This invention relates to transducers, and particularly to hand-held microphone devices.

Where a microphone is to be used in situations that require ready movement of the microphone, so as to make it impractical to utilize a conventional support or microphone stand, it has been customary to provide what has been termed a hand-held microphone that may be laid upon a table, the floor, or any other convenient shelf-like surface when not in use, and which is grasped and held in the hand of the operator when the microphone is to be used. Hand-held microphones are, of course, intended for use in a close-talking relationship, and for this reason most hand-held microphones are highly directional in character, and in the use of hand-held microphones as hereinafter constructed, the inherent difficulties experienced in handling and orienting the microphone, so as to insure impingement of the sound directly on the diaphragm of the microphone, have resulted in faulty transmission as well as objectionable delays in transmission, and to enable such difficulties to be avoided and eliminated is an important object of this invention.

Further objects related to the foregoing are to enable microphones to be so constructed that the user may quickly and easily grasp a microphone in such a manner that orientation of the microphone may be accomplished easily and accurately and without loss of time so that in a practical sense the microphone is self-orienting, to enable microphones to be so constructed and arranged that they may be readily grasped in the hand of the user in such a position that the user may readily and easily determine the location of the sound receiving openings of the microphone, and to enable the connector cord that extends from the microphone to contribute to the self-orienting properties or characteristics of the device. A more specific object of the invention is to enable microphones to be embodied in a relatively long and narrow form so that the body that is thus afforded may be readily grasped in the hand of the user, and a further and more specific object is to so locate the sound receiving openings of such a microphone at one end of an elongated body that is adapted to be grasped in the hand of the user so that when this body is thus grasped, the user will at once know that the sound receiving openings of the microphone are located in a particular end of the body.

In those instances where the user may be required to support a hand-held microphone in an operating position for long periods of time it is highly desirable that the user's arm and hand be disposed in a natural or normal position so as to thereby avoid strain and fatigue, but in hand-held microphones as heretofore constructed it has been impossible to attain this desirable result. Thus, in prior hand-held microphones, the form and relationship of the parts has invariably required that the user grasp and support the microphone with the palm of the user's hand faced toward the user's mouth. This required twisting of the hand and lower arm to a strained and unnatural position, and as a result it has been found that objectionable fatigue and strain are imposed upon the user. It is therefore a further object of this invention to enable hand-held microphones to be supported in an operative relation to the user's mouth while the user's hand and arm are disposed in a natural or normal holding position. A related object is to enable such a hand-held microphone to be grasped in a normal encircling relation by the hand of the user and to be supported in the desired operative relation to the user's mouth while the thumb-side of the hand is disposed adjacent to the mouth.

In many uses of hand-held microphones, it is customary to embody a control switch as a part of the microphone so that by manipulation of this control switch, the operator may render the microphone or the associated transmitter, or both, operative or inoperative at will, and a further object of the present invention is to simplify the operation of such a control switch as embodied in a microphone. Another and related object is to embody control switch means in a microphone in such a manner that the switch may be readily operated by the user as soon as the microphone is picked up in a normal manner. A further object is to enable a microphone to be constructed in an elongated form adapted to be grasped in the hand of the user and to locate the switch control member on the side of the elongated body so that the control switch may be readily operated merely by squeezing the elongated member as it is normally grasped in the hand of the user.

Where communications equipment such as a microphone is to be used in warm and humid climates, it is essential that switch means as well as the other electrical elements of the microphone be effectively sealed against the entrance of water or water vapor, and to enable this to be accomplished in a simple and expeditious manner is a further object of the present invention. Another object related to the foregoing is to enable a microphone and a control switch thereof to be so mounted and related that a con-
trol switch as well as the microphone are effect-
ually sealed against the entrance of water or
water vapor, and a further and related object is
to enable a microphone, a control switch means
and an impedance matching transformer to be
so related and housed as to protect the operative
electrical elements thereof against water or water
vapor.

When hand-held microphones of the character
to which the present invention relates are in
service in the field, it often becomes necessary to
replace or repair some of the parts thereof, and
particularly, it becomes necessary to replace the
connector cord whereby the microphone is con-
ected to the transmitting or other related appar-
atus, and to facilitate and simplify such repair
or replacement operations is a further object of
this invention.

In the event that hand-held microphones of
the kind to which this invention relates are to
be used in tropical climates, the electrical ele-
ments thereof must be effectually sealed against
the action of water and water vapor, and to effect
such sealing of the parts requires exceptionally
skilled workmen. Therefore it is desirable that
this sealed relationship be maintained at all
times, and that the sealed relationship be effected
in such a manner that the usual servicing opera-
tions may be performed without disturbing the
sealed relationship of the major parts of the
device, and to enable this to be accomplished is
another object of the invention. A more specific
object is to mount the microphone element of a
hand-held microphone device in such a relation
that it may be readily removed from a sealed
relationship for repair or replacement, and an-
other and related object is to afford a hand-held
microphone device embodying terminal means
and switch means in such association with a
microphone that either the microphone or the
connections to the terminals may be repaired or
replaced without disturbing the sealed relation-
ship of the switch means.

When a connector cord is extended into the
casing of a hand-held microphone or the like
so as to connect the wires of the cord to terminal
means within the housing, it is desirable that
a seal be afforded about the connector cord so
as to prevent entrance of water or water vapor
into the space where the wires are connected to
the terminal means, and to enable this to be ac-
complished in a simple and effective manner
is still another object of the present invention.
Other and further objects related to the fore-
going are to enable a connector cord to be firmly
gripped at the point where such a cord enters
a terminal chamber of a hand-held microphone
device or the like, thereby to prevent endwise
withdrawal of the cord, and to enable such a
gripping of the cord to be accomplished without
twisting of the connector cord, thereby to avoid
tension on the connections between the wires and
the terminals. More specifically it is an object
to provide a releasable gland for embracing a
connector cord at the point where such a cord
enters a terminal housing or the like, and to en-
able such a gland to be tightened by means of a
screw threaded member that is so associated with
the other elements of the gland that the desired
sealing and gripping action is attained without
impacting rotative or twisting movement to the
connector cord.

Other and further objects of the present in-
vention will be apparent from the following de-
cription and claims and are illustrated in the
accompanying drawings which, by way of illus-

invention has the body thereof constructed in an elongated form and of such size and dimensions that the device may be readily grasped in the user's hand, as shown in Fig. 1, and in accordance with certain aspects of the invention, control switch means are afforded within the body of the device for operating one or more switch operating means 24 extended along one side of the body of the device so as to be readily engageable by a portion of the user's hand in any rotative relationship in which the device may be grasped. When the microphone device 20 is thus grasped, it may be readily and easily supported with the switch operating means 22 and projecting switch operating means 24 extended along one side of the body of the device so as to be readily engageable by a portion of the user's hand in any rotative relationship in which the device may be grasped, and the switch operating means 24 may be operated at will by a mere contraction or squeezing action of the hand.

In providing the hand-held microphone device 20 of the present invention, a sectional housing 25 that is preferably of generally cylindrical external form is made from a rigid insulating material such as Bakelite to afford elongated sections 25A and 25B that are separable substantially separately from each other. Thus, the microphone device 20 is disassembled in the manner illustrated in Fig. 5 in the drawings. The sections 25A and 25B are held together by securing means such as a self-tapping screw 26 that is extended through a bore 27 in the section 25B and is tapped into a bore 29 in the section 25A, as shown in Fig. 7 of the drawings, and when the screw 26 is in its final position, the head thereof is located within a clearance recess 31 formed in the section 25B. After the sections 25A and 25B are placed in their assembled relationship as shown in Fig. 7 of the drawings, the opposite ends thereof are covered by end caps 33 and 35 that are made from metal and are of generally cup-shaped form so as to be movable in an endwise direction into an encircling relationship with respect to the opposite end portions of the casing 25.

The end of the casing 25 that is embraced by the end cap 35 is so formed as to afford a mounting chamber 40 within which a microphone unit 41 is positioned, and the chamber 40 is afforded by matching recesses formed in the casing sections 25A and 25B. The recess 40 opens outwardly or longitudinally through the end of the casing 25 so that when a microphone unit 41 is disposed in position within the chamber 40, the sound-receiving openings 42 of the microphone unit may face outwardly toward sound-receiving openings 43 formed in a dome-shaped central portion 35A of the end wall of the end cap 35.

The chamber 40 terminates in a bottom surface 44 that constitutes one side of a division wall 45 that separates the chamber 40 from another mounting chamber 50 that is formed in the casing 25 by matching recesses 50A and 50B formed respectively in the sections 25A and 25B. The mounting chamber 50 constitutes the chamber in which associated electrical elements are to be disposed, and in the present instance such associated electrical elements include an impedance matching transformer 51 and switch means 52 that are operable by the switch operating means 24 extended along one side of the body of the device so as to be readily engageable by a portion of the user's hand in any rotative relationship in which the device may be grasped, and the switch means 52 are associated with each other and with the connector cord 21 and the microphone unit 41 in a manner which will hereinafter be described in detail, and circuits are extended therefrom to terminal means 55 that are housed within a terminal chamber 56 that is provided by the end cap 36. Hence, when the end cap 36 is removed from the position shown in Fig. 7, the terminal means 55 are exposed for such servicing operations as are required, and this may be accomplished without disturbing the other elements of the device.

In affording the terminal chamber 56, the section 25B of the casing is terminated at 57 just within the edge of the end cap 36, while the section 25A has an integral extension 25′ that serves as a mounting for the terminal means 55 and also as means for enabling the end cap 36 to be secured in the desired position on the end of the casing 25. Thus, the end cap 25′ of the extension section 25A has a laterally facing recess 60 formed therein and this recess is shouldered at 61 to afford a mounting face for an arm 62 of an angle bracket 63. The arm 62 of the angle bracket, in effect, comprises a relatively large having an opening 62′ formed therein so as to open into a chamber 60A that in reality constitutes an extension of the recess 60. The chamber 60A has an opening or passage 65 extended through the material of the casing section 25A and into the recess 50A, and within the recess 50A, the insulating terminal plate 69 is placed along a longitudinal groove 65A formed along the bottom of the recess 50A so that wires may be extended through the recess 50A beneath the transformer 51 and switch means 52. Thus it is possible to extend connecting wires from the electrical means within the chamber 50 to the chamber 60A, and within this chamber, such wires are connected to electrical terminals 69 that are carried on a fibreglass plate 70 that covers the opening 62′ in the plate 62. The terminals 69 are secured in place on the insulating terminal plate 70 by integral tubular rivet portions or projections and the necessary electrical connection between a wire and a terminal 69 is effected by passing the wire through the tubular rivet portions and soldering the same so as to close the opening in the tubular rivet as indicated at 69′ in Fig. 8 of the drawings. The insulating plate 70 and the mounting plate 62 are secured in position on the shoulder 61 by drive-screws 71, or self-tapping screws may be used in place of drive-screws in this instance as well as the other cases where drive screws have been shown or described. The mounting bracket 63 has a second arm 75 that serves as a support for a connecting gland 76 that includes means for clamping the end cap 36 in place and also includes means for clamping the connector cord 21 in the desired position at its point of entry into the terminal chamber 56, as will hereinafter be described in detail.

In accordance with the present invention, all of the electrical elements that are permanently mounted in the device are mounted on the section 25A of the casing so that assembly of the device is thereby facilitated. Thus the transformer 51 and the switch means 52 are permanently mounted within the recess 50A in the casing section 25A, as shown in Figs. 7 and 8, and this mounting is accomplished in such a manner that when the two casing sections 25A and 25B are assembled, the switch means 52 are disposed in an operative relationship with respect to the switch operating means 24 so as to be readily engageable by a portion of the user's hand in any rotative relationship in which the device may be grasped, and the switch means 52, which in the present instance includes two switches 52—1 and 52—2, are disposed in the recess 50A near the end thereof that is adjacent to the chamber 60A. Such switch means may of course take many different forms, but as herein shown, the switch means are of the over-center
Thus the switch means include a mounting block 80 seated in the deep portion of the recess 50A and having a mounting bar 81 along its upper edge, and the mounting bar 81 has its ends rested upon pedestals 82 formed opposite sides of the recess 50A on the shoulder 82 so that securing means such as drive-screws 83 may be extended through the ends 81 and into the pedestals 82 so as to secure the switch means 82 in place. Each switch of the switch means 52 includes a stationary contact 84 that is in the form of a blade extended through the mounting block 80 to expose one end 84 thereof for connection with a wire that is to be associated with the switch. Each switch also includes a movable contact blade 85 that is also extended through the block 80 as at 85' to afford terminal means for connection with the wire or the like. The movable contact 85 is adapted to be bent or shifted from the normal open position shown in Fig. 7 to a closed position wherein it engages the stationary contact 84, and this is accomplished by an over-center spring 87 that has one end thereof pivoted to the end of the movable contact 85 while the other end thereof is pivoted to an operating spring arm 88 mounted in the mounting block 80.

When the operating spring arm 88 is moved to the left, in Fig. 7, the movable switch contact 85 is also forced to the left until the back face thereof comes into contact with an abutment plate 89 that is carried in the mounting block 80, and after the movement of the arm 88 has progressed to such an extent as to move the upper end of the spring 87 substantially to the left beyond the position of the lower end of the spring 87, the over-center action of the spring causes the movable contact 85 to be quickly shifted to the right and into its closed relationship with respect to the stationary contact 84. Similarly, when the operating spring arm 88 is allowed to return in a right-hand direction toward the position shown in Fig. 7, the spring 87 again moves through its center position so as to quickly move the movable contact from its closed position to its open position. The operation of the spring arm 88 is accomplished by the switch operating means 24 in the manner that will hereinafter be described in detail.

The impedance matching transformer 51 is disposed within the recess 50A in the casing section 25A in the space between the switch means 52 and the wall 45, and such mounting is accomplished by mounting straps 95 that are secured as by rivets 95' to opposite ends of the core or laminations of the transformer 51. The other ends of the mounting straps are disposed on the ends of what may be termed pedestals 96 formed at adjacent ends of the ledges 82', and drive screws 87 secure these pedestals 95 on the tops of the pedestals 96. One of the windings of the transformer 51 has the leads 98 thereof associated with the microphone unit 41 and in accomplishing such association, the leads 98 are extended to a pair of terminals 100 mounted in the recess 50A of the section 25A. The terminals 100 are secured on the lower face of the wall 45 as viewed in Figs. 7 and 8 by means such as rivets 101 that extend through the wall 45. The upper ends of the rivets 101 are arranged to secure terminal brackets 102 in position within recesses 103 formed in the upper face 44 of the wall 45, as will be evident from the drawings. The rivets 101 extend the electrical circuits from the respective terminals 100 to the brackets 102, and these brackets 102 have angularly related terminal arms 105 formed therewith as shown in Figs. 7 to 12 so as to extend upwardly along one side of the recess 40 in spaced grooves 106. The terminal brackets 102 are made from a spring material such as phosphor bronze so as to enable efficient contact to be made with the connecting terminals 101 of the microphone unit 41, and the upper ends of the terminal arms 105 are in position for engagement by such connecting terminals 107 when a microphone unit 41 is moved in an endwise direction into position in the chamber 40 as will hereinafter be explained.

Leads 108A and 108B from the other winding of the transformer 51 are extended toward the bottom of the recess 50A and into the groove 65A, and are then extended within the groove 65A toward the passage 65. In the present instance the wire 108A is extended directly through the passage 65 and into the chamber 60A, and is connected on an appropriate operation of the terminal 69. The other lead 108B however is extended beneath the mounting block 80 and is then extended out of the groove 65A and to the stationary contact 54 of the switch 52-2, to which it is connected as by soldering. The other or movable contact 55 of the switch 52-2 has a wire 108A connected thereto as by being Bahrain to the other side of the wire is led into the groove 65A and through the passage 65 and into the chamber 60A where it is connected to another one of the terminals 69. Wires 109C and 105D are connected to the other two terminals 69, and are extended through the passage 65 from which they are further extended into the recess 50A and are connected respectively to the terminals 84 and 85 of the switch 52-1. Thus, the closure of the switch 52-2 closes circuit from two of the terminals 69 through one winding of the transformer 51, thereby to control circuit to the microphone unit 41, while closure of the switch 52-1 completes circuit between the other two terminals 69. Such operation of the switch 52-1 may be utilized to cause operation of relay means or the like for governing operation of an associated transmitter or other device by the switch operating means 24.

The switch operating means 24 are mounted on the other section 25B of the casing so as to cooperate with the spring arms 88 in effecting operation of the switches 52-1 and 52-2. Thus, the section 25B of the casing has an elongated slot 110 formed therein so as to extend longitudinally of the casing, and an operating lever 111 formed from a rigid insulating material such as Bakelite is disposed in this slot so as to extend outwardly beyond the side of the casing section 25B. The operating lever arm 111 is supported on a mounting plate 112 that has ears 113 formed thereon in close ends of the struts 95 of the other side of the ears 113. A pivot pin 115 extends through the lug 114 and into the ears 113 so that the arm 111 may be pivoted about the axis of the pivot pin 115. The mounting of the lever arm 111 in the slot 110 is in the present instance accomplished in such a manner as to seal the opening or slot 110 against the entry of water or water vapor. This is accomplished through the provision of a sheath 120 that is molded from a flexible material such as rubber so as to embrace the side surfaces and the flange 121 at the innermost edge of the sheath, and this flange

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121 is clamped against a shoulder 122 formed about the inner edge of the slot 110. Such clamping action is in the present case effected by the bordering edge of the mounting plate 112, this bordering edge being secured against the shoulder 122 by drive-screws 124, as will be evident in Figs. 7, 9 and 11 of the drawings. The lever arm 111 has a switch operating finger 125 formed thereon that extends through an opening 120 formed in the mounting plate 112, and as will be evident in Figs. 9 and 11, this operating finger 125 is of such a width that it will engage both of the operating spring arms 85 of the two switches. The spring arms 85 act on the lever arm 111 to normally maintain the arm 111 in its outwardly projected relationship of Fig. 7, thereby to maintain the switch means 52 normally open, and the strength of the spring action of the arms 85 is such that the switch means 52 will not be inadvertently closed as for instance when the device 20 is laid down with the switch operating means 24 in a downward position. Thus when the user applies a positive inward pressure to the sheath 120, the arm 111 is pivoted about the axis 115, thereby to force the spring arms 85 in a switch-closing direction. In order that damage to the switch means may be avoided, the sheath 120 is provided near the free end of the lever arm 111, and this stop finger is arranged to engage the mounting plate 112 when the lever arm 111 has been moved for a distance sufficient to cause closure of the switch means.

When a hand-held microphone of the character to which the present invention relates is to be utilized in a tropical climate, it is desirable that all of the electrical elements of the device be sealed against the entry of water or water vapor. In the case of the microphone device of this invention, it is particularly desirable that the electrical means included within the chamber 56 be permanently sealed against the entry of water or water vapor, and so far as the switch operating means 24 are concerned, it will be evident that the provision of the sheath 120 serves to effect this result. In this connection, however, it may be pointed out that a suitable sealing compound or adhesive means may be provided before the sheath is clamped in place against this shoulder. Another path along which water or water vapor might tend to enter the chamber 56 is afforded along the separation line or plane 25C, and to simplify the provision of an effective seal between the two sections 25A and 25B, an interlocked arrangement is provided about at least a portion of the border about the cavities that provide the chamber 56. Thus as shown in Figs. 7, 8, 9 and 11, a continuous ridge or rib 130 is provided about the sides and lower edge of the cavity 56A, that is formed in the section 25A, this rib being bordered at its outer edge by a flat surface 131 that lies in the plane of separation 25C. The section 25B has a flat surface 132 that is adapted to have flat surface engagement with the bordering surface 131 of the section 25A, and inside of the bordering surface 132, the section 25B has a continuous rib 133 into which the rib 130 is adapted to fit, as will be evident in Figs. 7 and 11. In the portions of the two sections 25A and 25B that afford the upper end of the casing, the sections 25A and 25B are provided respectively with flat surfaces 134 and 135 that have a flat surface engagement when the two sections are in their assembled relationship. In the course of assembly of the two parts or sections 25A and 25B, it is preferable to apply a suitable adhesive or sealing compound along the sides of the cavities that form the chamber 56, and in a continuous line about the borders of the cavities 56A and 56B so as to cover at least a portion of the surfaces that are to be placed in abutting relationship, as indicated in Fig. 11, and hence when the two sections are drawn together by tightening of the self-tapping screw 28, the sealing compound will provide an effective and continuous seal about the entire border portion of the chamber 56 and along the bottom and sides of the chamber 56. Thus a seal is thus afforded is maintained by the interlocking action of the rib 130 and the groove 133 which are in turn held in such interlocking relation by the screw 28.

It will be recalled that the chamber 56 communicates with the chamber 56A through a passage 65, and hence in order that the electrical means may be fully sealed, the mounting of the plates 62 and 70 across the face of the recess 60A is accomplished in such a manner as to effectually seal the chamber 56A. Thus a suitable adhesive or sealing compound is placed between the plate 62 and the shoulder 61, while such a compound is similarly placed between the abutting faces of the plate 70 and the plate 62. Thus when the two plates are secured in position by the action of the screws 71, the border portions of the chamber 56A are properly sealed. It will also be recalled that the rivets that serve to secure the terminals 69 in place originally have openings therethrough, but in the course of connecting the wires to the terminals 69, the soldering at 69 serves to effectually seal against water and water vapor the openings of these terminals. The openings through which the rivets 101 are extended are also sealed against passage of water and water vapor, and this is accomplished by application of a sealing compound or substance about the rivets 101 and the terminals 100 when those elements are put in place. Thus the chamber 56A as well as the chamber 56 are effectively sealed against the entry of water or water vapor.

In associating the connector cord 21 with the microphone device of the present invention, the end cap 36 is removed, thus to expose the connecting arms of the terminals 69 so that the wires 21A of the connector cord 21 may be connected as by soldering to the appropriate terminals 69. In this connection it will be observed that the end cap 36 has an axial opening 140 formed therein so as to surround one end of an externally threaded nipple 141 that is secured as by snapping or staking the nipple in the lateral projecting arm of the bracket 63. The nipple 141 has means screw threaded thereon for clamping the end cap 36 in position on the end of the casing 26, and in this connection it will be noted that the end cap 36 is so related to the other elements of the device that the terminal chamber 56 is sealed against water or water vapor when the end cap 36 is properly secured in position. Thus it will be evident in Fig. 7 of the drawings that an annular washer 145 of a resilient material is disposed against an annular shoulder 145 on the casing 26, and the washer 144 is so located that it will be engaged by the edge of the cup-shaped end cap 36 when the end cap is placed in position. About the nipple 141 and in abutment with the end wall of the end cap 36, another sealing washer 146 is provided in
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...fitting relation to the nipple 141, and this resilient washer 143 is clamped against the end wall of the cap 35 by a metallic washer 147 and a clamping nut 148, the nut 143 being threaded on the nipple 141. The sealing gland 76 also includes a clamping nut or member 150, and when the washers 145 and 147 and the nuts 143 and 150 are removed, the end cap 35 may be removed by endwise withdrawal along the axis of the nipple 141. The gland 76 utilizes the nut or threaded sleeve 150 to apply clamping and sealing pressure to the connector cord 21, and for this purpose, the lower end of the nipple 141 is reamed to afford an inwardly tapering conical surface 192 against which an enlarged conical end portion 153 of a resilient sealing sleeve 154 is adapted to engage. The nut 150 is flanged inwardly at 155 to afford an angularly disposed shoulder upon which a metallic washer 156 is disposed. The washer 156 engages an annular abutment shoulder of the sleeve 154 so that by tightening the nut 150, the enlarged sealing end 153 of the sleeve 154 may be forced inwardly into the conical surface 152 of the nipple 141. Thus the sealing portion 153 is compressed or contracted so as to clamp the cord 21 and effect a tight seal with the surface thereof, and this is accomplished without objectionable movement of the sleeve 154 and the connector cord 21. Thus twisting of the cord 21 with the consequent damage to the connections with the terminals 60 is avoided. The compression of the sealing sleeve 154 and the resultant clamping of the cord 21 serves to prevent endwise displacement of the cord.

At the other end of the casing 23, the end cap 35 is so associated with the casing 25 and with the microphone unit 41 that objectionable entrance of water or water vapor into the chamber 40 is prevented. Thus it will be noted that the end cap 35 fits down over the upper end of the casing as viewed in Figs. 7 and 8, and the lower edge of the end cap 35 is arranged to rest upon a resilient annular sealing washer 160 that in turn bears upon an annular abutment shoulder 151 formed on the two sections of the casing 25. When the end cap 35 is thus positioned, it is held in a firmly clamped relationship with respect to the sealing ring or washer 160 by a retaining ring 165 that is annular in character and which surrounds the side walls of the end cap 35. This retaining ring 165 has a plurality of set screws 185 extended therethrough, as will be evident in Figs. 4, 5, 10, 12 and 13, and these set screws are engaged with matching recesses 167 formed in the walls of the casing sections 25A and 25B. It will be observed in Fig. 12 that the casing section 25A has a relatively wide rib 168 formed longitudinally thereof opposite the grooves 166, thereby to afford proper wall thickness adjacent these grooves, and the end cap 35 has a complementary rib 170 formed therein to embrace the ring 165. The outer surface of the securing ring 165 is, however, truly annular in character, but the inner surface thereof is cut away as at 171 so as to provide clearance for the rib 170 of the end cap 35. The mounting of the end cap 35 on the casing 25 serves also to hold the microphone unit 41 in position in the chamber 40, and the relationship of the parts is such that the chamber 40 is effectively sealed against the entrance of water or water vapor. As will hereinafter be described in greater detail, the microphone unit 41 has a cap 178 that is formed of Bakelite or like material so as to overlie the diaphragm 176 of the microphone, and it is in the cap 175 that the sound-receiving openings 42 are formed. The diaphragm 176 is of a waterproof construction so as to thereby protect the internal elements of the microphone unit 41 against the entry of water and water vapor, and a sealed arrangement is afforded about the upper border portions of the cap 175 so that water or water vapor cannot pass into the microphone unit 41. Thus the cap 175 has a rib 175A about the area in which the openings 42 are formed, such rib 175A being annular in character as will be evident in Fig. 10 of the drawings. When the microphone unit 41 is to be placed in the chamber 40, a cushioning pad 178 of rubbery material is placed at the bottom of the chamber 40 against the surface 44 of the wall 45, and in many instances it may be desirable to secure this cushioning pad in position by adhesive so as to insure against loss of the pad. The microphone unit 41 is moved endwise into position in the chamber 40, and in the course of such movement the top of the microphone unit are moved into operative engagement with the spring terminals 105. The mounting operation thus described also moves the bottom of the microphone unit 41 into abutment with the pad 178, which, it will be noted, serves to insulate the unit from the wall 45 and the terminal brackets 102, and after this operation is accomplished, a sealing washer 180 of rubber or like material is placed in such a position that it engages the upper edge of the flange 175A as well as the upper edges of the walls that define the chamber 43. In this connection it should be noted that the sealing washer 180 is of such a form that it extends onto the top of the rib 168, thereby to effectively close the upper ends of the slots 165. The end cap 35 is then put into position and is forced downwardly so as to compress the lower sealing ring 160 and the upper sealing ring 180, there being also an incidental compression of the pad 178 which serves to hold the diaphragm 176 firmly against the sealing ring 165. Thus the chamber 40 is sealed against the entry of water or water vapor, and the electrical elements such as the terminals 105 are protected against any undesirable leakage that might result from the presence of such water or water vapor. When the two metallic end caps 35 and 36 are thus secured in place on opposite ends of the casing 25, they serve not only as additional means for preventing separation of the casing sections 23A and 23B, but also as a protecting means about the ends and end edges of the casing, and hence the end caps strengthen the assembly and prevent damage that might otherwise be caused by blows striking the ends of the device. The clamping or fastening ring 165 also serves as a part of the mounting means for removably securing the noise shield 23 in position on the microphone device, as will be evident in Fig. 2 of the drawings, the noise shield 23 having a sleeve-like portion 183 that surrounds the side wall of the end cap 35, and this sleeve-like portion 183 has an internal groove 185 formed near one end thereof that embraces the securing ring 165, thereby to hold the sleeve-like portion in position on the microphone device. At the other end of the sleeve-like portion 183, the portion 185 includes a flared portion 186 having its end edges 188A formed in such a manner as to be adapted to embrace the surfaces of the user's face about the mouth as shown in Fig. 1, thereby to exclude outside noise. The noise shield 23 has a plurality of pressure relief openings or passages 190 formed
therein whereby air pressure within the noise shield 23 is relieved while entrance of objectionable noise from the outside is prevented.

It will be recognized that under the broad aspects of the present invention, the characteristics or type of the microphone unit 41 as well as the noise shield 23 and microphone 76A may be disposed in a variety of ways as illustrated, the microphone unit 41 is so constructed and arranged that it is in effect complementary to the specific construction of the noise shield 23 insofar as frequency response characteristics may be concerned, and the joint action of the particular microphone and the noise shield 23 is such as to produce a substantially flat frequency response curve throughout the normal range of speech frequencies. In the form that is herein illustrated, the microphone unit 41 is of the dynamic or moving coil type, and as shown in Figs. 14 to 18 of the drawings, this microphone unit comprises a cup-like outer shell or housing 208 having integral annular side walls 201. Adjacent the upper end of the side walls 201, an internal annular shoulder 202 is provided, and above the shoulder 202, the thin walls are relatively thin as indicated at 201A in Fig. 15 of the drawings. The shoulder 202 is disposed in a plane parallel to the inner surface 204 of the bottom wall of the housing 208, and a cylindrical permanent magnet 205 is rested on the surface 204 of the bottom wall so as to be concentric with the shoulder 202. The magnet 205 is preferably secured in position on the surface 204 by soldering the same to this surface as indicated at 206. The housing 208 is made from a soft iron material so that it constitutes a part of the magnetic circuit. The upper end of the magnet 205 constitutes the inner pole of the magnetic circuit. The outer pole of the magnetic circuit is provided by a soft iron pole plate 208A that has a central opening 209, Fig. 18, formed therein so as to be spaced from the magnet 205 and the plate 208A forms an annular magnetic gap. The outer pole plate 208 is fitted into the upper end of the housing 208 so as to rest upon the shoulder 202, and in order that an upward annular rim or ledge 208A may be afforded about the upper surface of the pole 208 for supporting the diaphragm 176, in a spaced relation to the plate 208A, the plate 208A is so disposed as to present an offset about its outer edge, thereby to also provide a rabbeted annular groove 208B about its lower outer corner. This rabbeted annular groove 208B fits over the shoulder 202.

Before the outer pole plate 208 is put in position in the housing 208, means are mounted within the annular space about the magnet 205 for controlling the response characteristics of the microphone, and in the present instance such means are relatively simple in character. Thus a molded washer-like magnetic core made from hard rubber or other moldable material is put in position about the magnet 205, and this member 212 serves to accurately define a back chamber and limit the volume of air that is trapped between the upper surface 212A of the member 212 and the lower surface of the outer pole plate 208.

After the outer pole plate 208 has been put into position, the diaphragm 176 is mounted in position so as to be supported upon the annular ledge 208A. In the form herein shown the diaphragm 176 is made in two parts from a waterproof material such as molded paper pulp having a waterproofing ingredient such as asphaltic material included therein. The diaphragm 176 thus includes a substantially flat annular flexing portion 176A, the outer border of which is seated upon and secured as by adhesive means to the upper face of the annular ledge 208A. The inner edge of the annular flexing portion 176A has a generally cylindrical portion 176B formed thereon in an integral relationship so as to afford a voice coil support. This cylindrical portion 176B has an annular offset or shoulder 176C formed therein so that on the outer surface of the cylindrical portion 176B, the offset 176C affords a guiding shoulder against which one end of a voice coil 215 may be wound. The annular portion 176B is so disposed on the flexing portion 176A that the voice coil 215 is disposed within the annular magnetic gap formed between the surface 203 and the magnet 205. After the flexing portion 176A has been secured in position on the annular ledge 208A in a properly centered relationship which centers the voice coil with respect to the axis of the magnetic gap, a dome portion 176D having a cylindrical flange 176B at its outer edge is inserted into the cylindrical portion 176B, and such inserting movement is limited by engagement of the flange 176B with the wall 201B of the dome 176D is of course secured by a waterproof adhesive in the position that is thus determined by the offset 176C, and thus the waterproof diaphragm is completed.

The ends 215A of the voice coil 215 are extended outwardly through the flexing portion 176A of the diaphragm in a sealed waterproof relation there being a waterproof substance applied to the wires and the diaphragm at the points where the wires extend through the diaphragm, and the wires are then extended outwardly in a generally radial direction along the upper surface of the flexing portion and are secured thereto by adhesive means. The outer ends of the wires 215A are extended substantially beyond the edge of the flexing portion 176A for connection with the terminals 107 as will now be described. The terminals 107 are mounted in an outwardly extending terminal block portion 175B of the cap 175, and provision is made for extending the wires 215A outwardly beneath the edge of the cap 175 in a simple and effective manner. Thus it will be noted in Figs. 15 and 18 of the drawings that the cap 175 has an outwardly extending extension or flange 220 about its edge and this flange has a downwardly extending annular flange 221 formed or cemented at its outer edge, and the cap 175 is inserted in the upper end of the wall 201A so that the flange 221 bears upon the border portion of the diaphragm to hold the same down against the ledge 260A, and it will be observed that the radially projecting terminal block 175 extends through a slot 223 formed in the rim or upper edge of the wall 201A. After the cap has been put in position as just described, the upper edge of the wall 201A is flanged inwardly as indicated at 223 so as to overlie the flange 220 of the cap 175 and thus the cap 175 is held in position. It will be observed that when the cap is in this position, the downwardly extending flange 221 on the cap provides an appreciable clearance space above the flexing portion of the diaphragm.

In extending the wires 215A outwardly for association with the terminals 107 it should be observed that the upwardly extending portion 176A of the wires are formed in the flange 221 and these portions extend outwardly into vertically extending grooves 231 formed in the outer face of the terminal block portion 175B. These vertical grooves extend outwardly so as to enter the respective bores 233 in which the shanks 175A of the terminals 107 are to be driven. Thus when the wires 215A are led outwardly through the notches 230, they are then...
extended upwardly through the grooves 231 and are wound about the respective shanks of the terminals 107 which are at this time partially inserted into the bores 232. The wires may then be soldered to the shanks if desired, after which the terminals 107 are driven completely into the bores 233, such inward movement being limited by enlarged spacing shoulders 101B formed on the terminals 107.

The telephone device of the present invention is normally shipped in completely assembled relationship so as to include a connector cord 21 in an operative relationship to the device, and hence the initial association of the microphone device with a transmitter or the like is accomplished merely by establishing coincident between the other end of the connector cord and the equipment with which the device is to be used. In the use of the device the operator may rely upon the self-orienting characteristics of the microphone as afforded by the present invention, and when the microphone device is to be used, the operator merely grasps the elongated body of the device in the manner shown in Fig. 1 of the drawings. When the body of the microphone device has been encircled by the hand of the user, the switch operating means 24 are invariably in such a position that they may be readily operated merely by a squeezing action of the hand without disturbing the sealed relationship of the sealing gland 76 which not only clamps the connector cord 21 but also produces the desired seal to prevent the escape of water vapor. The sealing and clamping action that is thus accomplished by the gland 76 is effected in such a way that objectionable rotative movement of the cord is avoided, and this, taken in connection with the clamping action that is exerted on the cord 21, undesireable stresses upon the connections that have been established between the wires 21A and the terminals 59.

From the foregoing description it will be evident that the present invention materially simplifies the problem of attaining rapid and efficient transmission about the cord so as to prevent under or over tension and assures a sealed connection in such a way that the normal servicing operations in respect to the connector cord 2 are materially simplified through the novel and efficient action of such a character that it may be supported in the desired operative relationship to the user's mouth without placing the hand and arm of the user in an unnatural or strained relationship, and because of this, the microphone device of the present invention may be used for relatively long periods of time without apparent strain or fatigue. It will also be evident that the hand-held microphone device of the present invention attains an effective sealing of the electrical elements thereof in a simple and highly effective manner; and it will be clear that this sealing action is attained in such a way that the normal servicing operations that must be performed upon devices of this character may be accomplished without disturbing the sealed relationship of most of the elements of the device.

The hand-held microphone device of the present invention also materially simplifies the operation of switch means that are in some instances associated with hand-held microphone devices, and in accordance with the present invention, such switch means may be readily and easily operated as soon as the user has grasped the device in the manner illustrated. Thus, while we have illustrated and described the preferred embodiment of our invention, it is to be understood that this is capable of variation and modification and we therefore do not wish to be limited to the precise details set forth, but desire to reserve to ourselves such changes and alternations as fall within the purview of the following claims.

We claim:
1. A hand-held microphone device, an elongated sectional body comprising a pair of elongated sections of substantially disposed substantially through the longitudinal axis of said body, said sections at one end thereof being formed with matched cavities defining a first chamber opening longitudinally of the body through said one end thereof, said sections of said body having matched cavities therein spaced from opposite ends thereof and defining a main chamber, switch means mounted in the main cavity of one of said sections, a transformer mounted in said main cavity of said one section, the other one of said sections having an opening formed therethrough and facing toward said switch means, a flexible waterproof sheath extended outwardly through said opening and having flanges thereon engaged with an inner surface of the main cavity in said other member about the inner borders of said opening, a switch operat-
ing member movably supported within said sheath and acting to urge said sheath into a projecting relationship with respect to the outer surface of said body, means forming an operative connection between said switch operating member and said switch, said switch having a moveable protruding end, said movement of said sheath and said switch operating member serves to operate said switch means, means affording a sealed relationship between the flange of said sheath and the surface of said cavity with which it is engaged, means securing said terminal plate and said switch means in a waterproof relationship across said open side of said connecting chamber, a screw threaded connector nipple means extending in said flange distal to said terminal plate, a cup-shaped end cap having an opening therein to embrace said nipple, means on said sections of said body affording a continuous shoulder facing endwise toward said other end of said body, said nipple having its axis disposed coaxially with said shoulder, a resilient sealing ring disposed against said shoulder, said cup-shaped end cap having its open end edges disposed against said resilient sealing ring, a nut disposed on said nipple, a resilient sealing ring disposed between said nut and said cup-shaped end cap to afford a seal about said nipple, means associated with said nipple for affording a seal about a connector cord when such a cord is extended through said means and said nipple, and means affording a perforated end cap for said one end of said body to house and protect a microphone unit disposed in said sheath.

2. In a hand-held microphone device, an elongated sectional body member comprising a pair of elongated sections separable in a plane extending substantially through the longitudinal axis of said body member, said sections at one end thereof being formed with matched cavities defining an end chamber opening longitudinally of the body through said one end thereof, said sections of said body having matched cavities therein spaced from opposite ends thereof and defining a main chamber, switch means mounted in the cavity of one of said sections, a transformer mounted in said cavity of said one section, the other one of said sections having an opening formed therethrough and facing toward said main chamber, means for operating switch member serves to operate said switch means, resilient means affording a sealed waterproof relationship between said main member and the section in which it is mounted, means securing said sections together to seal said main chamber, terminal means on said one of said sections of said body member, and means including connecting wires extended from said switch means and said transformer to said terminal means in a waterproof relationship.

3. In a hand-held microphone device, an elongated sectional body member comprising a pair of elongated sections separable in a plane extending substantially through the longitudinal axis of said body member, said sections at one end thereof being formed with matched cavities defining an end chamber opening longitudinally of the body through said one end thereof, said sections of said body having matched cavities therein spaced from opposite ends thereof and defining a main chamber, switch means mounted in the cavity of one of said sections, a transformer mounted in said cavity of said one section, the other one of said sections having an opening formed therethrough and facing toward said switch means, a flexible waterproof sheath extended outwardly through said opening and having flanges thereon engaged with an inner surface of the cavity in said other member about the inner borders of said opening, a switch operating member movably supported within said sheath so as to urge said sheath into a projecting relationship with respect to the outer surface of said body, means forming an operative connection between said switch operating member and said switch means whereby inward movement of said sheath and said switch operating member serves to operate said switch means, means affording a sealed relationship between the flange of said sheath and said switch means in a waterproof relationship across said open side of said connecting chamber, a screw threaded connector nipple means extending in said flange distal to said terminal plate, a cup-shaped end cap having an opening therein to embrace said nipple, means on said sections of said body affording a continuous shoulder facing endwise toward said other end of said body, said nipple having its axis disposed coaxially with said shoulder, a resilient sealing ring disposed against said shoulder, said cup-shaped end cap having its open end edges disposed against said resilient sealing ring, a nut disposed on said nipple, a resilient sealing ring disposed between said nut and said cup-shaped end cap to afford a seal about said nipple, means associated with said nipple for affording a seal about a connector cord when such a cord is extended through said means and said nipple, and means affording a perforated end cap for said one end of said body to house and protect a microphone unit disposed in said sheath.

4. In a hand-held microphone device, a housing having a central chamber sealed against the entrance of water and water vapor and affording a secondary chamber at one end of said sealed chamber and connecting chamber at the other end of said sealed chamber, said secondary chamber having a pair of contact terminals therein, a microphone unit disposed within said secondary chamber and having contact terminals engaging said first mentioned terminals, a releasable cap member engaging said microphone unit and releasably retaining the same in said secondary chamber, an impedance matching transformer means and switch means mounted within said sealed chamber, said transformer having primary and secondary windings one of which is electrically connected at its opposite ends to said stationary terminals, connections including wires extended from the ends of the other winding of said transformer to said terminal means.

5. In a hand-held microphone device, an elongated sectional casing comprising matched sections separable along a longitudinal plane of separation, said sections having opposed recesses formed therein to open through the matched faces thereof to afford a mounting chamber, a microphone unit mounted at one end of said
casing, switch means mounted in the cavity in one of said sections and operatively connected to said microphone unit for governing operation thereof, and a switch operating element movably mounted on the other of said sections in position to be operatively related to said switch means as an incident to the positioning of said sections in matched opposing relationship.

6. In a hand-held microphone device, an elongated sectional casing comprising matched sections separable along a longitudinally extended plane of separation, said sections having opposed recesses formed therein to open through the matched faces thereof to afford a mounting chamber, a microphone unit mounted at one end of said casing, switch means mounted in the cavity in one of said sections and operatively connected to said microphone unit for governing operation thereof, terminal means on said one section arranged to be disposed in an exposed relation when said sections are assembled, a switch operating element movably mounted on the other of said sections in position to be operatively related to said switch means as an incident to the positioning of said sections in matched opposing relationship, and a cup-like end cap secured to said casing in surrounding relation to said terminal means.

7. In a hand-held microphone device, an elongated sectional casing comprising matched sections separable along a longitudinally extended plane of separation, said sections having opposed recesses formed therein to open through the matched faces thereof to afford a mounting chamber, a microphone unit mounted at one end of said casing, switch means mounted in the cavity in one of said sections, means operatively connecting said switch means to said microphone unit in a waterproof relation for governing operation thereof, terminal means on said one section arranged to be disposed in an exposed relation when said sections are assembled, means including wires extended from said mounting chamber to said terminal means in a waterproof relation, a switch operating element movably extended in a waterproof relation through a wall of said mounting chamber and operatively related to said switch means for actuating the same, means securing said sections together to seal said mounting chamber against water and water vapor, and a cup-like end cap secured to said casing in surrounding relation to said terminal means.

8. In a hand-held microphone device, an elongated sectional casing comprising matched sections separable along a longitudinally extended plane of separation, said sections having opposed recesses formed therein to open through the matched faces thereof to afford a mounting chamber, a microphone unit mounted at one end of said casing, switch means mounted in the cavity in one of said sections and operatively connected to said microphone unit for governing operation thereof, said other section having an opening formed therefrom in said sections, switch operating means extended through said opening in position to be operatively associated with said switch means as an incident to assembly of said sections, a flexible waterproof sheath covering the exposed surfaces of said member and having border portions thereof secured to said other section about said opening in a waterproof relation, and means securing said sections together in a sealed and waterproof relation to keep water and water vapor out of said chamber.

9. In a hand-held microphone device, an elongated sectional casing comprising matched sections separable along a longitudinally extended plane of separation, said sections having opposed recesses formed therein to open through the matched faces thereof to afford a mounting chamber and also to define an end chamber adjacent one end of said mounting chamber and opening through the adjacent end of the casing, a microphone unit mounted in said end chamber and having a waterproof diaphragm, switch means mounted in the cavity in one of said sections, means including wires extended in a waterproof relation between said chambers and operatively connecting said switch means to said microphone unit for governing operation thereof, said other section having an opening formed therethrough from said mounting chamber, a switch operating member extended through said opening in position to be operatively associated with said switch means as an incident to assembly of said sections, a flexible waterproof sheath covering at least the outer surfaces of said member and having border portions thereof secured to said sections about said opening in a waterproof relation, an end cap with a centrally perforated end wall and an imperforate border portion in said end wall about the central perforated portion, a resilient sealing washer within said end cap and securing said imperforate portion of said end cap, the edges of said opening about said end chamber and said microphone unit near the edge portions of the diaphragm thereof, and means securing said end cap on said end chamber to compress said sealing washer between the parts engaged thereby.

10. In a hand-held microphone device, an elongated casing having a waterproof mounting chamber formed therein and also having an end chamber adjacent one end of said mounting chamber and opening through the adjacent end of the casing, a microphone unit mounted in said end chamber and having a waterproof diaphragm, switch means mounted in said mounting chamber, means including wires extended in a waterproof relation between said chambers and operatively connecting said switch means to said microphone unit for governing operation thereof, said casing having an opening formed therefrom from said mounting chamber, a switch operating member extended through said opening in position to be operatively associated with said switch means, a flexible waterproof sheath covering at least the outer surfaces of said member and having border portions thereof secured to said sections about said opening in a waterproof relation, an end cap with a centrally perforated end wall and an imperforate border portion in said end wall about the central perforated portion, a sealing washer within said end cap and engaging said imperforate portion of said end cap, the edges of said opening about said end chamber and said microphone unit near the edge portions of the diaphragm thereof, and means securing said end cap on said end chamber to compress said sealing washer between the parts engaged thereby.

11. In a hand-held microphone device, an elongated sectional casing comprising a pair of elongated separable sections disposed with their parting faces in opposed relation and having matched cavi-
ties affording an elongated main chamber defined at one end by an end wall and at its other end by a relatively thick division wall, and also affording an end chamber adjacent to and defined on one surface by said division wall and opening through the adjacent end of said casing, means including a fastening element extended into said division wall and securing said sections together to prevent entry of water and water vapor into said main chamber along said parting faces of said sections, one of said sections having an integral extension formed thereon so as to extend longitudinally beyond said end wall, and the other of said sections terminating at said end wall so as to thereby leave the parting face of said one section exposed throughout the length of said extension, said extension having a recess formed therein and opening laterally through said parting face of said extension, said one of said sections having a passage therein connecting said recess and said main chamber, a terminal plate having terminals disposed on one face thereof and having conductors disposed on and extended from the other face thereof and connected in a waterproof relation to said terminals, means including an angle bracket securing said terminal plate in a waterproof relation to the open face of said recess with said conductors enclosed within said recess and with said terminals exposed, said bracket having an arm disposed normal to said parting face, a threaded nipple secured on said arm and disposed on the longitudinal axis of said casing, a cup shaped end cap surrounding and protecting said extension and said terminals, said casing having a continuous shoulder formed thereon and in opposed relation to the edge of said end cap, a compressible sealing washer disposed on said shoulder for engagement by said edge of said end cap, means including another sealing washer and a clamping nut surrounding said nipple and clamping said cup in position with said sealing washers in compressed and sealing relation, said nipple being counterbored to afford an inwardly tapering face in the exposed end thereof, a nut on said end of said nipple having an interwound flange, a bearing washer on said flange facing toward said end of said nipple, and a resilient sealing sleeve having an enlarged sealing head disposed between and having surfaces substantially complementary to said bearing washer and said tapering face for clamping and sealing a connector cord extended into said end cap through said sleeve, a microphone unit mounted in said end chamber and having a waterproof diaphragm, switch means mounted in said main chamber, means including other conductors extended in a waterproof relation between said chambers and also including said first mentioned conductors and operatively connecting said switch means to said terminals and said microphone unit for governing operation thereof, said casing having an opening formed therethrough from said main chamber, a switch operating member extended through said opening in position and operatively associated with said switch means, a flexible waterproof sheath covering at least the outer surfaces of said member and having border portions thereof secured to said other section about said opening in a waterproof relation, a second end cap with a centrally perforated end wall and an imperforate border portion in said end wall about the central perforation portion, another sealing washer within said second end cap and engaging said imperforate portion of said end cap, the end edges of said casing about said end chamber and said microphone unit near the edge portions of the diaphragm thereof, and means securing said second end cap on said casing to compress said last mentioned sealing washer between the parts engaged thereby.

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