July 12, 1927. 1,635,959

H. J. ROUND

MEANS FOR REPRODUCING SOUND

Filed Feb. 2, 1924

Fig. 1

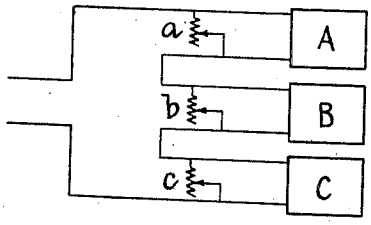


Fig. 2

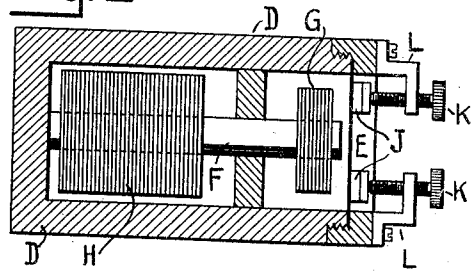


Fig. 4

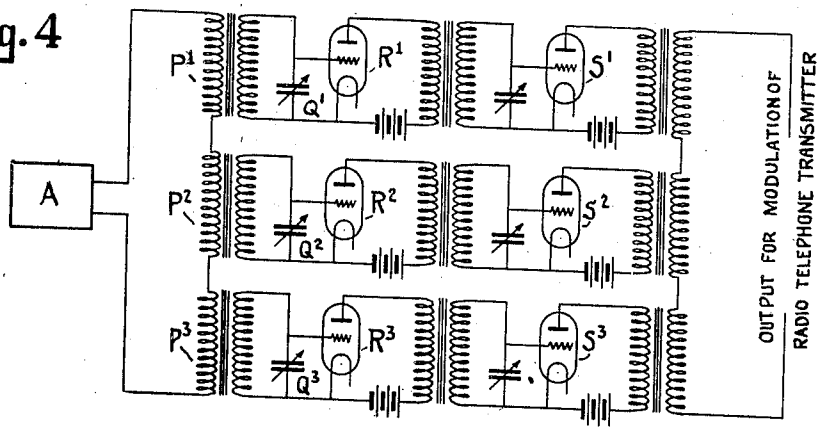


Fig. 5

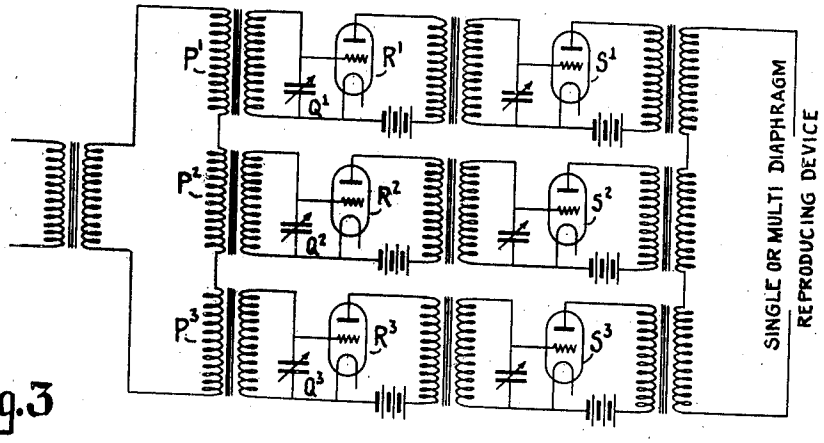
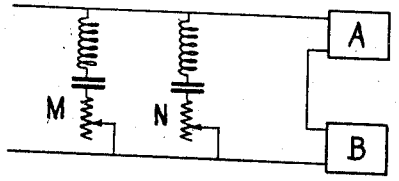


Fig. 3



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UNITED STATES PATENT OFFICE.

HENRY JOSEPH ROUND, OF LONDON, ENGLAND, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE.

MEANS FOR REPRODUCING SOUND.

Application filed February 2, 1924, Serial No. 690,221, and in Great Britain February 5, 1923.

The object of this invention is to provide sound reproducing means in which the distorting effects due to the natural tone of a diaphragm may be substantially eliminated.

According to this invention I employ a plurality of diaphragms of different pitches, each with its own electromagnet and the input coils of the magnets being connected together preferably in series, and I preferably arrange a shunt across one or more of the magnets.

In the drawings Fig. 1 is a diagrammatic representation of an arrangement in accordance with the invention;

Fig. 2 is an illustration of a suitable form of magnetophone;

Fig. 3 shows an arrangement in which a combination of resistance, inductance and capacity is used for damping and

Figs. 4 and 5 are diagrammatic representations of an arrangement in which tuned circuits are utilized for controlling the damping of different audible frequencies.

Referring to the arrangement shown in Fig. 1, A B C are three magnetophones with their input coils connected in series and with adjustable resistances *a b c* arranged across the coils.

The term input coil is used here to distinguish the coil G shown in Fig. 2 from the coil H. The coil H is a polarizing coil which may be energized from an independent source in a manner which is well-known in this art and need not be described further here.

When sound waves fall upon the three diaphragms the amplitude of the currents due to the movements of the various diaphragms can be adjusted by adjusting the resistances, so that a larger or smaller current can be produced by any particular diaphragm of the combination as is found desirable. The shunts have the double effect of giving the correct strength and also of damping the combined mechanical and electrical circuit.

Similarly, when currents due to sound are led through the coils of the magnets, the amplitude of the vibrations of any particular diaphragm can be adjusted at will by adjusting the shunts.

The diaphragms of different pitches may be constructed of iron of different thickness and diameters. The diaphragms should be well damped by means of washers of india rubber or the like and should be mounted in heavy rigid cases.

Figure 2 shows a form of magnetophone specially suitable for use in carrying out my invention. D is a heavy rigid case in the front of which is mounted a diaphragm E behind which is a pole piece F surrounded by the active coil G and a polarizing coil H, the case acting as the return circuit. J are pads of rubber or other suitable material which can be pressed by means of screws K working in brackets L against the diaphragm to damp it.

In cases where sufficient damping cannot be obtained I can place in the circuit capacity, resistance, inductance arrangements for the purpose of weakening the effect of the diaphragms at their resonant points.

Figure 3 shows such an arrangement where M N are two rejector circuits containing resistance, capacity and inductance placed across a combination of two magnetophones A B.

I have found that a very good reproduction of the human voice can be obtained by employing two diaphragms one having a natural tone of about 6000 per second and the other a tone of about 600 per second, this latter being shunted since it is more sensitive than the former. For the reproduction of music in which bass is present a suitable combination consists of three diaphragms whose natural tones may be 200, 900 and 6000, while a still better combination consists of five diaphragms whose tones are about 200, 500, 900, 2,000 and 8,000.

According to a modification of my invention I connect or couple to the electromagnet of a diaphragm having a moderately high pitch, say, 2000, a plurality of filter circuits in parallel, each circuit being adapted to select a different range of frequencies, and I then amplify one or more of these ranges as desired and then resynthesize the results.

Such an arrangement is shown in Fig. 4. In series with the coil of the magnetophone A are arranged three coils P^1, P^2 and P^3 which are coupled to three circuits Q^1, Q^2, Q^3 tuned to different frequencies and connected to the grids and filaments of three valves R^1, R^2, R^3 by which the oscillations

in these circuits Q^1, Q^2, Q^3 can be amplified as desired and conveyed to the line through other amplifying valves S^1, S^2 and S^3.

It is obvious that in any of these arrangements instead of using a magnetophone I may use any other proportional device such as an electrostatic telephone or the piezo electric effect.

In a loud speaking telephone I employ a single horn of great effective length so that it is practically equally resonant to all periods above, say, 100 per second, and I arrange on the base of this a plurality of diaphragms with shunted magnets as above described or a single diaphragm to which is applied a current distorted by parallel filter circuits as above described.

Having described my invention what I claim is:—

1. In means for reproducing sound, a plurality of diaphragms of different pitches each having its own electromagnet and the coils of the magnets being connected together and a shunt across one or more of the magnets.

2. In means for reproducing sound, the combination of a plurality of diaphragms, an electromagnet in proximity to each diaphragm, a plurality of circuits coupled to the circuits of the magnet and adapted to select different ranges of frequencies and means for amplifying selectively one or more of these ranges of frequencies.

3. In a device for amplifying broad band high frequency oscillations, a plurality of oscillatory circuits tuned to independent frequencies, separate means associated with each of said oscillatory circuits to amplify the oscillations received thereby, each of said amplifying means being independently variable, and a separate acoustic device associated with each of said amplifying means.

4. In means for reproducing sound a source of current of a plurality of audible frequencies, a plurality of acoustic means selectively responsive to different ranges of frequencies in said source and means for controlling the response of one or more of said selective means to control the reproduction.

5. Means for reproduction sound comprising the combination of a plurality of diaphragms and an electromagnet for each diaphragm, said diaphragms having different natural periods and said electromagnets being energized from the same source and a shunt across the coils of one or more of the electromagnets.

6. Means for reproducing sound comprising the combination of a plurality of diaphragms and an electromagnet for each diaphragm, said diaphragms having different natural periods and said electromagnets being energized from the same source and a rejector circuit associated with each electromagnet for damping currents of a frequency corresponding to one or more of the natural periods.

7. Means for reproducing sound comprising the combination of a plurality of diaphragms and an electromagnet for each diaphragm, said diaphragms having different natural periods and the coils of said electromagnets being connected in series and a shunt across one or more of the coils.

8. The method of reproducing broad band oscillations which comprises impressing said oscillations upon a plurality of magnetophones each of which is provided with an input coil and an associated diaphragm having a natural vibration frequency and controlling the output of each magneto-phone by varying the effective resistance of its associated input coil.

9. The method of amplifying broad band high frequency oscillations which comprises the steps of separating the broad band into narrow band frequencies, amplifying the narrow bands, separately varying the degree of amplification of the separate narrow bands, and finally combining the narrow bands in a single instrumentality.

HENRY JOSEPH ROUND.