

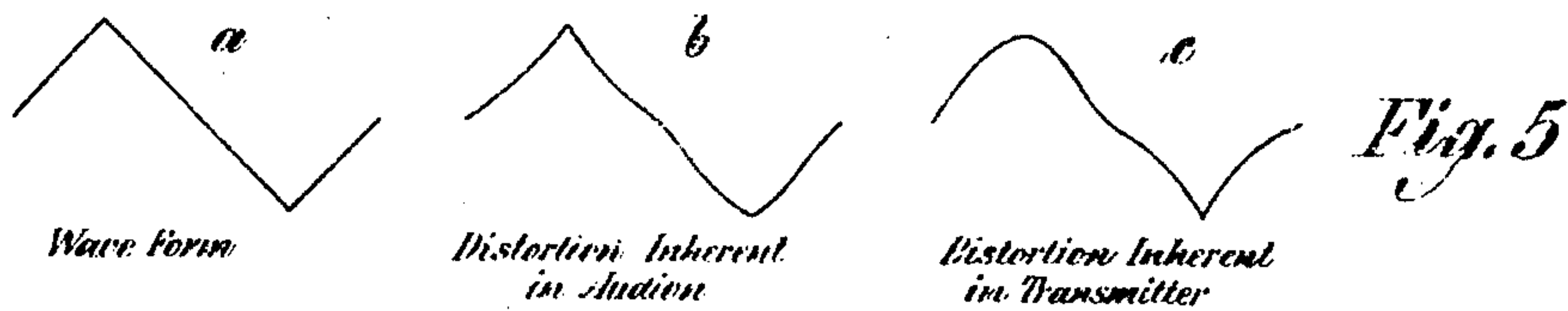
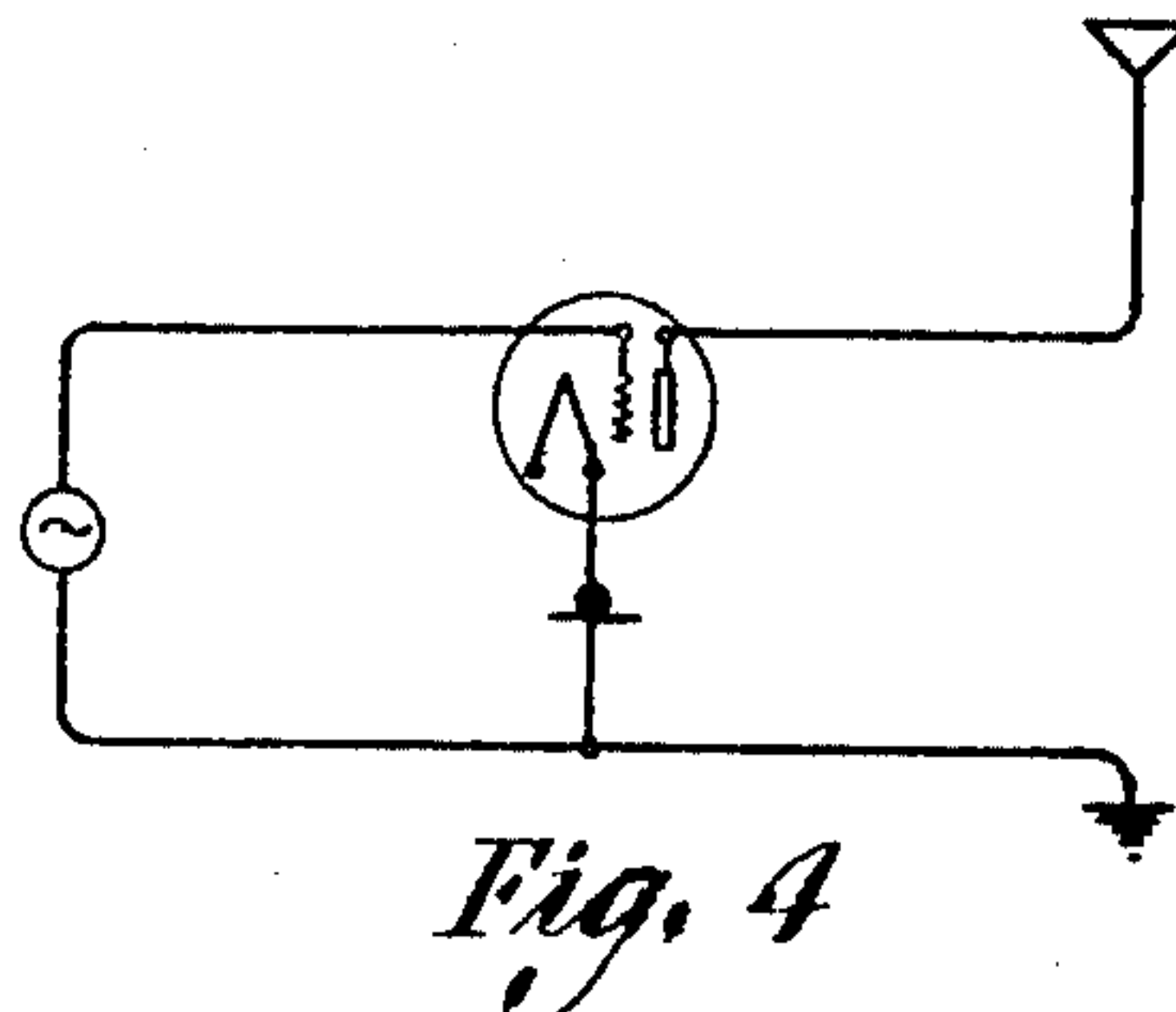
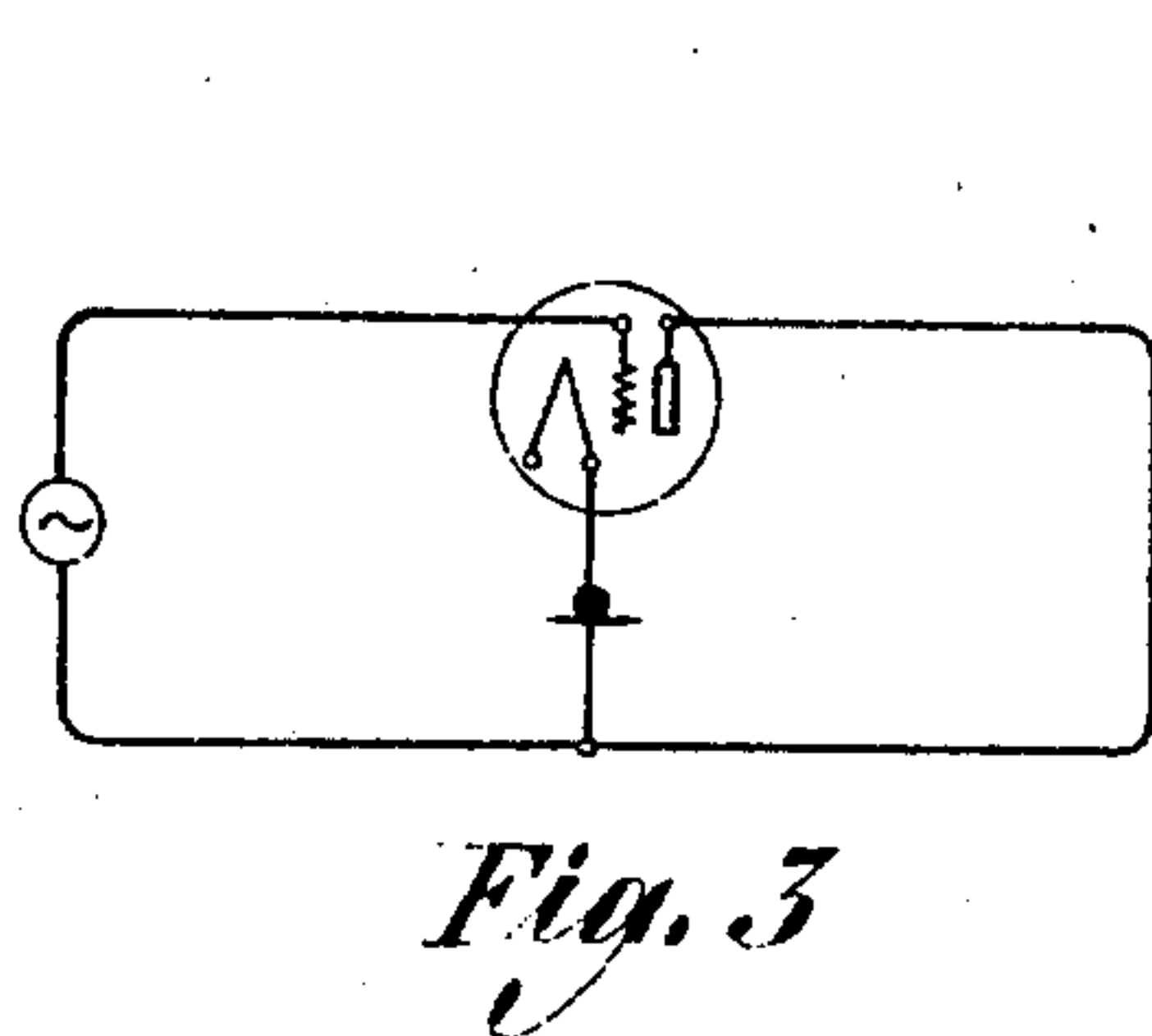
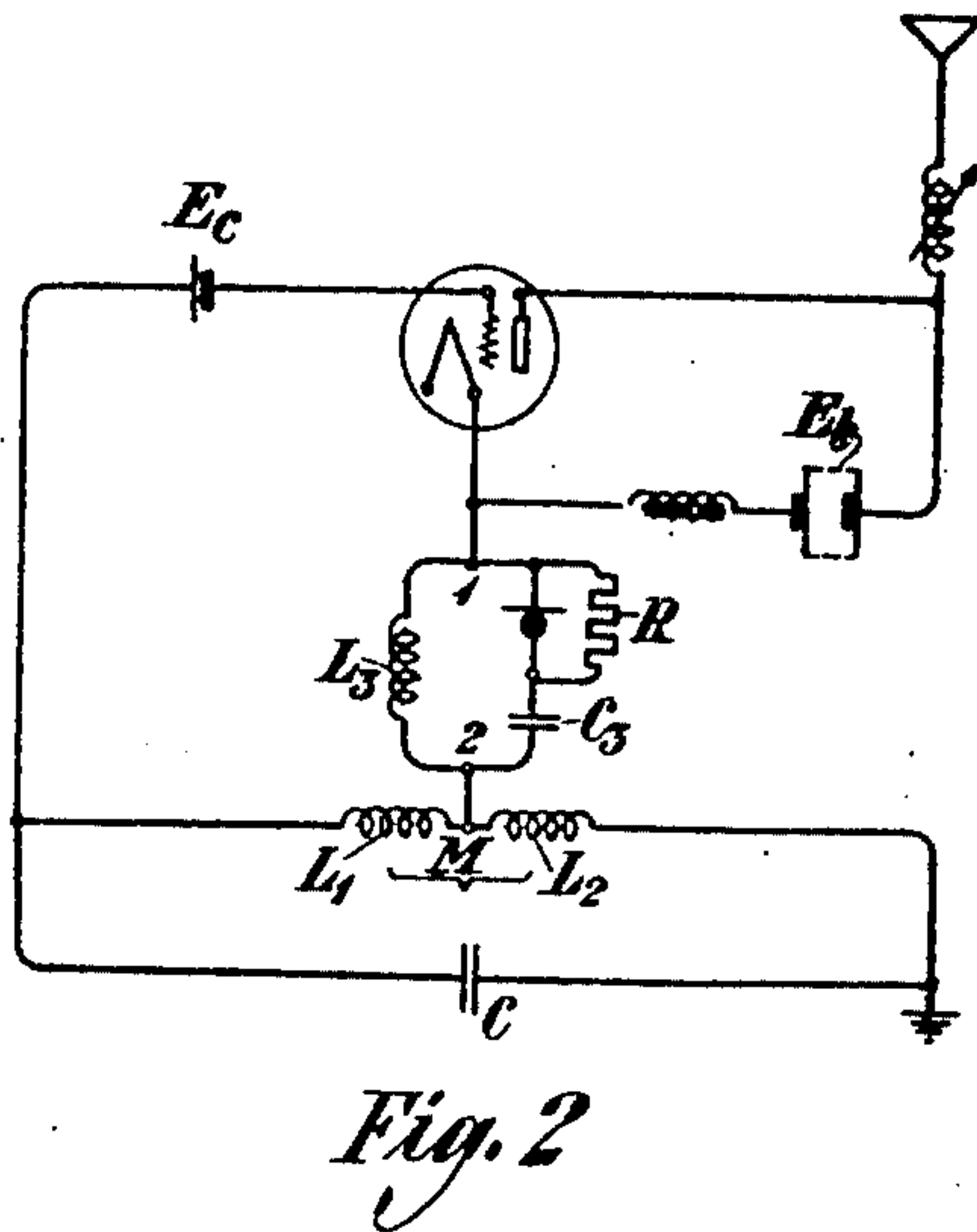
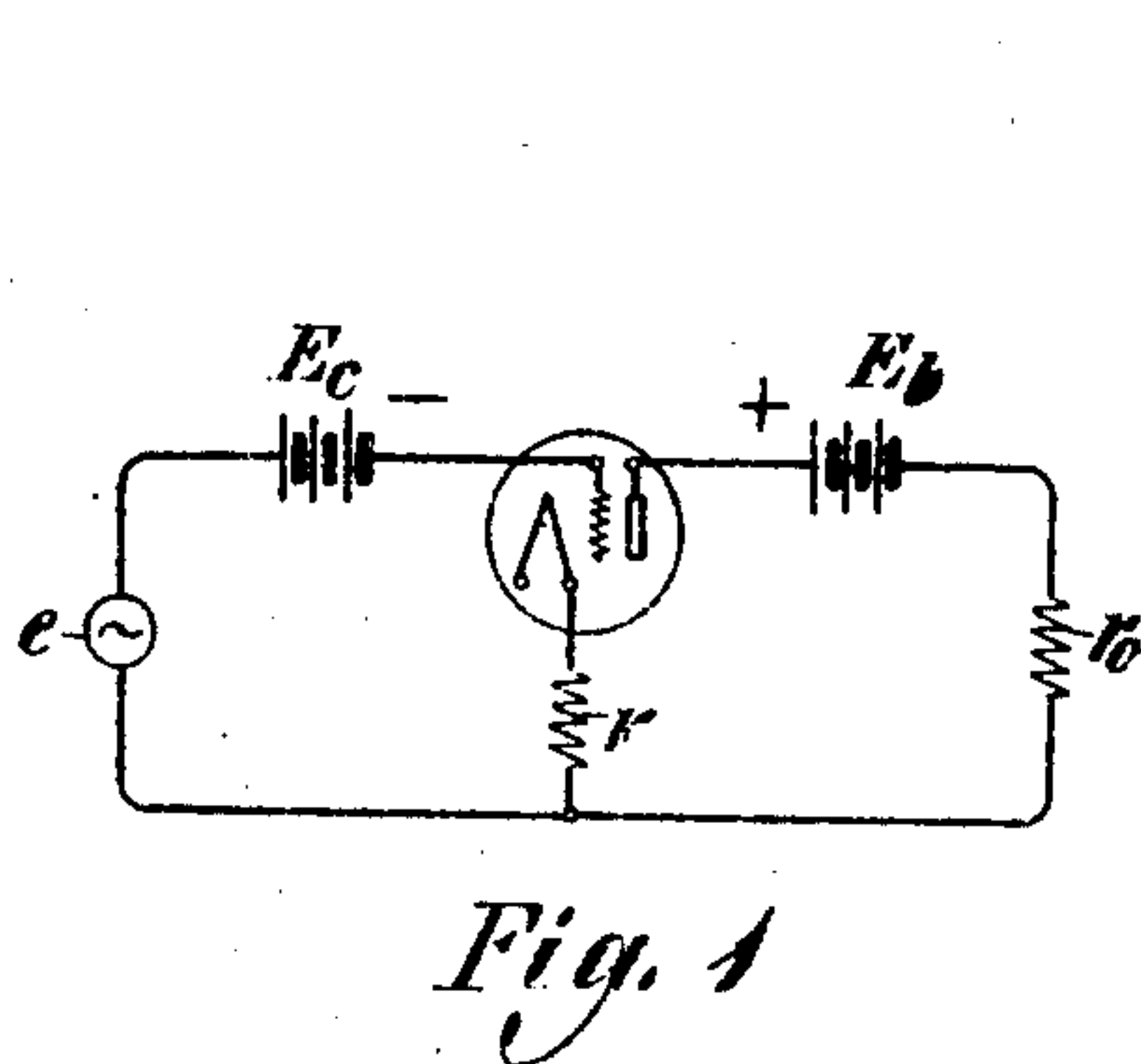
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J. S. STONE

THERMIONIC MODULATOR

Filed Nov. 23, 1923



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THERMIONIC MODULATOR.

Application filed November 23, 1923. Serial No. 676,625.

To all whom it may concern:

Be it known that I, JOHN STONE STONE, residing at San Diego, in the county of San Diego and State of California, have invented certain Improvements in Thermionic Modulators, of which the following is a specification.

An object of my invention is to provide a new and improved device and method for modulation of an alternating current for signaling and other purposes. Another object of my invention is to provide a system in which the modulating force is applied most effectively. Still another object is to provide a three-electrode thermionic tube modulator with means for applying the modulating force in an efficient manner. These and other objects of my invention will become apparent on consideration of a limited number of specific examples of the invention, which are disclosed in the following specification and which I now proceed to describe with the understanding that the invention is defined in the appended claims.

Referring to the drawings, Figure 1 is an elementary diagram illustrating the principle involved in my invention, Figs. 2 and 3 are diagrams showing simple modifications, Fig. 4 is a diagram showing another application of the invention and Fig. 5 is a diagram to which reference will be made in explaining one of the advantages of the invention.

Referring to Fig. 1, this shows a three-electrode thermionic vacuum tube with simple associated circuits. In accordance with the usual recognized theory, its operation is known to be in conformity with the following equation:

$$I_p = f\left(\frac{E_p}{\mu} + E_g + \epsilon\right) \quad (1)$$

where I_p is the plate circuit current, f stands for "function of", E_p is the voltage between the plate and filament, μ is the well known characteristic tube constant, E_g is the voltage between the grid and the filament and ϵ is the intrinsic potential difference between the filament and the system constituted by the grid and plate, which is of comparatively small value and will be neglected as we proceed.

From Fig. 1, it is at once apparent that—

$$E_g = E_c + e - rI_p \quad (2)$$

and

$$E_p = E_b - (r + r_o)I_p \quad (3)$$

Substituting from equations (2) and (3) in equation (1) the result is obtained that—

$$I_p = f\left[\frac{E_b}{\mu} + E_c + e - \left(r + \frac{r + r_o}{\mu}\right)I_p\right] \quad (4)$$

From this it is evident that the resistance r in the common branch of the grid and plate circuits is equivalent to a resistance $(1 + \mu)r$ in the plate circuit, so far as it affects the plate current. That is, the resistance r placed in the common branch is more effective to alter the plate current than it would be if introduced in the plate circuit alone. A very simple modulation system can be made to utilize this property, as shown, for example, in Fig. 3, where a microphone transmitter is introduced in the common branch of the plate and grid circuits. Its variation of resistance under the influence of voice waves will be more effective in varying the output plate current than if the microphone were introduced in the plate circuit alone. In Figs. 2 and 4 the same principle is involved in a simple elementary radio transmitter.

Instead of introducing the telephone transmitter directly between the points marked 1 and 2 in Fig. 2, I have there shown the transmitter included in a resistance amplifying loop $C_3 L_3$ and the transmitter is shunted by a distortion reducing resistance coil R . In this case, if the resistance of the transmitter is amplified n -fold by the loop circuit, then its effect will be the equivalent of a transmitter of $n(1 + \mu)$ -fold resistance connected in the antenna so far as the plate current of the audion is concerned.

The mode of modulation herein disclosed has the advantage that it will reduce the distortion as compared with the introduction of the modulating force in the plate circuit alone. This is because the distortion inherent in the telephone transmitter is somewhat opposite in effect to that inherent in the audion. This is illustrated in Fig. 5, where a represents an assumed arbitrary wave form of impressed electromotive force;

b gives the wave form that may be expected from the output of the audion in this case; and c gives the wave form for the transmitter output when acted upon by a sound wave of the form a . It will be seen that b and c , when combined, will have a tendency to neutralize the distortion due to either one alone.

What is claimed is:

- 10 1. A modulating system comprising a three-electrode thermionic vacuum tube with input and output circuits and a common conductor connected to the tube filament, a resistance amplifying loop interposed in said

conductor, a telephone transmitter interposed in one side of said loop and a resistance shunting said transmitter.

2. A modulating system comprising a three-electrode thermionic vacuum tube with input and output circuits and a common conductor connected to the tube filament, and a telephone transmitter and a resistance amplifying device connected in said conductor.

In testimony whereof, I have signed my name to this specification this 14th day of November, 1923.

JOHN STONE STONE.