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B. O. AUSTIN

2,476,794

CONTACTOR

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2 Sheets-Sheet 1

Fig. 1.

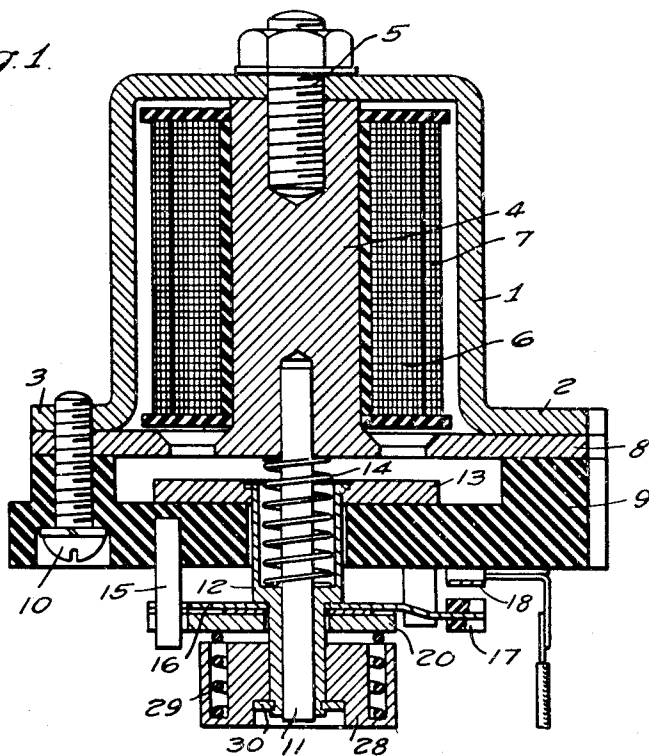
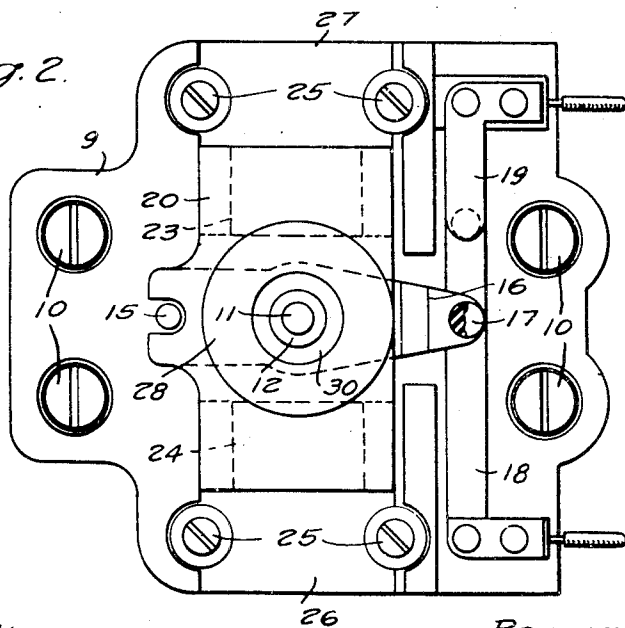


Fig. 2.



WITNESSES:

E. A. M. Lockey
Chas. W. King

INVENTOR

Bascom O. Austin.

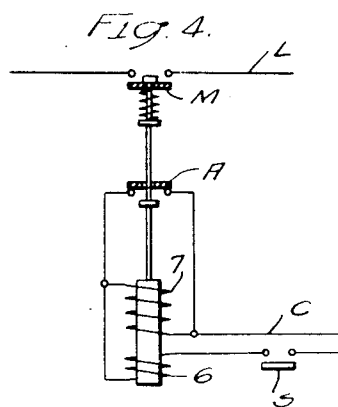
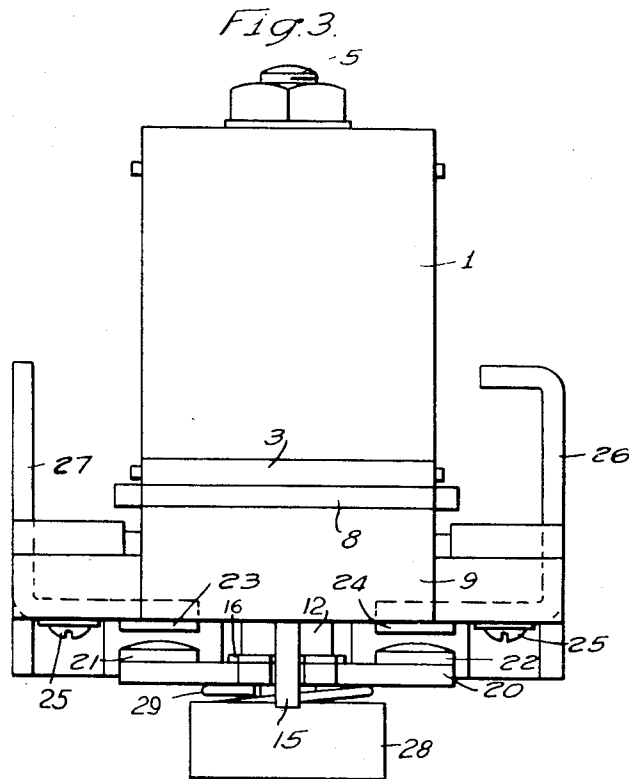
BY

Paul E. Friedmann
ATTORNEY

Filed Oct. 8, 1945

CONTACTOR

2 Sheets-Sheet 2



E. A. M. C. C. C.
Capt. in Army

Bascom O. Hustin.

BY
Paul E. Friedmann
ATTORNEY

UNITED STATES PATENT OFFICE

2,476,794

CONTACTOR

Bascom O. Austin, Lima, Ohio, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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8 Claims. (Cl. 200—87)

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My invention relates to electric contact devices such as electromagnetic contactors or relays and has for its main objective to improve the switching performance of this type of device by reducing the possibility of contact freezing or the disturbing effects caused by such freezing.

To this end, and in accordance with my invention, I provide the movable assembly of the contact device with an inertia weight which is movable relative to the movable contacts and cooperates with the contact-pressure spring of the assembly to impose during the switching performance an inertia effect on the contacts in order to produce a transient force between the movable contacts and the appertaining stationary contacts. This temporary force is effective when closing the contacts to diminish bouncing and the attendant arcing or sparking at the contacts, thus reducing the cause of freezing; or it acts when opening the contacts to force the contacts rapidly apart in order to secure a separation of the contacts even if they are slightly frozen. According to a preferred way of embodying the invention, and as will be exemplified hereinafter, the device may be so designed that a single inertia weight is capable of performing both above-mentioned functions.

The invention has proved especially favorable for electromagnetic relays and contactors of small dimensions and relatively high switching capacity as used, for instance, in aircraft and therefore is represented in the drawing by the example of a relay for such purposes.

In the drawing, Figure 1 represents an axial section through a contactor according to the invention; Fig. 2 is a lateral view; Fig. 3 is a side view of the same contactor at a right angle to the view of Fig. 2; and Fig. 4 is a diagram of the appertaining circuit connections.

According to the drawing, the contactor has a substantially U-shaped magnetic frame structure 1 with outwardly extending flanges 2 and 3. A magnetic core 4 is firmly attached to the bottom of the U-shaped frame structure 1 by means of a screw 5. The core 4 carries a pick-up coil 6 and a high-resistance holding coil 7. A face plate 8 of magnetizable material is mounted on flanges 2 and 3 and forms together with core 4 an annular interstice. The pole faces of core 4 and face plate 8 lie in a common geometrical plane.

A base 9 is mounted on plate 8, and parts 1, 8 and 9 are firmly secured together by means of

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screws 10 which engage corresponding threaded bores of flanges 2 and 3.

A guide pin 11 extends coaxially to core 3 and is firmly secured thereto. A sleeve member 12 is slidably seated on the guide pin 11 and carries an armature 13. The sleeve and armature assembly is biased by a kickout spring 14 in the direction away from the core.

A guide post 15, attached to the base 9, engages the recessed end of an arm 16 which is brazed to a shoulder of the sleeve member 12 and carries an insulating button 17. Two contact springs 18 and 19 are attached to the base 9. In the illustrated position of arm 16, the contact spring 18 rests resiliently against the contact spring 19 so that a circuit connection is established between springs 18 and 19 or the terminals and wires attached thereto. When arm 16 moves upwardly with reference to the showing in Fig. 1, button 17 engages the contact spring 18 and moves it out of contact with spring 19. Contact springs 18 and 19 form an auxiliary contact device for controlling the excitation of the holding coil 7 as will be explained below in conjunction with Fig. 4.

The main contact device of the relay comprises a movable bar-shaped contact member 20 which carries two contacts 21 and 22 for engagement with two respective stationary contacts 23 and 24 (Fig. 3). Contacts 23 and 24 are fastened to base 9 by means of screws 25 and are associated with terminals 26 and 27, respectively, for connection to the circuit to be controlled. The contact member 20 is slidable on sleeve 12. An inertia weight 28 is also slidably seated on the sleeve 12. A helical contact-pressure spring 29 tends to hold the contact member 20 against the adjacent stop or abutment formed by the arm 16 while holding the weight 28 against a retainer 30 fastened to the sleeve member 12.

When the core 4 is magnetized by electric energization of coil 6, the armature 13 is attracted in opposition to the biasing force of the spring 14. When the armature reaches the closed position, it seals against pole faces of core 4 and plate 8 so that thereafter a reduced magnetic force suffices to maintain the device in closed condition. In accordance therewith, the relay control circuit is so designed that the high-resistance holding coil 7 lies in series with the low-resistance pick-up coil 6, but is shorted by the contact springs 18 and 19 when the relay is in dropped-off condition. Hence, only coil 6 is at first effective to actuate the relay. When coil 6 is energized and after the armature 13

has moved the contacts 21 and 22 into engagement with the stationary contacts 23 and 24, the member 20 is stopped while the armature 13 and the sleeve 12 with arm 16 are permitted to travel a further extent under increasing compression of the contact pressure spring 29. During the period of this overtravel motion and shortly before the armature 13 seals against the magnet, the engagement of contacts 18 and 19 is interrupted. This interruption eliminates the short circuit of holding coil 7 so that the latter becomes energized in series with the pick-up coil 6. Hence, a reduced current is thereafter effective to hold the relay closed. This performance will be more fully understood from the circuit diagram of Fig. 4 in which the main contact device of the relay is schematically represented at M and the auxiliary contact device at A. The load circuit to be controlled by contact device M is denoted by L, while C indicates the control circuit for energizing the relay coils 6 and 7. When a switch or contact S in the control circuit is closed, the pick-up coil 6 is energized and causes the relay to first close contact device M and then open the contact device A. Thereafter, both coils 6 and 7 are excited in series connection until contact S is opened.

During the above-described closing motion of the movable armature and contact assembly, starting from the position shown in Figs. 1 and 3, the inertia weight 28 is caused by the retainer 30 to follow the movement of the armature 13 and sleeve 12. After the contacts 21 and 22 of the contact member 20 abut against the stationary contacts 23 and 24, a further movement of member 20 is prevented. Slightly later, the armature 13 abuts against the pole faces of the field structure and is also stopped. The weight 28, however, due to its inertia will now continue to move a further extent toward the stopped contact member 20, thus separating itself from the retainer 30. As a result, the spring 29 is additionally compressed and exerts temporarily an increased force on the member 20. This force prevents the contacts from bouncing and chattering and thus stabilizes the switching-in performance of the relay. When thereafter the inertia effect of the weight 28 ceases, the danger period of resonant vibrations of the movable contacts has passed so that the persisting amount of spring force suffices to hold the contacts safely in closed condition under the contact pressure required for a permanent transmission of current.

During the opening motion of the armature assembly, the armature 13 and sleeve 12, together with the inertia weight 28, start moving away from the field structure of the relay before the part 16 comes into engagement with the contact member 20. At the moment of engagement, the inertia of the moving weight 28 causes a hammer effect to take place between the sleeve 12 or the part 16 attached thereto and the contact member 20 so that suddenly a relatively great force is applied. This force suffices to secure a separation of the contacts even if they are slightly frozen.

It thus will be understood that the embodiment of my invention represented by the drawing utilizes the inertia effect of the weight 28 in two ways, thus reducing the tendency of arcing and freezing and also overcoming the effects of any residual freezing tendency.

It will be understood by those skilled in the art that devices according to my invention can be modified as regards the arrangement and detail design of its component parts without departing

from the principle and gist of the invention and within the essential features of the invention as set forth in the claims annexed hereto.

I claim as my invention:

1. A contact device, comprising a stationary contact, movable contact means, electromagnetic means having an armature for controlling said contact means to move between opening and closing positions relative to said stationary contact, an inertia weight movable relative to said armature and relative to said contact means and associated with said armature to move in the direction of motion of said contact means during changes of position of said contact means, stop means effective between said weight and said contact means for limiting the motion of said weight in the direction away from said contact means, and a spring disposed between said weight and said contact means, said weight having a mass rated relative to the biasing force of said spring so as to move prior to the motion of said contact means when said contact means are controlled to move into said opening position, whereby said weight is caused to thereafter exert a hammer effect through said stop means on said movable contact means if the latter tend to freeze to said stationary contact.

2. An electromagnetic contact device, comprising a stationary contact, movable contact means engageable with said stationary contact, electromagnetic means having an armature structure movable between two positions for controlling said movable contact, an inertia weight disposed on said structure and being movable relative to said structure and relative to said contact means, said contact means being disposed between said armature and said weight, a contact-pressure spring arranged to bias said weight and said contact means away from each other toward given respective positions relative to said armature structure so that, when said structure changes its position, said weight is caused by its inertia to move relative to said structure toward said contact means in opposition to said spring for reducing bouncing between said contact and contact means.

3. A contact device, comprising a stationary contact, movable contact means engageable with said contact, electromagnetic means having an armature structure movable between two positions and biased toward one of them, said movable contact being movably mounted on said structure so as to permit an overtravel motion of said structure when the latter moves toward one of said positions and after said contact means have established engagement with said contact, a contact-pressure spring engaging said contact means and disposed to bias said contact means toward a given position relative to said structure so that said spring is stressed due to said overtravel motion, and an inertia weight mounted on said structure so as to be movable relative thereto and relative to said contact means, said weight being engaged by said spring and having an inertia mass of sufficient magnitude relative to the force of said spring to move, due to inertia, relative to said contact means after said contact means touch said contact and before said contact means separate from said contact.

4. A contact device comprising a stationary structure having an electromagnet and a stationary contact, an armature structure movable relative to said magnet between magnetically open and closed positions, means for biasing said armature structure toward the open position, contact

means disposed on said armature structure for engaging said stationary contact when said armature structure is in one of said positions and being movable relative to said armature structure in the direction of motion of the latter, said armature structure forming an abutment for limiting the relative motion of said means toward one side, an inertia weight also forming part of said assembly and being movable relative to said armature structure and said contact means in said direction, said armature structure having a rigid abutment for limiting the relative motion of said weight toward the other side, a contact-pressure spring disposed so as to bias said weight and said contact means apart from each other toward said respective abutments, said weight having sufficiently large mass to perform due to its inertia an overtravel motion in opposition to said spring toward said contact means after the latter is moved into engagement with said stationary contact during a change in position of said armature structure thereby preventing bouncing between said contact means and said stationary contact.

5. A contact device, comprising a magnet core, a guiding pin projecting from the core, a sleeve slidably mounted on said pin so as to be movable toward and away from said core, an armature attached to said sleeve at the side of said core, a spring for biasing said sleeve and armature away from said core, a contact member and an inertia weight slidably seated on said sleeve, said contact member being disposed between said armature and said weight, a contact-pressure spring arranged so as to bias said member and said weight away from each other toward given positions relative to said sleeve, and stationary contact means to be engaged by said member in one position of said armature, said inertia weight having a mass rated relative to the biasing force of said contact-pressure spring so as to lag temporarily behind the motion of said sleeve in opposition to said latter spring in order to thereby render a transient force effective between said member and said stationary contact means.

6. A contact device, comprising a stationary structure having an electromagnet and stationary contact means, an assembly comprising an armature and a sleeve portion, means forming part of said structure for guiding said assembly for motion toward and away from said magnet, a spring for biasing said assembly away from said magnet, said sleeve portion forming two axially spaced abutments, a contact member slidably seated on said sleeve portion for engaging said stationary contact means when said assembly moves toward said magnet, an inertia weight slidably seated on said sleeve portion at the side of said member opposite said armature, a contact-pressure spring disposed between said member and

said weight so as to bias them toward said abutments respectively, said inertia weight having a mass rated relative to the biasing force of said contact-pressure spring so as to lag temporarily behind the motion of said sleeve portion in order to render a transient force effective between said member and said stationary contact means.

7. A contact device, comprising a stationary structure having an electromagnet and stationary contact means, an assembly comprising an armature and a sleeve portion, means for guiding said assembly for motion toward and away from said magnet, a contact member slidably seated on said sleeve portion for engaging said stationary contact means when said assembly moves toward said magnet, an inertia weight slidably seated on said sleeve portion at the side of said member opposite said armature, and a spring disposed between said contact member and said weight to bias them to limiting positions on said sleeve portion, said inertia weight moving from its limiting position toward said armature in opposition to the action of said spring, after said contact member has engaged said contact means, to temporarily increase the engagement pressure therebetween.

8. A contact device, comprising a stationary structure having an electromagnet and stationary contact means, an assembly comprising an armature and a sleeve portion, means for guiding said assembly for motion toward and away from said magnet, a contact member slidably seated on said sleeve portion for engaging said stationary contact means when said assembly moves toward said magnet, an inertia weight slidably seated on said sleeve portion at the side of said member opposite said armature, and a spring disposed between said contact member and said weight to bias them to limiting positions on said sleeve portion, said inertia weight moving from its limiting position toward said armature in opposition to the action of said spring, after said contact member has engaged said contact means, to temporarily increase the engagement pressure therebetween, and said inertia weight moving along with said assembly prior to the opening motion of said contact member to thereafter exert a hammer effect on said contact member to assist the opening movement thereof.

BASCUM O. AUSTIN.

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