Aug. 2, 1927.

A. F. SYKES

1,637,397

TELEPHONE TRANSMITTER AND RECEIVER

Original Filed July 21, 1924 2 Sheets-Sheet 1

Fig. 1.

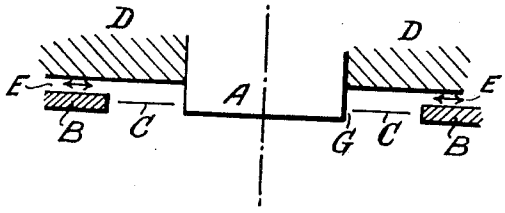


Fig. 2.

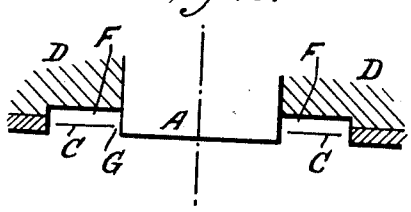


Fig. 3.

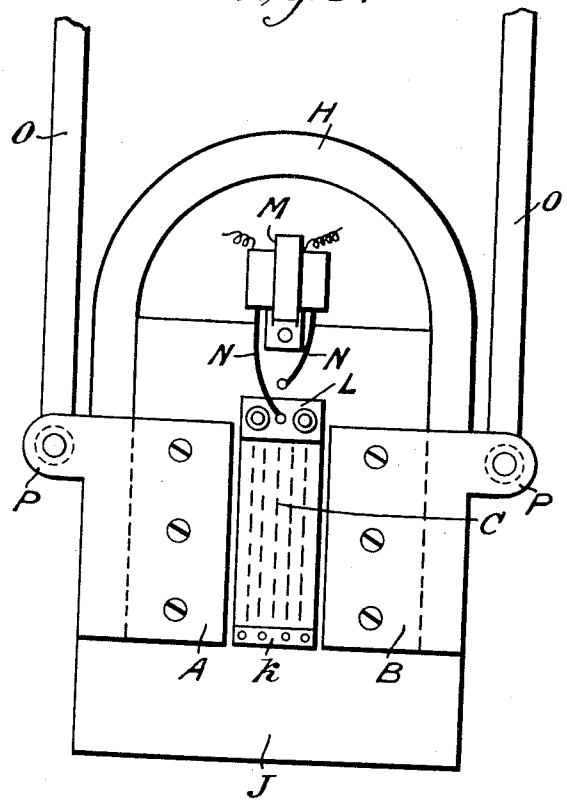
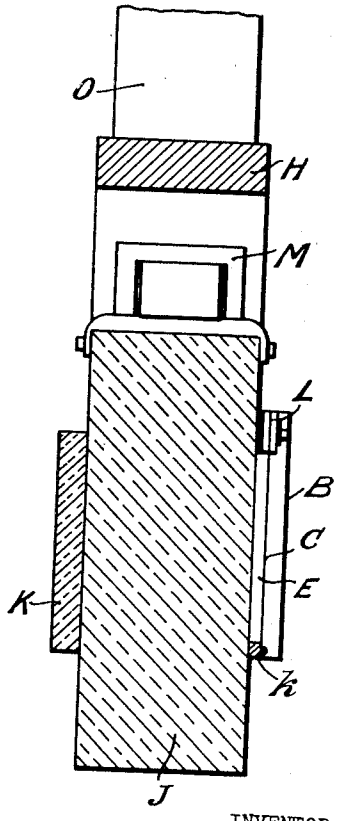


Fig. 4.



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Fig. 5.

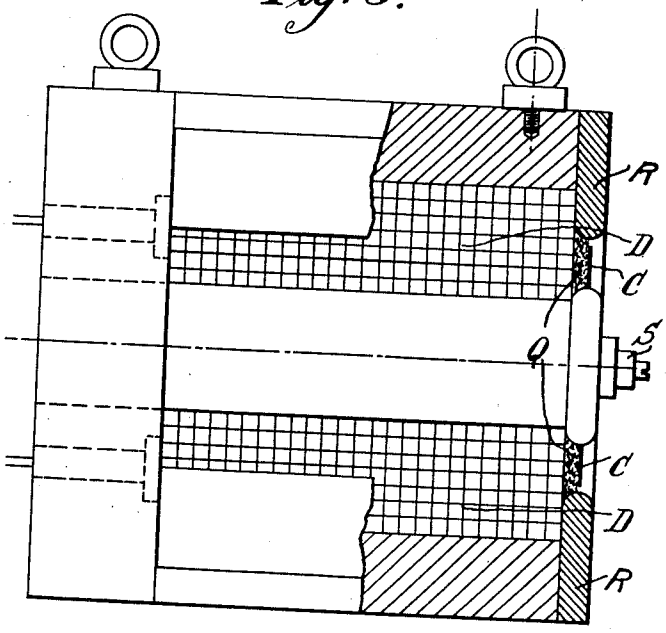
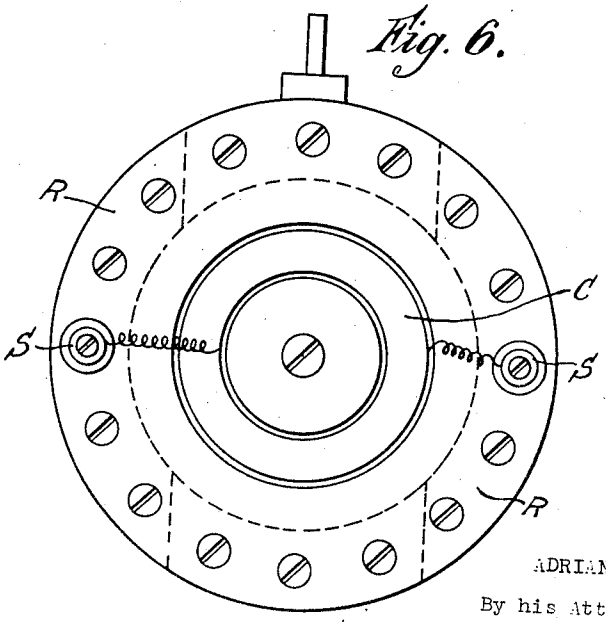


Fig. 6.



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UNITED STATES PATENT OFFICE.

ADRIAN FRANCIS SYKES, OF NEW BARNET, HERTS, ENGLAND.

TELEPHONE TRANSMITTER AND RECEIVER.

Original application filed July 21, 1924, Serial No. 727,242, and in Great Britain July 21, 1923. Divided and this application filed November 28, 1925. Serial No. 71,919.

This invention relates to telephone transmitters and receivers. This application is a division of my application 727,242 filed July 21, 1924.

My British specification No. 160,223 described the employment of electric circuits for distorting the currents produced by the influence of sound waves on a detector or transmitter in order to give the higher frequencies their proper proportionate effect. By the present invention I am enabled to dispense either wholly or in part according to circumstances with the circuital arrangements for obtaining systematic distortion as described in that specification.

According to my invention I combine with a conducting winding or membrane, which is in effect non-resonant and is immersed in a magnetic field, a barrier or means for restricting the motion of the air particles which convey the sound waves.

Preferably the conducting winding or membrane is arranged in front of a cavity or channel formed in material which permits a strong magnetic field to act upon such winding or membrane and which is of sufficient mass as to render it relatively non-resonant to the sound waves compared with the much lighter detecting membrane.

For instance, a sheet of thin metal foil or leaf may be supported in front of a shallow cavity or channel in a massive shield of bronze which may be placed between the poles of an electromagnet. When sound waves fall upon such foil a potential is developed therein and this may be transformed up and control the grid of the first valve in a relay system. The shield restricts the motion of the air particles in its immediate vicinity more in the case of low frequencies than in the case of high frequencies, so that a relatively greater potential will be developed in the foil by sound waves of short length than by long waves. Thus the result of the appliance may be regarded as a differentiating process. Such an appliance may also be used as a receiver, that is to say, telephonic currents may be applied to the winding or membrane to cause it to vibrate and generate sound waves, and in this case there is a greater tendency of the air in front of the strip to slip round to the back of the strip for low frequencies than for high frequencies. In consequence of this with suitable design the receiver and the transmitter yield a nominally true reproduction of the original sounds merely with an amplifier connecting the two instruments and without further correction. The size of the reflecting surface set at the back of the detecting membrane has some bearing on the properties of the instrument; a small reflecting surface yields higher pitch speech than one of larger dimensions because the local effects due to the obstruction of the instrument itself depend on the size of the instrument up to a point. It is obvious that a horn may be used to increase the effects whether the instrument is used as a transmitter or receiver.

In the accompanying drawings, Figure 1 shows a construction on the lines of my British specification No. 160,223; Figure 2 is a corresponding diagram illustrating my present invention; Figures 3 and 4 show an embodiment of my invention; and Figures 5 and 6 show a modification adapted to be operated with a coil of many turns.

Figure 1 shows in diagram form one method of operating the active element, that is to say, the coil, of an electromagnetic telephone constructed on the lines set forth in my British specification No. 160,223. Only the rudiments of the apparatus are indicated in order to distinguish more clearly the feature which differentiates the apparatus of this my present invention from the apparatus described in the basic patent. It will be seen that for the purpose of this argument the sound reproducing apparatus comprises in essence magnetic poles A and B, a coil C itself forming the sound reproducing element, an obstruction D generally constituted by the field magnet winding, and a sound channel E which conveys the sound not intercepted by the coil C when transmitting or receiving. The double ended arrows indicate the alternating character of the vibrations of the air in the channel E. In Figure 2, however, which represents the corresponding state of affairs in a detector or transmitter operated according to my present invention, the channel E no longer exists and the amount of air capable of storing up sound energy is limited to the small space F at the rear of the conducting element C. When sound acts on this arrangement the pressures resulting from the reflection of the wave by the surfaces D and C relatively vary with the frequency of the sound; con-

versely, when the element C vibrates under the action of electromagnetic forces due to telephone currents circulating in the element, the amount of air that is driven from back to front or vice versa also depends on the frequency of the induced vibration; in both cases the efficiency of the action depends on the simultaneous difference of the pressures established immediately in front or to the rear of the element C. The effect of the combination of element C, the free passage way G and the cavity F is to delay the establishment of a pressure effect in the cavity corresponding to the pressure effect in front of the element C, in other words, the device establishes a difference of phase between the front and the rear of the sound reproducing element, which phase difference is dependent on the frequency.

Figures 3 and 4 show an elevation and section respectively of an instrument constructed according to my invention. In this construction a cobalt steel permanent magnet H is clamped to a bronze casting J by a bronze plate K and by the polar extensions A and B, or is otherwise fixed relatively to the bronze casting. A strip of aluminium foil C is in electrical contact with the bronze casting at *k* and insulated from and clamped to the casting by the system of plates and insulators L. The potential developed in the strip C by the action of the impinging sound is applied to the potential transformer M via the leads N; conversely, telephone currents or derivatives thereof are supplied by this transformer when the apparatus is used as a receiver. Rubber straps or cables O attached to the lugs P serve at one and the same time to insulate the instrument when used as a transmitter from extraneous vibration and also as a means of support. To avoid effects due to the foil not being perfectly flat a number of slits are usually cut in the foil as shown and the whole surface is smeared with vaseline or the like. As the cavity or channel behind the strip may give trouble by acting as a resonator we may fill this cavity space or channel E with a sound absorbing medium, such as asbestos wool, pile velvet, cotton wool, in similar fashion to the use of the sound absorbing medium used in the hydrophone described in the Sykes Morris British specification No. 127,296. I may find it desirable to use for this purpose pile velvet which does not quite touch the sensitive element but otherwise fills the space.

Figures 5 and 6 are side and front views of a form of instrument specially adapted to operate with a coil of many turns.

In this instrument an electromagnet is used to provide the field and the energizing winding D also takes the place of the casting J of Figures 3 and 4. Numerous experiments have shown that a convenient and effective method of supporting the coil C aperiodically is to stick it with the minimum of adhesive to a pad of cotton wool Q; in these circumstances the coil C is so lightly constrained that its natural period of vibration is far below frequencies of acoustic value. The polar ring R is attached by screws to the magnet limbs and also to gun metal covers which together with the magnet limbs completely encircle the windings. The diameter of the ring R may be six inches and the coil C may be one quarter of an inch from the winding D. In Figure 5 the gun metal covers are omitted showing the general construction, while in Figure 6 their position is indicated by dotted lines; some of the screws enter the magnet casting, others enter the gun metal covers. In another construction I make the field magnet itself in the form of a pot of cast iron. Wires from the sensitive coil are brought out to insulated terminals S. I do not limit myself to any particular method of mounting the coil. Other methods are to suspend it on ligaments or in the case of a very thin coil I may attach one or more points rigidly to the outer pole, the inner pole or the reflecting surface, by means of clamps, and the sound absorbing material situated in the cavity may or may not touch the coil itself.

What I claim is:—

1. In non-resonant electromagnetic means for reproducing sound, a non-resonant reflecting surface, and a conducting surface set in proximity to said reflecting surface to establish a difference in phase between the front and the rear of the conducting surface.

2. In non-resonant means for reproducing sound, the combination of a non-resonant reflecting barrier, a magnetic field and a conducting element set in close proximity to the barrier.

3. In non-resonant means for reproducing sound, the combination of a field magnet, a conducting element aperiodically mounted in relation to the structure, a non-resonant reflecting barrier set to the rear of the conducting element, partial access to the sound waves to the rear of the conducting element being possible, and an electric circuit connected to the conducting element.

4. In non-resonant means for reproducing sound, as claimed in claim 1, the insertion of a sound absorbing medium of fibrous character between the said conducting and reflecting surfaces.

5. In non-resonant means for reproducing sound as claimed in claim 2, the insertion of a sound absorbing medium of fibrous character between the said conducting element and the said reflecting barrier.

6. In non-resonant means for reproducing sound as claimed in claim 3, the insertion of a sound absorbing medium of fibrous

character between the said conducting element and the said reflecting barrier.

7. In non-resonant means for reproducing sound as claimed in claim 1, the insertion of a sound absorbing medium of fibrous character between the said conducting and reflecting surfaces, the conducting surface being mounted on the said sound absorbing medium.

8. In non-resonant means for reproducing sound as claimed in claim 2, the insertion of a sound absorbing medium of fibrous character between the said conducting element and the said reflecting barrier, the conducting element being mounted on the said absorbing medium.

9. In non-resonant means for reproducing sound as claimed in claim 3, the insertion of a sound absorbing medium of fibrous character between the said conducting element and the said reflecting barrier, the conducting element being mounted on the said absorbing medium.

10. In non-resonant means for reproducing sound, a transmitter or receiver comprising in combination a field magnet, a reflecting barrier and a conducting sheet of foil supported in the air gap of the field magnet, but smaller than the air gap so as to leave a passage way on either side of the foil.

11. Apparatus according to claim 10, in which the foil has in it slits or the like.

12. Apparatus according to claim 10, in which the cavity to the rear of the conducting foil contains a sound absorbing medium to prevent air pocket resonance.

In testimony that I claim the foregoing as my invention, I have signed my name this 16th day of November, 1925.

ADRIAN FRANCIS SYKES.