S. M. LUCAS.

ELECTROMAGNET.

APPLICATION FILED DEC. 16, 1920.

1,421,269.

Patented June 27, 1922.

4 SHEETS—SHEET 1.

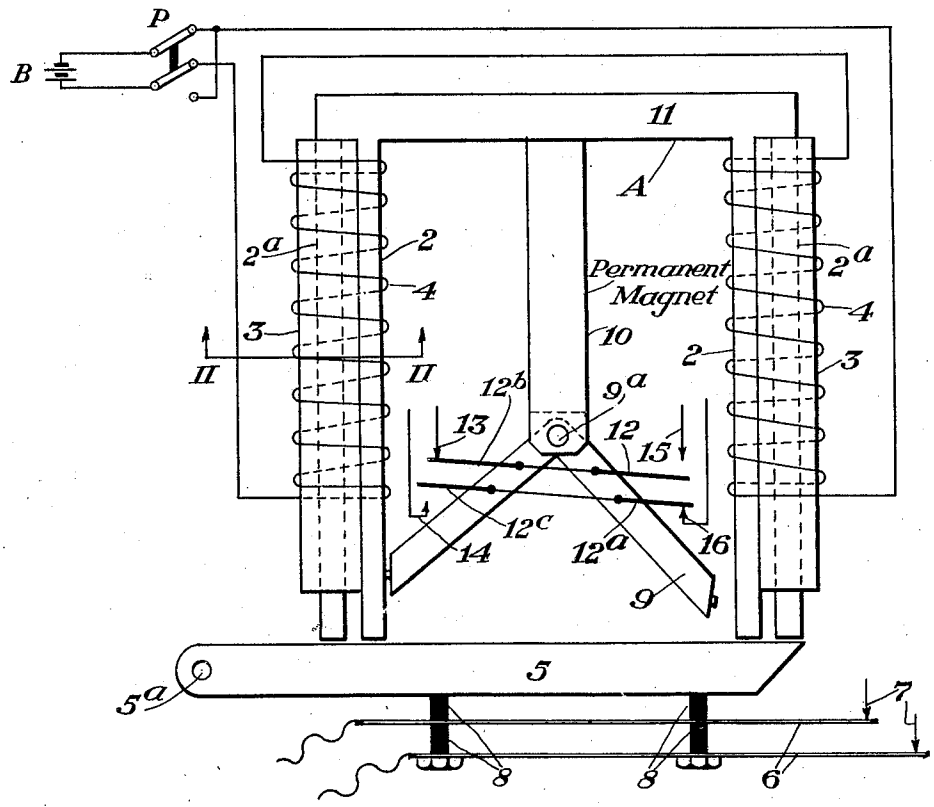


Fig. 1.

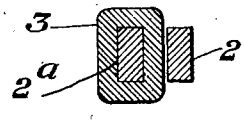


Fig. 2.

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4 SHEETS—SHEET 2.

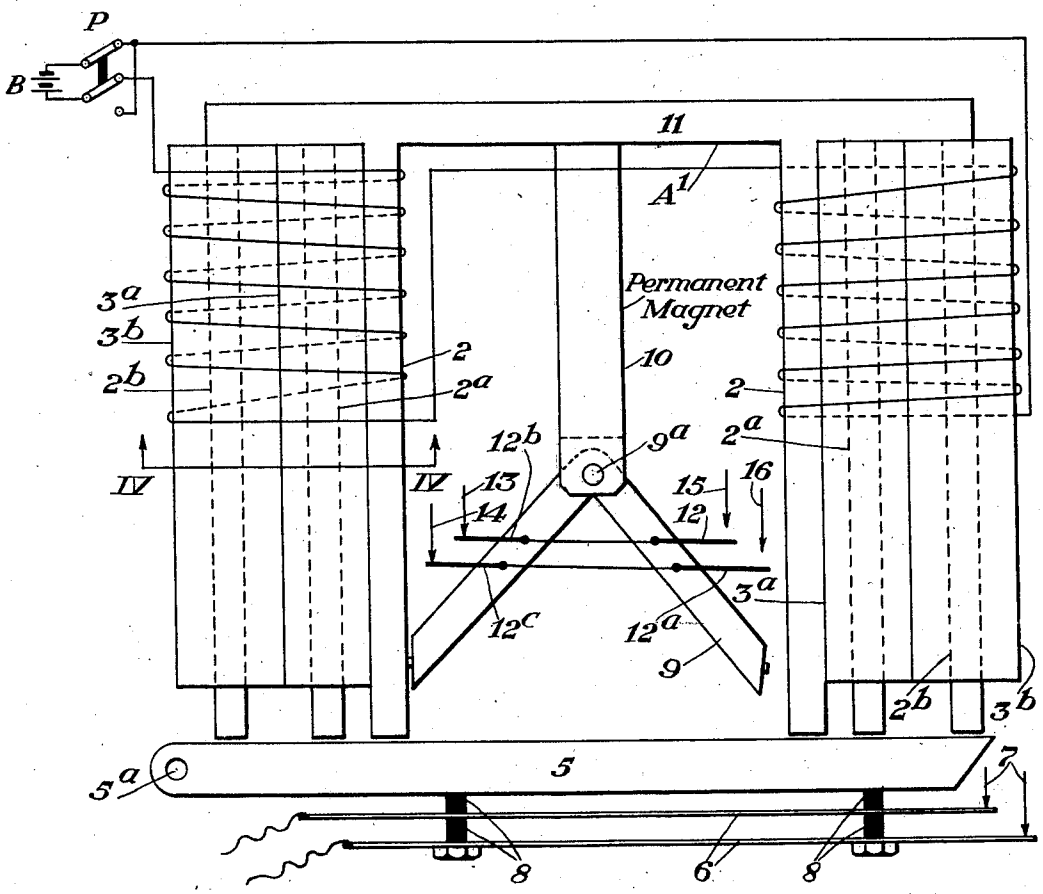


Fig. 3.

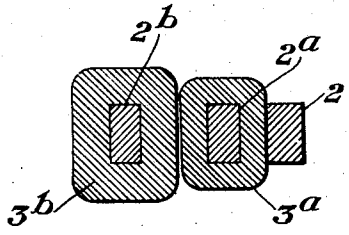


Fig. 4.

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4 SHEETS—SHEET 3.

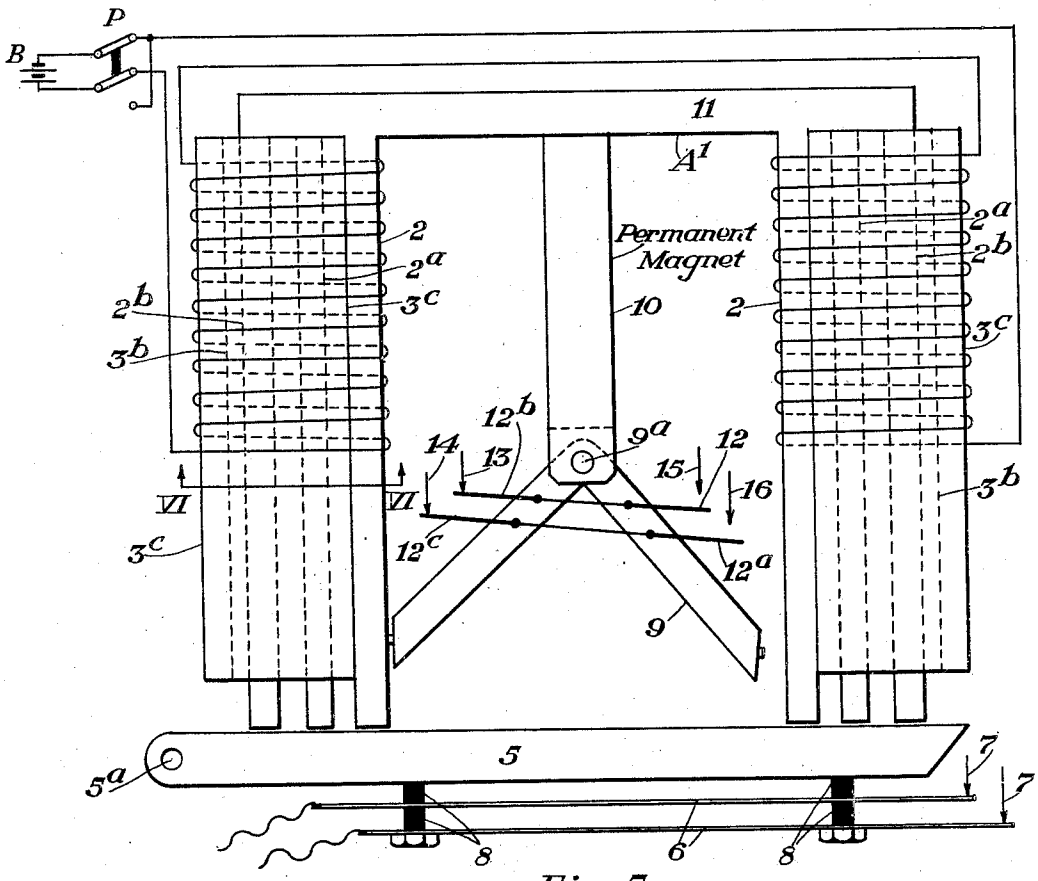


Fig. 5.

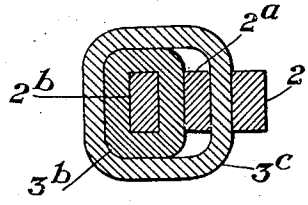


Fig. 6.

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4 SHEETS—SHEET 4.

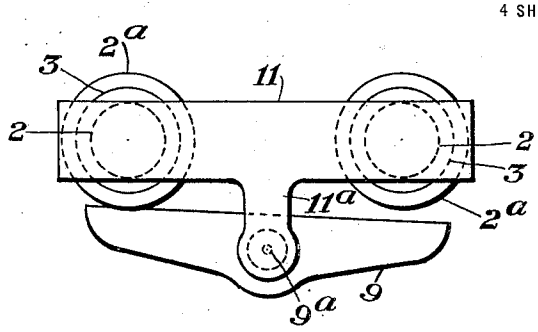


Fig. 9.

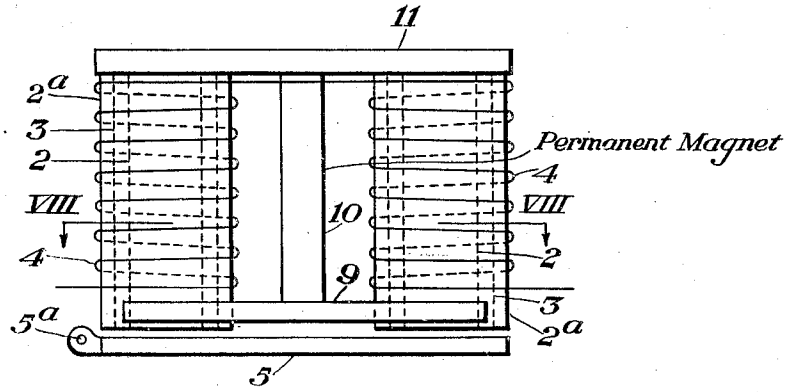


Fig. 7.

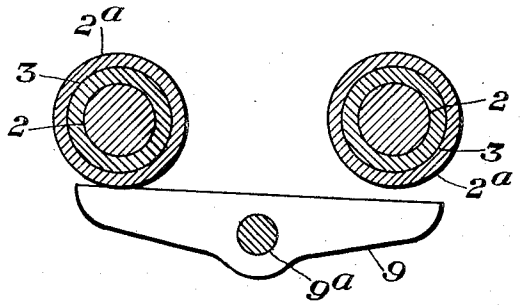


Fig. 8.

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UNITED STATES PATENT OFFICE.

SAMUEL M. LUCAS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELECTROMAGNET.

1,421,269. Specification of Letters Patent. Patented June 27, 1922.

Application filed December 16, 1920. Serial No. 431,078.

To all whom it may concern:

Be it known that I, SAMUEL M. LUCAS, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Electromagnets, of which the following is a specification.

My invention relates to electromagnets, and particularly to magnets of the type comprising a neutral armature responsive to the presence and absence of current, and a polarized armature responsive to the polarity of the current supplied to the magnet.

One object of my invention is the provision of a magnet of this character the neutral armature of which is not released when the polarity of the current supplied to the relay is reversed.

Magnets embodying my invention are particularly well adapted for use in electrical relays, and in the present application they are illustrated in connection with devices of this nature, with the understanding that they are not limited to this specific adaptation but are capable of general application.

I will describe several relays in which are incorporated various forms of magnets embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a view, partly in front elevation and partly diagrammatic, showing a relay having one form of electromagnet embodying my invention. Fig. 2 is a sectional view on the line II—II of Fig. 1 with the winding omitted. Fig. 3 is a view similar to Fig. 1 but showing a modified form of electromagnet embodying my invention. Fig. 4 is a sectional view on the line IV—IV of Fig. 3 with the winding omitted. Fig. 5 is a view similar to Fig. 1 but showing another modified form of electromagnet embodying my invention. Fig. 6 is a sectional view on the line VI—VI of Fig. 5 with the winding omitted. Fig. 7 is a view showing in front elevation a fourth form of electromagnet embodying my invention. Fig. 8 is a sectional view on the line VIII—VIII of Fig. 7, and Fig. 9 is a top plan view of the magnet shown in Fig. 7.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1, the electromagnet in the form here shown includes a U-shaped soft iron core A, having a back strap 11 and two legs each of which comprises two parallel sections 2 and 2^a. Each leg section 2^a encased in a tube or sleeve 3 of non-magnetizable electro-conductive material such as copper, but the leg sections 2 are not provided with such tubes. The magnet is provided with a winding 4 having two coils, one on each leg of the core, and each of which coils surrounds the entire leg including the copper tube 3. This winding is at times supplied with current from a suitable source such as a battery B, and the polarity of the current thus supplied to the winding may be reversed by a pole-changer P.

The reference character 5 designates a neutral soft-iron armature which is pivotally mounted at 5^a to move towards and away from the poles of the magnet, that is, the free ends of the core sections 2 and 2^a. It will be seen, therefore, that substantially all of the magnetic flux in the core A passes through the neutral armature, so that this armature is closed against the poles of the core when winding 4 is supplied with current, and falls away from the pole cores or "opens," by gravity, when the supply of current to the winding ceases. As here shown, one or more contact fingers 6 are attached to armature 5 by studs 8 of insulating material, and each of these fingers coacts with a fixed contact member 7 in such manner that the contact is closed when the armature is closed, and open when the armature is open.

The reference character 10 designates a polarizing member such as a permanent magnet, one end of which is attached to the back strap 11 of the core A midway between the two core legs, and the free end of which is bifurcated to permit a polarized armature 9 to be pivotally mounted therein at 9^a. The polarized armature may be L-shaped as shown in the drawing, and is arranged to swing between two extreme positions wherein its arms are substantially in engagement with section 2 of one core leg or the other. Armature 9 carries one or more contact fingers, such as 12 and 12^a, which fingers co-act with fixed contact members 13, 14, 15 and 16. When the armature is in the extreme left hand position, contacts 12^b—13 and 12^a—16 are closed, and when the armature is swung to its extreme right hand position, contacts 12—15 and 12^c—14

will become closed. It will, of course, be understood that when current of one polarity is supplied to winding 4, armature 9 will be swung to the left, and that when current of the other polarity is supplied to this winding the armature will be swung to the right.

The purpose of the tubes 3 is to delay the reversal of flux in the core leg sections 2^a when the polarity of the current supplied to the winding 4 is reversed. The result of these tubes is that during reversal of polarity the flux in core sections 2 reverses before the flux in section 2^a, so that at all times during reversal of polarity some flux is passing into and out of the neutral armature 5. It follows that this armature is not released during reversal of polarity of the current in winding 4.

Referring now to Figs. 3 and 4, the structure is substantially the same as that shown in Figs. 1 and 2, except that each leg of the core, which is here designated A', comprises three parallel sections 2, 2^a and 2^b. Section 2^a of each leg is provided with a copper tube 3^a, while section 2^b of each leg is provided with a copper tube 3^b. The tube 3^b is of larger cross sectional area, and, consequently, of lower electrical resistance, than the tube 3^a, so that during reversal of polarity the flux in leg section 2^b does not reverse until after the flux in section 2^a has reversed. That is, the tube 3^a delays the decay of flux in leg section 2^a while the flux in section 2 is reversing, and the tube 3^b delays the decay of flux in section 2^b while the flux in section 2^a is reversing. It follows that the pull on the neutral armature 5 does not pass through zero, and that, consequently, the neutral armature does not open during reversal of the polarity of the current supplied to winding 4.

With structure shown in Fig. 3, the theoretical maximum attainable pull on armature 5 during reversal of polarity drops to two-thirds of the normal pull exerted on this armature by the magnet cores. In this respect the structure shown in Fig. 3 is preferable to that shown in Fig. 1, wherein the theoretical maximum attainable pull on armature 5 during reversal of polarity drops to one-half of the pull normally exerted thereon.

Referring now to Figs. 5 and 6, the structure shown therein is similar to that shown in Figs. 3 and 4, with the exception of the arrangement of the copper tubes. In this instance the core leg 2^b is surrounded by a copper tube 3^b, and the two legs 2^a and 2^b are surrounded by a second copper tube 3^c. During reversal of the polarity of the current supplied to the relay windings, the tube 3^c delays the decay of flux in sections 2^a and 2^b while the flux in section 2 is reversing, whereas the tube 3^b delays the decay of flux in section 2^b while the flux in section 2^a is reversing. The net result is substantially the same as that of the device shown in Figs. 3 and 4.

Referring now to the structure shown in Figs. 7, 8, and 9, each leg of the core A comprises a cylindrical inner section 2 surrounded by a copper sleeve 3 which, in turn, is surrounded by an outer sleeve 2^a of soft iron constituting the second section of the core leg. Winding 4 surrounds the outer section 2^a. The permanent magnet 10 in this instance projects downwardly from an offset portion 11^a of the back-strap, and the polarized armature 9 is pivotally mounted at the lower end of such magnet to swing on a vertical axis, one end or the other of the armature being attracted towards the corresponding outer leg section 2^a according as the winding 4 is supplied with current of one polarity or the other.

The operation of this form of magnet will be readily understood. When the polarity of the current in winding 4 is reversed, the flux in each core section 2^a reverses before the flux in section 2, so that some flux is passing in or out of armature 5 at all times during such reversal and so this armature remains closed.

Relays incorporating electromagnets embodying my invention are particularly well adapted for use in connection with railway signaling apparatus, although they are not limited to this particular application.

Although I have herein shown and described only four forms of electromagnets embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. An electromagnet comprising a neutral armature and a polarized armature, a winding for creating magnetic flux to control both of said armatures, and means for delaying the reversal of part of the flux in the neutral armature when the polarity of the current supplied to said winding is reversed.

2. An electromagnet comprising a neutral armature and a polarized armature, a winding, two paths for magnetic flux created by said winding, the flux in one path controlling the polarized armature and the fluxes in both paths controlling the neutral armature, and means for delaying the reversal of the flux which does not control the polarized armature when the polarity of the current supplied to said winding is reversed.

3. An electromagnet comprising a neutral armature and a polarized armature, a winding for creating magnetic flux to con-

trol said armatures, and means for delaying the change of intensity of part of the flux employed for controlling said neutral armature when the intensity of the current supplied to said winding is varied.

4. An electromagnet comprising a winding, two paths for the magnetic flux produced by current in said winding, means for delaying the reversal of the flux in one path until after the reversal has occurred in the other path when the polarity of the current supplied to said winding is reversed, a neutral armature controlled by the flux in both paths, and a polarized armature controlled by the flux in one path.

5. An electromagnet comprising a winding, two paths for the magnetic flux produced by current in said winding, means for delaying the reversal of the flux in one path until after the reversal has occurred in the other path when the polarity of the current supplied to said winding is reversed, a polarized armature controlled by the flux in the second path, and a neutral armature controlled by the fluxes in both paths.

6. An electromagnet comprising a core having two sections in multiple, a winding for creating magnetic flux in said core, a tube of non-magnetizable electro-conductive material surrounding one of said sections, a polarized armature controlled by the flux in one section, and a neutral armature controlled by the fluxes in both sections.

7. An electromagnet comprising a winding, a plurality of paths for the magnetic flux produced by current in said winding, means for causing reversal of the flux successively in the several paths when the polarity of the current supplied to said winding is reversed, and neutral and polarized armatures controlled by the fluxes in said paths.

8. An electromagnet comprising a winding, a plurality of paths for the magnetic flux produced by current in said winding, means for causing reversal of the flux successively in the several paths when the polarity of the current supplied to said winding is reversed, a neutral armature controlled by the fluxes in all of said paths, and a polarized armature controlled by the flux in one of said paths.

9. An electromagnet comprising a neutral and a polarized armature, a winding for creating magnetic flux in said armatures, a plurality of paths for said flux, and means for causing reversal of flux successively in the several paths when the polarity of the current supplied to said winding is reversed.

10. An electromagnet comprising a neutral and a polarized armature, a winding for creating magnet flux to control said armatures, a core for said winding having a plurality of sections in multiple, and tubes of non-magnetizable electro-conductive material surrounding certain of said sections and arranged to cause successive reversals of flux in the several sections upon reversal of polarity of the current supplied to said winding.

11. An electromagnet comprising a U-shaped core each leg of which comprises at least two parallel sections, a winding for creating magnetic flux in said core, means associated with each leg of said core for delaying the reversal of flux in one section thereon until the flux in the other section has reversed upon reversal of the polarity of the current supplied to said winding, a neutral armature controlled by the fluxes in both sections of each leg, and a polarized armature controlled by the flux in one section of each leg.

In testimony whereof I, affix my signature.

SAMUEL M. LUCAS.