between the arcing contacts during contact opening.

A further object of my invention is the arrangement of the spring and pigtail connections for the arcing contact arm so that they are very near the pivot point of the entire assembly, and so that they will thus have less effect in slowing down the opening speed of the circuit breaker.

The foregoing and many other objects of my invention will become apparent in the following description and drawings, in which

Figure 1 is a side view of a circuit breaker contact structure embodying the principles of my invention.

Figure 1A is a side view of the stationary contact elements embodying the principles of my invention.

Figure 2 is a front view of Figure 1A.

Figure 3 is a front view partly broken away of the movable contact arm of Figure 1.

Figure 4 is a side view of a modified form of a stationary contact member.

Figure 5 is a front view partly broken away of the stationary contact member of Figure 4.

Figure 6 is a side view of a modified form of circuit breaker contact structure embodying substantially the structure of Figure 1 but showing a pigtail-less connection for the arcing contact.

Figure 7 is a front view partially broken away of the movable contact structure of Figure 6.

Figure 8 is a side view of a circuit breaker contact structure showing a movable contact structure adapted to cooperate with the stationary contact of Figure 4.

Referring now to Figure 1, the circuit breaker contact structure 10 comprises an upper stationary terminal 11, to which are secured, by means of appropriate bolts 12, the opposite spaced plate extensions 13, 13 (see also Figure 2). The stationary contact block 15, hereinafter more specifically described, is pivotally mounted on a pin 16 supported between the opposite plates 13, 13.

The contact block 15 is provided with a bore 20 in which the compression spring 21 is positioned. One end of the compression spring 21 bears against the base of the bore and the opposite end of the spring 21 bears against the leg 22 of the positioning bracket 23.

The positioning bracket 23 is secured to the front end of the stationary conductor 11 in any suitable manner, as for instance by the screws 25. Bracket 23 also has a re-entrant extension 27 which enters into a slot 28 in the lower end of the contact block 15 to limit both the outward and inward movement of the contact block 15, as it rotates about the pin 16. That is, when the movable contact is moved away from the stationary contact, the spring 21 drives the lower end of the stationary contact block 15 to the right until the left hand wall of slot 28 bears against the re-entrant flange 27.

The right hand wall of slot 28 ensures that the movable contact block 15 will not be rotated to the left for so great a distance as to result in injury to the spring 21 or damage to the stationary contact structure.

The contact block 15 is provided with a main contact surface 30 and an arcing contact surface 31. The main contact surface 30 is engaged by the movable main contact 32 which is positioned on the movable contact arm 38.

The arcing contact surface 31 is engaged by the movable arcing contact 33. Arcing contact arm 36 is pivotally mounted on the pin 37 carried by the movable contact arm 38 and is provided with an arcing horn 35 along which the arc is magnetically driven. The lower end of the arcing contact arm 36 is provided with a spring bias (hereinafter described) which tends to rotate the arcing contact arm 36 in a counterclockwise direction so that the arcing contact 33 is biased to the left.

The contacts 31 and 33 will therefore engage before the contacts 30 and 32. The arcing contact arm 36, as will more readily be seen in Figure 3, is actually a compound arm 36a and 36b mounted on either side of the movable contact arm 38.

The pin 37 passes through an opening in the movable contact arm 38, and the arcing contact arms 36a and 36b are rotatably mounted on the said pin 37. The two arcing contact arms 36a and 36b are connected by a bridging plate 40. The movable contact carrying arm 38 itself also consists of two arms 38a and 38b (see also Figure

3) which are connected together at their upper end by the contact block 45 so that they operate together.

A bolt 55 is secured in any suitable manner to the center of the bridging plate 40 which interconnects the arcing contact arms 36a and 36b, and this bolt passes between the movable contact carrying plates 38a and 38b and projects beyond the front of the movable contact arm. An additional pin 56 interconnects the two movable contact arms 38a and 38b and pivotally receives the link 24 which operates the contact bridge 33 between the open and closed position by means of an appropriate operating mechanism.

A compression spring 57 surrounds the bolt 55 and is compressed between the bridging plate 40 and the head 53 of the threaded bolt 55. The opposite end of the bolt 55 is provided with a plate 42 which bears against the front surface of the main contact bridge arms 38a and 38b and is secured in place with respect to the plate 42 by means of the nut 43. A locknut 59 maintains the predetermined adjustment. The compression spring therefore biases the arcing contact arm 36 toward counterclockwise rotation so that the movable arcing contact 33 is biased outwardly toward the left of the movable contact arm 38.

A pigtail 60 is connected between the arcing contact arm 36 and the pigtail boss 47. It will, of course, be clear that a separate pigtail 60 is provided on each side. The plates 38a and 38b of the movable contact arm are mounted on either side of the lower stationary conductor 62. A bolt 63 passes through appropriate registering openings in the contact arm plates 38a and 38b, and in the stationary conductor 62.

A spring washer 64 of highly conductive material is placed between the head of the bolt 63 and the contact arm plate 38a on one side of the structure and an additional washer 65 of similar material is placed between the nut 66 of the contact arm plate 38b on the other side of the structure. The nut 66 is tightened and secured in tightened position.

Contact arm 38 comprising plates 38a and 38b now has rotative movement around the shaft of the bolt 63. The inner surfaces of the plates 38a and 38b are in tight frictional engagement with the outer surface of the lower conductor 62, thus creating an appropriate current carrying path between the movable contact arm 38 and the lower conductor 62.

In order further to ensure an appropriate current carrying relationship between the lower conductor 62 and the lower ends of the plates 38a and 38b, additional washers 67 and 68 may be placed between the lower conductor 62 and the plates 38a and 38b.

The current carrying path between the contact arm 38 and the lower conductor 62 is essentially a divided path. A portion of the current passes from the outer surface of each of the plates 38a and 38b to the spring washers 64 and 65, then to the head of the bolt 63 and the nut 66, then to the shaft of the bolt and through the shaft of the bolt to the lower conductor 62. The remainder of the current passes directly from the inner surfaces of plates 38a and 38b through the washers 67 and 68 to the surface of the lower conductor 62. By this means a pigtail connection between the movable contact arm 38 or the movable contact 32 to the lower conductor 62 is obviated.

The pigtail 69 between the arcing contact arm 36 and the movable contact arm 38 may be ob-

viated in a similar manner by providing for a similar mounting at 37 of the contact arm 36 on the movable contact arm 38, although in order to provide a freely rotatable bearing surface at 37, the actual current path in Figure 1 is provided by the pigtail 60 in Figure 1.

As seen more particularly in Figure 2, the stationary contact block 15 is made up of two contact fingers 15a and 15b. Contact fingers 15a and 15b are rotatably mounted on the pin 16 between the plates 13, 13 as above pointed out. Each of the contact fingers 15a and 15b is provided with a lateral opening 70 through which the pin 16 passes.

The inner surface of each of the contact blocks 15a and 15b is counterbored at 71 to produce two co-axial and adjacent openings which register with each other to form a single continuous housing for the compression spring 73. Compression spring 73 bears against the opposite bases of the counterbore 71 to drive the contact fingers 15a and 15b apart. A spacer washer 75 of highly conductive material is provided around the pin 16 between the outer surface of each of the contact fingers 15a and 15b to provide an efficient current carrying path between the respective contact fingers to the plates 13, 13. The compression spring 71 thus ensures that the contact block 15 comprising the contact fingers 15a and 15b will be in appropriate current carrying relationship with the plates 13, 13 and hence with the upper stationary conductor 11.

By this means therefore, although the main stationary contact 30 is pivotal around the pin 16 and is provided with a spring bias urging it away from the upper stationary conductor 11, nevertheless a pigtail connection from the main stationary contact 30 to the upper stationary conductor 11 is made unnecessary. The spring 71 and the spacer washers 75 provide for such a current carrying path. Since the main stationary contact 30 is thus provided with the necessary spring bias to ensure appropriate contact pressure, the main movable contact 32 may be rigidly secured to the movable contact arm 38.

Since, however the stationary arcing contact tip 31 is mounted on that portion of the contact block 15 which has relatively the smallest amount of rotation and has substantially no inward or outward movement with respect to the upper stationary conductor 11, the movable arcing contact 33 is mounted on the pivotal arm 36 and is provided with the necessary spring 57 to ensure proper arcing contact pressure.

As will now be obvious, when the circuit breaker is open, the arcing contact 33 is rotated to a substantial extent counter-clockwise with respect to the movable contact arm 38 by means of the spring 57 so that the arcing contact tip 33 projects substantially beyond the movable main contact 32.

Accordingly on a closing operation of the circuit breaker the arcing contacts 31 and 33 will meet first. On completion of the closing movement however the main movable contact 32 moves into engagement with the main stationary contact 30, the contact block 15 is rocked about its pivot 15 compressing spring 21 until the right hand side of slot 28 engages re-entrant flange 27. At the same time the spring 57 on the movable contact arm which applies the necessary bias to the arcing contact tip 33 is progressively compressed.

On the initiation of the opening movement of the movable arm 38, movable contact 32 will

move to the right followed by contact 30 under the action of spring 21 until the left wall of the slot engages projection 27. Thereafter contact 32 will separate from the stationary main contact 30 while the spring 57 maintains the movable arcing contact tip 33 in engagement with the stationary arcing contact tip 31. When the base of the U-shaped bracket 40 moves into engagement with the back surface of the movable contact arm 38, then the movable arcing contact will be withdrawn from engagement with contact 31. It will thus be seen that the arcing contacts open last in order to protect the main contact surfaces. This is obtained of course by the spring bias of compression spring 57, as above pointed out.

This result is also obtained, however, by reason of the mechanical arrangement of the arcing contact arm 36. As is well known, current in the loop formed by the conductor 62, the contact arm 38 and conductor 11 provides a magnetic force tending to rotate the movable arm 38 clockwise about its pivot. On short circuit this blow off action assists in the disengagement of contacts 32 and 30.

This same magnetic action acting on arm 36 will provide a rotative force on the arcing contact arm 36 driving the part of the arm below pivot 37 in a counterclockwise direction, and the part of the arm above pivot 37 in a clockwise direction. However, since leverage for the portion below the pivot 37 includes not only the arm 36 but also the pigtail 60 extending down to the conductor 62, the total force providing the counterclockwise rotation about pivot 37 is greater than the force tending to produce a clockwise rotation.

Accordingly, the net magnetic force of the short circuit current is to drive the arcing contacts 31 and 33 into engagement while the main contacts separate. This force added to that produced by the compression spring 57 already described insures a firm arcing contact engagement during the initiation of contact separation.

Thus the arc will be drawn at the arcing contacts only and the main contacts will be protected.

The design of the stationary contacts as has above been pointed out obviates the necessity for any pigtail or shunt connections of any kind whatever. These contact structures have been found under test to operate efficiently with only normal temperature rise. The only possible disadvantage which at least for the present is theoretical rather than actual, is that the two parallel fingers carrying the parallel currents may be magnetically attracted under conditions of very high short circuit to such an extent that they may be pulled out of contact. The construction shown in Figures 4 and 5 obviates even this possibility. In Figures 4 and 5 I have shown a modified form of stationary contact structure within the spirit of my invention. It is sufficient to point out, however, that the movable contact members which cooperate with the stationary contact members shown in Figures 4 and 5 are fully rigid—that is, both the movable arcing and movable main contact are rigidly secured to the movable contact arm.

In Figure 4, the upper stationary conductor or main connection stud is a simple rectangular bar 111. A pair of contact arms 115a and 115b are mounted on either side of the upper connected stud 111 and are rotatably secured thereto by means of the bolt 116 which passes through the

opposite arms 115a and 115b and through the connection stud 111. A spring washer 164, 164 is mounted on either side between the head 170 of the bolt 116 and contact plate 115b and between the nut 171 of the bolt 116 and the contact plate 115a. Contact plates 115a and 115b are provided at their lower end with the main stationary contact tips 130, 130. An appropriate current carrying path, as above pointed out, is provided from the main stationary contact tips 130 through the plates 115a and 115b to the conductor 111, so that no pigtail or shunt connecting members are required.

An appropriate contact pressure is provided for by means of the pin 180 which bears against the flange 181 on each of the plates 115a and 115b on each side of the conductor 111. The pin 180 is biased for movement toward the flange 181 in order to obtain the necessary contact pressure by means of the compression spring 181. A bolt 137 passes between the plates 115a and 115b at the upper end of each thereof and supports the stationary arcing contact 136 at the end of which the stationary arc tip 131 is located. The bolt 137 is also provided with spring washers 165 so that on tightening of the bolt, appropriate current carrying engagement is created between the arcing contact member 136 and the plates 115a and 115b.

A pin 156 is mounted between the plates 115a and 115b at the upper left end thereof. The said pin supports a block 156a through which the link 155 passes. Link 155 is pivotally connected at the opposite end to the pin 140 passing between the arcing contacts 136. A compression spring 157 is mounted between the block 156a and a boss 158 on the link 155 adjacent the arcing contacts 136. The compression spring thus tends to rotate the arcing contact 136 counterclockwise so that the arcing contact tip 131 tends to move outwardly. This outward movement is limited by the adjustable nut 159 mounted on the outer threaded end of the link 155 which may be secured in appropriate adjusted position by the locknut 159a. It will here be obvious that as the movable contact arm brings the movable contacts into engagement with the stationary contacts, the movable arcing contact will first engage the stationary arcing contact 131. Then on continued movement toward closing position of the movable contact arm, the spring 157 will be compressed so that the stationary arcing contact tip 131 will move to position shown in Figure 4, whereupon the main stationary contact 130 will be engaged by this complementary contact.

On continued movement of the movable contact arm, the contact plates 115a and 115b will be rotated counterclockwise around the pivot 116 to compress the spring 181, thus ensuring appropriate contact pressure. The current from the plates 115a and 115b will pass readily to the stationary conductor 111 by means of the bolt 116 and the washers 164 as above pointed out. Similarly the current from the arcing contact 136 will pass to the plates 115a and 115b by means of the bolt 137 and the spring washers 165, as above pointed out, and thence also to the conductor 111. By this means therefore the necessity for utilization of any pigtail or shunt connections in the entire circuit breaker contact structure is obviated.

Also, it will be seen that since the contact plates 115a and 115b are on the outside of the stud 111 and of the arc tip 131, parallel current will pull them together and increase the contact pres-

sure thus avoiding the theoretical disadvantage of the structure shown in Figure 2.

The contact plates 115a and 115b are limited in movement with respect to the conductor 111 by reason of the fact that the conductor 111 is provided with a reinforced slot 123 passing therethrough and which engages the pin 127 in each of the plates 115a and 115b. The cooperation of the pin 127 and the slot 123 will limit inward and outward movement of the plates 115a and 115b in the manner similar to that described in connection with the slot 28 and the re-entrant extension 27 of Figure 1, and for the purposes therein set forth.

The arcing contact arm plates 36a and 36b are each provided with a frontwardly projecting lug 59, through which the mounting pin 37 passes, which secures them to the main movable contact arm 38.

The main movable contact arm 38 is provided with a rearward extension 52 at the end of which the main movable contact 32 is mounted. This extension is so arranged that a substantial clearance 46 is provided between the rear surface 54 of the main arm 38 and the front surface 58 of the arcing contact arm 36.

To ensure a good conducting path for short circuit currents, the arcing contact arm 36 is connected by the pigtail connections 60 to the lower conductor 62.

As will also be obvious, the current in the contact arm 38 is in the same direction as in the arcing contact arm 36. Thus, the lower end of arm 36 below the pivot point 37 is attracted magnetically to the arm 38.

The provision of the clearance 46 between these arms, by reason of the shape thereof, causes this attraction to exert a counterclockwise force on the end of the arcing contact arm 36 below the pivot 37. This, of course, increases the contact pressure between the arcing contact tips 31 and 33.

By this means, therefore, when main contact separation occurs under short circuit conditions (due to the current which still flows over arm 36 and through pivot 37) this arrangement further ensures that the arcing contacts will continue to remain in engagement for the longest possible period after the main contacts have separated.

As will also now be clear, the portion of the arcing contact arm 36 below the pivot point 37 being substantially greater than the portion of the arm 36 above the pivot point 37, the magnetic forces produced by the current loop reacting on the portion of the arm 36 below the pivot point 37 causes a further blow on effect.

In addition, it will be obvious from Figures 1 and 3 that the arcing contact arms 36a and 36b are outside the main bridging plates 30a and 30b, so that the skin effect of the assembly would help the arcing contacts take more current and increase the main contact protection.

Furthermore, the portion of the arcing contact arm 36 above the pivot point 37, owing to its position (its mass is closer to the pivot 37 than is the mass of the portion of the arm below the pivot 37), has a greater inertia effect than that portion of the arcing contact arm 36 below the pivot point 37 and thus aids in maintaining the arcing contacts in engagement during the opening of the circuit breaker.

Furthermore, the spring 57 and the pigtail 60 of the arcing contact arm 36 are very near the assembly pivot 63, so that they have less effect

in slowing the opening speed of the circuit breaker as a whole.

In addition, this structure has the advantage that the direction of the current in the moving arcing tip is in the direction to drive the current to the upper end of the tip, by its own magnetic field, thus hastening the movement of the arc into the arc chute (not shown) and its rupture there.

Usually in an air circuit breaker or contactor, the arcing tips are provided with magnetic blow out coils to quickly drive the arc to the top of the arcing tip and into the arc chute. This action is aided by the shape of the arc tip, shown in Figure 1, and is a decided improvement over the usual "inverted" arc tip.

It should, of course, be recognized that this type of contact arrangement may be as important for an ordinary contactor as it is in a circuit breaker.

In the usual power system, a feeder breaker is used to distribute power to a load consisting of one or more motors. The circuit breaker is primarily for the purpose of providing fault protection and is designed to interrupt any short circuit that may develop. At each motor, there is installed a contactor which is provided with an overload device, usually in the form of a thermal overload relay, having a long time delay corresponding to the heating curve of the motor. The contactor is designed to open overloads a large number of times but is not designed to open short circuits.

Should a short circuit occur on the load side of the contactor, the operation requires that the contactor remain closed and that it should not attempt to open the circuit. The contactor is thus required to carry the short circuit current without opening. It is, therefore, important that the contacts of the contactor do not blow open due to this high current.

Accordingly, a contactor may be constructed, substantially in the form shown in Figure 1, to have the blow on effect herein described.

In Figure 6 I have shown a modified form of the moving contact structure of the circuit breaker of Figure 1. The essential distinction between the structures of Figures 1 and 6 is that the movable member is pigtail-less.

The contact structure 510 comprises a main stationary contact 212 and a stationary arcing contact 213 mounted on a stationary contact block 214, which, in turn, is pivotally mounted at 215 on the upper stationary conductor 216. The stationary contact structure of Figure 6 is identical with the stationary contact structure of Figure 1.

The movable contact bridge 520 is pivotally mounted at 521 on the lower conductor 522. Movable contact bridge 520 is operated between open and closed position by means of an appropriate operating mechanism connected thereto by the link 525 which is controlled by any well-known tripping mechanism of a circuit breaker.

Link 525, as shown in Figures 6 and 7, is connected between the plates 520a and 520b of the movable contact bridge 520 by a pin 525a passing through suitable matching openings in the plates 520a and 520b; and the link 525 is secured in position by cotter pins 525b.

Movable contact bridge 520 carries the main movable contacts 526 which engage the main stationary contacts 212.

The arcing contact arm 530 is pivotally mounted on the movable contact bridge or arm 520 by means of the pin 532.

As may more readily be seen in Figure 7, the arcing contact lever 530 comprises a pair of arms 530a and 530b mounted on the outside of the movable contact bridge 520 and pivotal with respect thereto.

The arms 530a and 530b are interconnected at their upper ends by the arcing contact member 535 which carries the movable contact tip 536 and the arcing horn 537 along which the arc is magnetically driven.

The lower ends of the arms 530a and 530b are interconnected by the plate 538 which is provided with an appropriate opening through which the bolt 539 passes.

The opposite end of the bolt 539 is provided with a plate 542 which bears against the front surface of the main contact bridge arms 520a and 520b.

A compression spring 540 is mounted between a head 541 of the bolt 539 and the front plate 542.

The end of the bolt 539 opposite the head 541 and outside the plate 538 is provided with a nut 543 and a lock nut 543a which maintains compression of the spring 540.

It will thus be seen that the compression spring 540, acting between the head 541 of the bolt 539 and the plate 542, biases the arcing contact arm 530 toward counterclockwise rotation, so that when the contactor or circuit breaker is in open circuit position, the arcing contact 536 projects substantially beyond the lower main movable contact 526.

The arcing contact arm plates 230a and 230b are each provided with a frontwardly projecting lug 550 through which the mounting pin 532 passes which secures them to the main movable contact bridge 520. The pin 532 is held in position by the cotter pins 532a.

The pivot or mounting of the main contact arm 520 at 521 on the lower conductor 522 is exactly the same as that described for the similar mounting of the lower end of the contact arm of Figure 1 on the lower conductor—that is, a tight pigtail-less connection is provided.

However, instead of the pigtail connection between the arcing contact arm and the lower conductor which is shown in Figure 1, a similar pigtail-less connection is provided between the arcing contact arm 530 of Figure 6 and the main contact arm 520.

A bolt 550 passes through matching slots 551 in the plates 520a and 520b of the contact arm 520 and through appropriate openings in the plates 530a and 530b of the arcing contact arm.

The slots 551 in the plates of the main contact arm 520 are sufficiently long as to permit the desired maximum rotation of the arcing contact arm 530 with respect to the main contact arm 520.

Spring washers 555 are provided between the head 556 of the bolt 550 and the securing nut 557 of the bolt and are tightened against the outside surfaces of the plates 530a and 530b of the arcing contact arm 530 by the nut 557 which is then secured in position by the lock nut 558.

The lower ends of the plates 530a and 530b of the arcing contact arm 530 are inwardly curved at 560 and 561 to provide a pressure contacting surface for these plates to make contact with the surfaces of plates 520a and 520b of the main contact arm 520. Tightening of the nut 557 and the lock nut 558 of the bolt 550 will draw these curved extensions of the arcing contact arm plates inwardly toward each other into tight contacting current carrying engagement with the plates of

the main contact arm. By this means, therefore, a pigtail connection between the arcing contact arm and the lower conductor is obviated.

The principles, however, which govern the operation of the contact structure of Figures 6 and 7 are the same as those which govern the operation of the contact structure of Figure 1, and all of the previous discussion with respect to Figure 1 applies to the construction of Figures 6 and 7.

In Figure 8 I have shown a moving contact structure adapted to cooperate with the stationary contact structure of Figures 4 and 5.

The stationary contact structure 600 is exactly the same in every respect as that shown in Figures 4 and 5. Since the stationary contact structure has an arcing contact which may pivot with respect thereto, the moving contact structure may be an arcing contact which is rigidly affixed to said moving contact structure.

The moving contact structure comprises a contact arm 620 which may preferably be composed of a pair of plates which are bridged together by the cross-piece 625a on which the main moving contact 626 is mounted. The lower ends of the plates which form the moving contact arm 620 are secured at 621 to the lower conductor 622 in the manner described in connection with Figures 1 and 6.

An operating link 625 is connected to the pin 625a secured between the plates of the movable contact arm 620 and held in position by the cotter pins 625a. The operating link 625 may be connected to any suitable operating mechanism, as previously described.

The movable arcing contact 635 is secured to the bridging plate 620a of the arm 620 by means of bolts 660 passing through the clamping plate 661 and the flange 662 of the arcing contact 635 into the bridging plate 620.

The arcing contact member 635 carries a movable arcing contact 636 and an arcing horn 637 for purposes previously described.

In the embodiment here shown in Figure 8, the arcing contact structure 635 is thus rigidly connected and has no motion with respect to the movable contact arm 620, since the stationary arcing contact 131 is movably mounted, as previously described in connection with Figures 4 and 5. Thus, the arrangement of the stationary contact of Figure 4 permits the use of a simplified movable contact structure as above described.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the structure, arrangement and uses of my invention 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.

I claim:

1. In a circuit breaker having a first movable arm, a main contact mounted on said movable arm, a second movable arm pivotally mounted on said first movable arm, an arcing contact on said second movable arm, cooperating contact means for said main and movable contacts, studs connected to said cooperating contact means and arms, said studs, contacts and first movable arm forming a U-shaped loop, said second movable arm having an elongated portion extending within said U-shaped loop generally parallel with said first movable arm and forming a parallel electrical path therewith whereby a mutual magnetic attraction urges said first and second arms

toward each other and in the same direction as the magnetic forces tending to extend the loop.

2. In a circuit breaker having a first movable arm, a main contact mounted on said movable arm, a second movable arm pivotally mounted on said first movable arm, an arcing contact on said second movable arm, cooperating contact means for said main and movable contacts, studs connected to said cooperating contact means and arms, said studs, contacts and first movable arm forming a U-shaped loop, said second movable arm having an elongated portion extending within said U-shaped loop generally parallel with said first movable arm and forming a parallel electrical path therewith whereby a mutual magnetic attraction urges said first and second arms toward each other and in the same direction as the magnetic forces tending to extend the loop, the distance from the pivot of said second arm to said arcing contact being smaller than from said pivot to the end of said second movable arm opposite the end on which said arcing contact is mounted.

3. In a circuit breaker having a first movable arm, a main contact mounted on said movable arm, a second movable arm pivotally mounted on said first movable arm, an arcing contact on said second movable arm, cooperating contact means for said main and movable contacts, studs connected to said cooperating contact means and arms, said studs, contacts and first movable arm forming a U-shaped loop, said second movable arm having an elongated portion extending within said U-shaped loop generally parallel with said first movable arm and forming a parallel electrical path therewith whereby a mutual magnetic attraction urges said first and second arms toward each other and in the same direction as the magnetic forces tending to extend the loop, the distance from the pivot of said second arm to said arcing contact being smaller than from said pivot to the end of said second movable arm opposite the end on which said arcing contact is mounted, and a movable member for said pivotal support for moving said movable contact out of engagement with said cooperating contact.

ARTHUR S. CASWELL.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,395,327	Aalborg	Nov. 1, 1921
1,395,348	MacNeill	Nov. 1, 1921
1,560,308	Perry	Nov. 3, 1925
1,762,604	Ainsworth	June 30, 1930
1,763,027	Wilms	June 10, 1930
1,804,628	MacNeill	May 12, 1931
1,935,428	Atwood	Nov. 14, 1933
2,055,114	Woernley	Sept. 22, 1936
2,214,471	Ludwig et al.	Sept. 10, 1940
2,227,160	Seaman	Dec. 31, 1940
2,285,890	Blosser	June 9, 1942
2,328,318	Wood	Aug. 21, 1943

FOREIGN PATENTS

Number	Country	Date
182,315	Great Britain	July 6, 1922
541,281	Great Britain	Nov. 20, 1941
546,435	Great Britain	July 14, 1942
834,884	France	Sept. 5, 1938