

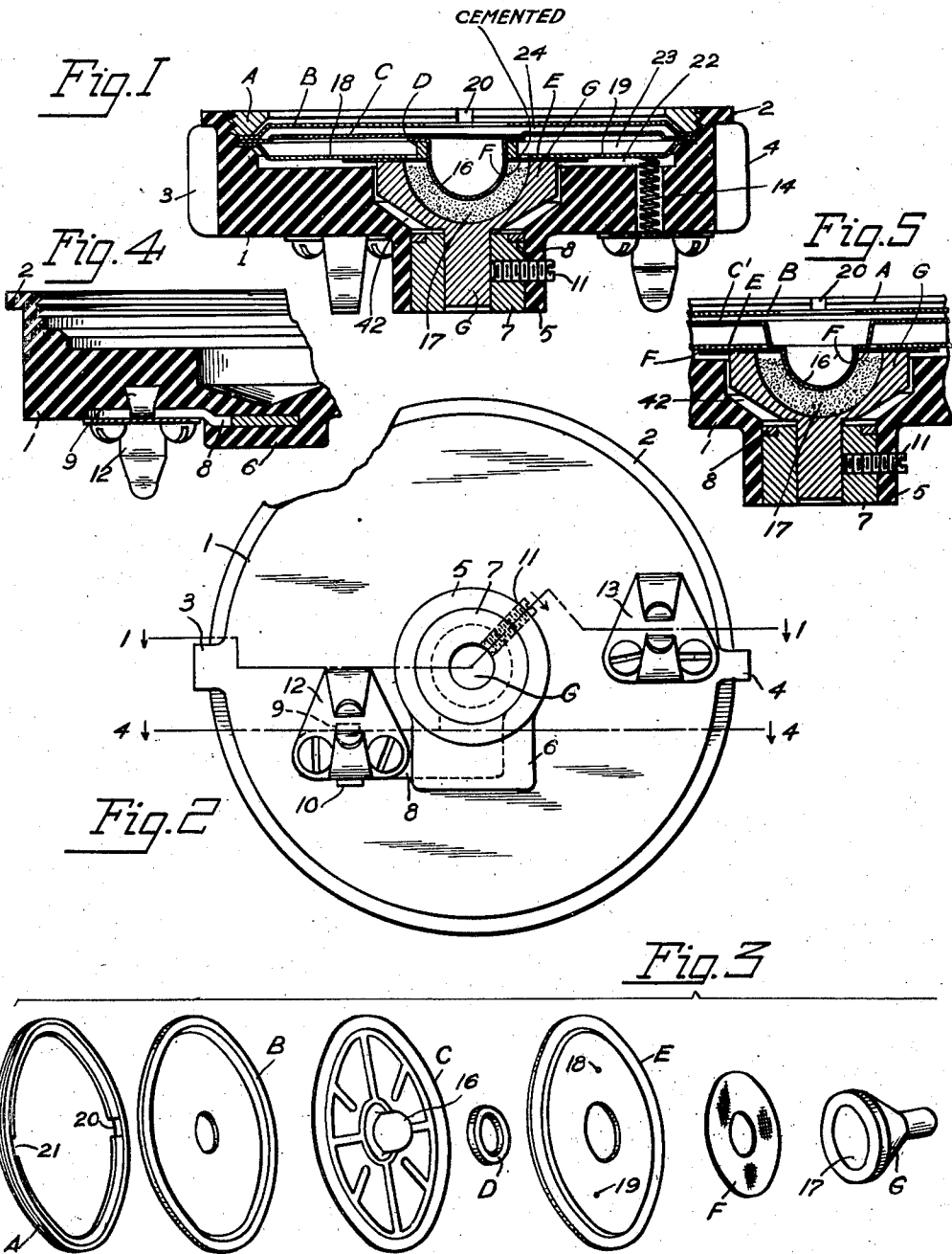
July 30, 1946.

G. H. BRODIE

2,404,772

TELEPHONE TRANSMITTER

Filed Dec. 21, 1942



Inventor:
George H. Brodie.
By C. S. A.
Att'y.

UNITED STATES PATENT OFFICE

2,404,772

TELEPHONE TRANSMITTER

George H. Brodie, La Grange, Ill., assignor to
Kellogg Switchboard and Supply Company,
Chicago, Ill., a corporation of Illinois

Application December 21, 1942, Serial No. 469,767

5 Claims. (Cl. 179-122)

1

This invention relates to telephone transmitters. The general object is to provide a telephone transmitter of simple and reliable construction which has a substantially uniform output level throughout the frequency range important in telephone transmission.

Generally speaking, the transmitter disclosed herein is a direct improvement on the transmitter disclosed in Patent No. 2,014,427, issued September 17, 1935, to George R. Eaton. A general feature of improvement over the Eaton transmitter is that the closure ring (usually of felt) for the carbon chamber in the Eaton transmitter is replaced by a washer-like closure member cut from suitable sheet material, such as silk cloth.

A special feature of the above-noted construction is that the inner edge of the closure member is permanently attached to a shoulder surrounding the movable electrode, as by cement, and is removably held in annular engagement with the fixed electrode by a washer-like clamping disc.

According to a further feature of improvement, the air chamber enclosed between the case and the diaphragm is divided into front and rear air chambers, separated by a partition. By providing suitably sized openings through the partition, the rear air chamber is caused to cooperate with the front one to permit a more uniform output over the entire frequency range to be obtained.

A special feature of the arrangement last discussed is that the clamping disc for the closure piece is conveniently employed to separate the front and rear air chambers, and the interchamber communication openings are conveniently made through the clamping disc.

Other objects and features of the invention will appear more fully as the description progresses.

The accompanying drawing, comprising Figs. 1 to 5, show sufficient views of a transmitter embodying the features of the invention to enable the invention to be understood.

Fig. 1 is a front sectional view taken along the irregular section line 1-1 of Fig. 2;

Fig. 2 is a bottom view;

Fig. 3 is an exploded view of the parts A to G;

Fig. 4 is a broken-away front sectional view taken along the line 4-4 of Fig. 2; and

Fig. 5 is a fragmentary front sectional view showing a desirable modification.

Fig. 3 is at a scale of about 1 to 1, while the remaining views are at a scale of about 2 to 1.

The invention is illustrated as applied to what is termed a capsule unit, of the type commonly used in the transmitter opening of a hand telephone.

CONSTRUCTION

In the illustrated construction, the capsule unit is provided with a casing 1, illustrated as molded of plastic insulation material. Casing 1

2

is provided with a rim 2, used in practice for locating the capsule longitudinally in the transmitter opening of the instrument, and with opposed ribs 3 and 4 which are used to locate the capsule rotationally.

In the disclosed construction, the diaphragm C is preferably stamped from thin sheet metal, and is firmly clamped peripherally by the screw-threaded clamping ring A, notched at 20 and 21 (Figs. 1 and 3) for the insertion of a suitable wrench.

Diaphragm C is overlaid by shield disc B, also clamped firmly at the periphery, and having a central opening for the admission of sound waves.

The movable electrode 16 is of generally hemispherical configuration, and is formed integrally with the diaphragm C.

Fixed electrode G has a generally hemispherical carbon chamber 17 formed therein within which the electrode 16 lies, the space between the electrodes being occupied by the usual carbon particles. The stem portion of electrode G is held in its desired longitudinal position of adjustment by set screw 11, threaded into a side opening through the annular depending boss 5 and the metal insert sleeve T.

The carbon chamber 17 is sealed against the escape of the transmitter material by closure disc F (Figs. 1 and 3). This disc may be formed of any suitable thin sheet material, the material chosen being preferably one having a minimum of the characteristics of spring material. Closely woven silk cloth has been found to be suitable. In the embodiment of the invention shown in Fig. 1, the inner annular portion of the closure disc F is secured against a shoulder provided about the electrode 16 by collar D.

The collar D may be made of thermoplastic material, with a slightly undersized inside diameter. The collar D may be heated sufficiently to render it slightly plastic and then forced upon the base portion of the electrode. When the collar D cools and contracts, it is held firmly in position by the resulting frictional grip around the base of the electrode 16.

The spring, or clamping, disc E, having the illustrated central opening therethrough larger than the outside diameter of collar D, is next assembled over the electrode 16 and collar D, following which the inside edge of closure member F is cemented or otherwise firmly secured to the shoulder formed by the lower end surface of collar D, thus annularly securing the inside portion of the closure member to the movable electrode.

The parts are next assembled as illustrated in Fig. 1, a desired quantity of transmitter material being first placed in chamber 17. The effective outside portion of closure disc F lies on the an-

nular shoulder formed by the upper end of fixed electrode G, and is firmly clamped against this shoulder by the annular inner portion of clamping disc E. This clamping disc, being preferably formed of suitable metal, has inherent springiness which becomes effective to grip closure member F securely when the assembly consisting of parts B, C, and E is firmly drawn into position, against the illustrated annular shoulder in casing 1, by a tightening of clamping ring A.

The closure disc F is preferably made somewhat larger than the opposed end portion of electrode G on which it is clamped, thereby assuring fully effective clamping in the event that the outer portion of such closure member is distorted somewhat from a true disc shape because of irregularities in the punching or cutting operation.

External electrical connections to the fixed and movable electrodes, respectively, are afforded by the depending contact clips 12 and 13. Fixed electrode G is held firmly in engagement with insert collar 7 by set screw 11, as previously pointed out. Collar 7 has an annular recess around its upper end into which the ring-like end portion of contact member 8 fits, the two parts being preferably end-staked or otherwise secured together. Contact member 8 has a portion which extends to the rear and then to the left, as seen best in dotted outline in Fig. 2. The rearwardly extending portion of contact member 8 is embedded in the rear extension 6 of depending boss 5, Figs. 2 and 4. The portion of contact member 8 which extends to the left to the mounting position of contact clip 12 is preferably offset upwardly as shown in Fig. 4 to bring the lower surface thereof at least within the confines of the lower surface of the casing.

It will be understood, of course, that the parts 7 and 8 are first assembled together, and then incorporated in the casing 1 during the molding operation. The side extension of member 8 may have a pair of upwardly extending lugs, shown at 9 and 10 (Figs. 2 and 4) which anchor the contact member more securely in the casing. Contact clip 12 may be held firmly in electrical engagement with contact member 8 by a pair of screws, as illustrated, or in any other desired manner.

An electrical circuit path from contact clip 13 to the movable electrode 16 is established by the compression spring 14, which passes through the illustrated vertical opening in the casing 1. The lower end of spring 14 contacts the upper surface of clip 13, while the upper end of spring 14, under compression, contacts the lower side of retaining disc E, the disc E and the diaphragm C being held tightly in electrical engagement around their respective peripheries, by ring A.

The modification disclosed in Fig. 5 will now be described. The construction in Fig. 5 may be the same as that in Fig. 1, except that the plastic collar D of Fig. 1 is omitted in Fig. 5, and the shoulder to which the inner portion of closing disc F is secured is formed as a part of the diaphragm C' and electrode 16'.

An advantage possessed by the arrangement of Fig. 5 is that collar D of Fig. 1 is eliminated, producing a simpler structure and slightly lowering the mass of the diaphragm-electrode assembly. The arrangement of Fig. 1, however, has a somewhat offsetting advantage in that the same diaphragm C can be used either in the construction of the improved transmitter herein disclosed or as a replacement part in the repair of an ex-

isting transmitter of the construction disclosed in the previously noted patent to Eaton.

It is clear that the disclosed construction permits a transmitter to be readily disassembled for inspection or repair, and to be readily reassembled, for the parts B to F are held in assembled position solely by clamp ring A.

PERFORMANCE CHARACTERISTICS

In the construction of a rugged and reliable transmitter, it is considered by many to be imperative that the diaphragm be clamped firmly at its periphery, in the general manner herein disclosed and as disclosed in the previously mentioned Eaton patent. Such construction insures that the diaphragm is maintained permanently in a fixed normal position. The clamping of the diaphragm affords a hermetic seal for the carbon chamber, for any other openings through which air might enter or escape are sealed, as by shellac or the like.

It is an inherent characteristic that a diaphragm clamped around the periphery and carrying an attached electrode is mechanically resonant at a given frequency, causing the transmitter output to peak rather sharply at the point of diaphragm resonance. If uncorrected, this characteristic causes distortion in the transmitted voice currents by accentuating those which are at or near the resonant frequency of the diaphragm.

Two corrective methods have been used. One corrective method is to provide a damping arrangement which is most effective at or near the resonant peak of the diaphragm, while the other is to provide structure affording other resonant peaks spaced more or less uniformly across the frequency range, tending to increase the volume output at points in the frequency range above and below the resonant frequency of the diaphragm.

The acoustic system comprising the rear and front chambers 22 and 23 interconnected by the restricted openings 18 and 19 partakes of both of the above-mentioned corrective methods and it cooperates with other portions of the disclosed transmitter structure to provide a transmitter whose output remains in the same general volume range throughout the desired frequency range.

The important overall performance characteristics of a typical transmitter constructed in accordance with this disclosure are as given in the following performance table:

PERFORMANCE TABLE

Points	Frequency	Output
1. Lower limit.....	200	17.5
2. Minimum output.....	400	16.5
3. 22, 23 peak.....	750	21
4. 22, 23 trough.....	1,100	22
5. C peak.....	1,250	26
6. 24 peak.....	1,500	27
7. 23 peak.....	1,800	28
8. B peak.....	2,000	28
9. Entrance peak.....	2,800	27
10. Upper limit.....	3,700	17.5

In the selected frequency range, from 200 cycles to 3700 cycles, minimum output occurs at about 400 cycles, being about 16.5 db., as given in the above table. The highest output occurs at about 1800 and 2000 cycles, where it is about 28 db., as shown.

The following explanation is given of the action indicated by the above table:

5

Point 5

Consider first the resonant characteristic of the diaphragm C, with its peak at about 1250 cycles, point 5 in the table. The output of the transmitter is thereby increased for a considerable band of frequencies extending above and below the resonance peak, as is well known.

Point 3

Consider next the interaction of the chambers 22 and 23 through the restricted openings 18 and 19. These two chambers, acting in combination, appear to reach a resonance peak at point 3, about 750 cycles, as is indicated in the table. At that point, the transmitter output, controlled by all factors then operative, is about 21 db. When plotted, this point is on the slope leading up to the diaphragm peak point at 1250 cycles.

The effect of the above-noted 22, 23 peak at 750 cycles, diminishes with rising frequency, as the diaphragm resonance response builds up toward its peak, at 1250 cycles.

Point 4

The same acoustic system (comprising chambers 22 and 23 interconnected by the restricted openings 18 and 19) is believed to reach an anti-resonant, or trough, condition at about 1100 cycles, point 4. This is only slightly below point 5, at which the diaphragm C peaks. This trough tends to largely cancel the peak diaphragm resonance response. The output of the transmitter at 1100 cycles is 22 db., while at 1250 cycles, diaphragm resonance peak, the resonance is only 26 db.

Point 6

At point 6, about 1500 cycles, air pocket 24 (Fig. 1), contained between the protecting shield B and the diaphragm C, reaches its resonant peak. This point lies on the upper declining slope of diaphragm resonance, raising the output to 27 db.

Point 7

At point 7, about 1800 cycles, front chamber 23, then acting largely independently of rear chamber 22, reaches its resonance peak. The output is thereby raised to 28 db., one of the two high points of output.

Point 8

At point 8, about 2000 cycles, shield B, acting as a secondary vibratory diaphragm, gives its peak response, the coupling between it and the diaphragm C being directly across the air pocket 24, again raising the output to about 28 db.

Point 9

In practice, the mouthpiece employed with the disclosed transmitter acts as a resonant chamber, with a resonant peak at about 2800 cycles, at which point the output level is about 27 db. This point is termed the entrance peak.

Point 10

Point 10 in the performance is the upper limit of the selected frequency band. At this point, about 3700 cycles, the output, controlled by all factors there operative, is about 17.5 db.

Point 2

Point 2 in the performance table is the point of minimum output. This point occurs at about 400 cycles, where the output is about 16.5 db. This point is on the lower slope of the 22, 23 peak (point 3), and is so far down on the slope of the

6

diaphragm peak (point 5) that the effect of the latter is very small.

Point 1

Point 1 in the performance table is the lower limit of the selected frequency range. The output there is about 17.5 db., or 1 db. higher than the output at point 2. The difference is believed to result from the compound nature of the rear chamber 22, with an action about as follows.

Rear chamber 22 comprises a main disc-shaped cavity (lying between the lower surface of clamping disc E and the opposed surface of casing 1), and the deep-pocket, central space 42, surrounding the main portion of fixed electrode G, between it and the opposed side walls of casing 1. It is believed that the 22, 23 peak at point 3 (about 750 cycles) is influenced mainly by front cavity 23 and the disc-shaped portion of rear cavity 22. It is further believed that both portions 22 and 42 of the rear cavity cooperate with the front cavity 23, through restricted openings 18 and 19 to provide a resonance peak somewhere below 200 cycles. Point 1 of the performance table lies on the upper slope of the last-named peak raising the output at that point to 17 db.

By changing the volume and depth of the deep pocket 42, the general output level below point 3 in the performance table can be raised or lowered, within limits, with negligible effect on the output from points 3 to 10.

In the illustrated construction, best results have been obtained when openings 18 and 19 are each about .019 inch in diameter. With substantially smaller openings, the effect of the rear chamber 22 begins to be lost, with resulting distortion in the output performance. When openings 18 and 19 are made considerably larger than the above-indicated size, the comparatively free communication then resulting between the two chambers 22 and 23 causes the action to approach that of only a single large chamber behind the diaphragm, resulting again in a distorted output.

I claim:

1. In a telephone transmitter, a support having an outer annular shoulder thereon, an electrode fixed to said support and being surrounded by an inner shoulder, a diaphragm, a movable electrode secured to said diaphragm in operative spaced relation to the fixed electrode, a flexible annular closure member having its inner portion secured to the movable electrode, the outer portion of said closure member being opposite the inner shoulder, an annular clamping disc having its peripheral portion located between the periphery of the diaphragm and the outer shoulder, the inner portion of the clamping disc lying between the diaphragm and the outer portion of the closure member, means for annularly clamping the peripheral portions of said diaphragm and said clamping disc against the outer shoulder, the inner portion of said clamping disc thereupon clamping the outer portion of said closure member against the inner shoulder, and resistance-varying material contained in the space between said electrodes and confined by said closure member.

2. In a telephone transmitter, a support having an outer annular shoulder thereon, an electrode fixed to said support and being surrounded by an inner shoulder facing in the same axial direction as the outer shoulder, a diaphragm, a movable electrode so secured to said diaphragm as to be in operative spaced relation to the fixed electrode when the diaphragm is assembled with the support, a flexible annular closure member hav-

7

ing its inner portion permanently secured to the diaphragm and movable electrode prior to the assembly of the diaphragm with the support, the outer portion of said closure member being opposite the inner annular shoulder with the parts in assembled position, and means effective with the parts in assembled position for clamping the peripheral portion of the diaphragm against the outer shoulder and for clamping the outer portion of said closure member against the inner shoulder, and resistance-varying material contained in the space between said electrodes and confined by said closure member.

3. In a diaphragm-actuated telephone transmitter wherein the resistance-varying material lying between the fixed and movable electrodes is confined by a flexible annular closure member, the inner portion of said closure member being secured to the movable electrode, there being an inner shoulder surrounding the fixed electrode and an outer shoulder underlying the periphery of the diaphragm, means for clamping the periphery of the diaphragm against the outer shoulder, and means responsive thereto for clamping the outer portion of said closure member against the inner shoulder.

4. In a telephone transmitter, a cup-like casing, a first electrode fixed in the casing and sur-

8

rounded by a shoulder, a diaphragm, a movable electrode secured to the diaphragm in opposition to the fixed electrode, a flexible annular closure member extending from the movable electrode outwardly across the face of said shoulder, an annular retaining disc for said closure member, the inner portion of said retaining disc lying between the diaphragm and the outer portion of the closure member, the peripheral portion of said retaining disc underlying the peripheral portion of the diaphragm, and means for urging the peripheral portion of the diaphragm inwardly against the peripheral portion of the retaining disc, the retaining disc being thereby urged inwardly to frictionally hold the closure member between the inner portion thereof and said shoulder.

5. A sub-assembly for a telephone transmitter comprising a metal diaphragm having an electrode portion formed integrally therewith, said electrode portion comprising a cylindrical connecting part ending in a generally hemispherical electrode, a collar secured around the cylindrical part, and a flexible annular member having its inner portion secured to said diaphragm and electrode by said collar.

GEORGE H. BRODIE.