Aug. 30, 1966 | J. VAN LEER | 3,270,300

REVERBERATION UNIT MAGNETIC ASSEMBLY

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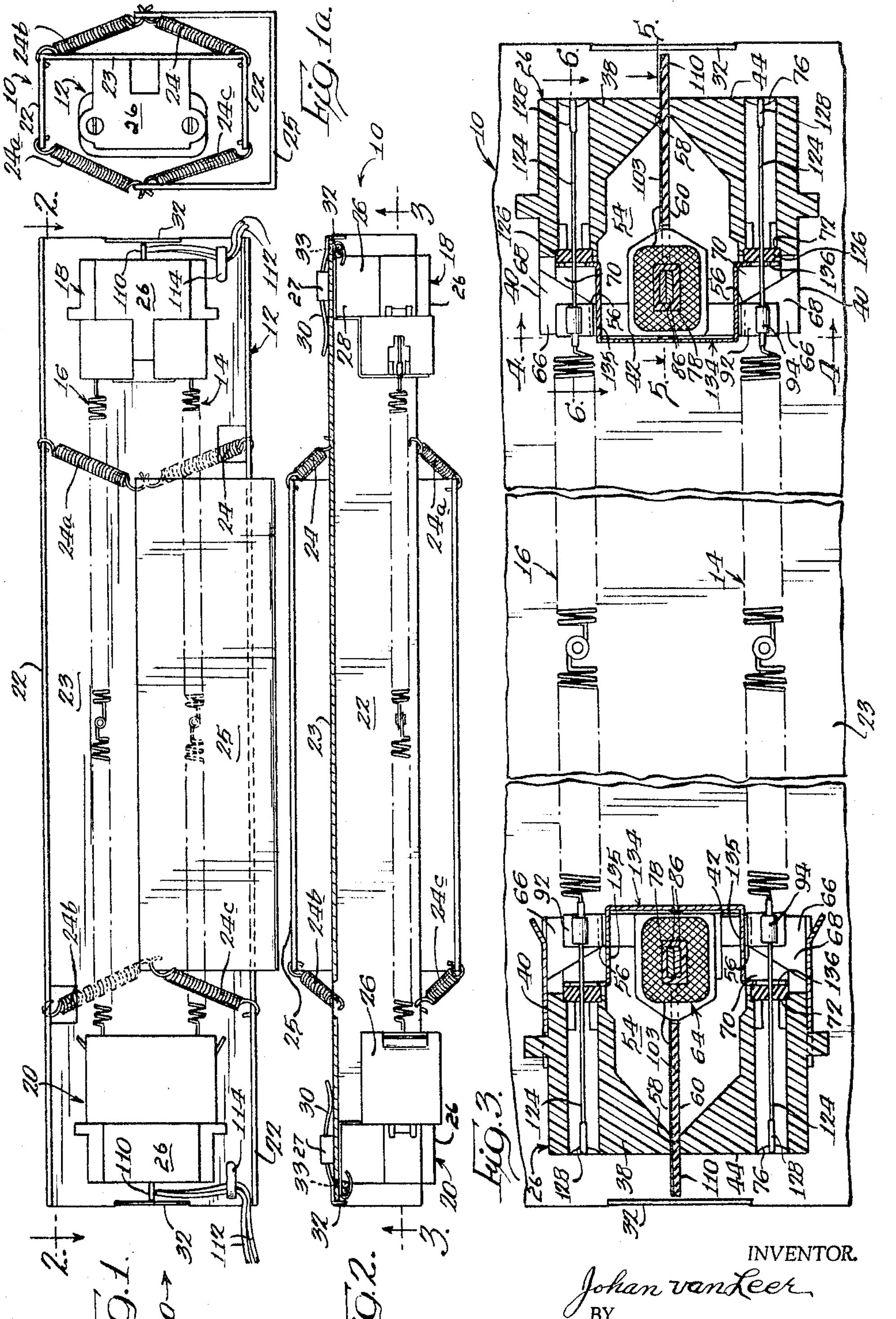

FIG. 1a. FIG. 1. FIG. 2. FIG. 3.

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Fig. 4.

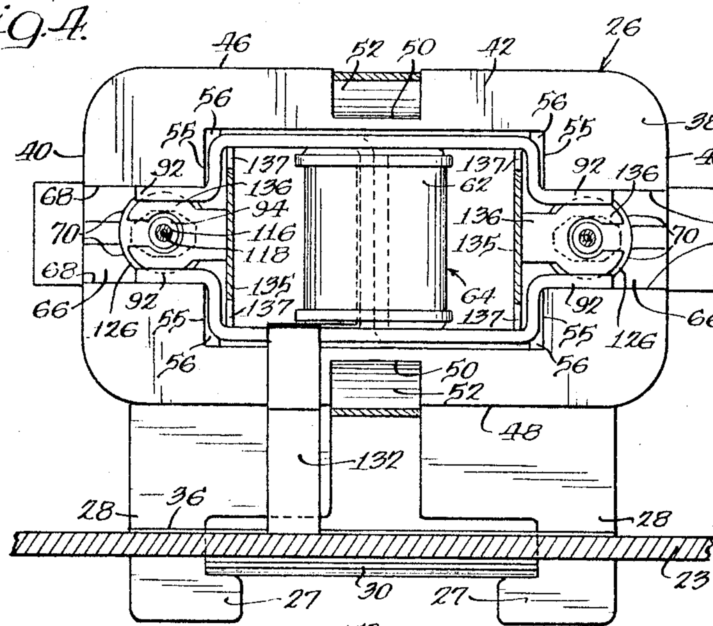

Fig. 5.

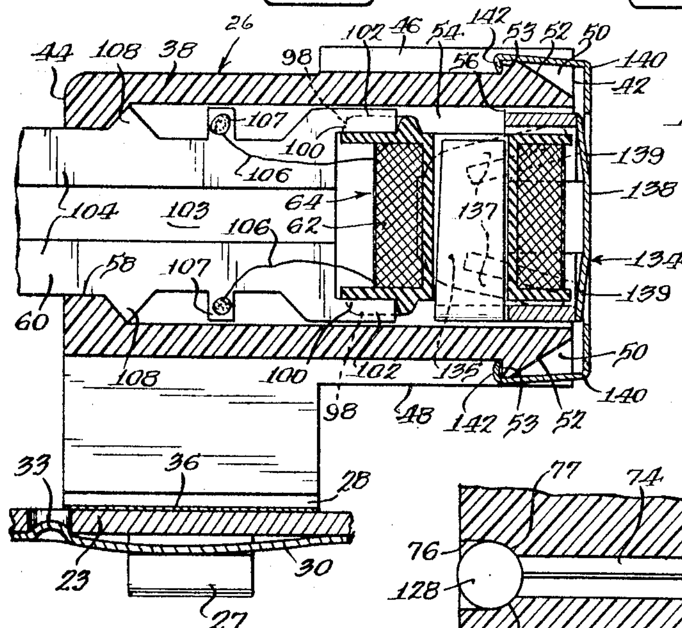

Fig. 6.

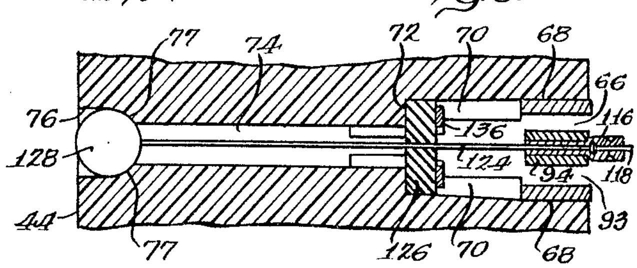

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Fig. 7.

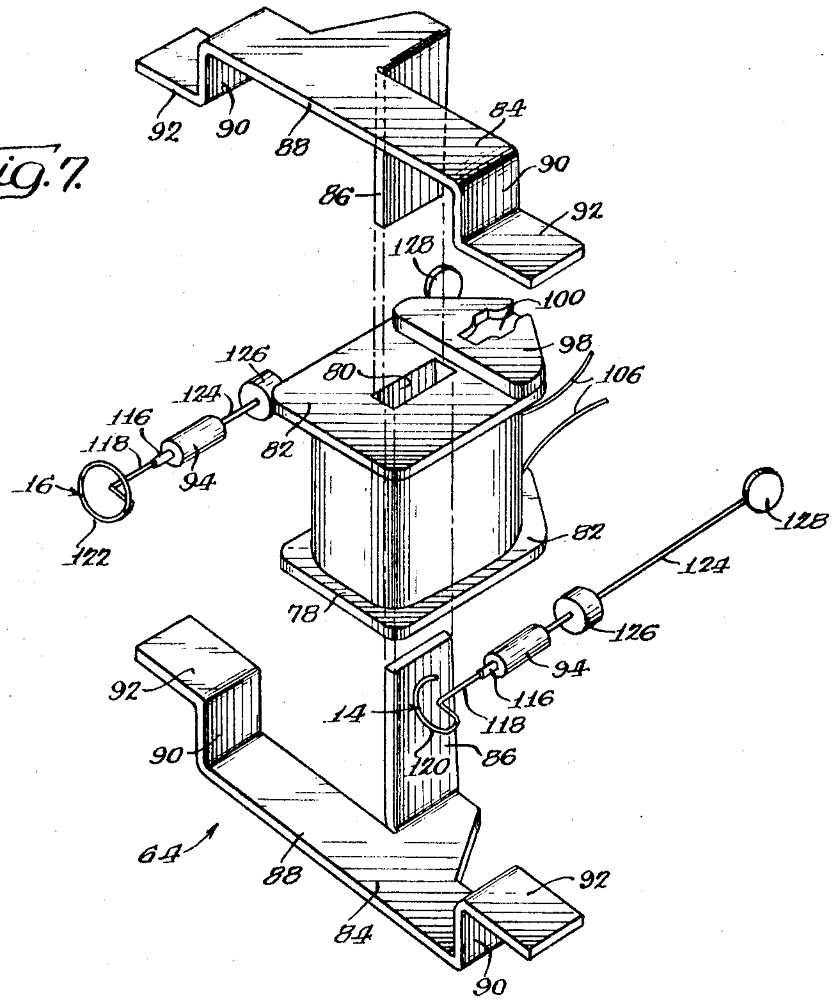
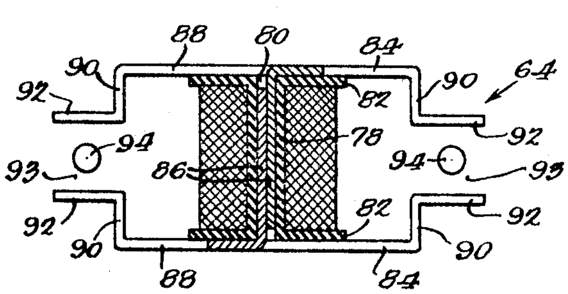


Fig. 8.



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REVERBERATION UNIT MAGNETIC ASSEMBLY

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Filed Apr. 26, 1962, Ser. No. 190,439
4 Claims. (Cl. 333—30)

This invention relates in general to reverberation units for use with musical instruments, such as, either organs, radios or phonographs, and more particularly relates to an improved and more economical magnetic arrangement for use in a reverberation unit.

Reverberation units generally comprise several coil springs which serve as transmission lines to convey signals in different time intervals to an output circuit for the purpose of simulating the acoustical effect of an auditorium. In such a unit there must be provided a signal generating assembly or driver comprising an input coil at one end of the spring. The input coil responds to an input electrical signal for controlling a tiny magnet attached to the adjacent end of the respective transmission lines. This introduces a corresponding mechanical wave into the transmission line which is sensed by a signal receiving assembly or pickup at the other end of the line. The pickup assembly comprises another magnet and coil which respond to the transmitted mechanical wave by providing an output electrical signal having a delayed interval dependent on the length of the spring and the rate of wave transmission. This output signal is then applied through suitable amplifying devices to an output transducer, such as a loud speaker, for the purpose of simulating the effect described above.

The reverberation unit utilizes at least two transmission lines for effective operation. Each transmission line must have a small magnet at both the driver and pickup ends and since signal values are minute, these must each be located in an area of maximum flux density generated by a coil at both the driver and pickup ends in order to function efficiently. Thus the problems with respect to the signal generating and signal receiving ends of the transmission lines revolve around the need to provide simple signal generating and receiving apparatus which may be duplicated at both ends and for both lines since such an arrangement permits the most economical construction and assembly and also provides the maximum in magnetic flux density from the available power.

In overcoming these problems the invention utilizes a coil and pole piece assembly of identical construction at both the driver and pickup ends of the transmission lines. Each coil and pole piece assembly comprises a simple interchangeable unlaminated two part pole piece construction having a left hand and right hand symmetry to permit an identical magnetic circuit to be established for the magnets of the respective transmission lines. In addition, the pole pieces each incorporate a portion of the coil core structure, and each is assembled to the coil by inserting the core structure therein to simultaneously form the completed core. Thus the pole pieces are all interchangeable permitting a simple standardization. In addition, the pole pieces are formed so that they are spaced in close proximity only over an area adjacent the transmission line magnets. This prevents excessive flux leakage and enables the flux to be confined to a prescribed area thereby increasing its density and enabling the maximum efficiency.

It is therefore an object of the present invention to provide an improved driver and pickup assembly for a reverberation unit.

It is another object of the present invention to provide an improved coil and pole piece assembly for use in a reverberation unit.

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Other objects together with the features of the present invention will become apparent on examination of the following specification, claims and drawings, wherein:

FIG. 1 is an elevational view of the reverberation unit assembly;

FIG. 1*a* is an end view of the assembly shown in FIG. 1 with certain details omitted;

FIG. 2 is a sectional view taken along the line **2—2** in FIG. 1;

FIG. 3 is a sectional view taken along the line **3—3** in FIG. 2;

FIG. 4 is a sectional view taken along the line **4—4** in FIG. 3;

FIG. 5 is a sectional view taken along the line **5—5** in FIG. 3;

FIG. 6 is a sectional view taken along the line **6—6** in FIG. 3;

FIG. 7 is an exploded perspective view of the magnet and pole piece assembly; and

FIG. 8 is a sectional view illustrating the relationship between the coil, pole pieces and magnets.

In the drawings, the reverberation unit assembly is indicated by the reference character **10**. It comprises a channel member **12**, a pair of transmission lines **14** and **16**, a driver unit assembly **18** and a pickup unit assembly **20**. The channel member **12** comprises opposite longitudinal side walls **22** and a back wall **23** therebetween. Each wall **22** is provided with apertures adjacent the pickup and driver assemblies for receiving the ends of respective coiled springs **24–24*c***. The springs **24–24*c*** serve to suspend the reverberation unit **10** from a suitable mounting channel **25** for isolating the unit **10** from extraneous vibrations as explained in an application Serial No. 190,444 filed April 26, 1962 simultaneously herewith by William C. Laube, Jr.

The driver and pickup units **18** and **20** are substantially identically constructed and dimensioned. Each includes an integrally formed case **26** having a pair of spaced apart depending L-shaped lugs **27** that extend through the back wall **23** as best seen in FIGS. 4 and 5 and project towards each other. A shoulder **28** on each lug limits the downward movement of the case. A leaf spring **30** is inserted between the respective lugs **27** along the lower side of wall **23** to seat the respective cases **26** in position. An angle stop **32** on the leaf spring engages the edge of wall **23** as best seen in FIGS. 2 and 3, while a detent **33** engages an aperture in wall **23** to control the position of spring **30** and prevents its shifting. In addition, a ground strip **36** is inserted between the shoulder **28** and the top of wall **23** and is held firmly engaged the wall **23** when clip **30** is inserted.

Each case **26** comprises a generally rectangular main body **38** having side faces **40**, a front face **42**, a back face **44**, a top face **46**, and a bottom face **48** from which the lugs **27** depend. A groove **50** in both the top and bottom faces extends back from the front face **42** towards the rear of the body **38** and a sloping stop element **52** having a vertical rear wall **53** is located in each groove as best seen in FIGS. 4 and 5.

The body **38** is provided with a deep substantially rectangular shaped recess **54** in its front face **42**. The recess **54** has side walls **55** intersected by vertical stop walls **56**. In the posterior portion of the recess **54** as seen in FIGS. 3 and 5, the vertical walls converge and a narrow aperture **58** connects the recess **54** to the back face **44** of the body. The aperture **58** is adapted to receive a connector strip which extends through the recess **54** for the purpose of enabling electrical connections to be extended to a coil **62**. The coil **62** comprises part of a coil and pole piece assembly **64** adapted to be received in the recess **54** and in a pair of horizontal slots **66**.

A horizontal slot **66** connects each side of the recess

54 with the side faces 40 of the body 38 for a predetermined distance from the front face 42. Each slot 66 is defined by flat upper and lower wall portions 68 from the front face 42 to a position intermediate the slot ends and then by arcuate top and bottom wall portions 70 which terminate at a stop wall 72 as best seen in FIG. 6. A narrow horizontal passageway 74 connects each slot 66 through the wall 72 to the back face 44 where the respective passageways terminate in a circular opening 76 having aligned narrow recesses 77 crosswise to the slot 74 extending inwardly from the opening 76.

The coil and pole piece assemblies 64 each comprise a bobbin 78 on which the coil 62 is wound in a conventional manner. The bobbin 78 has a rectangular passageway 80 therein and generally rectangular spool heads 82. A pair of pole pieces 84 are each adapted to be engaged on a respective spool head 82 and each has a core portion 86 for engagement in the passageway 80.

The pole pieces 84 each comprise an elongate web 88 of magnetic material and the respective core portions 86 depend therefrom adjacent the transverse axis of the web and to one side thereof. An L-shaped flange 90 is provided at opposite ends of each pole piece and each flange has an arm 92 extending in opposing directions. The core portions 86 are inserted through spool heads 82 into opposite ends of passageway 80 and in abutting relationship. The webs 88 are thus supported so that the arms 92 on one pole piece are in a more closely spaced relationship to an arm on the other pole piece than the pole piece webs. This reduces the area of flux leakage to that of arms 92 since only these areas are in close proximity to each other.

The spacing between respective arms 92 defines the gaps 93 of identical magnetic circuits and a tiny cylindrical magnet 94 at the end of each transmission line is located in each of the gaps. The magnets 94 each have an axial dimension substantially the same as the transverse dimension of the associated arms 92. It will be noted that the magnets 94 intersect the confined main flux path in the limited area traversed by arms 92 so that the maximum signal efficiency is achieved. In addition, the construction enables the gaps for the magnets at each end of both transmission lines to be effectively defined by a single pair of pole pieces and that these are all interchangeable.

It will be noted that each of the spool heads 82 is provided with a boss 98 along one end and that a recess 100 is provided in one end of each boss. Each recess 100 is adapted to receive respective arms 102 of the connector strip 60. The connector strip 60 is a flat elongate insulating plate 103 upon which is affixed a pair of thin conductive layers 104 to which respective leads 106 of the coil are extended at lugs 107. The strip 60 has top and bottom stop portions 108 which abut the back wall of recess 54 when the coil and pole piece assembly 64 is inserted in the recess 54. A tab portion 110 on the connector strip extends through aperture 58 for the purpose of extending external electrical leads 112 to the coil. The leads 112 are positioned by a tab 114 that is staked onto wall 23.

The magnets 94 each have a central aperture in which a stepped tube 116 is inserted and cemented thereto. The stepped tube 116 has a portion which is cemented to and crimped about a respective straight end 118 of a coil spring 120 or 122. The springs 120 and 122 each form a part of a respective transmission line 14 or 16. Each transmission line comprises two springs 120 or 122 respectively joined in the center of the line by an eyelet, for example, and connected at opposite ends to the magnets 94. The springs 120 or 122 are joined so that their windings are of opposite direction for the purpose of suppressing undesired vibrational modes.

It will be noted that although the springs of each transmission line are of identical length that the springs 122 of the transmission line 16 have a larger helix diameter than springs 120. Thus the springs of each line are wound to the same length with their turns in compressive relationship so that adjacent turns are normally touching. When assembled to the driver and pickup assemblies the springs are stretched to separate the turns and the smaller diameter line 14 will of course transmit higher frequencies than the larger diameter line 16. However in the range where the frequency transmitted by line 16 begins to fall off substantially, little acoustical effect is lost since in that range the single line 14 contributes sufficient reverberation effect.

Due to the step in the tube 116 a shoulder is formed which serves as a stop for a flattened end of a support wire 124 inserted partially therethrough as best seen in FIG. 6. The support wire 124 is extended through a rubber damping disc 126 and its other end is fastened along one diameter of an anchor disc 128 which serves as a bayonet connection as will be explained. Thus, each transmission line 14 and 16 is a self contained subassembly comprising a pair of coiled springs 120 or 122 joined in the center of the line and having at each end a magnet 94, support wire 124, damping disc 126 and anchor disc 128.

To assemble the reverberation unit, a coil and pole piece assembly 64 is inserted in recess 54 in each case 26 with the tab 112 projecting from the rear of the case. The ground strip 36 which has an elongate leg 132 extending towards the front face 42 and this is bent over and inserted between the lower pole piece and associated spool head before the assembly 64 is inserted in recess 54. Each case 26 is mounted on the channel 12 and held thereto by leaf spring 30 either before or after the assembly 64 is assembled thereto, but in either event the walls 55 and 56 in recess 54 serve to control the position of the assembly 64.

The transmission lines 14 and 16 are assembled to the driver and pickup assemblies 18 and 20 by inserting the anchor disc 128 at one end of each transmission line through the passageway 74 and on passing therethrough and being aligned with the circular opening 76, each is given a slight rotational movement and a slight pull thereon enables the anchor disc 126 to be seated in the recesses 77 to form a bayonet connection. Since the anchor disc 128 is then no longer aligned with the passageway 74, it cannot be pulled back through it so that one end of each transmission line is held in position. The disc 128 at the other end of each transmission line is then inserted through a passageway 74 in either the driver or pickup means as the case may be in the same fashion.

The distance between the two ends of passageways 74 is calculated to just stretch the springs so that their turns are separated by an identical amount with the turns having a low helix angle to insure the proper propagation of the transmitted waves while at the same time the total spring length is held short. Thus, by the positioning of the cases 26 the correct spacing between the turns can be easily achieved. The magnets 94 then lie in the gaps 93 formed between a respective pair of arms 92 of the pole pieces.

In order to properly position and secure the pole pieces with respect to the magnets 94 while securing the coil and pole piece assembly 64 and in order to maintain the damping discs 126 properly positioned, a spring clip 134 is used to complete the positioning of the assembly. The clip 134 is generally U-shaped with the ends of the side legs 135 having ring shaped slotted right angle arms 136 thereon. In addition, a pair of wings 137 are provided at the end of each leg 135 and in the same plane, but projecting back therefrom at a transverse angle.

The back leg 138 of the clip 134 is provided with respective upwardly and downwardly projecting tines 139 and L-shaped arms 140. Each arm 140 has a locking bend 142 at the end thereof.

The clip 134 is assembled to the case 26 by inserting the side legs 135 together with wing 137 in the recess 54 while arms 140 engage grooves 50. The slots in ring shaped arms 136 permit the arms to engage over the wire 126 between the magnets 94 and damping discs 126.

As the clip **134** is pressed back, the arms **136** move the damping discs **126** through slots **66** between the arcuate wall portions **70** and **72** to properly seat the same. At the same time the wings **137** press the webs **84** of the pole pieces against the respective upper and lower walls of recess **54** to size the gap **93** therebetween. Simultaneously the walls **56** serve as stops for the arms **90** so that the pole pieces are positioned properly with respect to the magnets **94**.

The tines **139** serve to apply pressure against the coil and pole piece assembly **64** and when the locking bend **140** on the clip passes over the vertical wall **53** of the stop **52**, the assembly is securely held in position.

A rectangular resilient shielding element **142** is slipped over the front of the driver unit case **26** preferably before the transmission lines **14** and **16** are assembled thereto. The element **142** has a set of ears **143** which engage around a tab **144** protruding from the sides of each case so that the element **142** is properly seated and supported. The element **142** additionally seats the leg **132** of the ground strip **36** against the bottom face **48** of the case so that it is in no danger of entanglement.

There has been described one embodiment of my invention, and since this embodiment is capable of many adaptations and modifications, there is appended hereto a series of claims for accurately setting forth the limitations of the invention.

I claim:

1. A spring type reverberation unit assembly comprising a base, a pair of spaced apart abutment units secured to said base, each of said units providing a coil structure, core members for said coil structure, and said core members providing pole pieces with a magnetic gap therebetween, a coil spring member, torsionally compliant mounting elements secured to the ends of said spring member and extending away from said spring member substantially axially with respect to said spring member, resilient damping members secured to said compliant elements, fittings secured to said compliant elements beyond said damping members, transversely permanently magnetized cylindrical elements secured substantially axially to the end of said spring so as to rotate with the spring ends, mounting means on said units adapted for securement to said fittings to support said spring in stretched condition betewen said units with said magnetized cylindrical elements within said magnetic gaps, means for securing said damping members to said units, and said fittings when secured to said units defining a predetermined angular relationship as between the polarity of said magnetized cylindrical elements and said pole pieces.

2. A coil and pole assembly for providing a pair of aligned spaced apart magnetic gaps having substantially identical characteristics, comprising a coil bobbin having parallel flat ends and a rectangular core passage therethrough between the ends, a coil wound on said bobbin, a sheet metal core strip extending into said passage from one end of said bobbin in face-to-face engagement with a second identical core strip extending into said passage from the opposite end of said bobbin, each of said core strips being bent over at right angles to provide a tab lying against each end face of said bobbin, each of said tabs being integrally edge joined to an offset transversely extending strip having offset L-shaped ends, the offset at both ends being in the direction of the integral core strip, said offset ends forming pole pieces equally spaced from the core passage, the L-shaped ends of one of said transverse strips being in alignment with the L-shaped ends of the other of said transverse strips to provide a pair of magnetic gaps at each side of said coil bobbin.

3. A pole piece structure, two of which used together provide a pair of aligned spaced apart magnetic gaps having substantially identical characteristics, comprising a narrow rectangular sheet metal core strip adapted to extend into a core passage of a coil, said core strip having an integral tab at one end extending at right angles to the plane of the core strip, said tab being integrally edge joined to an offset transversely extending strip having offset ends, said transverse strip being tangential to said core strip, the offset at both ends of the transverse strip being in the direction of the integral core strip, said offset ends forming pole pieces, and said pole pieces being equally spaced from one of the faces of the core strip.

4. A coil and pole assembly for providing a pair of aligned spaced apart magnetic gaps having substantially identical magnetic characteristics, comprising a coil bobbin having parallel flat ends and a core passage therethrough between the ends, a sheet metal core strip extending into said passage from one end of said bobbin in face-to-face engagement with a second identical core strip extending into said passage from the opposite end of said bobbin, each of said core strips being formed integrally with a tangentially offset transversely extending strip having offset ends, said offset ends forming pole pieces equally spaced from the core passage, the offset ends of one of said transverse strips being in alignment with the offset ends of the other of said transverse strips to provide a magnetic gap at each side of said coil bobbin.

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