

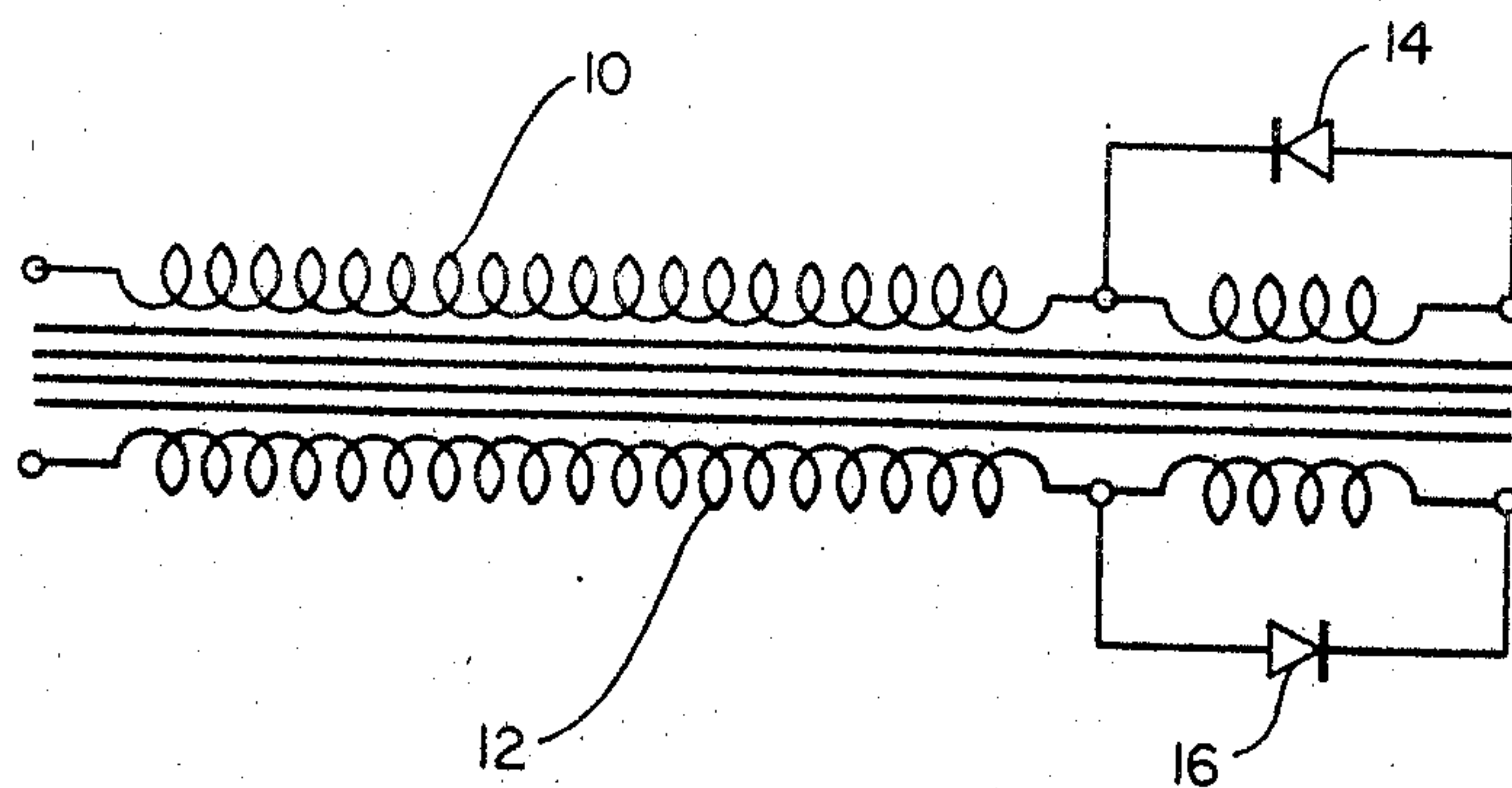
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RELAY DAMPING

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RELAY DAMPING

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This invention relates to a novel arrangement for damping a reed relay of the kind used in telephone exchanges. Reed type relays are currently widely used in central office telephone switching equipment, and have been found to be highly advantageous because of their relatively simple and inexpensive construction, as well as their reliability and high speed operating characteristics. Some difficulty has been experienced with relays of this type, however, in utilizations where they are required to follow dialing pulses. For reasons that are presently not fully understood, reed relays tend to introduce extra pulses, that is, to pick up during disconnect intervals, resulting in the insertion of erroneous dialing information into the system. The causes for this appear to be relatively complex and variable, depending upon the nature of the various different lines to which the relay may be connected from time to time.

In accordance with the invention, it has now been found that improved reliability in reed type pulsing relays can be achieved by connecting a diode in the back-wave direction across a selected portion comprising fewer than half the total number of turns of the relay coil. The diode acts to delay the drop-out of the relay only slightly. Unexpectedly, its principal effect has been found to be the prevention unwanted pick-up of the relay, and to render the relay relatively insensitive to random transients and oscillations that occur in the line.

It is recognized that the use of a back-wave connected diode across a relay coil is a well-known expedient for suppressing surge voltages developed by the coil upon de-energization. Heretofore, however, the diode has been connected across the entire coil, and its principal side effect has been to slow the release time of the relay. By connecting the diode in accordance with the invention across only a selected portion of the coil, it has been found that the release time is not significantly affected, but the sensitivity of the relay appears to be reduced so that it does not pick up in response to transients, oscillations, or other random fluctuations in the line voltage that have heretofore caused false pulsing of relays of this type.

The invention arose in the course of work on relays of the type that are used in a so-called balanced circuit, and include two coils, one of which is connected between one battery terminal and one lead of the subscriber's line, the other being connected between the second battery terminal and the second lead. In arrangements of this type, the impedances of the two coils must not only be held within very narrow limits, but the coils must be balanced so as not to disturb the electrical balance of the line and the switching system. Also, any devices used to temper or modify the action of the relay must have no significant adverse effect on transmission of a voice signal. Moreover, the operation of the relays in response to dial pulses must meet relatively stringent requirements, and only a very small margin is available to accommodate delays in pick-up or drop-out.

When applied to relays of this type, the diodes, in accordance with the invention, are connected across about one-fifth to about a quarter of the turns of each winding in the back-wave direction. The shunted portions of the windings are selected to have as nearly equal resistance and inductance as possible to maintain the balance requirement. Shunting only a small portion of each wind-

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ing not only ensures preservation of the electrical balance, but also minimizes the effect the diodes would otherwise have on the voice signal.

It is not fully understood, however, how the diodes operate to reduce the sensitivity of the relay without also causing an appreciable delay in its dropping out, but it has been demonstrated empirically that relays with their coils partly shunted in accordance with the invention follow dial pulses faithfully and are not subject to unwanted pick-up between the dial pulses, while relays without the shunt diodes, but otherwise of identical construction to tend to pick-up at unwanted times.

The invention will now be described in greater detail in connection with the accompanying drawing, wherein the single figure is a schematic circuit diagram of a presently preferred embodiment of the invention.

Referring now to the drawing, the relay coil shown therein is bifilar, and includes two windings 10 and 12, wound together but insulated from each other. Each of the windings 10 and 12, as wound for an actual coil for a reed type pulsing relay included four thousand turns of No. 35 A.W.G. insulated copper wire. The coil was wound on an insulated iron core, and had an inside diameter of 0.327" and a length of about 2½ inches.

Both of the windings 10 and 12 were tapped at the end of the first 3100 turns, and the diodes 14 and 16 were connected in shunt across the last 900 turns. By the use of bifilar winding, and tapping both windings at the same turn, differences between the two windings are minimized and maximum assurance is achieved that the diodes 14 and 16 will have substantially equal effects on their respective windings so as to preserve the electrical balance of the telephone system.

The diodes 14 and 16 may be of any desired type. As actually used in reducing the invention to practice, they were silicon diodes of the commercial type 1N1694.

To minimize the un-balancing effect of the diodes 14 and 16, it was decided to ascertain the smallest portions of the windings that could be shunted without losing the de-sensitizing effect. This was found to be, in the cases studied, about 800 turns. If fewer than 800 turns, or about one-fifth of the windings, were shunted, the relays would respond to spurious signals. The figure of 900 turns was selected to provide a safety factor to ensure adequate de-sensitizing without danger of upsetting the electrical balance of the system or introducing an excessive insertion loss.

Also to maintain maximum electrical balance in the telephone circuit, the diodes 14 and 16, as shown in the embodiment described herein are oppositely oriented relative to the end terminals of the windings 10 and 12. The end terminals to which the diodes are connected lead ordinarily to the battery in the telephone exchange, and the opposite end terminals are arranged for connection to the subscriber's line.

The practice of the invention is, of course, not limited to the exact construction shown and described, but will be effective for use with relays of many different types, especially in circumstances where it is desired to reduce or to adjust the sensitivity of the relay with only little effect on the timing of its operation and minimum effect on the circuit used for energizing it.

What is claimed is:

1. Method of modifying the operating characteristics of an electromechanical relay of the type having a coil and intended to be energized by direct current comprising shunting fewer than half of the turns of the coil with a diode connected in the back-wave direction.

2. Method of modifying the operating characteristics of an electromechanical relay of the type having a coil and intended to be energized by direct current comprising shunting about one-fifth to about one-quarter of the turns

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of the coil with a diode connected in the back-wave direction.

3. An electromechanical relay comprising a coil, and a diode in shunt across fewer than one half of the turns of said coil.

4. A relay in accordance with claim 3, wherein said diode shunts about one-fifth to about one-quarter of the turns of the coil.

5. A relay in accordance with claim 3, wherein the turns shunted by said diode are the outermost turns of the coil.

6. A bifilar wound electromechanical relay for use in an electrically balanced telephone switching circuit comprising a pair of diodes connected across corresponding portions of each of the respective windings of the relay, each of said diodes being in shunt with fewer than half the turns of one of the windings.

7. A relay in accordance with claim 6, wherein said diodes are in shunt with radially outer terminal portions of the windings, and are electrically oppositely oriented relative to the adjacent ends of the windings.

8. A relay comprising a coil having two similar windings in bifilar configuration, each of said windings having

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a radially inner end terminal, an intermediate terminal, and a radially outer terminal, each of said windings having at least about three times as many turns between said inner terminal and said intermediate terminal as between said intermediate terminal and said other terminal, a first diode connected between the intermediate and outer terminals of one of said windings with its anode connected to said outer terminal, and a second diode connected between the intermediate and outer terminals of the other one of said windings with its cathode connected to the outer terminal.

9. A relay in accordance with claim 8, wherein the inner portion of each of said windings includes from about 3100 to about 3200 turns, and the outer portion includes between about 900 and about 800 turns.

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