Sept. 29, 1931. W. T. WINTRINGHAM 1,824,857

ELECTRICAL SWITCHING DEVICE

Filed Aug. 21, 1929

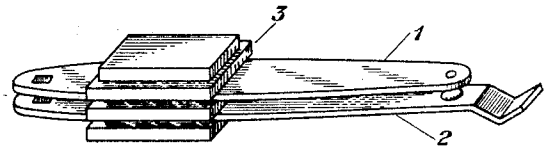


Fig. 1

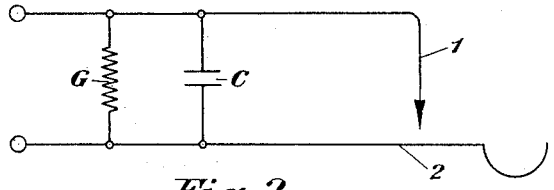


Fig. 2

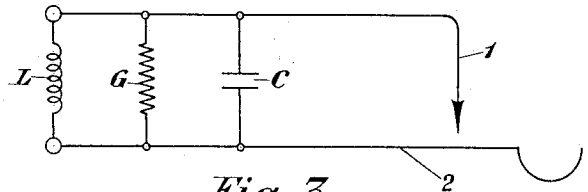


Fig. 3

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UNITED STATES PATENT OFFICE

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ELECTRICAL SWITCHING DEVICE

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This invention relates to improvements in switching devices, such as keys or jacks, used in communication or transmission systems, and more particularly relates to a method of and means for neutralizing the effect of the capacity between the springs or members of such switching devices.

In equipment of the type utilized in telephone systems progressively greater difficulties are encountered due to stray capacities as the frequency of the currents transmitted over such systems is increased. For example, switching devices, such as keys or jacks of the ordinary types, may become useless at radio frequencies of, for example, ten megacycles, due to the inherent capacity between the springs of such devices. The primary object of this invention is to provide arrangements which, when applied to such switching units, will tend to minimize the effect of such capacities, so that such units may be used freely in high frequency circuits. In the arrangements of the invention an inductance is shunted across the springs of a switching device, such as a key, to tune with the inherent capacity between the springs. As a consequence of this tuning, the key in its open condition more nearly represents an open circuit at the higher frequencies. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawings, in the Figures 1, 2 and 3 of which the invention is illustrated. Fig. 1 is a side-plan view of an ordinary switching device, such as a key or jack. Fig. 2 is a circuit diagram showing the equivalent of Fig. 1. Fig. 3 is a circuit diagram showing the arrangements of the invention. Similar reference characters have been utilized to denote like parts in all of the figures.

In Fig. 1 a typical pile-up of springs in a switching device, such as a key or jack, is shown. The springs are designated 1 and 2 and the inter-spring spacing elements are designated 3. In such a device the two springs shown form the two plates of a condenser, the dielectric of which is formed in part by air and in part by the material of the inter-spring spacing elements 3. The equivalent circuit of this pair of springs is shown in Fig. 2. At low frequencies, when the contact is open, the admittance between the springs is represented almost entirely by the conductance G. As the frequency is increased, however, the susceptance of the capacity C between the springs increases, so that for radio or high frequencies, the total admittance is large enough to prohibit the use of the key, jack, or other open contact device of this form.

Since the admittance between the springs is determined largely by the susceptance of the capacity C at high frequencies, it is proposed in accordance with the arrangements of this invention as shown in Fig. 3, to shunt an inductance L between the springs to resonate with C. If the inductance has the value

$$L=\frac{1}{4\pi^2 f^2 C}$$

the total admittance between the springs at or near the frequency f will be very small, and if the resistance of L is small, practically equal to G. In other words, in consequence of such tuning when the contacts of the springs are open, the switching device will form an anti-resonant circuit at the higher frequencies and will more nearly represent an open circuit when the key is open.

For the purpose of illustration, assume that G is equal to zero and that C is equal to 20×10^{-12} farads. The following table shows the admittance between the springs at several frequencies:

Frequency	Admittance of 20 $\mu\mu f$	L to tune 20 $\mu\mu f$
1 kc/sec	1.26×10^{-7} mho	1266. h.
10 kc/sec	1.26×10^{-6} mho	12.66 h.
100 kc/sec	1.26×10^{-5} mho	126.6 mh.
1 mc/sec	1.26×10^{-4} mho	1.266 mh.
10 mc/sec	1.26×10^{-3} mho	12.66 micro-h.

From this table, two facts become evident. First, for circuits of nominal impedance (say

500 ohms) the admittance between the springs is negligible for frequencies below 100 kc. Second, at frequencies higher than 100 kc., where it would be inadvisable to use the key or other switching device, because this admittance becomes so large, the inductance required to tune the capacity is of reasonable magnitude. In the case considered, where the conductance G is assumed zero and the inductance perfect, the admittance would fall to zero at the resonant frequency only. In practice, however, the conductance G would be of appreciable magnitude and also the inductance would contain resistance, so that the admittance would remain small over a finite band of frequencies.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many other forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A switching device comprising contact members so positioned that an inherent capacity effect will exist therebetween, and an inductance shunted across said contact members and tuned to resonate with said capacity.

2. A switching device comprising contact members, and an inductance shunted across said contact members, the value of said inductance being so chosen with respect to the inherent capacity between said contact members that when said contact members are in open position said switching device forms an anti-resonant circuit.

3. The method of reducing the admittance in a circuit at certain frequencies due to the capacity between the contact members of a switching device, which consists in rendering the portion of the circuit containing said contact member anti-resonant at those certain frequencies.

In testimony whereof, I have signed my name to this specification this 20th day of August, 1929.

WILLIAM T. WINTRINGHAM.