March 10, 1925. 1,529,616

F. L. DODGSON

RELAY CONTACT AND METHOD OF MAKING THE SAME

Filed Jan. 13, 1919 2 Sheets-Sheet 1

FIG. 1.

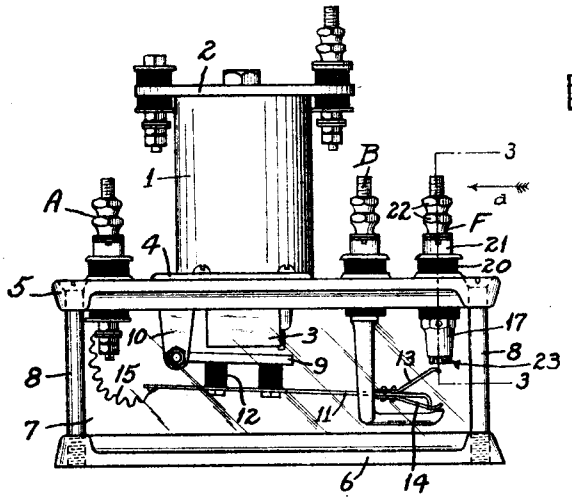


FIG. 2.

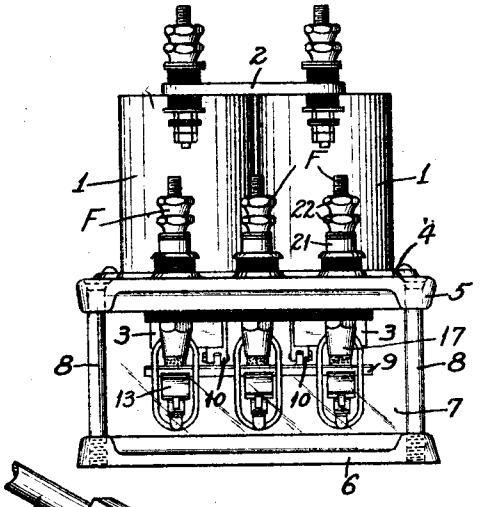


FIG. 3

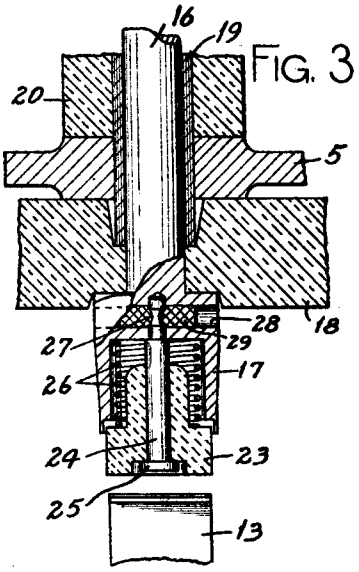
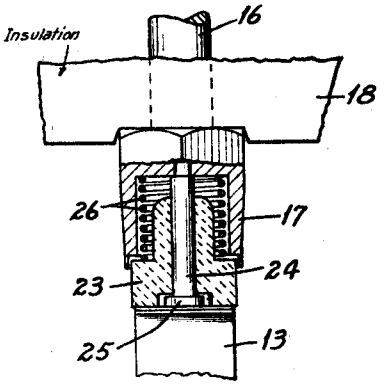


FIG. 4.



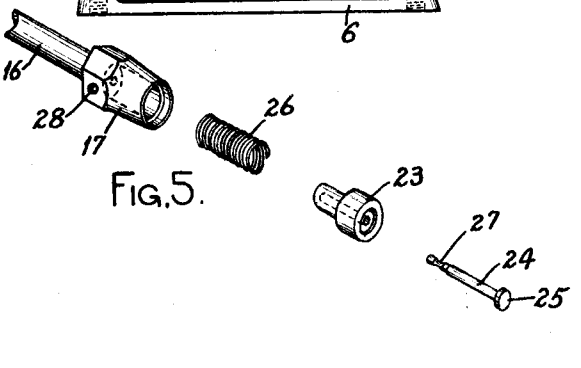


FIG. 5.

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FIG. 6.

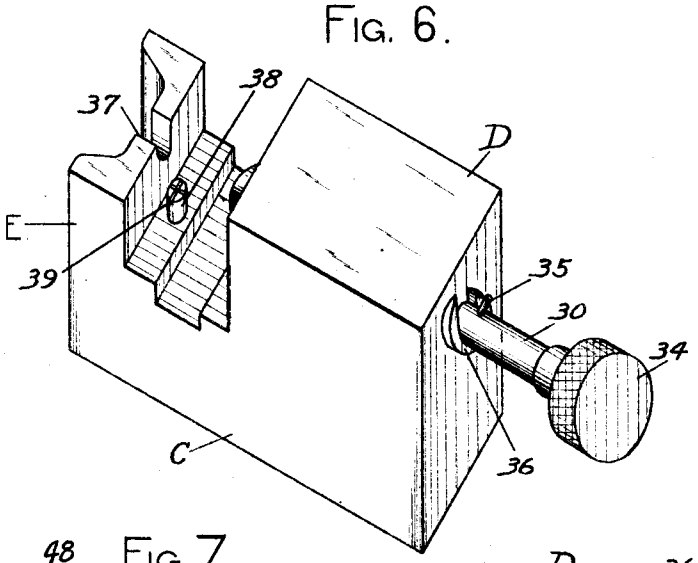


FIG. 7.

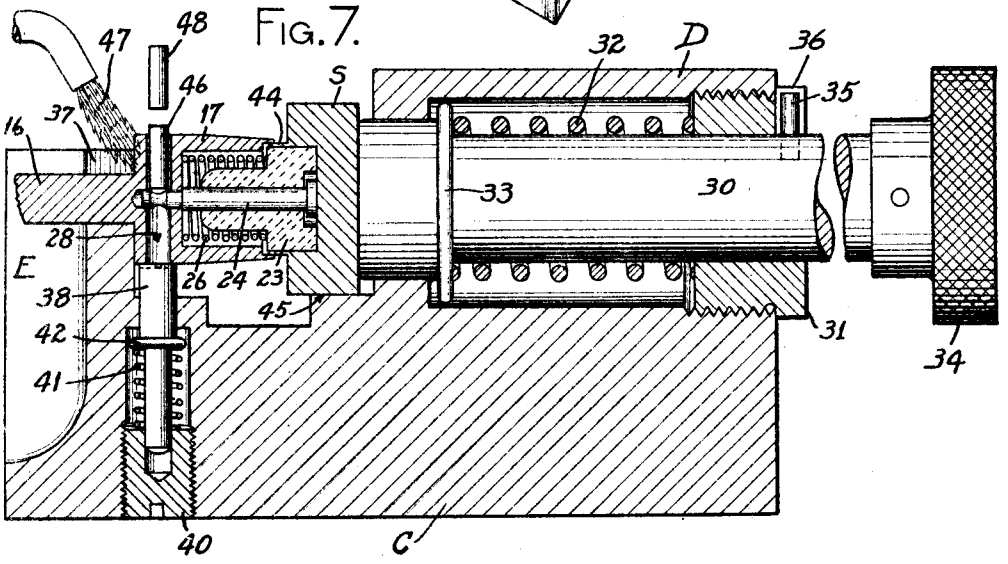


FIG. 8.

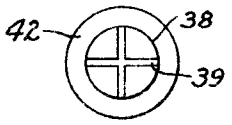
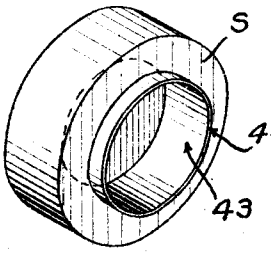


FIG. 9.



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Patented Mar. 10, 1925. 1,529,616

UNITED STATES PATENT OFFICE.

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RELAY CONTACT AND METHOD OF MAKING THE SAME.

Application filed January 13, 1919. Serial No. 270,970.

To all whom it may concern:

Be it known that I, FRANK L. DODGSON, a citizen of the United States, and resident of the city of Rochester, in the county of Monroe and State of New York, have invented a new and useful Relay Contact and Method of Making the Same, of which the following is a specification.

This invention relates to an improved construction of a contact for relays used in railway signaling systems, and to a method of making such an improved contact.

It is important to have low resistance between the contacts of relays used in railway signaling systems, especially contacts in motor circuits where the resistance of the contact, if high, constitutes a large proportion of the total resistance. It has been proposed to obtain such low contact resistance by employing metal to metal contacts, but such contacts are objectionable because the arcing or sparking, generally occurring upon separation of the contacts, causes the contact surfaces to become pitted or roughened, thus increasing the contact resistance and necessitating frequent renewal. Moreover, the interruption of current often draws an arc across the relay contacts as they separate, sufficient in some instances to cause the metal to metal contacts to actually fuse together,—something which cannot be tolerated in railway signaling systems, because safety requires actual separation of contacts at the proper time. The metal to metal contacts in railway signaling relays are specially susceptible to such fusing because the force tending to cause separation of the contacts is small. Lightning and other heavy current discharges accentuate this difficulty, so that the objectionable features of metal to metal contacts has led to the use of carbon, graphite, or some similar refractory material for one or both of the contacts. Graphite to metal contacts, however, have the disadvantages that the contact resistance is high and often variable.

With these considerations in mind, it is contemplated, according to this invention, to provide a relay contact in which the actual making and breaking of the circuit will occur between metal and graphite, while the flow of current in the circuit will take place through the low resistance of a metal to metal contact. Such a construction gives the desired low resistance for conducting the current, and at the same time provides for the satisfactory making and breaking of the circuit.

I am aware that it has been heretofore suggested to make and break circuits between carbon to metal contacts, as in the well known circuit breaker; but the application of this idea to the delicate relays used in railway signaling, presents a number of difficult problems, which it is the purpose of my invention to solve. The contacting parts in a relay must be light, because of the small amount of energy available for operating them. For example, in the relay in which I am familiar the operating force for each pair of contacts is only about one ounce. Yet, the contacts must have a substantial and rugged construction sufficient to withstand long service under wide variations of temperature and atmospheric conditions.

Also, the requisite operating characteristics of railway signaling relays, together with the small size of parts and the small amount of operating force available, imposes certain limitations upon the construction not found in other circuit controlling devices. In a relay contact, one member should be resilient so as to make a good firm contact with the other member, and also to cause a scraping or abrasion of the contact surface of said other member as the contact members are brought together. It is likewise important to have a spring action at the contact members of a relay so as to provide an initial pressure, when the relay is energized, tending to force the armature away, or in other words, assist in the drop-away of the armature. The small amount of operating force available, (for example, only one ounce per pair of contacts), requires that the resiliency or spring action for accomplishing these two functions should be combined and derived from the same member. This is accomplished in the relays with which I am familiar, by making one contact member resilient and shaping it such that it rubs across the contact face of the other contact member during the closing movement, the resiliency of this same member affording the desired spring action both

for kicking off the armature when the relay is deenergized and for making good contact. When an attempt is made to incorporate with such a contact construction the functions of making and breaking the circuit between graphite and metal, while maintaining the circuit between metal and metal, it will be evident that a still further spring action is required, for the reason that the initial contacting between the graphite and metal contacts, upon energization of the relay, must give way to permit the contacting of metal to metal contacts, while on the other hand, upon deenergization of the relay, the contacting between graphite and metal must follow up and succeed the breaking of the contact between metal and metal. If it is attempted to obtain this latter spring action from the resilient contact member, it is found that the duty imposed is too great for satisfactory and reliable operation. These limitations impose conditions upon the construction of a contact suitable for relays used in railway signaling which are not found in ordinary circuit breakers and similar devices.

Also, the requirements of performance of relays, especially in the breaking of circuits, are also extremely exacting. The parts should be constructed so there is no chance of binding or sticking, since safety requires the separation of contacts at the proper time, even though the force tending to produce separation is very small. Furthermore, any construction meeting these requirements should also be one which can be made by ordinary manufacturing methods by average skilled labor.

One of the principal objects of this invention, is to provide a relay contact having these essential and desirable characteristics, which is simple, practical, and reliable in its operation, and which will withstand long service under severe operating conditions.

After a satisfactory construction of a relay contact has been determined, it is found that the making of its delicate parts, and the assembly and fastening together of these parts in the relation required, together with proper clearances for satisfactory operation, presents a number of difficult problems; and a further object of my invention is to devise a method of making a relay contact of the character described which can be practiced efficiently by average skilled labor, and which can be used commercially to produce a relay contact having the desired features of construction and operation.

Other objects and advantages of my invention will appear as the description progresses; and the novel features of the invention will be pointed out in the appended claims.

In describing the invention in detail, reference will be made to the accompanying drawing, in which is illustrated a preferred physical embodiment of the invention, in which like reference characters refer to corresponding parts in the several views, and in which:

Fig. 1 is a view in side elevation of a relay of well known construction, showing a contact embodying my invention applied thereto;

Fig. 2 is a view in end elevation of the relay shown in Fig. 1;

Fig. 3 is an enlarged section of a contact embodying my invention, taken substantially on the line 3—3 in Fig. 1 and looking in the direction indicated by the arrow *a*, the parts of the contact being in the open position corresponding to the deenergized condition of the relay;

Fig. 4 is a fragmentary section, similar to Fig. 3, showing the parts in the closed position, corresponding to the energized condition of the relay;

Fig. 5 illustrates in perspective the separate parts of the contact disassembled;

Fig. 6 is a perspective view of the apparatus used in accordance with my invention to assemble and fasten together the parts of the relay contact;

Fig. 7 is an enlarged vertical section through the apparatus shown in Fig. 6;

Fig. 8 is an end view of the stopper plunger forming a part of the apparatus shown in Fig. 7; and

Fig. 9 is a perspective view of another part of the apparatus illustrated in Fig. 7.

Referring first to the general construction of the well known type of relay shown in Figs. 1 and 2, this relay comprises the usual pair of coils 1—1, with a back strap 2, and pole pieces 3 fastened to a coil support 4, all of these parts being supported by the top plate 5 of the relay casing. This casing consists of the metal top plate 5, a base plate 6, and glass walls or sides 7, which are clamped between the top plate and the base plate by screws 8. The armature 9 of the relay is pivotally supported at one edge to downwardly extending lugs 10 integral with the coil support 4. A number of contact fingers 11 are fastened to the armature 9 with interposed pieces 12 of insulating material. Each contact finger 11 is provided at one end with resilient contact pieces 13 and 14 which are adapted to cooperate with fixed back and front contacts, respectively. These front and back contacts are in the form of binding posts B and F, with which the parts actually touching the contact pieces 13 and 14 are associated. The opposite end of each contact finger 11 is electrically connected by a flexible conductor 15 to a binding post A secured to and insulated from the top plate 5.

I have shown my invention applied particularly to the construction of the front

contact or binding post F. Referring to Figs. 3 and 4, the front contact post F comprises a stem 16, which is screw threaded for part of its length at one end and which has an enlarged head or holder 17 at its lower end. The base portion of the holder 17 is squared and fits without turning in a groove in the bottom of a block 18 of insulating material which extends across the under side of the top plate 5. The stem 16 extends through a larger hole in the top plate 5 and through a bushing 20 of insulating material. A sleeve 19 of treated silk or similar insulating material surrounds the stem 16 and insulates it from the metal top plate 5: and the whole front contact post F is clamped in place by a nut 21, (Fig. 1), the post being provided with the usual nuts 22 for attaching wires.

The holder 17 of the contact post F has an axial cylindrical cavity formed therein, the lower end of which is counterbored to receive a contact member or button 23 of carbon, graphite, or other refractory material. This button 23 is formed with a lower cylindrical portion slightly less in diameter than the counterbore in the holder 17, and with a smaller guiding collar, and is bored axially to fit freely and snugly around a contact pin 24 of silver or other good contact material. This pin 24 has a thin cylindrical head 25 at the lower end; and in the lower end of the graphite button 23 is a cylindrical recess which is slightly deeper than the thickness of said head of the pin. The upper end of the contact pin 24 is fastened to the holder 17, and between the bottom of the cavity in said holder and the button 23 is interposed a light compression coil spring 26, which tends to urge the button 23 downward to the position, shown in Fig. 3, where the head 25 of the pin 24 limits further movement, and the lower contact surface of the button 23 is below the contact surface of the head 25.

I prefer to make the contact finger 11 of brass or similar good conducting material of the requisite stiffness, the contact piece 13 and pin 24 of coin silver or other highly conductive and non-corroding material, and the button 23 of graphite or other refractory material having good conducting properties.

One of the important features of the invention is the way of fastening the contact pin 24 to the holder 17. The upper end of the pin 24 extends into an axial bore in the holder 17; and the upper end portion of said pin is reduced in diameter, so as to leave a shoulder which bears against the bottom of the cavity in the holder 17. This upper end portion of said pin 24 is formed with gripping edges or shoulders, preferably formed by a circumferential groove 27; and when the pin 24 is in place this groove 27 is aligned with a transverse hole 28 in the holder 17. After the parts are properly positioned, as hereinafter explained, solder 29 is run in the hole 28 around the upper end of the pin 24, thereby securely fastening the pin in place.

With the relay deenergized, the parts of the contact device assume the positions shown in Fig. 3, the spring 26 having moved the graphite button 23, guided by the pin 24, to its lowermost position, where the lower face of the head 25 of said pin is above the lower face of the button 23. When the relay is energized, and its armature 9 is attracted, the front contact piece 13 of the contact finger 11 moves upwardly and makes contact first with the graphite button 23. The pressure of the spring 26 on the button 23, however, is made slight and less than the pressure which the contact finger exerts, so that the button is moved upward until the pressure of the contact finger falls directly upon the enlarged head 25 of the contact pin 24, thus establishing a direct metal to metal connection from the contact finger 11 to the binding post F. This position of the parts is shown in Fig. 4.

When the relay is again deenergized, its armature and its contact fingers are returned to their lower position by their weight. During this movement, the button 23, being urged downward by the spring 26, will follow up the downward movement of the contact piece 13. Consequently, the contact piece 13 first leaves contact with the head of the pin 24, thereby separating the metal to metal contacts but leaving the circuit completed through the graphite button 23; and then, when the downward follow-up movement of the button 23 is arrested by the head 25 of the pin 24 (see Fig. 3), the contact piece 13 finally breaks contact with the button 23, thereby interrupting the current between graphite and metal. Thus, it will be evident that my invention provides a construction in which the initial making and final breaking of the circuit takes place between a refractory material and a metal, while the circuit is established through the low resistance of a metal to metal contact.

It will be observed that the construction described is simple and compact. The graphite button 23 and the contact pin 24 are combined into a unitary structure adapted to cooperate with a single metal contact piece. The spring action, demanded to bring about the breaking and making of the circuit between graphite and metal, is derived from the spring 26, independently of the resiliency of the contact piece 13, thereby dividing the duties imposed upon the parts and satisfying the limitations of construction previously explained. The front contact post F, embodying the invention, can be readily applied to any of the present types of relays, and if desired, may be ap-

plied to relays now in service. The use of the improved contact requires no change in the contact fingers now used. Regarding details of the construction, it will be noted that the graphite button 23 is guided by the silver contact pin 24 with ample bearing surface, so that the proper relation of the parts will be maintained. It is found that the friction between the button 23 and its guiding pin 24 is extremely slight, perhaps due to the lubricating qualities of the graphite. There is sufficient clearance between the button 23 and the holder 17 to obviate any chance of binding or sticking. The spring 26 is fully enclosed and protected, and likewise the contact pin 24, so that corrosion and deterioration of the parts is prevented. Other meritorious features of the construction will be appreciated by those skilled in the art without further explanation.

It will be evident that the parts of the contact device embodying my invention must necessarily be delicate and small in a practical device. For instance, my present preferred form of construction is only one-half the size illustrated in Figures 3 and 4, the approximate actual size of the parts being shown in Fig. 5. On account of the small size of the contact pin 24, any ordinary way of fastening this pin to the holder 17, such as screw-threaded connections or pinned joints, is impracticable. The limitations of commercial manufacture prevent the exactness in the diameter of this pin and the diameter and alignment of the bore in the holder, required for a driving fit, or needed to position this pin in the precise alignment needed. The soldered connection between the pin 24 and the holder 17, previously described, provides a satisfactory way of fastening the pin in place; but before this fastening is done, it is necessary to assemble and position the parts in the proper relation. To accomplish these ends I have devised a method of making the contact. One form of apparatus suitable for practicing this method is illustrated in Figs. 6 to 9.

This apparatus comprises a base block C formed with two end portions D and E, leaving a space between them for receiving the assembled contact, as shown in Fig. 7. In the larger end portion D is a horizontal recess in which is disposed a spring-pressed plunger 30, one end of which extends through a guiding bore in the end portion D out into the space between said end portions D and E, for the purpose hereinafter explained. The other end of the plunger 30 is guided in a plug 31 closing the end of said cylindrical recess. Encircling the plunger 30 is a compression spring 32 which bears at one end against said plug 31 and at the other end against an integral collar 33 on the plunger 30. The plunger 30 is provided with a knob or handle 34; and to facilitate the withdrawal of the plunger and to hold it in the withdrawn position, a pin 35 in said plunger and a cam ridge 36 on the plug 31 are arranged in cooperative relation, in a way readily understood by those skilled in the art, so that turning the handle 34 in one direction causes the plunger 30 to be withdrawn and be held in that position, while a twist in the opposite direction allows the plunger 30 to move to its projecting position under the action of the spring 32.

In the end portion E is a horizontal groove 37 adapted to receive the spindle 16 of a contact post, so that this contact post will be aligned axially with the plunger 30, as shown in Fig. 7. In the bottom of the base block C is supported a movable stopper plunger 38, adapted to project into position to cover the lower end of the hole 28 in the holder 17 of an assembled contact when the latter is in position in the apparatus. This plunger 38 is preferably made of aluminum, or a similar material, to which ordinary solder will not stick; and the upper end face of this plunger is formed with cross cuts 39, (see Fig. 8) constituting vents, all for the purpose hereinafter explained. The stopper plunger 38 is guided at its lower end in a screw plug 40. Around this plunger 38 is a light compression spring 41, which bears at one end against said plug 40, and at the other end against a collar 42 integral with said plunger. The tension of the spring 41 is comparatively light, being sufficient to hold the upper end of the plunger 38 in close contact with the holder 17 of a contact post, as shown in Fig. 7, and without lifting said contact post out of position.

Associated with the apparatus is a spacing or guiding member S, shown in perspective in Fig. 9. This member S is formed with a cylindrical recess 43 adapted to receive snugly the graphite button 23; and integral with this member is a thin ring or collar 44 of a thickness corresponding to the clearance between the button 23 and the counterbore in the holder 17.

In using the apparatus described to practice my method, the spring 26 is inserted in the holder 17 of the contact post, then the button 23, and the pin 24. The spacing member S is then applied and adjusted to the position as illustrated in Fig. 7, with its thin collar 44 spacing the button 23 in proper relation with the holder 17. The assembled parts are then placed in the apparatus, the holding plunger 30 having been first withdrawn. The stem 16 of the contact post is supported in the groove 37, and the spacing member S rests upon a shoulder 45 formed on the base block C. The contact post is turned so the hole 28 in the holder 17 is vertical, with its lower end covered by the plunger 38. When the parts are properly

aligned, the plunger 30 is again projected to hold the assembled parts of the contact post firmly in the proper position.

It will be noted from Fig. 7 that the spacing member S bears against the pin 24, the shoulder of which in turn bears against the bottom of the recess in the holder 17. This positions the pin 24 lengthwise of the contact post F in the relation desired to adapt it for incorporation in a complete relay. The pin 24 is positioned axially in the exact relation desired by reason of being guided by the button 23, which in turn is positioned accurately with regard to the holder 17 by the thin collar 44 on the spacing member S. It will be evident that the primary factor determining the precise axial alignment of the pin 24 desired, provided the parts are otherwise within the narrow limits readily attained in ordinary manufacturing, is the clearance between the graphite button 23 and the holder 17, such as to permit the button to slide easily without any chance of binding. This desired relation is what is obtained by the spacing member S.

After the parts are in position, a short cylindrical piece of solder 46 is inserted in the upper end of the hole 28 in the holder 17, this piece of solder being long enough to stick out slightly when resting on the pin 24. The holder 17 is now heated, preferably by the flame of a torch or similar heating appliance, the flame being applied as indicated at 47 in Fig. 7. The operator watches the projecting upper end of the piece of solder 46 carefully, and as soon as this piece of solder melts and disappears, an additional piece of solder 48 is also dropped in, and the flame withdrawn. The parts are then allowed to cool, or are cooled artificially by a blast of air. if desired, and the contact post removed and inspected. If solder can be seen from the lower end of the hole 28, it is known that a proper joint has been made. The fact that solder has run past the pin 24, proves that this solder must have formed around the groove 27 in the end portion of this pin, and also that the solder must have been hot enough to make a good joint.

The purpose of putting in the piece of solder 46 into the holder 17 before heating it, is to provide a simple and reliable way of determining when the holder 17 has been heated sufficiently to properly melt the solder. Obviously, overheating should be avoided, because it is liable to distort the parts and injure the spring 26. The stopper plunger 38 prevents the solder from running out of the hole 28, and since this plunger is made of aluminum, the solder will not stick to it. The cross cuts 39 in the upper end face of the stopper plunger 38 afford vents to allow the heated air or gases to pass out from the hole 28 without interfering with the desired movement of the solder. The apparatus illustrated provides for the assembling of one contact post, but obviously several similar base blocks may be used in gangs, if desired.

This application is a continuation in part of my prior application, Serial No. 226,708, filed April 4, 1918.

Although I have particularly described the construction of one physical embodiment of my invention, and explained the operation and principle thereof; nevertheless, I desire to have it understood that the form selected is merely illustrative, but does not exhaust the possible physical embodiments of the idea of means underlying my invention.

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

1. In a relay for railway signaling, a contact construction comprising, an insulated contact post having a cup-shaped end, a metallic pin fixed to said post within its cup-shaped end and extending axially thereof, said pin having an enlarged head at its outer end, a carbon button partially enclosed within the cup-shaped end of said post and surrounded and guided by said pin, said button having a recess in its outer end to receive the enlarged head of said pin, this recess being deeper than the thickness of said head, a compression coil spring within the cup-shaped end of said post and acting to press said carbon button outward to a definite position determined by the engagement of the head of said pin with the bottom of the recess in the button, and a movable contact finger having a flat resilient contact piece at its end engaging the button before and after engagement with the pin during movement of the finger toward and away from the post respectively, whereby electrical contact between the finger and post is broken between carbon and metal and is maintained between metal contacts.

2. In a relay of the type described, a contact arrangement comprising, an insulated contact post having a cylindrical recess in its outer end, a pin of highly conductive material fixed to said post and extending axially thereof within said recess, a carbon button of general cylindrical shape having an axial bore to receive said pin, a spring within said recess acting to press said button outward, means limiting the outer position of said button to a point where its contacting face is beyond that of said pin, a contact finger having a resilient flat contact piece at its free end disposed at an acute angle to the axis of said button and pin, said finger being movable with respect to the post to cause electrical contact between said button and contact piece of the finger before and after contact between the pin and the contact piece as the finger is moved toward and away from the post, respectively, the angu-

lar disposition of the contact piece causing it to slide over the contacting surfaces of said button and pin, whereby a rubbing engagement of metal-to-metal contacts is employed for maintaining circuit connections while the circuit is broken by the rubbing engagement of metal-to-carbon contacts.

3. In a contact construction for relays of the type shown and described, a stationary contact post having a recess, a carbon button within said recess formed with a circumferential shoulder to engage the post around said recess, a metallic pin fixed to said post and passing through an axial hole in said button, said pin having an enlarged head at its outer end, the button having a recess in its outer face to receive the head of said pin, the cooperation of the button with the head of the pin limiting the outer movement of the button, means urging said button outward and a movable contact member engaging both the button and pin and exerting a pressure sufficient to force the button inward and permit the making of a direct metal-to-metal contact between said member and the enlarged head of said pin.

4. A relay for railway signaling having, in combination, a movable contact finger carried by the armature of the relay, a fixed metallic pin, and a movable graphite button surrounding said pin and spring-pressed toward said contact finger, said pin and button being both arranged to cooperate with said finger, said parts co-acting to make and break the circuit between the contact finger and the graphite button and to maintain the circuit through the contact finger and the metallic pin.

5. A relay for railway signaling having, in combination, a movable contact finger carried by the armature of the relay, and a contact post for cooperating with said contact finger, said post comprising a stem having an axial recess therein, a movable member of conducting refractory material in said recess, and a metallic member of highly conductory material attached to said stem, said movable member being yieldingly biased into position to make contact first and last with said contact finger as the latter is moved toward and from the contact post, whereby the circuit is made and broken between a metal and a refractory material and is maintained between metal and metal.

6. In a relay, the combination with a movable contact finger, a contact post for cooperating with said finger and provided with an axial recess, a carbon button in said recess movable lengthwise of the post, a spring enclosed in the recess and pressing the button outward, and a fixed metallic contact member of highly conductive material coacting with said button to limit the outward movement thereof to a position in which the contact face of the button is nearer the contact finger than that of the metallic contact, whereby the contact finger engages the button and the metallic contact in succession as it moved to its attracted position.

7. A graphite-metal contact for relays comprising a fixed metallic pin, a movable graphite button surrounding said pin, and resilient means for urging said button to a position where its contacting face is beyond the contacting face of said pin.

8. A graphite-metal contact for relays comprising a circular pin of highly conductive material, a movable graphite button surrounding said pin and guided thereby, said pin and button coacting to limit the movement of the button to a position where the contact face thereof is beyond that of the pin, and a compression coil spring acting to urge said button to its projecting position.

9. A graphite-metal contact for relays comprising a silver pin formed with an enlarged head, a graphite button surrounding said pin and movably guided thereby, said button having a recess in one end face adapted to receive the head of said pin, and a spring yieldingly holding said button projected against the head of said pin, the contacting end face of said button when projected being beyond the contact surface of the head of said pin.

10. A contact post for relays comprising a stem and an enlarged head having an axial recess therein, a metallic pin attached at one end to said head and extending out of the recess lengthwise of the post, a graphite button surrounding the pin and partially enclosed in said recess, and a compression coil spring in said recess tending to move the button outward, said button being limited in its outward movement to a position where its contacting face is beyond the outer end face of the pin.

11. A contact construction for relays comprising a post, a metallic pin extending axially of the post and fastened thereto at one end, a graphite button guided by said pin, said pin being adapted to cooperate with said button and limit the movement thereof to a position where its contacting face is beyond that of the pin, and a spring acting to move the button outward.

12. A contact construction for relays comprising a contact post, a metallic pin having one end portion thereof roughened and extending into a bore in said post, said post having a hole therein intersecting said axial bore and filled with solder which embraces the roughened end portion of the pin and holds it in place, a movable graphite button surrounding the pin, and means for resiliently urging said button to a position where its contacting face is beyond that of the pin.

13. A contact construction for relays in which a metallic contact pin is fastened at

one end to a contact post by solder in a hole in the post extending transversely of the axis of the pin and which embraces gripping edges formed on the end portion of said pin.

14. In a relay, the combination with a vertically movable contact finger, a contact post for cooperating with said finger and provided with an enlarged head having an axial recess therein, a button of conducting refractory material in said recess and yieldingly projected outward to a limited extent lengthwise of the post, and a fixed metallic member of highly conductive material having its contact face within the limits of the outer contacting face of said button, said contact face of said metallic member being in a horizontal plane above that of the button while the button is in its projected position.

15. In a relay, the combination with a movable contact finger having a resilient contact piece at one end, a contact post comprising a stem adapted to be fastened to the top plate of the relay, a fixed metallic pin of relatively low resistance attached to said stem and provided with a contact face at its lower end, a spring, and a movable carbon button supported by said pin and normally positioned by said spring so as to be engaged first by said contact piece as the finger is attracted, said contact piece on the finger being inclined with respect to the faces of said stem and button so as to rub over them as the finger is attracted.

16. A contact post for relays comprising a stem adapted to be attached to the top plate of the relay, a metallic contact member attached to said stem, a carbon button movable lengthwise of the stem and having its outward movement limited by said metallic member so as to have its contact face beyond that of the metallic member, and a spring acting to press said button outward.

17. A contact post for relays comprising a stem adapted to be attached to the top plate of the relay and provided at one end with an enlarged head having a recess therein, a carbon button in said recess movable lengthwise of the stem, a metallic contact member secured to said stem and adapted to limit the outward movement of the carbon button and position it with its contact face beyond that of the metallic member, and a spring enclosed in said recess for pressing said button outward.

18. A contact post for relays comprising a stem adapted to be attached to the top plate of the relay, a carbon button carried by said stem and movable lengthwise thereof, a metallic contact member fastened to said stem and having a contacting part within the limits of the outer contact face of said button, said button having a recess in its contact face to receive said contacting part of the metallic member, and a spring for pressing said button outward.

19. A contact post for relays comprising a stem having an axial recess therein, a carbon button in said recess, and movable lengthwise of the stem, said button having an axial bore lengthwise thereof, a spring enclosed in the recess and acting to press said button outward, a metallic member of highly conductive material attached to said stem, said metallic member passing through the bore in said button whereby said button and metallic member are disposed with their contact faces one within the limits of the other, and means whereby the outward movement of the button is limited so as to position its contact face normally outside of that of the metallic member.

20. A contact post for relays comprising a stem having an enlarged head with a downwardly opening axial recess therein, a carbon button in said recess and biased to move downward lengthwise of the stem to a predetermined projected position, and a metallic member of highly conductive material attached to said head with its contact face within the limits of and above the contact face of the button in its lower projected position.

21. A contact post for relays, comprising a stem screw threaded for part of its length at one end and having an enlarged head at its other end; said enlarged head having a cylindrical cavity formed therein which is counter-bored at one end; a conductive button of refractory material adapted to loosely fit in the counterbore of said cavity, said button having a hole passing therethrough which is counterbored at one end; a metallic spindle of relatively low resistance extending through said recess and rigidly secured to said stem, said spindle having a shank adapted to pass through the hole in said button and also having an enlarged head at one end adapted to fit loosely in the counterbore in said button and to loosely hold said button in position, the thickness of the head of said spindle being less than the depth of the counterbore in said button; and a spring, housed in said cavity and adapted to spring press said button outward in one direction, the movement of said button being limited by the under side of the head of said spindle.

22. In a relay, the combination with a movable contact finger having a resilient contact piece at its outer end, of a stationary contact post cooperating therewith and comprising a fixed metallic member of highly conductive material, a movable member of conducting refractory material, and a spring, said movable member being normally projected by the spring into position where its face is nearer said contact piece than the metallic member, the tension of

said spring being less than that of the contact piece, whereby the contact piece makes contact successively with the refractory member and the metallic member.

23. The method of making graphite-metal contacts for relays of the type shown and described in which a small contact pin is fastened at one end to a contact post and a graphite button is guided by said pin and partially embraced by parts of the post, said method consisting in positioning the pin in proper relation to the contact post by holding the button in alignment with the adjacent parts of the post embracing it with an intervening space for clearance, and then fastening the pin to the post in the position thus established.

24. The method of making graphite-metal contacts for relays of the type shown and described, in which a small pin with a roughened end portion fits loosely in a bore in a post intersected by a transverse hole in said post, said method consisting in assembling and holding the pin in the proper relation to the post, heating the post, and then running solder into the transverse hole around the roughened end portion of said pin.

25. The method of making graphite-metal contacts for relays of the type shown and described, in which a small pin with a roughened end portion fits loosely in a bore in a post intersected by a transverse hole in said post, said method consisting in assembling and holding the pin in proper relation to the post, inserting a piece of solder into one end of the transverse hole with part of the solder sticking out in sight, and then heating the post until the solder melts and disappears.

26. The method of making graphite-metal contacts for relays of the type shown and described, in which a small pin with a roughened end portion fits loosely in a bore in the post intersected by a transverse hole in said post, said method consisting in assembling and holding the pin in proper relation to the post, covering one end of the transverse hole in the post with a vented stopper, and then running solder into the other end of said transverse hole around the roughened end portion of said pin.

27. A contact construction for relays comprising, a stationary metallic contact, a movable contact member of refractory material having a recess therein to receive the contacting portion of said metallic member, and a movable finger for engaging said metallic contact and said refractory member, the contact between said finger and metallic member being broken in a substantially closed chamber formed by the recess in said member of refractory material.

28. Contact construction for relays, comprising a stationary metallic contact, a movable finger arranged to engage said contact, and a movable conducting refractory member partially enclosing said stationary contact and co-operating with the finger to form a closed chamber around the contacting portions of said finger and stationary contact when contact between the latter is broken.

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