June 2, 1942. H. L. BARNEY 2,284,617

RELAY SWITCHING CIRCUITS

Filed Oct. 22, 1940

FIG. 1

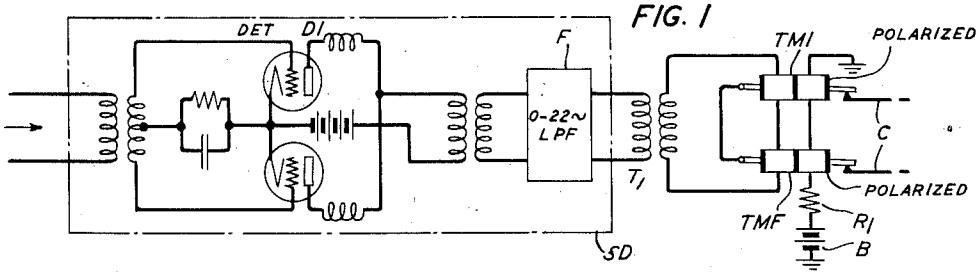


FIG. 2

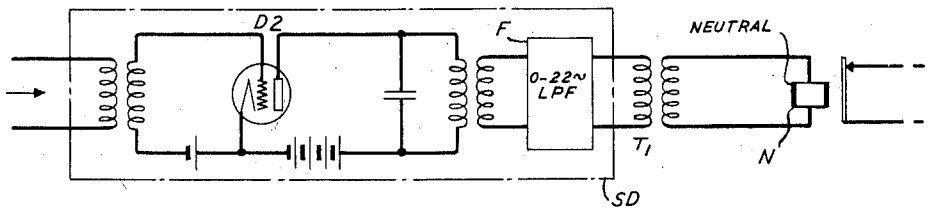


FIG. 3

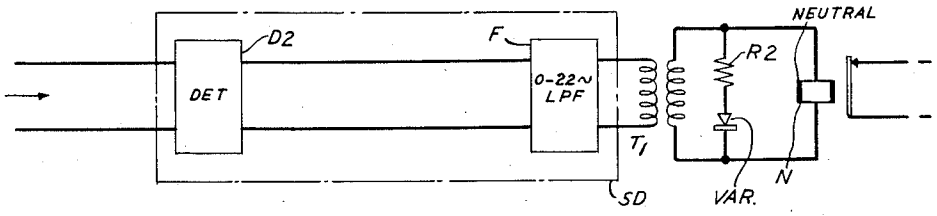


FIG. 4

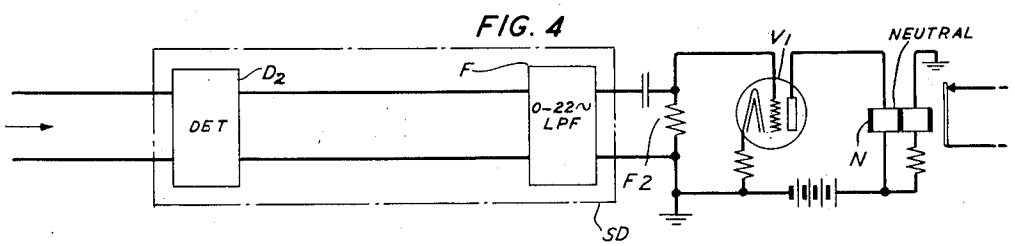


FIG. 5

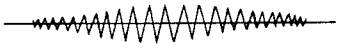


FIG. 6

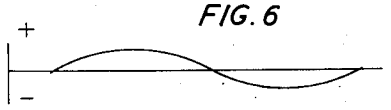


FIG. 7

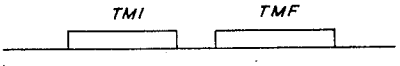
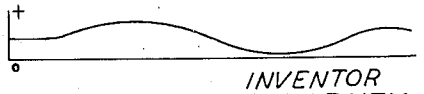


FIG. 8



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RELAY SWITCHING CIRCUITS

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2 Claims. (Cl. 178—44)

The invention relates to switching circuits and particularly to relay switching circuits controlled by alternating current.

The invention is particularly applicable to, although not limited to, voice-operated switching circuits of the "syllabic" type, employed in two-way telephone systems, which are responsive to the syllabic variations in speech waves but are substantially unresponsive to comparatively steady noise waves. In one circuit of this type in the prior art disclosed in Fisher Patent 1,939,680, issued December 19, 1933, a pair of polarized relays are connected in reverse order to the output of a low-pass filter, the cut-off frequency of which is about 22 cycles. The filter is connected in the output of a push-pull vacuum tube detector circuit the input of which is supplied from a transmission line carrying speech waves and subject to interfering noise waves. One of these relays operates upon the initial application of speech waves to the circuit and the other upon the cessation of the applied speech waves, the low-pass filter preventing transmission of the relatively steady rectified current due to noise waves to the relays. Other syllabic switching circuits of the prior art, for example, those disclosed in Nyquist Patent 1,749,841, issued March 11, 1930, employ a plurality of tandem detector circuits with an intermediate low-pass filter and selective networks transmitting current corresponding to the envelope of speech current and suppressing noise waves, for controlling a single switching relay. In the circuits disclosed in the latter patent the switching relay operates only either on the initial or the final parts of speech syllables, but not on both, or requires the use of a push-pull vacuum tube detector in the final detector stage to provide operation on both initial and final parts of syllables.

An object of the invention is to improve switching circuits such as described above.

A more specific object is to improve such switching circuits so as to obtain equivalent operation with the employment of less apparatus.

These objects are attained in accordance with the invention by a circuit employing a single vacuum tube detector and a neutral relay.

The various objects and features of the invention will be better understood from the following detailed description when read in conjunction with the accompanying drawing in which:

Fig. 1 shows schematically a prior art syllabic switching circuit;

Figs. 2 to 4 show schematically improved syllabic switching circuits embodying different modifications of the invention; and

Figs. 5 to 8 show curves illustrating the operation of the circuits of the invention.

In the syllabic switching circuit of the prior art shown in Fig. 1, the syllabic detector circuit SD comprising the push-pull vacuum tube detector D_1 and the low-pass filter F having a cut-off at about 22 cycles, has its input connected to a line transmitting speech waves and subject to interfering noise waves, and its output coupled through the low frequency transformer T_1 to the operating windings in series of the two polarized switching relays TMI and TMF, the biasing windings of these two relays being supplied in series with biasing current from battery B through resistance R_1, the operation of either relay TMI or TMF causing the circuit C to be opened. The current flowing in the operating windings of the two relays TMI and TMF, corresponding to a speech input pulse such as illustrated in Fig. 5, would be somewhat as shown in Fig. 6. On increasing amplitudes at the input the current flowing through the operating winding of the two relays is positive, and on decreasing amplitudes the current flows in the negative direction. Relay TMI is poled to operate on the positive current and relay TMF on the negative current. Operations of the contacts of these relays for the single input pulse are as illustrated in Fig. 7.

The circuit of the invention illustrated in Fig. 2 differs from the prior art circuit shown in Fig. 1 in the substitution of a single detecting vacuum tube D_2 for the push-pull vacuum tube detector D_1 in the latter circuit, and the substitution of a single "neutral" relay N for the two polarized relays TMI and TMF of the prior art circuit. The neutral relay N may be any of the types known in the prior art, which by suitable mechanical biasing means provides operation in the same manner for the positive and negative parts of the applied alternating current waves. One type of relay providing such operation is disclosed in the United States patent to Gachet, No. 1,992,610, issued February 26, 1935. The current flowing in the operating winding of relay N, either positive or negative, will cause operation of the relay against its mechanical bias, resulting in contact closures which should be identical with those shown on Fig. 7. The low frequency transformer T_1 operates to suppress the direct current component of the detector output current from the winding of relay N.

In syllabic switching circuits of the general

type illustrated in Fig. 1 employing two polar relays TMI and TMF, it is customary to make the relay TMF less sensitive than the relay TMI. The single neutral relay N in applicant's improved circuit may be readily adapted to perform in the same manner as the two polar relays of the prior art circuit in this respect simply by shunting its operate winding with a copper oxide varistor VAR as shown in Fig. 3. This varistor may be used in series with a resistance R_2 to limit its shunting effect, as shown in Fig. 3, and may be poled in the required direction to make either the initial or final operation on a syllable less sensitive.

The circuits of Figs. 1, 2 and 3 are all shown with a low frequency transformer T_1 used to suppress the direct current component from the detector output from the relay windings. Fig. 4 shows a modified circuit arrangement in accordance with the invention which uses an auxiliary vacuum tube for performing the function of the low frequency transformer in the other circuit. This vacuum tube designated V_1 is used as a direct current amplifier and has a constant direct current in its plate circuit on which are superimposed the variations at syllabic frequencies corresponding to the output of the resistance-capacity filter F_2 in its control grid-cathode circuit, which is connected to the output of the low-pass filter F in the syllabic detector circuit SD. The operating (left-hand) winding of the neutral relay N is included in the plate-cathode circuit of the direct current amplifier tube V_1. The plate current of the tube V_1 passing through the relay winding for a single applied speech impulse would be somewhat as shown in Fig. 8. In the circuit of Fig. 4, the direct current component of the plate current is balanced out in its effect on the magnetic circuit of relay N by the current in the (right-hand) biasing winding, leaving the relay armature to be held in the unoperated position by the mechanical bias. Thus, when the plate current of tube V_1 increases above its nominal value, relay N will operate with a positive value of total magnetic flux induced by currents in its windings. When the plate current of V_1 decreases below its nominal value, relay N will again operate, with the magnetic flux in its core reversed. This results in contact closures of relay N which are the same as illustrated in Fig. 7 for the prior art circuit employing two polar relays as shown in Fig. 1. Different sensitivities of the initial and final operations of the relay N may be easily obtained in the circuit of Fig. 4 by increasing or decreasing the value of the bias current by suitable design of the biasing and operating windings.

Various modifications of the circuits which have been illustrated and described within the spirit and scope of the invention will be apparent to persons skilled in the art.

What is claimed is:

1. In combination, a syllabic detector having an input circuit supplied with speech currents, and an output circuit, a single neutral relay having an operating winding coupled to said output circuit, means for suppressing the direct current component of the syllabic detector output current from said winding, said relay being operatively responsive in the same direction to the positive and negative portions of the syllabic current in said detector output circuit and a circuit including a unilateral device and an impedance of suitable value shunted across said operating winding to make the operation of said relay less sensitive to a desired degree to either the initial or final part of a syllable of said speech currents, depending on the poling of said unilateral device.

2. In combination, a syllabic detector having an input circuit supplied with speech currents, a direct current amplifier comprising an electron discharge device having an input circuit connected to the output of said syllabic detector and an output circuit, a neutral relay having a magnetic core and an operating winding which is connected in the output circuit of said electron discharge device, said relay being operatively responsive in the same direction to the positive and negative portions of the syllabic current in the output circuit of said device, and means to prevent the direct current component of the current in the output circuit of said device from appreciably affecting the operation of said relay comprising another winding on said relay supplied with biasing direct current, operating to substantially balance out the flux in said core induced by said direct current component flowing through said operating winding.

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