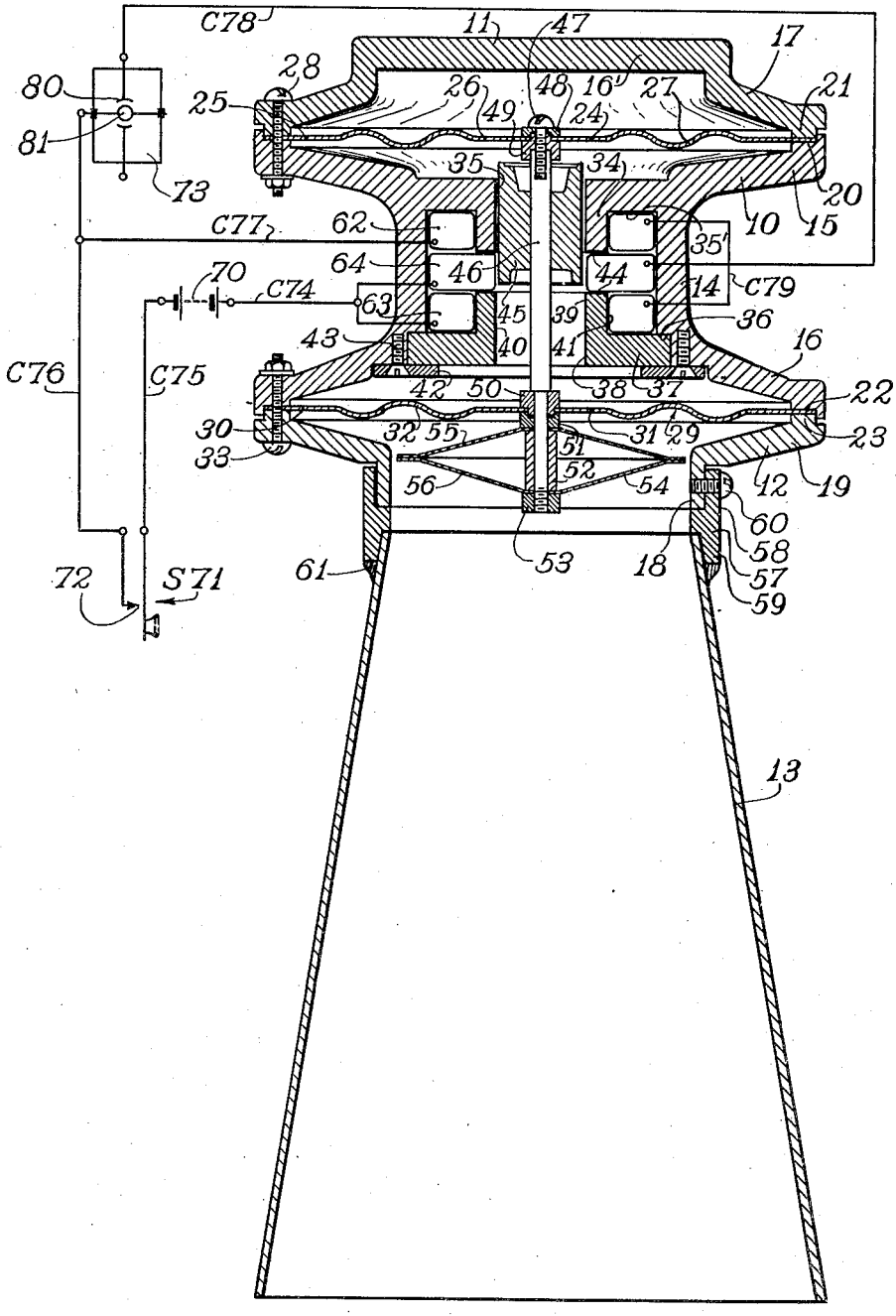
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SOUND PRODUCER

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INVENTOR
Irvin W. Cox
BY
Davis, Lindsey, Smith & Shontz
ATTORNEYS

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SOUND PRODUCER

Irvin W. Cox, Milwaukee, Wis., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

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The present invention relates to sound producers and more particularly to horns of the magnetic vibratory type.

A sound producer of the magnetic vibratory type is ordinarily of relatively complicated construction due, primarily, to the fact that it comprises a vibratory armature provided with a resilient mounting arrangement and a separate and distinct sound producing diaphragm operatively connected thereto.

Accordingly, it is an object of the present invention to provide a sound producer of the magnetic vibratory type which includes an improved and unitary diaphragm arrangement which is utilized not only to produce sound but also to support resiliently the associated vibratory armature.

Another object of the invention is to provide an improved sound producer of the magnetic vibratory type which is of extremely simple and rugged construction, which is compact and economical to manufacture and which is efficient in operation.

A further object of the invention is to provide a sound producer of the magnetic vibratory type which includes an improved electro-magnetic operating circuit arrangement.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and operations thereof, will best be understood with reference to the following specification taken in connection with the accompanying drawing in which the single figure is a longitudinal sectional view of a sound producer or horn and a diagrammatic illustration of an operating circuit therefor embodying the present invention.

Referring now more particularly to the drawing, there is illustrated a sound producer or horn embodying the features of the present invention and comprising a magnetic central casing element 10, two end casing elements 11 and 12 and a megaphone or trumpet 13. The central casing element 10 comprises a cylindrical body portion 14 and two outwardly extending annular flanges 15 and 16. The end casing element 11 comprises a substantially flat end wall 16' and an outwardly extending annular flange 17; while the end casing element 12 comprises a centrally disposed tubular portion 18 and an outwardly extending annular flange 19.

The annular flange 15 carried by the center casing element 10 is provided with an annular recess 20 adapted to receive an annular shoulder 21 provided on the annular flange 17 carried by the end casing element 11; similarly the annular flange 16 carried by the central casing element 10 is provided with an annular recess 22 adapted to receive an annular shoulder 23 provided on the annular flange 19 carried by the end casing element 12.

Further, the horn comprises a resilient disk-shaped diaphragm 24 provided with flat peripheral and center portions 25 and 26 respectively, connected together by an intermediate corrugated portion 27, the peripheral portion 25 of the diaphragm 24 being arranged in the annular recess 20 provided in the annular flange 15 carried by the central casing element 10 and clamped in place by the annular shoulder 21 provided on the annular flange 17 carried by the end casing element 11, the annular flanges 15 and 17 respectively carried by the central casing element 10 and the end casing element 11 being retained in assembled relationship by a plurality of bolts 28 carrying nuts on the outer threaded ends thereof.

Also, the horn comprises a resilient disk-shaped diaphragm 29 provided with flat peripheral and center portions 30 and 31 respectively, connected together by an intermediate corrugated portion 32, the peripheral portion 30 of the diaphragm 29 being arranged in the annular recess 22 provided in the annular flange 16 carried by the central casing element 10 and clamped in place by the annular shoulder 23 provided on the annular flange 19 carried by the end casing element 12, the annular flanges 16 and 19 respectively carried by the central casing element 10 and the end casing element 12 being retained in assembled relationship by a plurality of bolts 33 carrying nuts on the outer threaded ends thereof.

Further, the central casing element 10 comprises an inwardly disposed cylindrical wall 34 having a cylindrical bore 35 therein, the cylindrical wall 34 being arranged in spaced relationship with respect to the cylindrical body portion 14 in order to provide an annular cavity 35' therebetween. Also, an annular recess 36 is provided in the cylindrical body portion 14 of the central casing element 10 which is adapted to receive an annular flange 37 carried by a magnetic collar 38. Further, the collar 38 is provided with an inwardly disposed cylindrical wall 39 having a cylindrical bore 40 therein and arranged in spaced relationship with the cylindrical body portion 14 in order to provide an

annular cavity 41 therebetween. The annular flange 37 carried by the collar 38 is retained in place in the annular recess 36 provided in the cylindrical body portion 14 of the central casing element 10 by an arrangement comprising an annular ring 42 and a number of screws 43 extending through openings provided in the ring 42 and threaded into tapped holes provided in the cylindrical body portion 14 of the central casing element 10. It is noted that the cylindrical bores 35 and 40 respectively provided in the cylindrical walls 34 and 39 are arranged in alignment with respect to each other along the longitudinal center line of the horn. Also, it is noted that the cylindrical walls 34 and 39 extend inwardly toward each other but are arranged in spaced-apart relationship to provide an annular gap 44 therebetween.

A reciprocating magnetic armature 45 is arranged within the aligned bores 35 and 40 respectively provided in the cylindrical walls 34 and 39, which is rigidly carried by a shaft 46 supported at the opposite ends thereof by the diaphragms 24 and 29. More particularly, the rear end of the shaft 46 is secured to the central portion 26 of the diaphragm 24 by an arrangement comprising a screw 47 extending through an opening provided in the central portion 26 of the diaphragm 24 and threaded into a tapped hole provided in shaft 46 and two clamping washers 48 and 49 disposed on opposite sides of the central portion 26 of the diaphragm 24. The front end of the shaft 46 is of reduced cross-sectional area and projects through an opening provided in the central portion 31 of the diaphragm 29 and is retained in place by an arrangement comprising two clamping washers 50 and 51 disposed on opposite sides of the central portion 31 of the diaphragm 29, a spacing collar 52, and a nut 53 threaded on the outer end of the shaft 46. Also, it is noted that the outer end of the shaft 46 supports a piston 54 comprising complementary substantially dish-shaped piston elements 55 and 56. The peripheral portions of the piston elements 55 and 56 are welded together while the central portions of the piston elements 55 and 56 surround the outer end of the shaft 46, the central portion of the piston element 55 being arranged between the clamping washer 51 and the spacing collar 52, and the central portion of the piston element 56 being arranged between the spacing collar 52 of the nut 53. In other words, the arrangement comprising the clamping washers 50 and 51, the spacing collar 52 and the nut 53 not only securely fastens the outer end of the shaft 46 to the central portion 31 of the diaphragm 29, but this arrangement also securely retains the piston elements 55 and 56 in spaced-apart and assembled relationship upon the outer end of the shaft 46.

Further, the horn comprises an annular substantially T-shaped ring 57 provided with oppositely disposed annular flanges 58 and 59, the annular flange 58 surrounding the tubular portion 18 of the end casing element 12 and being secured thereto by an arrangement comprising a plurality of screws 60 extending through openings provided in the annular flange 58 and threaded into tapped holes provided in tubular portion 18 of the end casing element 12. Finally, the annular flange 59 carried by the ring 57 surrounds the inner end of the megaphone 13 and is welded thereto as indicated at 61.

The horn is provided with two annular field windings 62 and 63 and an annular operating winding 64, the field winding 62 being disposed in the annular cavity 35' formed between the cylindrical wall 34 and the cylindrical body portion 14 of the central casing element 10, and the field winding 63 being disposed in the annular cavity 41 formed between the cylindrical wall 39 and the cylindrical body portion 14 of the central casing element 10. In other words, the field windings 62 and 63 are arranged in spaced-apart relationship; while the operating winding 64 is arranged between the field windings 62 and 63 and extends into the annular gap 44 formed between the cylindrical walls 34 and 39. In other words, the operating winding 64 is positioned between the cylindrical body portion 14 of the central casing element 10 and the armature 45.

The arrangement for resiliently mounting the armature 45 comprising the operating shaft 46 and the diaphragms 24 and 29 is so constructed that the resiliency of the diaphragms 24 and 29 normally bias the armature 45 toward the end casing element 11 into a normal position while permitting movement of the armature 45 out of contact with the cylindrical wall 34 and 39 and the operating winding 64 toward the end casing element 12 against the bias of the resilient diaphragms 24 and 29 into an operated position.

The field windings 62 and 63 are connected in series cumulative relationship in such a manner that when these windings are energized a cumulative flux is produced in the armature 45, the central casing element 10 and the collar 38, which causes the armature 45 to be moved from its normal position in proximity to the end casing element 11 to its operated position in substantially equal proximities to the respective end casing elements 11 and 12 against the bias of the resilient diaphragms 24 and 29. The flux produced by the field windings 62 and 63 traverses a magnetic path extending from the cylindrical body portion 14 of the central casing element 10 by way of the annular flange 37 and the cylindrical wall 39 of the collar 38, the armature 45 and the cylindrical wall 34 to the cylindrical body portion 14 of the central casing element 10. When the operating winding 64 is energized, it produces a magnetic flux which neutralizes the magnetic flux produced by the field windings 62 and 63, thereby to cause the armature 45 to be returned to its normal position from its operated position due to the resiliency of the diaphragms 24 and 29. Accordingly, when the field windings 62 and 63 and the operating winding 64 are energized or deenergized, the armature 45 occupies its normal position. On the other hand, when the field windings 62 and 63 are energized and the operating winding 64 is deenergized, the armature 45 occupies its operated position. Hence, the armature 45 may be reciprocated between its normal position and its operated position by causing the field windings 62 and 63 to be steadily energized and the operating winding 64 to be intermittently energized.

The reciprocation of the armature 45 causes the diaphragm 29 to vibrate between the annular flanges 16 and 19 respectively carried by the central casing element 10 and the end casing element 12 and the piston 54 to reciprocate within the tubular portion 18 of the end casing element 12. The vibratory movement of the diaphragm 29 and the reciprocatory movement of the piston 54 sets the column of air in the megaphone 13 into vibration, thereby causing the horn to produce a predetermined note as determined by the

dimensions of the tubular portion 18 of the end casing element 12 and the megaphone 13. Further, it is noted that the movement of the piston 54, with respect to the tubular portion 18 of the end casing element 12, compensates for the variation of the volume of the tubular portion 18 of the end casing element 12 and the megaphone 13 incident to the vibratory movement of the diaphragm 29 and the reciprocatory movement of the piston 54, in order to cause the horn to produce a clear note of a substantially constant pitch. The armature 45 of the horn has a natural frequency of reciprocation as determined by the mass of the armature 45, the operating shaft 46, the diaphragms 24 and 29, and the piston 54, the stiffness of the diaphragms 24 and 29 and the reactance of the vibrating column of air in the tubular portion 18 of the end casing element 12 and the megaphone 13. Preferably the natural frequency of reciprocation of the armature is of the order of 200 cycles per second, in order to cause the horn to produce a note having a corresponding pitch.

An electric circuit network is associated with the horn which comprises a source of direct current supply, such as a battery 70, a control switch S71 and an automatic switch 73. Preferably the automatic switch 73 is of the magnetic vibratory hermetically sealed type disclosed and claimed in the copending application of Irvin W. Cox, Serial No. 306,802, filed November 30, 1939. More particularly, the automatic switch 73 comprises a stationary contact 80 and a vibratory contact 81 and is adapted to be set into operation by an arrangement, not shown, in order to cause the vibratory contact 81 alternately to engage and disengage the stationary contact 80 at a predetermined frequency. Preferably, the frequency of vibration of the vibratory contact 81 of the automatic switch 73 corresponds precisely to the natural frequency of reciprocation of the armature 45 of the horn, as previously explained.

In order to initiate operation of the horn, the automatic switch 73 is first set into operation, thereby to cause the vibratory contact 81 thereof alternately to engage and disengage the stationary contact 80 thereof; subsequently the control switch S71 is closed. When the control switch S71 is closed a series circuit is completed for energizing the field windings 62 and 63, this circuit extending from the positive terminal of the battery 70 by way of the conductor C74, the field winding 63, the conductor C79, the field winding 62, the conductor C77, the conductor C76, the contacts 72 of the control switch S71 and the conductor C75 to the negative terminal of the battery 70. Also, when the control switch S71 is closed a circuit is prepared for energizing the operating winding 64 intermittently under the control of the automatic switch 73, this circuit extending from the positive terminal of the battery 70 by way of the conductor C74, the operating winding 64 and the conductor C78 to the stationary contact 80 of the automatic switch 73, and from the negative terminal of the battery 70 by way of the conductor C75, the contacts 72 of the control switch S71 and the conductor C76 to the vibratory contact 81 of the automatic switch 73. Each time the vibratory contact 81 engages and disengages the stationary contact 80 of the automatic switch 73 the previously traced circuit for energizing the operating winding 64 is completed and interrupted. Accordingly, the field windings 62 and 63 are steadily energized; while the operating winding 64 is intermittently energized, thereby to cause the armature 45 to reciprocate in order to operate the horn as previously explained.

When the control switch S71 is returned to its normal position, the previously traced circuits for energizing the field windings 62 and 63 and the operating winding 64, are interrupted at the contacts 72 thereof, thereby to cause the operation of the horn to be arrested. When operation of the horn is not required, the operation of the automatic switch 73 may be arrested.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is contemplated to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A sound producer comprising a magnetic field structure including a continuous longitudinally extending outer wall and first and second continuous longitudinally extending inner walls, said first and second inner walls being spaced laterally with respect to said outer wall and magnetically connected thereto, said first and second inner walls being spaced longitudinally with respect to each other and having aligned longitudinally extending openings provided therein, a magnetic armature, means for resiliently mounting said armature for reciprocatory movement within the aligned openings provided in said first and second inner walls, said armature having a normal position wherein it is disposed in closer proximity to said first inner wall than to said second inner wall and an operated position wherein it is disposed in substantially equal proximities to said first and second inner walls, said resilient mounting biasing said armature toward its normal position, a field winding and an operating winding coupled to said field structure, said field structure and said field winding and said operating winding being so connected and arranged that when said field winding is energized and said operating winding is deenergized said armature is moved against its bias from its normal position to its operated position and that when said field winding and said operating winding are deenergized or energized said armature is moved by its bias from its operated position to its normal position, and a vibratory diaphragm operatively connected to said armature.

2. A sound producer comprising a magnetic field structure including a continuous longitudinally extending outer wall and first and second continuous longitudinally extending inner walls, said first and second inner walls being spaced laterally with respect to said outer wall and magnetically connected thereto, said first and second inner walls being spaced longitudinally with respect to each other and having aligned longitudinally extending openings provided therein, a magnetic armature, means for resiliently mounting said armature for reciprocatory movement within the aligned openings provided in said first and second inner walls, said armature having a normal position wherein it is disposed in closer proximity to said first inner wall than to said second inner wall and an operated position wherein it is disposed in substantially equal proximities to said first and second inner walls, said resilent mounting biasing said armature toward its normal position, first and second field windings arranged in longitudinaly spaced-

apart relationship and respectively disposed between said outer wall and said first and second inner walls, an operating winding disposed between said first and second field windings and mutually between said outer wall and said first and second inner walls, said first and second field windings and said operating winding being so connected and arranged that a substantial magnetic flux traverses said field structure when said first and second field windings are energized and said operating winding is deenergized and that no substantial magnetic flux traverses said field structure when said first and second field windings and said operating winding are energized, said field structure and said armature being so constructed and arranged that said armature is moved against its bias from its normal position to its operated position when a substantial magnetic flux traverses said field structure and that said armature is moved by its bias from its operated position to its normal position when no substantial magnetic flux traverses said field structure, and a vibratory diaphragm operatively connected to said armature.

IRVIN W. COX.