

April 4, 1939.

H. C. PYE

2,152,916

TELEPHONE INSTRUMENT

Original Filed Feb. 6, 1937

3 Sheets-Sheet 1

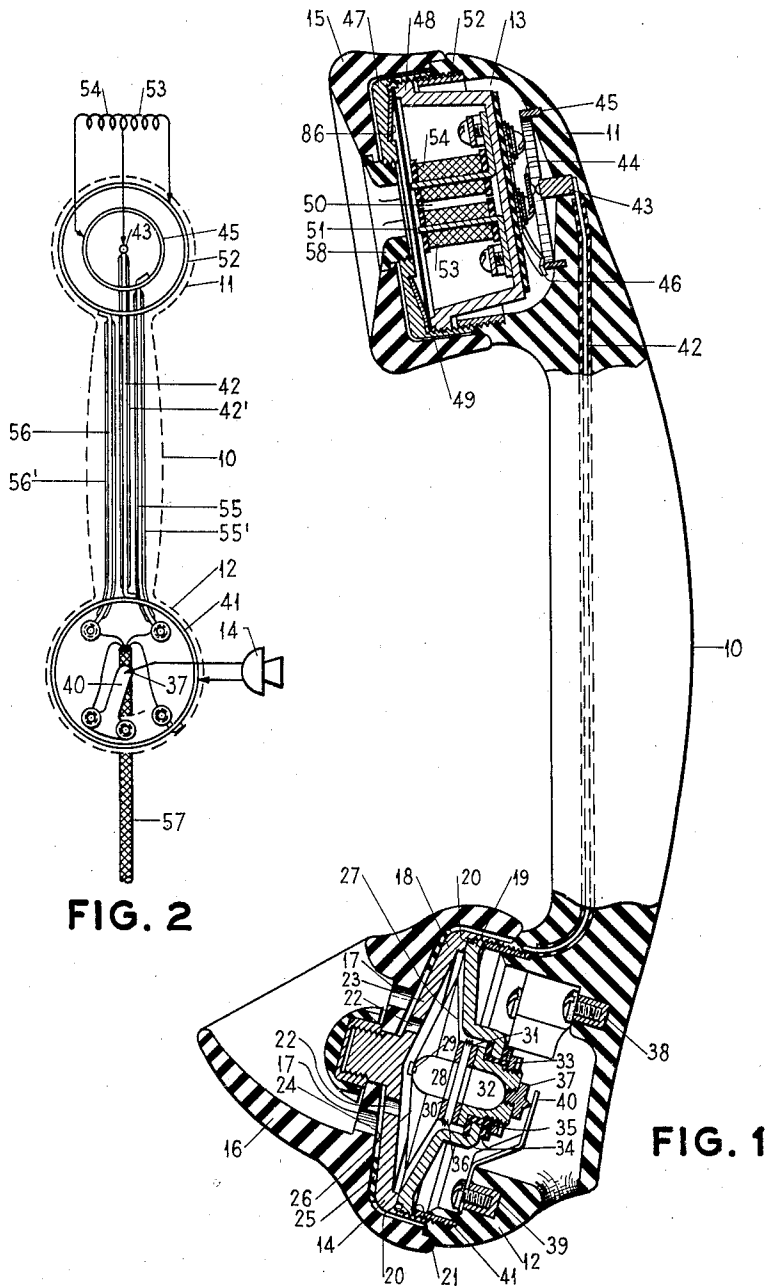


FIG. 2

FIG. 1

INVENTOR.
HAROLD C. PYE

BY *Davis, Lindsey, Smith & Shonts*

ATTORNEYS.

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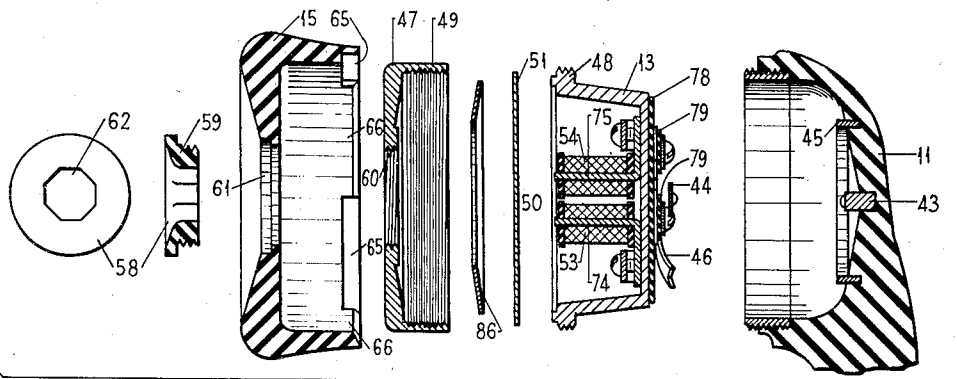


FIG. 3

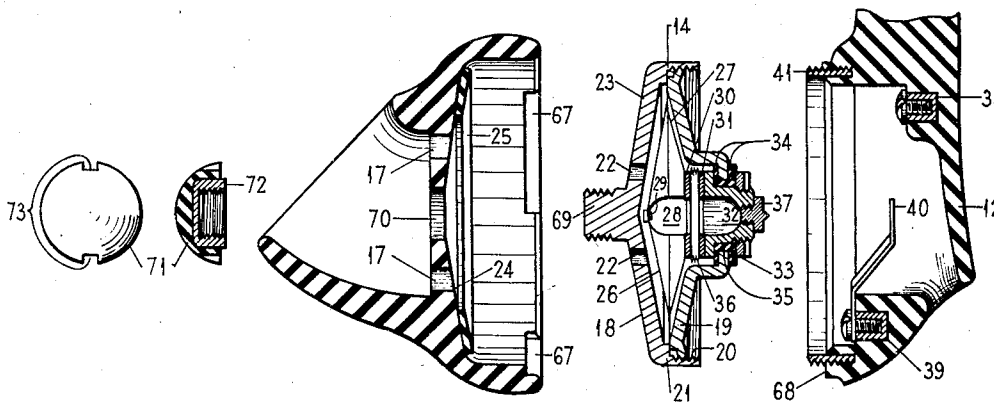


FIG. 5

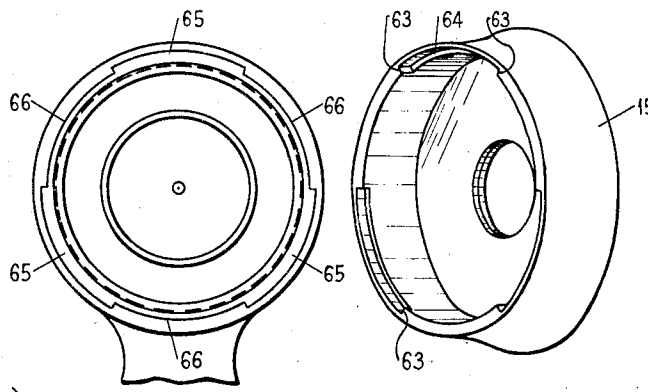


FIG. 4

INVENTOR.
HAROLD C. PYE

BY *Davis, Lindsey, Smith & Shonts*

ATTORNEYS.

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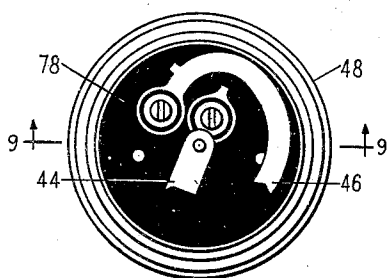


FIG. 6

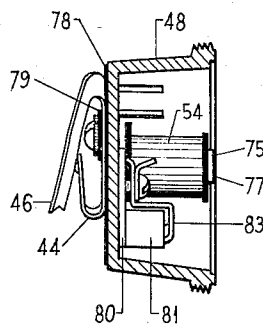


FIG. 8

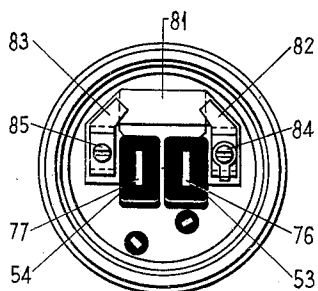


FIG. 7

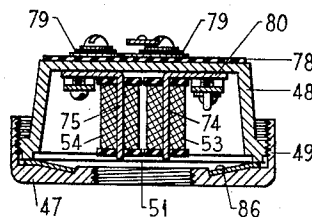


FIG. 9

INVENTOR.
HAROLD C. PYE

BY *Davis, Lindsey, Smith & Skonts*

ATTORNEYS.

UNITED STATES PATENT OFFICE

2,152,916

TELEPHONE INSTRUMENT

Harold C. Pye, Oak Park, Ill., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Original application February 6, 1937, Serial No. 124,425. Divided and this application September 23, 1937, Serial No. 165,257

1 Claim. (Cl. 181--31)

The present invention relates to electrical translating devices, and more particularly to improvements in diaphragm assemblies of the type used in telephone receivers. This application is a division of applicant's co-pending application Serial No. 124,425, filed February 6, 1937.

The physical requirements for satisfactory operation of a telephone receiver dictate that the diaphragm be rigidly supported at all points around its periphery. If any portion of the diaphragm periphery is permitted to vibrate freely, distortion of the translated energy results. In the prior diaphragm assembly arrangements, the practice is almost universally followed of clamping the diaphragm between oppositely disposed machined surfaces forming portions of solid metal members. This practice is not entirely satisfactory due to the difficulty and cost of obtaining absolutely flat clamping surfaces. Moreover, with conventional methods of diaphragm mounting no provision is made for artificially accentuating the stiffness of the diaphragm, this characteristic being determined solely by the physical characteristics of the metal comprising the same. The desirability of employing a stiff diaphragm resides in the more nearly uniform response of such a diaphragm to all frequencies within the audio range and the consequent improvement in the fidelity of reproduction.

It is an object of the present invention therefore, to provide in a telephone receiver cell an improved diaphragm assembly such that the diaphragm is rigidly and uniformly clamped at all points around its periphery and is stretched during the clamping operation.

In brief, the object as set forth above is attained in accordance with the present invention by providing in combination with the usual diaphragm supporting member and diaphragm, means comprising a dish shaped spring for uniformly clamping the diaphragm to the edge of the supporting member at all points around its outer periphery, and means comprising the same dish shaped spring for stretching the diaphragm during the clamping operation. This spring, which seats in a tapered groove provided in the clamping member cooperating with the supporting member, is so disposed with respect to the diaphragm that its outer radial portion is flattened and spreads during the clamping operation, whereby there is simulated the effect of pulling on the diaphragm at all points around its periphery.

The novel features believed to be characteristic of the invention are set forth with particularity

in the appended claim. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof will best be understood by reference to the specification taken in connection with the accompanying drawings, in which: Figure 1 is a cross-sectional view illustrating a telephone instrument of the hand set type having embodied therein the features of the present invention; Fig. 2 is a schematic view illustrating the manner of electrically interconnecting the various elements of the instrument; Fig. 3 is an exploded view illustrating the details of the receiver and the mode of assembling the various elements thereof; Fig. 4 illustrates the details of the locking means embodied in the receiver assembly; Fig. 5 is an exploded view illustrating the elements of the transmitter and their mode of assembly; and Figs. 6 to 9, inclusive, are bottom, top, and cross-sectional views respectively, illustrating the details of the receiver cell construction.

Referring now more particularly to Fig. 1 of the drawings, there is shown a telephone instrument of the hand set type having embodied therein the feature of the invention as outlined above. In brief, the instrument comprises a handle 10, having integral therewith the receiver and transmitter cups 11 and 12, respectively, which partially house the receiver and transmitter cells 13 and 14, respectively. Cooperating with the cups 11 and 12 completely to surround the cells 13 and 14 are ear and mouth pieces 15 and 16, respectively. The ear and mouth pieces or members 15 and 16 and the integral handle 10 and cups 11 and 12 are constructed of insulating material, preferably consisting of a phenol plastic compound such as Bakelite. The mouth piece or member 16 comprises a cup-shaped portion which is adapted to engage at its outer edge the edge of the cup 12, and is provided with spaced apart sound transmission holes 17 arranged to form a circle in the bottom portion of the cup in the manner illustrated.

The transmitter cell 14 may be of any desired type although preferably the moving parts thereof are constructed and arranged in the manner illustrated and described in applicant's co-pending application Serial No. 40,738, filed September 15, 1935. In brief, the cell comprises a pair of supporting members 18 and 19 preferably consisting of a light weight aluminum alloy, and are provided with interengaging threads 20 and 21 for assembling the cell. The member 18 is provided with spaced apart sound transmission

holes or openings 22 which are arranged on a circle of smaller diameter than the circle of the holes 17 in the mouth piece 16, the adjacent surfaces 23 and 24 of the members 18 and the mouth piece 16 being spaced apart by means of a thin washer 25 of soft rubber or other suitable material, to permit sound waves to travel through the two sets of openings 17 and 22 to the diaphragm of the cell. By offsetting the two sets of holes 17 and 22 in the manner described, dirt and moisture, more particularly the latter passing through the outer set of openings 17, are intercepted by the solid outer surface 23 of the member 18 and do not enter the openings 22 leading to the transmitter diaphragm. Thus, the delicate parts of the transmitter's moving system are protected from foreign matter.

As described in the above referred to co-pending application Serial No. 40,738, the moving system of the transmitter cell 14 comprises a conically-shaped main diaphragm 26 having a relatively wide flange around its outer edge which is clamped between adjacent surfaces of the supporting members 18 and 19 in the manner shown, and a secondary diaphragm 27 in the form of a conical ring having an opening in the center thereof. A dome-shaped cup 28 extends through this opening and is provided with a flange which overlaps the edge of the opening in the secondary diaphragm 27 and, in conjunction with a rivet 29, holds the diaphragm assembly together. A ring-shaped electrode 30 constructed of carbon is fastened to the flanged portion of the cup 28 in any suitable manner to move therewith, and opposite this moving electrode there is provided a second carbon electrode 31 of the same shape which is rigidly mounted on a second dome-shaped cup 32. The latter cup is, in turn, rigidly fastened to the housing or supporting member 19 by means of a threaded ring 33, being electrically insulated therefrom by means of ring-shaped insulating washers 34 and an insulating cylindrical ring 35. Between the adjacent edges of the carbon ring electrodes 30 and 31 there is cemented a flexible paper bellows 36 of circular shape which functions to confine the granular carbon in the cell formed by the two cups 28 and 32. This bellows may be attached by gluing the edges thereof to the respective electrode surfaces. The chamber as thus formed by the two cups 28 and 32 is provided with an opening whereby it may be filled with granulated carbon material after which the opening may be plugged by means of a contact member 37.

The moving system of the transmitter cell as briefly described above operates, in general, in the manner of conventional transmitter cells of similar construction. However, the cell has certain operating advantages, resulting from the features described, which are designed to improve the frequency response characteristic and thereby to enhance the fidelity of transmission over the range of frequencies ordinarily encountered in audible conversation. Since the general mode of operation of a transmitter cell of the general type shown is well understood and the details of the moving system and the operating features thereof form no part of the present invention, a detailed description thereof is omitted in the interests of simplicity.

In accordance with conventional practice, the contact members for terminating the cord conductors of the instrument are located at the transmitter end of the hand set and comprise metal inserts, two of which are shown at 38 and

39, partially embedded in the moulded Bakelite forming the cup 12. The insert 39 is connected by means of a spring contact piece 40 to the contact member 37 which forms the plug for the cup 32. A third contact member in the form of an annular ring 41 threaded along its outer surface is partially embedded in the Bakelite forming the mouth of the cup 12 and is of such a diameter that the threads of the exposed portion thereof engage the threads 20 along the inner surface of the member 18 to secure the cell 14 in its mounted position.

The last-mentioned annular contact member 41 is connected by means of an insulated conductor 42 embedded in the handle 10 to a contact member 43 at the receiver end of the set, which member is connected through a contact spring 44 to one of the terminals of the receiver cell 13. The contact member 43, together with a second contact member 45 in the form of a cylindrical ring, are partially embedded in the Bakelite forming the bottom of the receiver cup 11 and the latter contact member is arranged to be connected to a second terminal of the receiver cell 13 by means of a contact spring 46 mounted on the bottom of the cell.

The receiver cell 13 comprises, in general, a pair of supporting members 47 and 48 preferably of a light weight non-magnetic conducting material such as an aluminum alloy, the former of which is provided with a cylindrical flange 49 threaded along its inner surface and the latter of which is in the form of a flanged cup having threads along the outer surface of the flange which are adapted to engage with the inner threads of the flange 49 to assemble the cell. Supported within the cup-shaped member 48 on the bottom thereof is the magnetic field structure indicated generally at 50. This structure includes field windings 53 and 54 individually wound on corresponding pole pieces in the manner described more in detail hereinafter. A thin diaphragm 51 is provided which is rigidly clamped to the upper edge of the flanged cup-shaped member 48 by means comprising the member 47 and a dished spring member 86, in the manner illustrated, and described in greater detail in a later portion of the specification. It will be noted that the threads along the inner surface of the flange 49 in addition to engaging the threads of the member 48 to clamp the diaphragm 51 in place and complete the assembly of the cell 13, engage the exposed threaded portion of an annular contact member 52 which is partially embedded in the Bakelite forming the mouth of the receiver cup 11, thereby to secure the receiver cell in position within the cup independently of the ear piece 15.

Referring now more particularly to Fig. 2 of the drawings, there is illustrated in partially schematic form the manner of connecting the various contact members and circuit elements of the receiver and transmitter cells to form the complete hand set network of a substation circuit. The circuit corresponds to the antisidetone arrangement completely disclosed and described in the United States patent to Pye, No. 1,687,695, granted October 16, 1928. In conformance with the arrangement disclosed in this patent, the two field windings 53 and 54 have a common terminal, comprising the contact member 43, which is connected to one terminal of the transmitter through the conductor 42 and the contact member 41; and independent terminals connected to the contact members 45 75

and 52, respectively, which are terminated at the corresponding cord terminal contact members by means comprising a pair of conductors 55 and 56, respectively. As described in the patent referred to above, the windings 53 and 54 are so proportioned relative to each other that they perform the functions of a receiver and an induction coil during the reception and transmission of signals and also form an artificial line and provide the necessary balance to secure the desired antiside-tone effect during the transmission intervals. The other contact members mounted within the transmitter cup 12 are properly connected to the terminals of the transmitter cell 14 and the various conductors of the hand set cord indicated at 57 in the manner illustrated.

The conventional method of interconnecting the various contact members is that of embedding or moulding the conductors such as 42, 55, and 56, in the handle 10 during the process of manufacture, bare conductors being used and the moulded insulating material of the handle alone being depended upon to insulate the conductors one from the other. This method is not entirely satisfactory for the reason that it is difficult to maintain the conductors separated during the moulding operation and, consequently, there results a high percentage of failures or defective instruments.

In accordance with one feature of the invention disclosed in the above referred to co-pending application Serial No. 124,425, this difficulty is entirely obviated by employing conductors 42, 55 and 56 for making the necessary connections, at least a portion of which are pre-insulated by providing a layer of insulating material thereon. These layers for the individual enumerated conductors are indicated at 42', 55', and 56', respectively, and preferably consist of a material such, for example, as an asbestos compound, which is capable of withstanding, without deteriorating, the high temperatures necessarily involved in the moulding process. Although preferably all of the conductors are insulated in the manner shown, adequate protection against short-circuiting may be obtained if only a portion thereof are so insulated. Thus, perfectly satisfactory insulation may be obtained if only two of the three enumerated conductors 42, 55 and 56 are insulated.

Referring now more particularly to Figs. 3 and 4 of the drawings, there is illustrated the method of assembling the various elements of the receiver, whereby the desirable feature of protecting this element of the hand set against unauthorized disassembly is obtained. This method comprises clamping the diaphragm 51 to the upper edge of the cupped supporting or housing member 48 by means of the supporting member 47 and the dished spring 86, thereby to complete the receiver cell assembly. Following this, the member 47 is screwed onto the threaded ring 52 to secure the cell 13 in place within the receiver cup 11 and to bring the associated contact members mounted on the cell and within the cup 11 into firm engagement. It is pointed out here that the inner threads of the flange 49 engage the threaded portion of the member 48 and also the exposed threaded portion of the contact member 52, and thus serve the double function of clamping the diaphragm 51 rigidly in place to provide a unitary self-contained receiver cell and rigidly to mount the cell within the receiver cup 11 independently of the ear piece or member 15. Following the mounting of the receiver cell 13 in the manner described, the ear piece 15 is

placed in position over the cell so that in cooperation with the cup 11 it completely surrounds the cell. This piece is mounted on the cell 13, and more particularly on the member 47 by means of a flanged cap 58 having threads 59 along the shank thereof which engage threads 60 provided along the edge of a circular opening cut in the member 47. This cap is also provided with a small hexagonal sound transmission opening 62 through which the sound produced by vibration of the diaphragm 51 may be transmitted to the ear of a listener. The flange provided on the cap 58 is adapted to rest against the bottom of a groove 61 cut along the top edge of an opening in the ear piece 15 so that, when the cap is screwed into the member 47, the ear piece is firmly mounted on the cell 13.

In constructing a hand set of the form described it is extremely desirable to provide an instrument wherein the transmitter and receiver elements cannot readily be disassembled by curious and unskilled persons. The construction of the cap 58 contributes to this result in that the top thereof is flush with the face of the ear piece 15 and the element can only be unscrewed from the member 47 to remove the ear piece by employing a special tool having a hexagonal end of the proper size snugly to engage the sides of the hexagonal opening 62. It is pointed out, however, that this arrangement is alone not totally effective to prevent removal of the ear piece 15 due to the fact that sufficient friction exists between the engaging surfaces of this piece and the cap 58 to enable the cap 58 to be unscrewed sufficiently to permit its removal without the use of a special tool of the form noted when the ear piece 15 is rotated relative to the receiver cup 11.

In the present arrangement the difficulty as outlined in the preceding paragraph is obviated by providing means, in the form of inter-engaging locking means along the adjacent edges of the two enumerated elements, for preventing such relative movement between the member 15 and the cup 11. As shown more particularly in Fig. 4, this locking means comprises spaced apart projections 63 interposed between grooves 64 along the inner edge of the ear piece 15 which cooperate with similar grooves 65 and projections 66 alternately spaced around the outer edge of the cup 11. The interlocking action between the projections 63 and the grooves 65 prevents any substantial relative movement between the cup 11 and the ear piece 15 and thus positively prevents the cap 58 from being loosened without using a tool of the special form described.

As shown in Fig. 5, the method of assembling the elements of the transmitter is substantially similar to that described above in connection with the receiver assembly. Thus, the inner threads of the supporting member 18 cooperate with the threads of both the supporting member 19 and the exposed threaded portion of the contact member 41 to perform the double function of completing the transmitter cell assembly and securely mounting this cell within the transmitter cup 12 in such a position that each pair of associated contact members of the cell and the cup are in firm engagement. As in the case of the receiver assembly, the mouth piece 16 is provided with spaced apart grooves indicated at 67 along the inner edge of its cupped portion which cooperate with projections, one of which is indicated at 68, along the upper edge of the cup 12, to prevent relative rotational movement between the mouth piece or member 16 and the cup 12. A slightly

different means is provided, however, for mounting the mouth piece 16 on the transmitter cell 14. This means comprises a threaded stud 69 projecting outwardly from the supporting member 18, which stud is adapted to pass through an opening 70 in the bottom of the cupped portion of the mouth piece 16 and to have screwed thereon a cap 71 having a metal insert 72 provided with tapped threads for engaging the threads of the stud 69. This cap 71 is of a diameter not greater than the diameter of the circle tangent to the sound transmission holes or openings 17 and, with the exception of grooves 73 provided at diametrically opposite points along its sides, is of a smooth rounded contour. The grooves 73 are adapted to be engaged by the prongs of a special tool employed for the purpose of screwing the cap tightly against the outer adjacent surface of the mouth piece 16. By this method of assembly the transmitter cannot readily be taken apart except by using a special tool of the form described and consequently this portion of the hand set is also protected against unauthorized disassembly.

From the foregoing description of the transmitter and receiver assemblies it will be apparent that the individual telephone instrument cells, namely, the transmitter and the receiver cells, are mounted independently of the associated ear or mouth piece. Moreover the mounting arrangement is of an extremely rugged character. It is pointed out further that the method of assembly obviates the use of Bakelite to Bakelite threads between the individual transmitter and receiver cups and their respective associated mouth and ear pieces. Also, the latter pieces receive considerable support from the cells which they individually surround. Thus, the member 47 embodied in the receiver cell 13 fits snugly within the ear piece 15 so that the shock incident to a severe blow on the ear piece is largely absorbed by the sturdier metal parts of the cell 13. For the same reason the supporting member 18 of the transmitter cell is constructed to fit snugly within the cup portion of the mouth piece 16. This additional support for the walls of the pieces 15 and 16 permits the walls thereof to be made much thinner than is possible in these arrangements typical of the prior art.

Referring now to Figs. 6 to 9, inclusive, of the drawings, and more particularly to Figs. 7 and 8, there are illustrated the details of the receiver cell generally described above. As shown, the magnetic field structure comprises a pair of pole pieces 74 and 75 having pole faces 76 and 77, respectively, adjacent to but separated from the diaphragm 51 by an air gap of suitable length. Individually mounted on the pole pieces 74 and 75 are the windings 53 and 54, having terminals (not shown) commonly connected to the contact spring 44 and individual terminals not shown individually connected to the member 48 and the contact spring 46. The enumerated contact members are insulated from each other by insulating washers 78 and 79. Each of the pole pieces 74 and 75 includes an outwardly extending flange which is provided with a portion 80 offset with respect to the plane passing through the axial centers of windings 53 and 54. Mounted on these offset portions 80 and included in the magnetic circuit of the field structure is a polarizing permanent magnet 81.

It is pointed out that the best and improved forms of magnets suitable for use as the polarizing magnet 81 are constructed of exceedingly

hard alloy steels which render the conventionally used methods of mounting the same, consisting of drilling the magnet to accommodate mounting screws, costly and laborious. In the present assembly, this difficulty is obviated by employing a pair of small brackets 82 and 83 for rigidly clamping the magnet 81 against the offset portions 80 of the pole pieces 74 and 75 in the manner best illustrated in Fig. 8. The complete field structure is securely mounted within the cup-shaped supporting member 48 by means comprising a pair of screws 84 and 85 which extend through openings in the brackets 82 and 83 and in the pole pieces 74 and 75 and are threaded into the bottom portion of the member 48.

As previously pointed out, it is advantageous to clamp rigidly with uniform force all points of the receiver cell diaphragm periphery and to stretch the diaphragm during the clamping operation, thereby to secure greater stiffness thereof. In accordance with the present invention these advantages are attained by providing spring means in the form of a dished spring 86 which cooperates with the two members 43 and 47 to clamp the diaphragm 51 at its outer periphery against the upper edge of the cup-shaped member 48. This spring 86 rests in an outwardly tapering groove provided in the bottom of the cupped clamping member 47 and is so arranged that its outer edge projects beyond the outer edge of the groove to engage resiliently the adjacent surface of the diaphragm 51 during the clamping operation. Thus, as the member 47 is screwed onto the member 48 the extreme outer edge of the spring 86 comes in contact with the adjacent surface of the diaphragm 51 to exert a substantially uniform clamping pressure on the periphery of the diaphragm at all points thereof. Additional clamping pressure causes the outer peripheral edge of the dished spring to flatten with the result that it expands slightly in a radial direction and exerts a decided stretching force on the diaphragm 51. This force artificially enhances the stiffness of the diaphragm with the resulting advantage of improving its frequency response characteristic.

While there has been described what is at present considered to be the preferred embodiment of the invention it will be understood that various modifications may be made therein without departing from the invention and it is contemplated, therefore, in the appended claim to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

A diaphragm assembly for an electrical translating device comprising, in combination, a member having an annular clamping surface and provided with an externally threaded portion, another member having a cooperating clamping surface and provided with an internally threaded portion adapted to mate with the threads of said first-mentioned member, said second-mentioned member having a tapered recess therein disposed adjacent the clamping surface thereof, a diaphragm having a peripheral portion arranged adjacent the annular clamping surface of said first-mentioned member, an annular dish-shaped spring seated in the tapered recess in said second-mentioned member and provided with a portion projecting free of the tapered recess and extending between the peripheral portion of said diaphragm and the clamping surface of said second-mentioned member, said annular dish-shaped spring being so constructed and

arranged that the outer peripheral edge thereof initially engages the peripheral portion of said diaphragm and the body portion thereof is flattened and forced into engagement with the
5 peripheral portion of said diaphragm when said second-mentioned member is screwed onto said

first-mentioned member, whereby said diaphragm is stretched and the peripheral portion thereof is uniformly clamped thereabout to the annular clamping surface of said first-mentioned member.

HAROLD C. PYE.

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