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ELECTROMAGNETIC RELAY

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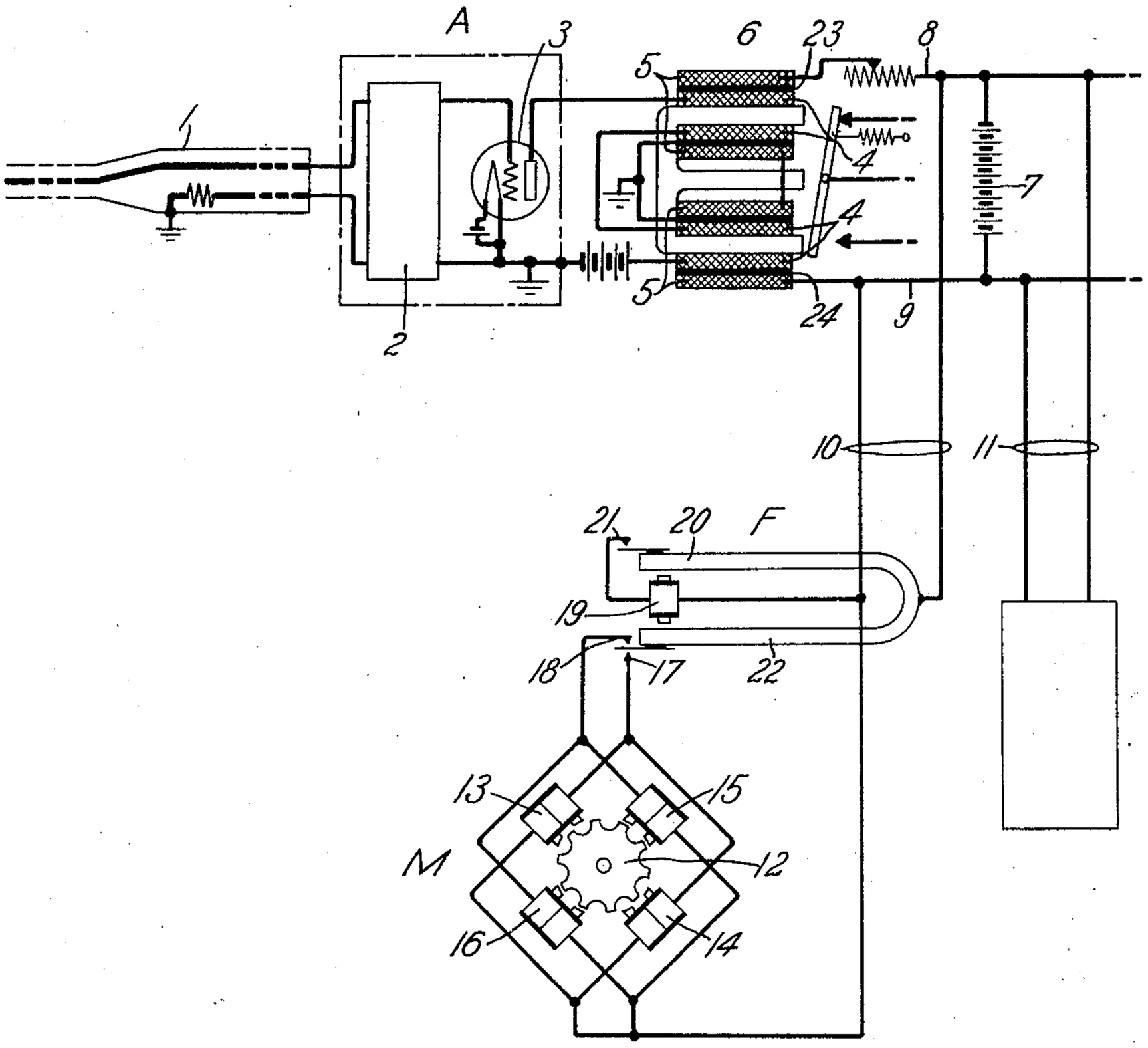

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ELECTROMAGNETIC RELAY.

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This invention relates to electromagnetic devices and more particularly to relays used in signaling circuits in which small currents are amplified.

An object of this invention is to prevent disturbing electrostatic action between the windings of a multi-winding relay.

This object is accomplished in a preferred embodiment of the invention by providing a metallic shield between windings of a multi-winding relay to prevent voltages applied to one winding from inducing disturbing voltages or currents in the other winding by reason of the electrostatic capacity between windings.

In a multi-winding relay which has its windings arranged one over the other in separate circuits, the arrangement constitutes a device which functions much the same as a condenser, the windings serving as the metallic plates and the insulating material between windings serving as the dielectric. It has been found in using a relay of this type in a signaling system that if one of the windings is connected in an operating, or signaling, circuit and the other in a biasing circuit which is subjected to disturbing impulses, such as may be caused by surges of voltages therein, a charge is induced upon the operating winding of the relay each time a sudden surge of voltage occurs in the biasing circuit, to such an extent as to have a detrimental effect on the incoming signals in the signaling circuit. This condition is particularly detrimental when a highly sensitive element, such as a vacuum tube amplifier, is employed in the signaling circuit because then the voltage induced upon the operating winding may be indirectly applied to the input circuit of the amplifier, and, being amplified thereby, distort the wave form of the incoming signals. If two or more amplifiers are connected in tandem, the energy radiating from the circuit including the operating winding of the relay when a voltage is suddenly induced thereon, may also impress voltages on the amplifiers of the preceding stages, which disturbances are amplified and thereby have a further distorting effect on the incoming signal. According to the present invention a highly responsive circuit such as may include a vacuum tube amplifier and the operating winding of a multi-winding relay, is arranged to be protected from capacity effects between adjacent windings by providing a metallic shield between the windings of the relay and arranging such shield with a connection to ground or to some neutral point in a manner such as to prevent any high voltage impulses in the biasing winding from being induced electrostatically upon the operating winding.

The invention will be more particularly described in connection with the accompanying drawing which shows a preferred embodiment of the invention employed at the receiving end of a submarine cable telegraph system.

In the drawing, a submarine cable 1 is shown terminating in an amplifier A consisting of several stages, the first stages being indicated by the block 2, and the last stage represented by a vacuum tube 3. The signals incoming over cable 1 are first amplified and then caused to flow through the inner, or operating, windings 4, 4 of relay 6 which may be arranged to repeat the signals to any of the well known receiving or recording devices. The relay is of the polarized type and may have several windings, although for the purpose of describing the invention, relay 6 is shown as having only two windings. In some cases, several of these relays may be employed for receiving signals from an amplifier, for example, two relays may be required for receiving signals and one for synchronizing. Connected to the outer, or biasing, windings 5, 5 is a continuously closed circuit in which is employed a relatively high voltage battery 7, and this battery may be utilized for many other purposes besides that of furnishing biasing current for the relay. During the intervals in which no signals are being received in the operating, or inner, windings, the armature of the relay will be normally held against one of the associated contacts, the upper contact being arbitrarily selected as an illustration to represent this condition.

The biasing circuit comprises the outer windings 5, 5, conductors 8 and 9, and the high voltage battery 7, and has no direct connection to ground. If an intermittently closed circuit is arranged to be operated from the same battery and consequently connected in parallel with the biasing circuit, as will probably be the case where a tuning fork is employed for driving a motor, such as a La Cour phonic wheel which, in turn, is used

in driving a rotary distributor (not shown) for distributing the incoming signal impulses in the printer (not shown), the voltage in the biasing circuit will be subjected to severe surges containing components of high frequencies, and such surges will produce potentials between the battery used for the biasing circuit and the earth. The filament circuit of vacuum tube amplifier 3 is connected to earth and these surges will impress impulses on the biasing windings of the relays, which, in turn, will cause current to flow through the capacitance between the biasing and the operating windings to earth in the filament circuit, particularly when the potential of the surge is higher than that of earth. This current produces high voltage surges between the plate and filament of vacuum tube 3 which may seriously distort the effects of the variations in the grid potential produced by the incoming signals. The major part of the current flows to earth through the common negative filament lead of the amplifier, and as the impedance to earth from this point may be considerable for the high frequencies contained in the surges a certain potential with respect to earth is created. The impedances between the filaments and grids of the various stages of the amplifier are usually very high, and the shielding of the amplifier is not by any means perfect, as in practice, it is impractical to arrange all its connections and batteries within one shield. The result is that the relatively high frequency fluctuations of the filament potential to earth caused by the surge currents passing from the relay biasing battery to earth by the way of the capacitance between the relay windings and the amplifier earth conductor, are effective in producing differences of voltages between the filaments and grids of the various stages of the amplifier. These are amplified and also rectified to a certain extent, and are added to the signal received from the cable. It is quite possible for the interference thus created to be sufficiently strong to entirely prevent operation of the system.

Illustrated in the drawing are two intermittently closed circuits 10 and 11 which are connected in parallel with the biasing circuit and, like the latter circuit, are arranged to be supplied with current from battery 7. It is understood, of course, that the arrangement is not to be limited to the number of circuits shown, but that in actual practice it is more usual to furnish ten or twelve such circuits in parallel with the biasing circuits. Circuit 11 is diagrammatically shown and it is understood that the arrangement therein is substantially identical with that shown in circuit 10. Once a tuning fork, such as F in circuit 10, is set in motion by any of the means well known in the art, the vibration of the tines will be continuous and effective to continue the operation of the motor M. The motor is of the well known phonic wheel type and consists of a rotor 12, a pair of operating magnets 13 and 14 having their windings connected in parallel, and a second pair of operating magnets 15 and 16, also having their windings connected in parallel. Magnets 13 and 14 are connected to the outer contact member 17 of the tuning fork and magnets 15 and 16 are connected to the inner contact member 18 of the tuning fork, and the fork is maintained in operation by means of a magnet 19 which is energized each time the tine 20 strikes against contact member 21.

In the operation of the system, a received signal impulse after it passes through the last stage of amplifier A, energizes the operating windings of relay 6 and overcomes the magnetic effect of the current in the biasing winding, so as to cause the relay armature to engage its lower contact, thereby closing a circuit extending to a printer (not shown). If, during the time the incoming impulse is discharging between the grid and plate of the vacuum tube 3 of the last stage, the contacts established by the tines 20 and 22 of the tuning fork F, are opened, a disturbing impulse is impressed on the biasing windings, thereby causing therein a surge of voltage which is effective ordinarily to produce, because of the capacitance effects between the windings, a similar surge upon the operating windings, and the surge in the latter windings causes a disturbance charge to be set up in the plate circuit of tube 3. The disturbance charge in turn, causes a variation in the grid potential and will therefore interfere with the potential impressed upon the grid by the incoming signal. This disturbance is eliminated by arranging metallic shields 23 and 24 between the operating and the biasing windings 4 and 5, respectively, and connecting such shields to ground as shown in the drawing. In this way any electrostatic charges due to surges of voltage in the biasing winding, are conducted directly to ground and do not flow to the operating winding through the capacitance between windings.

What is claimed is:

1. A circuit making and breaking device having a movable armature and a plurality of windings arranged to effect the operation of said armature, circuits including said windings, individual sources of current for said circuits, and means arranged on said device for automatically protecting one of said windings from the effects of impulses containing components of high frequencies produced in the other of said windings.

2. A circuit making and breaking device having relatively movable parts and a plurality of windings for effecting the operation of one of said parts, a separate circuit for each of said windings, individual sources of current for said circuits, and a shield for

separating said windings and arranged to prevent transfer of energy therebetween due to the capacity between the windings.

3. An electromagnetic device having a contact operating member and a plurality of windings for effecting the operation of said member, individual circuits for said windings, individual sources of current for said circuits, and an earthed metallic shield for separating said windings and arranged to prevent surges of voltage in one of said winding circuits from inducing similar surges of voltage in the other of said circuits thereby insuring the operation of said device by one of said circuits without interference from the voltages in the other of said circuits.

4. A relay comprising a circuit breaking armature and a plurality of windings, a circuit supply for each of said windings, a third circuit including contacts adapted to make and break in rapid succession and connected to one of said supply circuits, individual sources of current for said supply circuits, and means arranged between said windings to prevent surges of voltage impressed upon one of said supply circuits by the operation of said contacts from interfering with the voltages in the other of said supply circuits.

5. A relay comprising a movable armature and a plurality of windings, a circuit for each of said windings, individual sources of current for said circuits, a shield for separating said windings for protecting the voltages in one of said windings from surges of voltage produced in the other of said windings.

6. A relay comprising a movable armature and a plurality of windings, a circuit for each of said windings, individual sources of current for said circuits, a vacuum tube amplifier in one of said circuits, a plurality of continually opening and closing paths arranged in parallel and each including inductance elements in the other of said circuits, and means arranged between said windings to prevent surges of voltage produced in one of said circuits at the opening of said paths by the inductance of said elements from being induced in the other of said circuits, thereby preventing interference with the potential variations produced on the grid of said amplifier by the incoming signals.

7. A polarized relay comprising a movable armature and a plurality of windings, a signaling line associated with said relay, a circuit for each of said windings one of which is continuously closed, individual sources of current for said circuits, a vacuum tube amplifier in the other of said circuits arranged to amplify incoming signals for operating said relay, a plurality of paths arranged in parallel in said continuously closed circuit and adapted to produce high frequency voltage surges, and a shield on said relay arranged to prevent discharge voltages produced by the high frequency voltages in said parallel paths from affecting the potential variations produced on the grid of said amplifier by the incoming signals.

8. A polarized relay comprising an operating and a biasing winding, circuits for said windings, the circuit of said biasing winding being arranged to be continuously closed, individual sources of current for said circuits, a continually opening and closing path arranged in parallel to said biasing circuit and equipped with a source of high frequency voltage, a plurality of vacuum tube amplifiers associated with said operating winding, and a shield on said relay arranged to prevent surges of voltage impressed upon the biasing winding by the opening of said path from effecting differences of potential between the filaments and grids of said amplifiers.

In witness whereof, I hereunto subscribe my name this 28th day of January, A. D. 1927.

AUSTEN M. CURTIS.