This invention relates to electromagnetic diaphragm horns which are commonly used on motor vehicles.

One of the objects of this invention is to provide an electromagnetic horn that is more compact and which uses fewer parts than those herebefore known without the sacrifice of decibel rating.

Another object of this invention is to provide an electromagnetic horn wherein less movement of the diaphragm is required in order to cause an opening of the horn contacts. This object is carried forward by locating the fulcrum, contacts, and point of force application of the armature in such a relationship that the force applied to separate the contacts is applied at a point located between the contacts and the fulcrum for the contacts. With this arrangement, only a relatively small movement of the diaphragm will compensate for contact wear of the horn.

A further object of this invention is to provide an electromagnetic horn wherein rivets are used to secure the projector assembly to the power plant assembly. With this arrangement, the two-part projector assembly is riveted together with the same rivets that secure the power plant to the projector assembly.

Still another object of this invention is to provide an electromagnetic horn wherein the pole piece of the horn is formed with radially extending ribs that provide a light press fit with a portion of the back shell of the horn. By the use of these ribs, it is possible to correctly position the pole piece with respect to the back shell of the horn. By the use of these ribs, it is possible to correctly position the pole piece with respect to the back shell of the horn without using a large force application to perform this positioning. The pole piece thus may be accurately positioned within the back shell of the horn by relatively light force application. After the pole piece is positioned in its correct position within the back shell assembly, the back shell assembly is rolled to fix the pole piece permanently with respect to the back shell.

A further object of this invention is to provide an electromagnetic horn wherein a sliding type of movement is obtained between the armature and the contact arm that carries the movable contact of the horn.

Still another object of this invention is to provide an improved coil winding assembly for an electromagnetic horn wherein the lead ends of the coil winding are fixed with respect to the spool of the coil winding assembly and are wrapped around ribs formed integral with the coil winding assembly that receives rivets or other fastener means. In this arrangement, the assembly of the coil winding assembly to the back shell of the electromagnetic horn and the electrical connections for the coil winding assembly are easily and readily made. Moreover, with the use of the coil winding assembly of this invention, it is possible to eliminate the need for terminals that are ordinarily connected to the end of the lead wires of the coil winding. With the arrangement of this invention, the bared end of the lead wires form the electrical connections for parts of the horn assembly.

A further object of this invention is to provide an electromagnetic horn wherein at least a portion of the projector assembly is formed of a plastic molding material such as hard rubber.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings where-in preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is an end view of an electromagnetic horn made in accordance with this invention.

FIGURE 2 is a view partly in section taken along line 2—2 of FIGURE 1.

FIGURE 3 is an end view of the back shell assembly of an electromagnetic horn made in accordance with this invention and taken along line 3—3 of FIGURE 2.

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 3.

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 3.

FIGURE 6 is an end view of the coil winding assembly that forms a component part of the electromagnetic horn made in accordance with this invention.

FIGURE 7 is a side view of the coil winding assembly shown in FIGURE 6.

FIGURE 8 is a sectional view of a modified electromagnetic horn made in accordance with this invention and taken along line 8—8 of FIGURE 10.

FIGURE 9 is a sectional view taken along line 9—9 of FIGURE 10.

FIGURE 10 is a plan view shown partly in phantom of a modified electromagnetic horn made in accordance with this invention.

Referring now to the drawings and more particularly to FIGURES 2 through 5, the electromagnetic horn of this invention has a power plant or back shell assembly which is generally designated by reference numeral 10. The back shell assembly 10 includes a metal back shell 12 which has sections 14, 16 and 18 of progressively smaller diameter. The back shell 12 has an annular flange 20 which is formed with strengthening ribs 22. The section 16 could have a tapered or conical shape to contribute to the strength of the back shell assembly.

The intermediate diameter portion 16 of the back shell 12 receives a coil winding assembly which is generally designated by reference numeral 24 and which is shown in detail in FIGURES 6 and 7. The coil winding assembly 24 includes a spool 26 which is formed of a moldable plastic material such as nylon. The spool 26 has an inner cylindrical section 28 and a pair of end walls 30 and 32. The spool 26 has an integrally formed flange section 34 which is spaced from the top side of end section 30 to provide a wire receiving slot 36. A slot 38 extends to the cylindrical wall 28 of the spool member and is positioned substantially midway the length of the slot 36. The end wall 30 has annular ribs 40 and 42 which partially surround the cylindrical ribs 44 and 46. The ribs or projections 44 and 46 encircle openings 48 and 50.

In addition to the projections just described, the end wall has integral axially extending projections 52 and 54 and projections 56 and 58. The purpose of the ribs 52, 54, 56 and 58 is more fully described hereinafter.

The coil winding for the coil winding assembly 24 is generally designated by reference numeral 60. This coil winding assembly includes a plurality of turns of insulated wire which are wound on the central cylindrical portion 28 of the spool 26. One end 63 of the wire that forms the coil winding assembly is positioned between the cylindrical ribs 48 and the annular rib 42 and has an arcuate configuration. The wire 62, which forms a continuation of wire 63, is positioned in the slot 36 and passes through the slot 38 formed in the top section 30 of the spool. The wire 62 forms an inner turn of the coil winding 60 as is clearly apparent from an inspection of FIGURE 6. The other end 64 has an end portion 66 positioned between the cylindrical rib 44 and the arcuately extending rib 40. The lead wire
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64 is positioned in the space 36 provided by the flap 34 and the top section 30 of the spool and forms an outer turn for the coil winding 60. After the coil winding is wound on the spool and the ends of the wires of the coil winding have been positioned as shown in FIGURE 6, the flap 34 is joined to end wall 30 at points 67 and 69 by a heat sealing process. The entire coil winding assembly is now ready for its final assembly into the electromagnetic horn. The wire that makes up the coil winding assembly 60 is of a type having a thin coating of insulation and this insulation must be bare at portions 63 and 66 to make electrical contact with other parts of the horn in a manner to be more fully described hereinafter.

The intermediate diameter section 16 of the metal back shell 12 receives a portion of the coil winding assembly 24. FIGURES 4 and 5 show that the coil winding 60 is positioned within the tubular section 16 with the underside of the wall 30 engaging the wall 15 of the back shell assembly 12. The coil winding assembly 24 is fixed with respect to the back shell 12 by means of metal rivets 70 and 72 and by a metal retaining plate designated in its entirety by reference numeral 74 which engages projections 52 and 54 of the coil winding assembly. The metal retaining plate 74 is formed of magnetic material and has a central opening 76 as is seen from FIGURE 3. The plate 74 is riveted to the back shell 12 by rivets 78.

The metal rivet 70 is positioned in opening 48 of the spool and has a head 79 which engages the wire section 66 of the coil winding 60. The opposite end of the metal rivet 70 is riveted over and engages a metal male terminal 77. An insulating washer 80 insulates the male terminal 77 from the metal back shell 12. From the foregoing, it can be seen that the rivet 70 performs several functions. It helps in securing the coil winding assembly 24 to the back shell 12, it secures the male terminal 77 in place and it forms an electrical connection between the male terminal 77 and the bared end 66 of the coil winding.

The metal rivet 72 passes through the opening 50 in the spool 26 and passes through an opening formed in the metal back shell 12. The rivet 72 has a head portion 84. It is seen from FIGURE 4 that the rivet 72 passes through openings in several components which form the contact assembly for the electromagnetic horn. These components include a support member 86 which is formed of a metal material such as steel and which carries an electrical contact 88. An insulator member 90 is positioned between the support member 86 and a steel contact arm 92. The contact arm 92 carries the electrical contact 94 which engages the contact 88 carried by the arm 86. The bared end 63 of the coil winding 60 which is positioned between ribs 42 and 46 of the spool 26 directly engages the portion of the contact arm 92 which is located adjacent the rivet 72. The rib 46 serves to insulate the contact arm 92 from the rivet 72 and the insulator 90 serves to insulate the arms 86 and 92 from each other. One end of the support member 86 has an opening which receives the end of an adjusting screw 96 that is threaded into an opening formed in the metal back shell 12. The adjusting screw 96 is operable to adjust the position of the contact 88 with respect to point 94.

It is seen from FIGURES 4 and 5 that the contact arm 92 has a curved section 98 one end of which projects laterally beyond the arm 86 as is apparent from an inspection of FIGURE 5. This projecting end is at a right angle to the main body portion of contact arm 92. This laterally extending section is covered by the portion 100 of insulator member 90 and this portion 100 is engaged by the annular wall 102 of a reciprocal armature 104. The armature 104 is formed of magnetic material and has a cylindrical section 106 which passes through the opening 76 formed in the insulator member 75.
shell assembly 10 by means of a plurality of rivets 140 which pass through matching openings formed in the collar member 125, diaphragm 134, metal back shell 12 and cap member 122. These rivets thus serve to hold the parts of the projector assembly together and also serve to hold the projector, diaphragm assembly and back shell assembly together. An annular gasket 142 is interposed between the outer periphery of the metal diaphragm 134 and the flanged portion 20 of the metal back shell 12. The gasket 142 has openings which match with the openings formed in the annular flange 20 and in the collar member 125 and cap member 122. Some of these rivets may bypass at least a portion of the metal diaphragm but a majority of them pass through notches cut in the outer periphery of the metal diaphragm.

In using the electromagnetic horn of this invention on a motor vehicle, the bracket member 114 is secured to a metal part of the motor vehicle so that the bracket 114 and the metal back shell 12 are at ground potential in a motor vehicle electrical system. The male terminal 77 is periodically connected with some battery monitor that is other than ground, for example, through the contacts 94 of a horn relay. When a circuit is completed to the male terminal 77 from the side of the battery that is not grounded, current will flow through the male terminal 77, through the metal rivet 70, through the barec wire end 66, then through the coil winding 60 through the barec end 63 of the coil winding to the metal contact arm 92, through closed metal contacts 94 and 88 to the support arm 86, and then through the metal rivet 72 to the metal back shell 12 which is at ground potential. The rivet 72 is insulated from the barec end 63 of the coil winding 60 by the cylindrical rib 46 and that this rib 46 also insulates the rivet 72 from the contact arm 92. When the coil winding 60 energizes, a magnetic flux is generated which will cause the armature 104 to move toward the pole piece 108. As the armature 104 moves toward the pole piece, the wall 102 of the armature 104 engages the portion 100 of the insulator 90 overcoming the spherical or arcuate portion 98 of the contact arm 92 and therefore causes the contact 94 to separate from the contact 88. The point of force application on the contact arm 92 is between the contacts 94 and 88 and the rivet 72. This means that the point of force application to the contact arm 92 is between the fulcrum for the contact arm and the contacts. This arrangement is a considerable improvement as compared to the arrangement where the point of force application is located at a point beyond the contacts as in heretofore known contact actuating arrangements for horns. The advantage of the arrangement of the present invention resides in the fact that less movement of the diaphragm is required to separate the contacts as compared to heretofore known contact actuating arrangements for horns.

When the contacts 94 and 88 separate, the coil winding 60 is of course deenergized and the armature 104 is moved by the resilient bias of the metal diaphragm 134 away from the pole piece 108. During this movement, the contacts 94 and 88 will once more become engaged to cause the armature 104 to again move toward the pole piece with a consequent separation of the contacts 94 and 88. This reciprocation of the armature 104 continues as long as the terminal 77 is connected to one side of the battery and the reciprocation of the armature 104 and diaphragm 134 causes a sound wave to be generated in the sound passage or air column of the projector assembly.

FIGURES 8 through 10, show a modified electromagnetic horn made in accordance with this invention is illustrated. FIGURES 8 through 10 depicts a modification of the contact arrangement as compared to the embodiment of the horn shown in FIGURES 4 and 5. In FIGURE 8, the projector assembly is designated in its entirety by reference numeral 150, it being understood that this projector assembly is the same as the projector assembly illustrated in FIGURES 1 and 2. The back shell assembly in FIGURE 8 is generally designated by reference numeral 152 and includes the metal back shell 154 which supports the modified switch contact apparatus for the horn.

In the modification of FIGURES 8 through 10, a rivet 156 which is identical with rivet 72 of FIGURE 4 secures the coil winding assembly 158 to the metal back shell 154. The rivet 156 passes through openings formed respectively in a contact arm 160, an insulating washer 162, an opening in contact arm 164 and through an opening formed in the spool member 166 of the coil winding assembly 158.

The contact arm 160 carries an electrical contact 168 while the contact arm 164 carries an electrical contact 170. These two contacts correspond to the contacts 88 and 94 illustrated in FIGURE 4. The contact arm 164 has a projecting portion 172 which is generally spherical or arcuately shaped and which projects beyond one edge of the contact arm 160 as is clearly apparent from an inspection of FIGURES 9 and 10. The projecting portion 172 of contact arm 164 is engaged by an annular insulator member 174 which surrounds the smaller diameter portion 176 of the armature 178. This annular member engages a wall of the armature 178 which is the same as wall 102 illustrated in FIGURE 5. The distance between the point of engagement of washer 174 with the portion 172 of contact arm 164 and the rivet 156 is substantially equal to the distance between this rivet and the contacts 168 and 170. In other words, the distance between the fulcrum for the contacts and the contacts as compared with the distance between the fulcrum and the point of force application to one of the contact arms is substantially 1 to 1 ratio. This arrangement like the embodiment of FIGURES 1 through 7 is an improvement as compared to horns wherein the force is applied to one of the contact arms at a point beyond the contacts. The armature 178 is, of course, secured to the diaphragm 180 of the horn in the same manner as is illustrated in FIGURES 4 and 5.

The remainder of the horn illustrated in FIGURES 8 through 10 is identical with the horn illustrated in FIGURES 4 and 5 and it can be seen that the major difference between the embodiment of FIGURES 8 through 10 and that shown in FIGURES 4 and 5 is the arrangement for insulating the contacts 164 from each other and from the armature of the horn. In the arrangement of FIGURES 4 and 5, the insulator 90 performs the function of insulating the contact arms 86 and 92 from each other and also insulates the contact arm 92 from the armature. In the embodiment of FIGURES 8 through 10, a similar insulator 162 is used to insulate the contact arms 160 and 164 from each other but the annular insulating disk 174 serves to insulate the armature 178 from the contact arm 164. In each case, there is a sliding contact achieved between a surface that moves with the armature and a curved part of one of the contact arms.

In the embodiment of FIGURES 8 through 10, the supporting bracket is designated by reference numeral 181 and the male terminal by reference numeral 182. The male terminal 182 is held in place by a rivet 184 which performs the same function as the rivet 70 illustrated in FIGURE 5. The contact arm 160 can be adjusted by an adjusting screw 186 which is threaded into the back shell 154 of the electromagnetic horn. The retaining plate in the embodiment of FIGURES 8 through 10 is designated by reference numeral 187 and performs the same function as the plate 74 illustrated in the embodiment of FIGURE 3.

From the foregoing, it can be seen that a compact electromagnetic horn has been provided which is simple to assemble and which uses less parts than those heretofore known. This has been accomplished without the sacrifice of decibel rating for the horn.

While the embodiments of the present invention as
What is claimed is as follows:

1. An electromagnetic horn comprising, a sound projector, a diaphragm cooperating with said sound projector, a metal housing supporting said sound projector and diaphragm, an electromagnet including a coil wound on an armature, said armature reciprocating said diaphragm, switch contacts for controlling the energization of said coil winding operated by said armature, and a unitary coil winding assembly having a spool supporting said coil winding, said coil winding assembly including insulating portion means integral with the coil to support at least one of said switch contacts and position said coil winding assembly on said metal housing and insulated from said metal housing.

2. An electromagnetic horn comprising, a back shell having first and second tubular sections, a spool disposed within said first tubular section supported by said back shell, a coil winding wound on said spool, a diaphragm, a sound projector, said diaphragm being disposed between said sound projector and said back shell and secured thereto, a core armature secured to said diaphragm having a portion extending within said coil winding and a larger diameter portion extending within said second tubular section, a wall forming a part of said back shell joining said tubular sections, first and second contact arms secured at one end to said wall, said contact arms offset laterally from an axis of said core armature which passes substantially through the center of said tubular sections, one of said contact arms extending coextensively with the other contact arm and having an integral lateral projection which extend beyond one side edge of the other contact arm toward said armature, cooperating electrical contacts carried by said contact arms, said electrical contacts being electrically connected with said coil winding whereby said contacts control the energization of said coil winding, said integral lateral projection of said one contact arm being aligned with at least a portion of said larger diameter portion of said armature whereby said armature moves said integral lateral projection to periodically separate said electrical contacts as said armature reciprocates, said integral lateral projection being located between the point of attachment of said contact arms to said wall and said electrical contacts.

3. An electromagnetic horn comprising, a back shell, a spool supported by said back shell carrying a coil winding, a diaphragm, a sound projector, means securing said sound projector, said back shell and said diaphragm together, a core armature connected with said diaphragm having a portion located to be attracted by said coil winding and having a larger diameter portion, first and second contact arms extending at least partially coextensively supported at one end thereof on said back shell, said contact arms offset laterally from an axis of said core armature which passes substantially through the center of said back shell, said contacts arms carrying engageable electrical contacts, means connecting at least one of said electrical contacts with said coil winding whereby said contacts control the energization of said coil winding, one of said contact arms having an integral lateral projection which extends beyond the side edge of the other contact arm toward said armature and which is located in alignment with a portion of said larger diameter portion of said armature, said larger diameter portion of said armature and said laterally extending projection cooperating to periodically separate said contacts as said armature reciprocates, and adjusting means supported by said back shell engageable with the end of said contact arms opposite from its connection to said back shell to adjust said contacts.

4. An electromagnetic horn comprising, a back shell having first and second tubular sections joined by an annular wall, said second tubular section having a larger diameter than said first tubular section, a spool formed of insulating material positioned within said first tubular section, a coil winding on said spool, a diaphragm, a sound projector, said diaphragm and sound projector being secured to said back shell, a reciprocable core armature secured to said diaphragm, said armature having a section located at least partially within said spool and having a larger diameter section located within said second tubular section, and first and second contact arms extending at least partially coextensively and secured at one end thereof to said back shell, said contact arms offset laterally from an axis of said core armature which passes substantially through the center of said tubular sections, said contact arms having cooperating switch contacts at least one of which is electrically connected with said coil winding for controlling the energization of said coil winding, one of said contact arms having an integral laterally projecting part extending generally radially towards said armature, said laterally projecting portion extending beyond the side edge of the other contact arm and located in alignment with said larger diameter portion of said armature, said larger diameter portion of said armature and said laterally projecting portion cooperating to separate said contacts as said armature reciprocates.

5. An electromagnetic horn comprising, a back shell, a spool carrying within said second tubular section a wall forming a part of said back shell joining said tubular sections, first and second contact arms secured at one end to said wall, said contact arms offset laterally from an axis of said core armature which passes substantially through the center of said back shell, said first contact arm extending substantially coextensively with said second contact arm throughout its entire length, and electrical contacts carried by said contact arms electrically connected with said coil winding for opening and closing the circuit to said coil winding as said armature and diaphragm reciprocate, said second contact arm having an integral projection which extends radially toward said armature and beyond a side edge of said first contact arm, said integral projection being located in alignment with a portion of said armature to be engaged by said portion for periodic operation by said armature to separate said contacts.

6. An electromagnetic horn comprising, a housing having a tubular section, a unitary insulator including a spool portion and a flange section, a coil winding wound on said spool section, said insulator being positioned such that at least a portion of said coil winding is received within said tubular section, electrical switch contacts for controlling the energization of said coil windings, one of said electrical switch contacts being supported by a contact arm, said contact arm directly engaging one lead end of said coil winding, a fastener for holding said lead end of said coil winding in direct engagement with said contact arm, said fastener securing said contact arm and said insulator to said housing, said flange section of said insulator including means for insulating said fastener from said contact arm and insulating said contact arm from said housing, an armature located in a magnetic circuit with said coil winding, a diaphragm, means securing said armature to said diaphragm, a core armature securing said sound projector and diaphragm to said housing, said armature being positioned to operate said switch contacts during its reciprocation.

7. An electromagnetic horn comprising, a metal housing, a unitary insulator having a spool section and a flange section extending substantially normal to the longitudinal axis of said spool section, a coil winding on said spool section having an end lead supported by said flange section, a terminal adapted to be connected with an external conductor having an opening, an opening formed in said housing located in alignment with said opening in
said terminal and in alignment with an opening formed in said flange section of said insulator, a fastener passing through said openings securing said terminal to said housing and securing said insulator to said housing, said flange section of said insulator insulating said fastener from said housing, said fastener directly engaging said end lead of said coil winding to directly electrically connect said terminal and one side of said coil winding, insulating means for insulating said terminal from said housing, switch contacts connected with said coil winding, an armature located in a magnetic circuit with said coil winding, a diaphragm secured to said armature, a sound projector, and means securing said diaphragm and sound projector to said housing, said armature including means for operating said switch contacts as it reciprocates.

8. An electromagnetic horn comprising, a housing member formed of metal material, a unitary insulator having a spool section and a flange section extending radially of said spool section, a coil winding wound on said spool section having an end lead wire supported by said flange section, electrical switch contacts for controlling the energization of said coil winding including at least one contact arm, an opening formed in said housing, an opening formed in said contact arm, an opening formed in said flange section of said unitary insulator, a fastener located in said openings formed respectively in said housing, flange section and contact arm for fixing said contact arm and insulator to said housing, said end lead wire being held in direct engagement with said contact arm by said fastener, said flange section of said insulator having integral means for insulating said contact arm from said fastener, an armature, said armature being located in a magnetic circuit with said coil winding, and a diaphragm, said armature being secured to said diaphragm, a sound projector, said sound projector and diaphragm being secured to said housing member, said armature operating to reciprocate said diaphragm and operate said electrical switch contacts during energization of said coil winding.

9. An electromagnetic horn comprising, a metal housing, a unitary insulator including a spool section and a flange section, said flange section extending generally radially of said spool section, a coil winding wound on said spool section having first and second end lead wires supported by said flange section of said insulator, an electrically conductive fastener passing through an opening formed in said housing and an opening in said flange section and having means directly engaging said first end lead wire of said coil winding, switch means for controlling the energization of said coil winding including a contact arm which directly engages said second end lead wire of said coil winding, said contact arm being supported from said flange section of said insulator, an armature located in a magnetic circuit with said coil winding, a diaphragm, said diaphragm being connected to said armature whereby said armature reciprocates said diaphragm, and means securing said diaphragm and sound projector to said metal housing, said armature during its reciprocation operating said switch contacts to open and close a circuit to said coil winding, said electrically conductive fastener being adapted to be connected with a source of voltage.

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