

April 10, 1951

W. W. BROCKWAY

2,547,998

IMPULSE RELAY

Filed Nov. 3, 1945

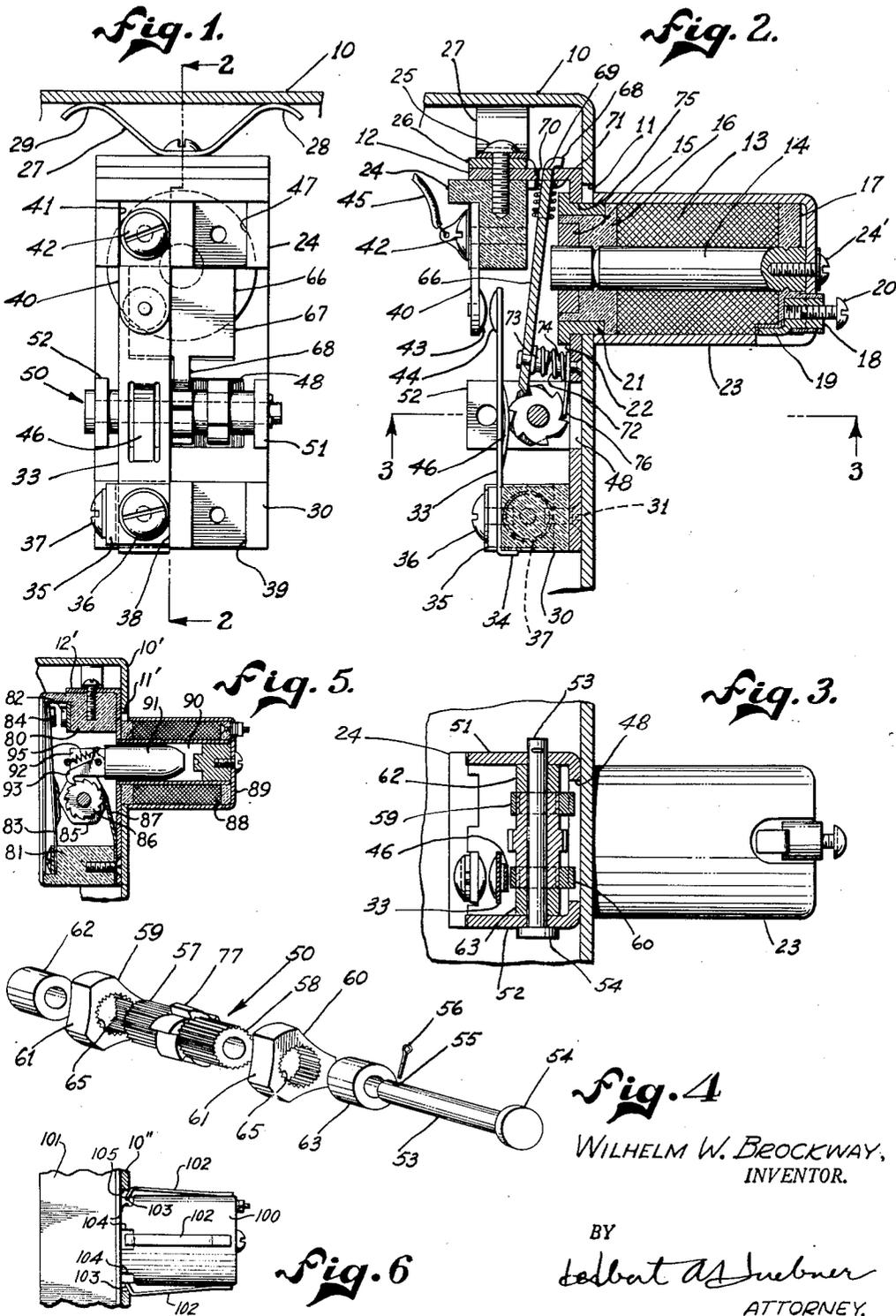


Fig. 4  
WILHELM W. BROCKWAY,  
INVENTOR.

BY  
Robert A. Schubner  
ATTORNEY.

# UNITED STATES PATENT OFFICE

2,547,998

## IMPULSE RELAY

Wilhelm W. Brockway, Los Angeles, Calif.

Application November 3, 1945, Serial No. 626,513

2 Claims. (Cl. 200—105)

1

The invention relates to electric apparatus and has particular reference to an impulse relay mounted in a conventional outlet box provided with knock-out holes. Although the design of electric apparatus and particularly switches and relays has been conventionalized to a large extent, there is an ever present need of simplifying structures of this kind so that they can be made economically and can be installed with a minimum expenditure of man hours of a mechanic's time.

It is accordingly among the objects of the invention to provide a new and improved relay device which is sufficiently compact so that it can be fitted to the knock-out hole of a standard conduit outlet box, provision being made for a low voltage connection outside and a high voltage connection sealed within the box.

Another object of the invention is to provide a new and improved impulse relay device wherein parts are held in place without the use of screws so that it may be quickly assembled and disassembled.

Still another object of the invention is to provide a new and improved impulse relay device necessitating the use of but a single screw in the initial assembly and having the parts so constructed that they are spring-located in assembled relationship permitting ready disassembly by contracting the spring to free one part from its engagement with another.

A further object of the invention is to provide an impulse relay incorporating an armature which is so mounted that it moves bodily against the resistance of springs, thereby reducing frictional resistance to a substantial minimum.

A still further object of the invention is to incorporate a snap-action contact in an impulse relay which is adjustable to a wide variety of contact combinations without necessitating any change in the operation of the armature.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in the claims and illustrated in the accompanying drawings, in which:

Figure 1 is an end elevational view of the device.

2

Figure 2 is a longitudinal sectional view of the device taken on the line 2—2 of Figure 1.

Figure 3 is a cross-sectional view of the device taken on the line 3—3 of Figure 2.

Figure 4 is an exploded view of an adjustable composite shaft incorporating a ratchet wheel and cam wheels.

Figure 5 is a longitudinal sectional view of a modified form of the device.

Figure 6 is a side view, partly in section, of a modified form of a coil cover.

Although considerable attention in the past has been directed to the simplification of manually operated electric switches there has been considerable resistance to changes in devices designed for automatic operation. Much of this resistance has been due to the feeling that unless automatic devices are of rugged construction they do not incorporate a sufficient safety factor to be installed in remote or inaccessible places where servicing may be difficult and infrequent. To provide an automatic switch which incorporates a sufficient safety factor and at the same time is of simple and inexpensive construction requires that careful attention be given to operating parts so that they have a freedom of operation while at the same time are so designed and are so assembled that they cannot readily get out of order. It is also highly desirable in apparatus of this kind to provide a simple assembly process so that the parts fit more or less automatically into their proper places with respect to each other and need be secured by only one or two tightening devices such as screws so that the likelihood of placing undue strain upon delicate parts when assembling or mounting is reduced to a negligible quantity.

An important application of a device of the kind described herein is its use in a normal house lighting circuit. It is contemplated that the impulse relay will be located in the light fixture box and connected to a push button switch adapted to momentarily close the circuit, such for example, as the push button switch disclosed in my co-pending application, Serial No. 626,512 filed November 3, 1945, now Patent No. 2,546,086, March 20, 1951.

Used in this manner the impulse relay eliminates conduit and high voltage wires between the light outlet and the switch. Inasmuch as only a normal door bell transformer circuit is

needed to operate the impulse relay carrying no more than 24 volts, ordinary door bell wire may comprise the only connection between the push button switch and the relay. The 110 volt wires can be led directly to the relay terminals within a suitable outlet box.

It will be apparent, also, that complex two, three and four way light switching circuits involving multiple wire connections and conduit may be replaced with equal facility by open run bell wire. In this set-up push buttons may be in parallel at the respective control points in the house. Normal prohibitive multiple switch costs are minimized, and any number of light control points can be used with only the added cost of extra switches.

Another important consideration is the fact that high voltage light circuits are connected to the relay within the outlet box. A low voltage circuit, although connected to the device, is secured to binding posts on the exterior. Insertion of the relay in a knockout hole plugs the knockout hole and satisfies necessary safety requirements.

In an embodiment chosen to illustrate a simplified device incorporating requisite safety factors, there is shown an impulse type relay assembly adapted to fit into outlet box 10 which has a conventional knockout hole 11 of the usual size, as small as, in some instances,  $\frac{7}{8}$ ". The relay device consists of two main operations, one constituting a mechanical device mounted upon a frame 12 and the other constituting an electric coil assembly 13.

The electric coil comprises a core 14 having a shaded pole 15 at one end held in place with relation to the core and coil by a molded plastic disk 16. At the other end of the coil is a similar molded plastic disk 17 in which is molded a terminal post 18 having a lateral extension 19 and a terminal screw 20.

A mounting ring 21 is secured in place around the shaded core from which it is insulated by a portion of the plastic disk 16. The ring is provided with a flange 22 for mounting purposes. It will be noted that the diameter of the flange is slightly smaller than the diameter of the knockout hole 11 so that the mounting ring may be passed through the hole. A coil cover 23 surrounds the coil and extends into a position surrounding the small end of the mounting ring and is held in place by a screw 24 which extends into the core 14. When the coil and cover are mounted upon the box the cover, together with the other metallic parts of the device, complete a magnetic circuit around the coil. It should be borne in mind, however, that the cover is preferably not applied to the coil until after the parts of the device are assembled.

The remaining parts of the impulse relay construction are all supported by the frame 12. Included among the parts is a mounting block 24 of dielectric material which is attached to the upper side of the frame by means of an assembly screw 25. Also attached to the frame by means of the same screw is a spring keeper 26 and a spring 27. It will be noted that the spring is provided with arcuately extending wings 28 and 29 designed to contact the inside surface of the top wall of the box 10.

At the other end of the frame is a similar mounting block 30 likewise of dielectric material which may be held in place by a flathead screw 31. Mounted upon the block 30 is a contact arm 33 having an overhanging portion 34 pressed

against the lower side of the block. The contact arm is retained by an angle element 35 held in place by screws 36 and 37. The block is provided with a recess 38 for the contact arm so that it cannot slip from its proper place. A second recess 39 is also provided within which another contact arm may be placed whenever desired.

On the other block 24 there is mounted a contact arm 40 received in a recess 41 and retained therein by a screw 42. A similar recess 47 is provided in the event a second set of contact arms may be used. The contact arm 40 has a point 43 adapted to engage a corresponding point 44 on the other contact arm so that a suitable electric contact can be made whenever the points are brought together. The screw 42 serves as a binding post for an electric lead 45, and the screw 37 provides a binding post a lead on the opposite side of the points. The contact arm 33 has a central depressed portion 46, the purpose of which will be described later.

Associated with the contact arm 33 is a composite shaft 50, shown in detail in Fig. 4, and adapted to be supported by brackets 51 and 52, at the sides of the frame intermediate the mounting blocks. The composite shaft comprises a shaft pin 53 having a head 54 at one end and a cotter pin aperture 55 at the other end in which may be inserted a cotter pin 56. The pin 53 extends through suitable holes in the brackets 51 and 52.

Mounted upon the pin is a ratchet wheel 71 which has serrated lateral extensions 57 and 58. At the sides of the ratchet wheel are cam wheels 59 and 60 having flats 61, three in number in this example for the sake of illustration, spaced equidistant about the circumference of the wheel. The number of teeth on the ratchet wheel normally will have a direct relation to the number of flats on the cam wheels. A cut-out portion 48 in the frame provides a space in which the cam wheels may rotate unrestricted. Collars 62 and 63 are adapted to fit between the respective cam wheels and adjacent brackets thus completing the composite shaft. The cam wheels are provided with serrated interiors 65 so that they may be adjusted upon the cam wheel with respect to each other and with respect to teeth on the ratchet wheel. The construction just described contemplates the substitution of a ratchet wheel or cam wheels or both having a different number of teeth or flats to allow a variation in the operating effect.

A combination actuator and armature 66 is adapted to rotate the composite shaft by means of the ratchet wheel. The armature consists of a relatively wide section 67 and a narrow actuating end 68 having a tapered edge which is adapted to engage the teeth of the ratchet wheel one by one. At its other end the armature is provided with a finger 69 which extends through a suitable hole in the end of the frame not shown but of a size substantially larger than the finger so that there is a certain amount of freedom of movement of the armature with respect to the frame. In order to hold the armature in proper position there are provided a pair of extensions 69 located one on each side of and spaced from the thin finger 69. The extensions are designed to fit loosely within holes 70. The extensions are spaced a sufficient distance on each side of the finger so that a spring 71 may be fitted around the finger between the finger and the extensions. The spring presses at one end against the end of the frame and at the

other end longitudinally against the armature at the bottom of the spaces separating the finger from the extensions. The thrust of the spring, therefore, tends to urge the armature endwise in a downward direction, as viewed in Figs. 1 and 2, and thus presses the end of the finger against the ratchet wheel.

A second coiled spring 72 is located at the opposite end of the armature, retained in position by spring keepers 73 and 74, and tends to rotate the armature in a clockwise direction as viewed in Fig. 2.

When the device is initially assembled all of the parts which are to be attached to the frame 12 are secured in place so that the frame and its numerous parts comprise one unit in the assembly and the parts of the coil which include the core, shaded pole, mounting ring and plastic discs comprise another unit.

To install both units thus described in the outlet box 10 the mounting ring is pushed through the knock-out hole 11 until the flange of the ring extends within the box. The frame is then applied to the box so that a hole 75 in the base of the frame receives the mounting ring. While this is being done the spring 27 may be depressed by pressing the frame upwardly. The flange of the mounting ring is then extended inside of the bottom of the frame so that the bottom of the frame underlies the flange and is pressed downwardly against the main portion of the mounting ring by force of the spring 27. This operation interlocks the coil within the frame and the outlet box. When the assembly just described has been completed the coil cover 23 may be applied to the coil and secured in place by the screw 24' so that the rim of the coil cover presses snugly against the exterior of the adjacent wall of the outlet box. When this has been completed all of the parts are firmly engaged one with another. Upon disassembly it is necessary only to elevate the frame 12 in order to disengage the upper rim of the hole 75 from the flange of the mounting ring and the frame can then be drawn from the box. Disengagement of the units likewise frees the coil assembly and, where the outside diameter has been kept to a size smaller than the knock-out hole, the coil can be removed through the box from its position behind the knock-out hole.

In operation, an electric lead, of voltage as low as 24 volts such as that from a door bell transformer, is connected to one coil terminal by the screw 20, the other coil terminal may be grounded through the coil cover and the metal cable of the electric lead. When the coil is energized the armature 66 is drawn against the end of the shaded pole against the pressure of spring 74 and likewise against the pressure of spring 71. The armature thus moves in two directions, both lateral and in an endwise upward direction. The throw of the armature is sufficient to advance the ratchet wheel one notch. When advanced, the ratchet wheel will be held in its new position by a detent 76. As soon as the coil is de-energized the springs 71 and 74 return the armature to the position shown in Fig. 2. The corner of the mounting block 24 adjacent the armature will block movement of the armature toward the left, as viewed in Fig. 2, and thus prevent the spring 74 from moving the armature too far when the coil is de-energized.

As the ratchet wheel is rotated it rotates the composite shaft and likewise the cam wheels 59 and 60. At initiation of operation one of the flats 61 of the cam wheel 59 may be located be-

neath the depressed portion 46 of the contact arm 33. In this position it may be presumed that the contact points 33 and 34 are separated from each other. As the cam wheel rotates a high portion of the cam adjacent the flat will be pressed against the depressed portion of the contact arm and lift the arm so that the contact points are engaged, thus closing a circuit through the relay. Continued operation of the armature continues the rotation of the composite shaft and periodically makes and breaks contact between the points. By adjusting the cam wheel 59 with respect to the position of the teeth on the ratchet wheel the points may be retained either separated or in contact for any given position of the ratchet wheel.

Should an additional number of contacts be desired by operation of the relay, another pair of contact arms may be applied to the mounting blocks on the opposite side in the space provided, and the second set of contact arms could then be operated by the cam wheel 60. This cam wheel likewise may be adjusted as desired with respect to the ratchet wheel or the cam wheel 59. To change the adjustment of either cam wheel it is necessary only to withdraw the cotter pin 66 and the pin 53 and then separate either one or both of the cam wheels from the ratchet wheel, rotating them a desired amount to provide the new adjustment and then re-apply them to each other followed by again mounting them upon the pin 53. The serrations will retain the cam wheels in fixed position with relation to the ratchet wheel. It will be obvious that a great variety of combinations of contacts may be incorporated, as for example, by selecting two cam wheels on one of which a low side or flat is followed by two high side intervals preceding another flat while on the other cam wheel a low side or flat is followed by one high side interval preceding two low side intervals or flats. With a combination such as this wherein the contact points close 110 volt lighting circuits of similar magnitude, rotation of the composite shaft one interval will close both circuits, rotation of the shaft a second interval will open one of the circuits but leave the second circuit closed following which rotation of the composite shaft still another interval will open both circuits. In this way a battery of lights could be turned on full, then diminished by one-half and finally turned out. It will be obvious that the cam wheels can be constructed with high sides and low sides in a wide variety of combinations and sequences to secure any one of a wide variety of effects. Although the low voltage coil connection may be exposed, high voltage lighting connections may safely be sealed within the outlet box.

In a modified form of the device illustrated in Figure 5 there is incorporated a moving core solenoid instead of the stationary core solenoid illustrated in the embodiment first described. In the modified form an outlet box 10' provided with a knockout hole 11' is designed to house a frame 12'. Secured to the frame are insulated mounting blocks 80 and 81. A switch contact point 82 is shown on the block 80, and on the block 81 is mounted a switch arm 83 bearing a contact point 84 adapted to close upon the point 82. For shifting the contact arm between open and closed positions there is provided a cam wheel 85 rotatably mounted upon the frame by means similar to that described in the first form. The cam wheel provides a lift for elevating the arm to a position wherein the contact points are separated,

Non-rotatably secured to the cam wheel is a ratchet wheel 86 which is engaged by a one way detent 87. A low voltage coil 88 secured within a cover 89 has an axial bore 90 within which a moving core 91 is adapted to reciprocate.

Mounted on the outside end of the moving core is a bracket 92 and a hook 93 pivoted to the bracket and adapted to engage the ratchet wheel. A coiled spring 95 anchored at one end to a projection on the hook and at the other end to a pin secured to the frame serves the combined purpose of drawing the core outwardly again after it has been retracted by a magnetic impulse and also holding the hook releasably in engagement with the ratchet wheel. In other respects the modified construction has the same general characteristics as the first described form which permits it to be readily removed from the outlet box.

A second modified form of the device, shown in Figure 6, incorporates a modified means of attaching the assembly to an outlet box 10'. The particular means of attachment may be used, with suitable modifications, with the device illustrated in either of Figures 1 or 5.

In particular, the device comprises a coil unit 100 having permanently attached at one end a frame unit 101. These units are substantially the same with regard to their working parts as the coil and frame portions of the previously described forms.

A special means of attachment is provided which consists of a series of spring clips 102 spaced about the circumference of the exterior of the coil unit and are adapted normally to spring outwardly. The spring clips have end portions 103 bent over at a slight angle. The exterior of the coil unit contains recesses 104 adapted to receive the end portions when they are pressed inwardly. It should be noted, also, that the diameter of the exterior of the coil unit, including the added thickness of the clips, will be slightly less than the diameter of a knock-out aperture 105. It will be appreciated, however, that the exterior of the coil unit itself may be slit so as to provide the necessary spring clips.

When the form shown in Figure 6 is assembled, the coil unit is pushed through the knock-out aperture, and during this portion of the assembly the spring clips will be pressed inwardly against the outer surface of the coil unit. As soon as the assembled coil and frame units reach the position shown in Figure 6, the clips will spring outwardly to the positions shown and firmly secure the parts in place. To remove the device from the outlet box it is necessary only to grasp the frame unit firmly and pull with sufficient force to force the bent over end portions of the clips inwardly sufficient to permit the coil unit to be pulled back through the knock-out aperture into the outlet box.

In all forms of the device, because of the fact that all of the working parts may be removed from the front of the box, the box in either case can be plastered in the ceiling or wall without in any way interfering with the accessibility of the interior of the box from the room side. Normally a light fixture will be so located as to cover the outside of the box on the room side.

By the construction just described there has been provided a compact impulse relay mechanism wherein moving parts have been held to a minimum and so designed that parts of the device perform a multiple function, thereby making it possible to reduce the number of parts without

reducing the number of functions. By constructing the device in separate units the units can be applied to a stationary structure such as an outlet box and a great deal of time saved in both installing and servicing. The device is further so designed that it is capable of a great number of contact combinations which can be changed at will in the field without it being necessary to entirely disassemble the relay apparatus.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent structures.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an impulse relay, a mounting bracket of generally L-shape, including a generally flat mounting plate and an integral arm projecting from one end thereof transverse to the plane thereof, a solenoid mounted on said plate, said arm having a pair of spaced apertures, an armature of flat plate form disposed generally parallel to said plate and having at one end a pair of fingers loosely extending through said apertures and terminating in hooked ends operative to engage said arm to limit endwise movement of said armature, said armature having a third finger disposed centrally between and spaced from said pair of hooked fingers, a coil spring encircling said third finger and engaged under compression between said armature and said arm, a rotatable step by step switch actuator having a ratchet wheel, mounted on said plate in a position for engagement of said ratchet wheel by the other end of said armature when the latter is energized by said solenoid, said spring yieldingly maintaining said other end in operative association with said ratchet wheel while allowing limited endwise movement of said armature to conform to arcuate movement of a ratchet wheel tooth, and a second spring operative between said armature and said plate to yieldingly resist movement of said armature toward said solenoid.

2. In an impulse relay, a mounting bracket of generally L-shape, including a generally flat mounting plate and an integral arm projecting from one end thereof transverse to the plane thereof, a solenoid mounted on said plate, with its axis substantially at right angles to the plate, said solenoid extending through the plate, with its pole end disposed adjacent the inner side of the plate, the major portion of the solenoid projecting from the outer side of the plate, a contact mounting member carried by the outer end of said arm, a second contact mounting member secured to and projecting from the other end of said plate, generally parallel to said arm, an electrical contact and a switch arm mounted on said mounting members respectively and projecting toward each other in overlapping relation and in generally parallel and spaced relation to said plate, an armature pivoted at one end to said arm between said first mentioned contact mounting member and said plate and extending across said pole, a rotatable step by step switch actuator mounted on said plate in operative association with the other end of said armature, including a ratchet wheel for actuation thereby when said solenoid is energized and a cam for actuating said switch arm, said armature and cam being dis-

posed in the space between said switch arm, contact and plate.

WILHELM W. BROCKWAY.

#### REFERENCES CITED

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

#### UNITED STATES PATENTS

Number	Name	Date	
515,484	Stirn	Feb. 27, 1894	
890,697	Noeggerath	June 16, 1908	
936,601	Carson	Oct. 12, 1909	
1,090,301	Hawkins	Mar. 17, 1914	
1,154,473	Zakrzewski et al.	Sept. 21, 1915	10
1,503,980	Carichoff	Aug. 5, 1924	
1,622,042	Miles et al.	Mar. 22, 1927	
1,780,612	Anderson	Nov. 4, 1930	

Number
1,844,169
2,090,619
2,129,948
2,216,935
2,224,239
2,235,038
2,306,820
2,321,834
2,324,844
2,355,047
2,381,080
2,399,295

Number
476,920

Name	Date
Livingston	Feb. 9, 1932
Biach et al.	Aug. 24, 1937
Lemmon	Sept. 13, 1938
Breitenstein	Oct. 8, 1940
Van Valkenburg	Dec. 10, 1940
Pearce et al.	Mar. 18, 1941
MacKay	Dec. 29, 1942
Marco et al.	June 15, 1943
Hutt	July 20, 1943
Bennett	Aug. 8, 1944
Ray	Aug. 7, 1945
Ray	Apr. 30, 1946

#### FOREIGN PATENTS

Country	Date
Great Britain	Dec. 17, 1937