United States Patent

Parkes

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[54] ELECTROMAGNETIC HORNS

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[58] **Field of Search**.....340/388, 391; 151/69

[56] **References Cited**

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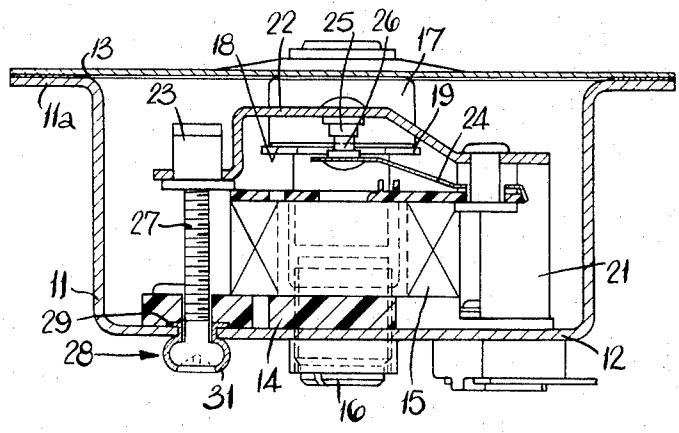
[57] **ABSTRACT**

An electromagnetic horn comprises a casing, a resilient diaphragm closing the casing, an electromagnet carried by the casing, an armature associated with the electromagnet and secured to the diaphragm and a movable contact within the casing. The movable contact is movable into or out of engagement with the fixed contact by the armature to control energisation of the electromagnet and a bolt extends through the casing and is connected to the fixed contact so that rotation of the bolt relative to the fixed contact adjusts the position of the fixed contact relative to the casing. The head of the bolt is accessible from the exterior of the casing and is engaged in a restraining member which is secured to the casing so as to be immovable relative to the casing in a direction parallel to the axis of the bolt. The restraining member holds the bolt against axial movement relative to the casing but permits angular movement of the bolt relative to the casing.

6 Claims, 2 Drawing Figures



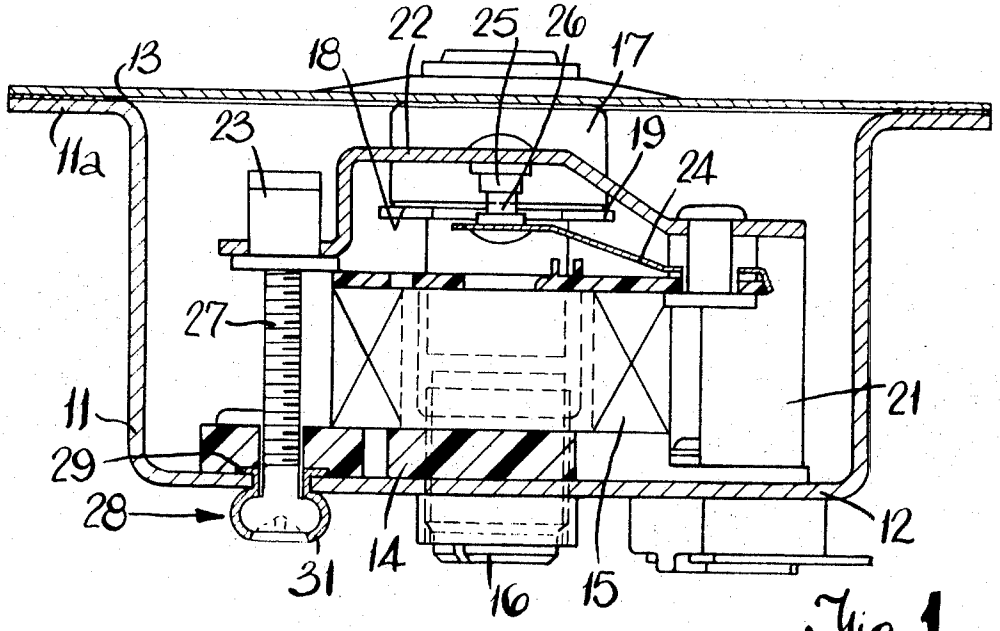


Fig. 1.

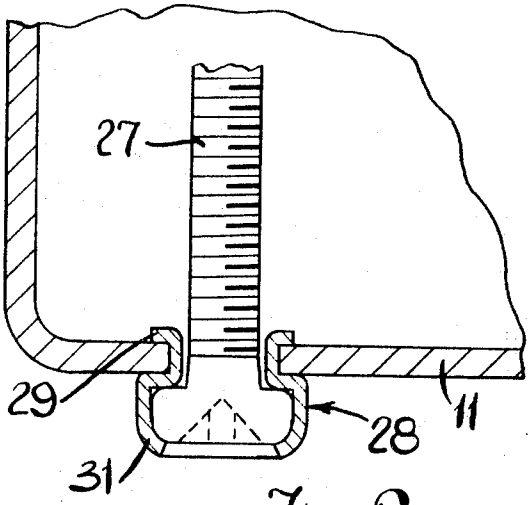


Fig. 2.

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ELECTROMAGNETIC HORNS

This invention relates to electromagnetic horns of the kind comprising a casing, a resilient diaphragm closing the casing, an electromagnet carried by the casing, an armature associated with said electromagnet and secured to said diaphragm, a fixed contact and a movable contact within the casing, the movable contact being movable into or out of engagement with the fixed contact by the armature so as to control energisation of the electromagnet, and a bolt extending through the casing so as to be accessible from the exterior of the casing, and said bolt being connected to said fixed contact so that rotation of said bolt relative to the fixed contact adjusts the position of the fixed contact relative to the casing, and thereby adjusts the maximum gap which can occur between the fixed contact and the movable contact during operation of the horn.

According to the invention in a horn of the kind specified the head of said bolt is accessible from the exterior of the casing and is engaged in a member which is secured to the casing so as to be immovable relative to the casing in a direction parallel to the axis of the bolt, said member holding said bolt against axial movement relative to the casing but permitting angular movement of the bolt relative to the casing.

The invention further resides in a method of manufacturing an electromagnetic horn including the steps of engaging a stepped sleeve like member with a horn casing, so that a first portion of the sleeve of smaller diameter extends through a hole in the wall of the casing, and a second portion of the sleeve of larger diameter extends from the exterior surface of the casing, a shoulder defined at the junction of said portions of the sleeve engaging the exterior surface of the casing, deforming said first portion of the sleeve into engagement with the inner surface of the casing to secure the sleeve to the casing against movement in direction parallel to the axis of the sleeve, securing a sub-assembly including a fixed contact and a movable contact within the casing, inserting a bolt through said sleeve so that the head of the bolt engages in said second portion of the sleeve, coupling the shank of said bolt to the fixed contact so that rotation of the bolt adjusts the position of the fixed contact relative to the casing, and deforming said second portion of the sleeve, so as to prevent axial movement of the bolt relative to the casing while leaving the head of the bolt accessible to an operating tool.

One example of the invention is illustrated in the accompanying drawings wherein:

FIG. 1 is a section view of an electromagnetic horn, and

FIG. 2 is an enlarged view of part of FIG. 1.

Referring to the drawings, the horn includes a cylindrical metal casing **11** which is closed at one end by an integral base **12**, and closed at its other end by a resilient diaphragm **13**. The diaphragm **13** is in sealing engagement with a peripheral flange **11***a* of the casing **11**. Secured to the inner surface of the base **12** is a hollow, cylindrical, synthetic resin former **14** having wound thereon the winding **15** of an electromagnet. Extending into the former **14** and in screw-threaded engagement with the walls of a plunged hole in the base **12** is a steel pole piece **16**, the pole piece **16** projecting from the exterior of the base **12**, and being slotted to receive a screw-driver, whereby the position of the pole piece, within the former, can be adjusted. Secured to the diaphragm **13**, and extending into the former **14** towards the pole piece **16** is a cylindrical steel armature **17** which is formed intermediate its ends with a peripheral shoulder **18** upon which a fibre washer **19** seats.

Extending upwardly from the base **12** towards the diaphragm **13** is a support member **21** which carries a metal bridge piece **22** at its upper end. The metal bridge piece **22** extends adjacent the armature **17**, generally parallel with the diaphragm **13**, and at its end remote from the support member **21** the bridge piece **22** carries a moulded synthetic resin nut **23**. Thrust between the bridge piece **22** and the former **14** is a conductive leaf spring **24**, the leaf spring **24** being insulated from the bridge piece **22** and being electrically connected to one end of the winding **15**. Secured to the bridge piece **22**, adjacent the free end of the leaf spring **24** is a fixed contact **25**, which is engageable by a movable contact **26** secured to the leaf spring **24**. The leaf spring **24** includes an integral tag (not shown) which is engageable by the fibre washer **19** on the armature **17**, and the leaf spring **24** is such that it urges the movable contact **26** into engagement with the fixed contact **25**. The fixed contact **25** is electrically connected through the bridging piece **22** and the support member **21** to a first terminal on the exterior of the casing, and the end of the winding **18**, remote from the leaf spring **24**, is electrically connected to a second terminal on the exterior of the casing.

Extending through an aperture in the base **12** of the casing **11** is a bolt **27**, the threaded shank of which is engaged with the nut **23**, and the head of which is engaged in a metal restraining member **28** on the exterior of the base **12**. The member **28** is in the form of a metal sleeve having an outwardly directed peripheral flange **29** which engages the inner surface of the base **12**, and a cup-like portion **31** which partially surrounds the head of the bolt **27** and which engages the outer surface of the base **12**. The portions **29**, **31** of the member **28** are inter-connected by an integral neck which extends through the aperture in the base **12**, and the member **28** holds the bolt **27** against axial movement relative to the casing **11** while permitting angular movement of the bolt **27** relative to the casing. The portion **31** of the member **28** does not totally enclose the head of the bolt **27**, but leaves the portion of the head which is engageable by a screwdriver clear.

In use, the two terminals on the exterior of the casing are electrically connected to respective poles of d.c. supply, and the contacts **25**, **26** are normally closed. Thus, current flows in the winding **15** thereby energising the electromagnet defined by the winding **15** and the pole **16**, whereupon the armature **17** is attracted towards the pole **16** and moves towards the pole **16** as permitted by deformation of the diaphragm **13**. As the armature **17** moves towards the pole **16** the fibre washer **19** engages said tongue of the leaf spring **24** and flexes the leaf spring **24** in a direction to move the contact **26** out of engagement with the contact **25**. As soon as the contacts **26**, **25** open, the circuit through the winding **15** is broken, and so the electromagnet is de-energised and the armature **17** moves in the opposite direction under the action of the inherent resilience of the diaphragm **13**, thereby permitting the contacts **25**, **26** to close again so that the cycle is repeated. Thus, as long as the d.c. supply is maintained across the external terminals the armature **17** will be caused to reciprocate back and forth, and the diaphragm **13** will be vibrated and will generate sound.

The horn is assembled in the following manner. The winding **15** is wound onto the former **14**, and the ends of the windings are secured to metal tags carried by the former. The nut **23** and the contact **25** are secured to the bridging member **22**, and the bridging member **22** and the support member **21** are riveted to the former **14**, with one end of the leaf spring **24** trapped between the former and the bridging member **22**. The contact **26** is at this stage already secured to the other end of the leaf spring **24**, and the leaf spring **24** is spaced from the bridging piece **22** by a synthetic resin washer so that the leaf spring **24** is insulated from the bridge piece **22**. The connection between said one end of the winding **15** and the leaf spring **24** is made by trapping said metal strip, which is secured to the one end of the winding, between the former and the leaf spring **24**, a single rivet being used to secure the bridge piece **22**, the synthetic resin washer, and the leaf spring **24** to the former. The stepped metal sleeve, which will subsequently define the member **28** is then engaged with the casing **11** by inserting the portion of smaller diameter through a previously formed aperture in the base **12**, so that the shoulder defined between the two portions of the sleeve engages the outer surface of the base **12**. The free end of the portion of smaller diameter is then deformed to define the flange **29** engaging the inner surface of the base **12**, thereby securing the sleeve to the base **12**.

The assembly including the support member **21**, the bridge piece **22** and the former **14** is then inserted into the casing,

and is riveted into position. One of the rivets securing the said assembly to the casing extends through part of the support member **21**, through part of the former **14**, through an insulating block engaged with the outer surface of the base **12**, and through a first terminal blade carried by the insulating block, the rivet serving to electrically interconnect the support member **21** and the first terminal blade. A second rivet securing the said assembly in the casing extends through the conductive strip which is electrically connected to said other end of the winding **15**, through a further part of the former **14**, through the base **12**, through said insulating block and through a second terminal blade carried by the insulating block, the rivet serving to electrically interconnect the conductive strip and the second terminal blade. Thus, when the contacts **25**, **26** are inter-engaged then the first and second terminal blades are electrically connected to the support member **21**, the bridge piece **22**, the contacts **25**, **26**, the conductive leaf spring **24**, and the winding **15**.

The diaphragm **13** carrying the armature **17** is then riveted to the flange **11***a* of the casing to close the casing, a sealing gasket being trapped between the diaphragm **13** and the flange **11***a*, and the pole piece **16** is screwed into a central, plunged hole in the base **12**, so that the pole piece **16** extends towards the armature **17** within the former **14**. The bolt **27** which is of the pan head type is then inserted through the sleeve, and the corresponding hole in the former **14** and the free end of the shank of the bolt **27** is engaged in the moulded synthetic resin nut **23**. The head of the bolt **27** engages in the portion of the sleeve of larger diameter, is then deformed to constitute the portion **31** trapping the head of the bolt **27**. The deformation of the portion of the sleeve of larger diameter is such that a cruciform groove in the head of the bolt **27** is left exposed so as to be accessible by a screwdriver.

The first and second terminals are then connected to respective poles of a d.c. supply, and the horn is energised. The pole piece **16** is then screwed in or out until the tone produced by the horn is approximately the desired tone. The movement of the pole is a relatively coarse adjustment of the tuning of the horn, and in order to finally tune the horn the bolt **27** is rotated. Since the bolt **27** is held by the member **28** against axial movement, the rotation of the bolt causes movement of the nut **23** in a direction parallel to the axis of the bolt **27**, and thereby flexes the bridge member **22** in a direction to move the fixed contact **25** towards or away from the movable contact **26**. The bolt **27** is rotated in this manner until the tone produced by the horn is that which is desired. It will be appreciated, that since the contact **26** is urged by the spring **24** into engagement with the contact **25** then unless the tongue of the spring **24** is engaged with the fibre washer **18** on the armature **17** then during movement of the contact **25** the contact **26** will remain in engagement with the contact **25** and will move with the contact **25**. However, the movement of the contact **25** adjusts the maximum gap which can occur between the contact **25**,**26** when the horn is operating, since the contact **25** is moved relative to the stable position of the armature **17**.

When the horn has been tuned to produce a desired tone the exterior of the horn is coated with paint and is then stoved. During the coating of the horn with paint the paint enters the member **28**, and so when the paint has been stoved, the bolt **27** is effectively locked to the member **28** by the layer of stoved paint. The nut **23** is split, and is such that it grips the shank of the bolt **27**, and thereby acts as its own lock nut to resist rotation of the bolt **27**, relative to the nut **23**, during operation of the horn due to the vibration of the horn. Moreover, the former **14** includes an internal annular collar through which the pole piece **16** extends, the collar of the former **14** gripping the pole piece **16** and acting as a lock nut to retain the pole **16** in the preset position.

In a modification the member **28** rotates with the bolt **27**, the former **14** gripping the flange **29** of the member **28** sufficiently tightly to prevent rotation of the bolt **27** and member **28** due to vibration during tuning of the horn, and the final painting of the horn locking the bolt **27** and the member **28** to one another and to the casing **11**.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An improved electromagnetic horn of the kind comprising a hollow casing, a resilient diaphragm closing the casing, an electromagnet carried by the casing, an armature associated with said electromagnet and secured to the diaphragm, a fixed contact and a movable contact within the casing, the movable contact being movable into and out of engagement with the fixed contact by the armature so as to control energisation of the electromagnet, and a bolt extending through the casing so as to be accessible from the exterior of the casing, said bolts being connected to said fixed contact so that rotation of the bolt relative to the fixed contact adjusts the position of the fixed contact relative to the casing and thereby adjusts the maximum gap which can occur between the fixed contact and the movable contact during operation of the horn, wherein the improvement comprises, the head of said bolt is accessible from the exterior of the casing and is engaged in a member which is secured to the casing so as to be immovable relative to the casing in a direction parallel to the axis of the bolt, said member holding said bolt against axial movement relative to the casing but permitting angular movement of the bolt relative to the casing.

2. A horn as claimed in claim **1** wherein the free end of the shank of said bolt is engaged in a nut carried by said fixed contact, said nut being split and being arranged to grip the shank of the bolt so that rotation of the bolt relative to the nut owing to vibration of the horn in use is prevented.

3. A horn as claimed in claim **1** wherein said member includes an integral, outwardly directed flange and an integral, substantially cup-shaped portion, said flange and said cup-shaped portion trapping the casing therebetween and the head of said bolt being engaged in said cup-shaped portion.

4. A horn as claimed in claim **1** wherein both said member and said bolt can move angularly relative to the casing, while turning the horn during manufacture thereof.

5. A method of manufacturing an electromagnetic horn including the steps of engaging a stepped sleeve like member with a horn casing, so that a first portion of the sleeve of smaller diameter extends through a hole in the wall of the casing, and a second portion of the sleeve of larger diameter extends from the exterior surface of the casing, a shoulder defined at the junction of said portions of the sleeve engaging the exterior surface of the casing, deforming said first portion of the sleeve into engagement with the inner surface of the casing to secure the sleeve to the casing against movement in direction parallel to the axis of the sleeve, securing a sub-assembly including a fixed contact and a movable contact within the casing, inserting a bolt through said sleeve so that the head of the bolt engages in said second portion of the sleeve, coupling the shank of said bolt to the fixed contact so that rotation of the bolt adjusts the position of the fixed contact relative to the casing, and deforming said second portion of the sleeve, so as to prevent axial movement of the bolt relative to the casing while leaving the head of the bolt accessible to an operating tool.

6. A method as claimed in claim **5** including the further steps of tuning the assembled horn to produce the required tone, coating the exterior of the casing of the horn with paint, the arrangement being such that paint is provided between the second portion of the sleeve and the head of said bolt, and stoving the paint to produce the required finish and to lock the bolt in position in said sleeve.

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