Aug. 22, 1939. R. DOPYERA 2,170,294

ELECTRICAL STRINGED MUSICAL INSTRUMENT

Filed April 13, 1936 3 Sheets-Sheet 1

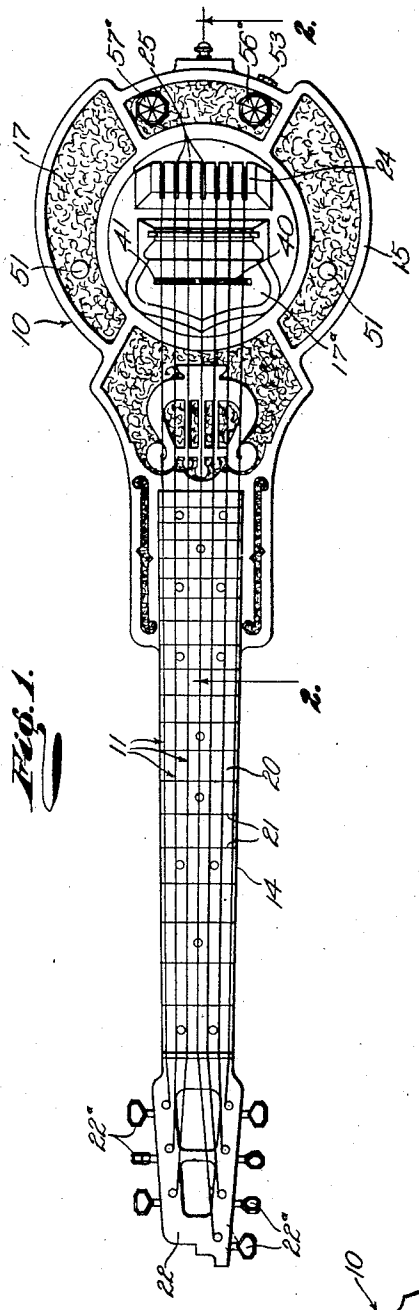

Fig. 1.

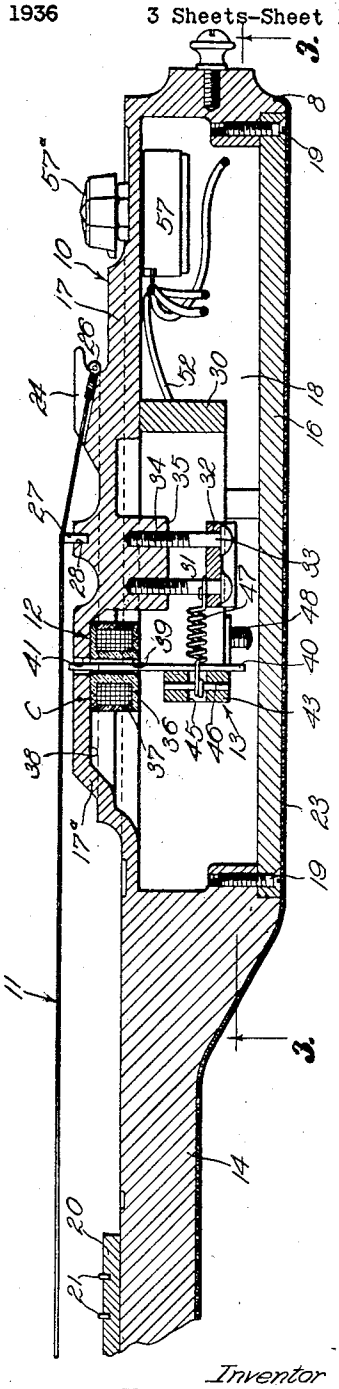

Fig. 2.

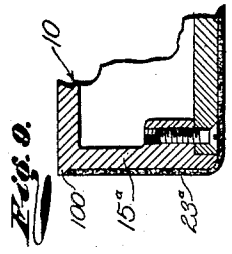

Fig. 3.

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Aug. 22, 1939. R. DOPYERA 2,170,294

ELECTRICAL STRINGED MUSICAL INSTRUMENT

Filed April 13, 1936 3 Sheets-Sheet 2

Fig. 3.

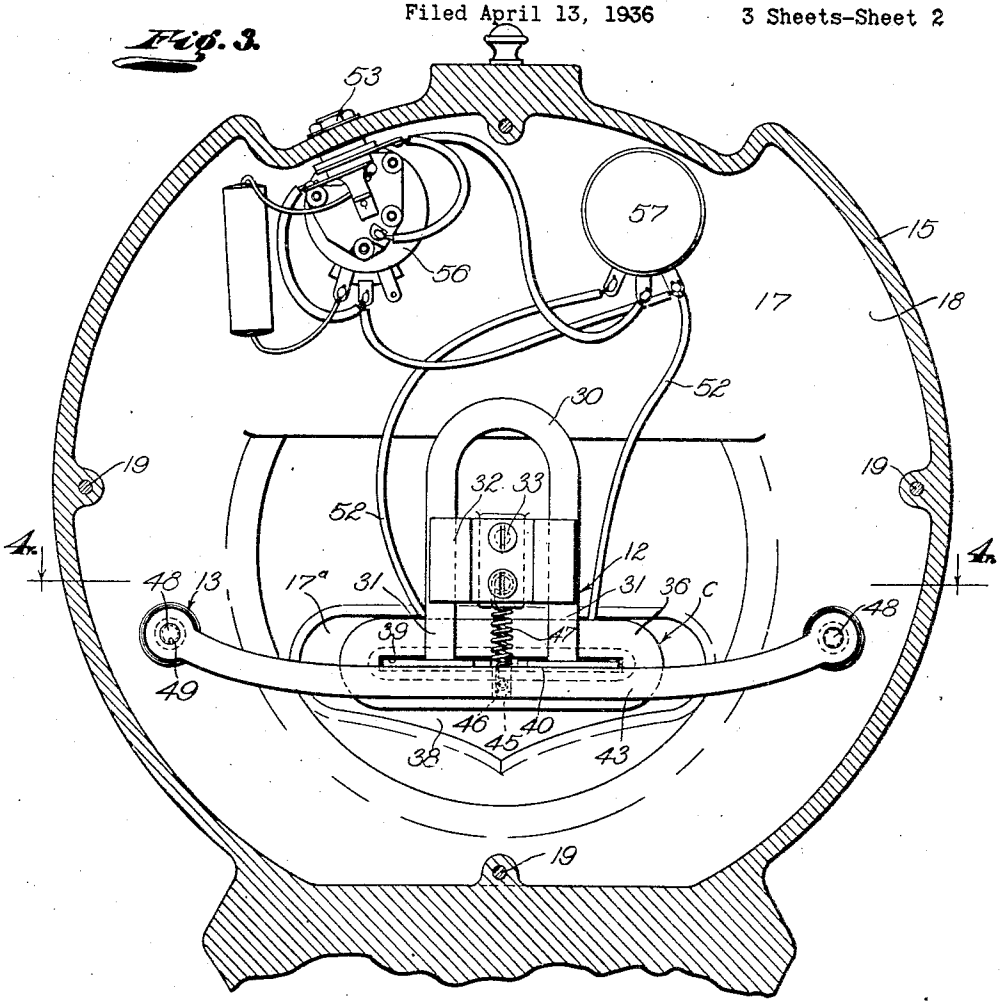
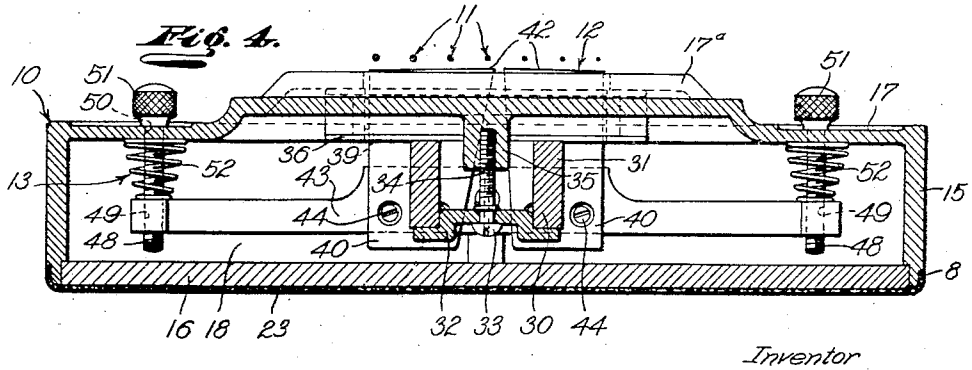


Fig. 4.



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Filed April 13, 1936 3 Sheets-Sheet 3

Fig. 5.

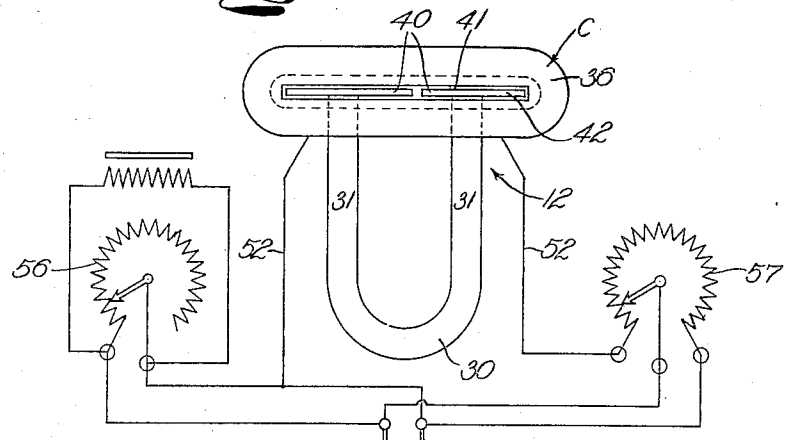
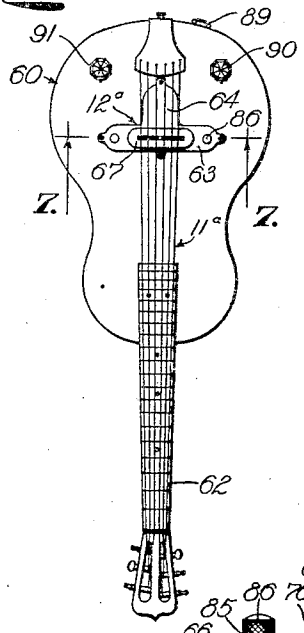


Fig. 6.



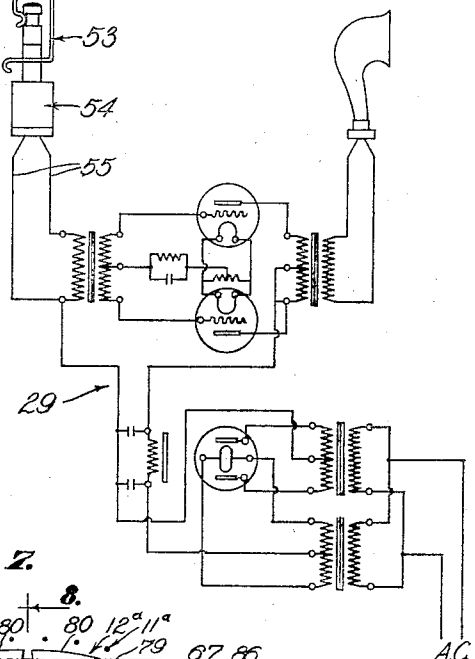


Fig. 7.

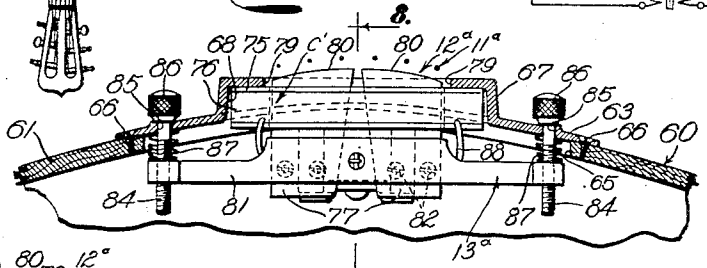
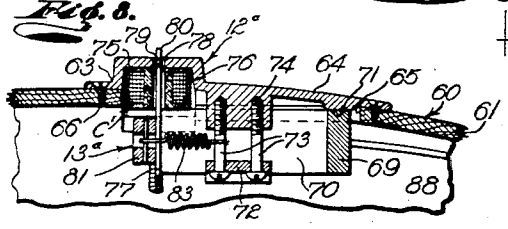


Fig. 8.



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Patented Aug. 22, 1939

2,170,294

UNITED STATES PATENT OFFICE

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ELECTRICAL STRINGED MUSICAL INSTRUMENT

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Application April 13, 1936, Serial No. 74,058

13 Claims. (Cl. 84—1.16)

This invention relates to stringed musical instruments and relates more particularly to electrical stringed musical instruments. A general object of this invention is to provide a simple, practical stringed musical instrument embodying an improved pick-up means.

Another object of this invention is to provide a stringed musical instrument embodying an improved pick-up which provides a concentrated magnetic field through which the instrument strings pass so that vibration of the strings varies the reluctance of the magnetic circuit to induce a current in an induction coil of the pick-up, which current may be suitably converted into clear sustained musical tones truly representative of the vibration of the strings and which may be made appreciably louder than the tones produced by ordinary stringed musical instruments.

Another object of this invention is to provide an electrical musical instrument of the character mentioned embodying a compact, novel and fully adjustable electro-magnetic pick-up means.

Another object of this invention is to provide an electrical musical instrument of the character mentioned in which the pick-up means may be easily and conveniently regulated or adjusted by the musican to provide for the production of tones of the desired quality, amplitude, etc.

Another object of this invention is to provide an electrical musical instrument of the character mentioned in which the only visible parts of the electro-magnetic pick-up unit are the adjusting knobs and the pole pieces of the magnet providing the concentrated magnetic field through which the strings pass.

Another object of this invention is to provide an electrical musical instrument of the character mentioned embodying an improved and simplified pick-up comprising a relatively stationary magnet, a relatively stationary induction coil and shiftable adjustable magnet pole pieces engaging the poles of the magnet, passing through the coil and concentrating a non-uniform magnetic field about the vibratory instrument strings.

Another object of the invention is to provide a musical instrument of the character mentioned in which the adjustable magnetic pole pieces carry the magnetic influence to the several strings of the instrument whereby the pick-up means is responsive to vibration of any one or all of the strings.

Another object of this invention is to provide an electrical musical instrument of the character mentioned in which the adjustable magnetic pole pieces may be readily adjusted toward and away from the series of instrument strings to a like or uniform extent to correspondingly increase or lessen the action of the several strings on the magnetic flux, or one pole piece may be adjusted relatively closer or farther away from its adjacent strings than the other pole piece to effect a greater or lesser action of certain of the strings on the magnetic flux.

Another object of this invention is to provide an electrical musical instrument of the character mentioned embodying novel means for adjusting the pole pieces and for maintaining the adjustable pole pieces in proper contact with the poles of the magnet.

A further object of the invention is to provide an improved electrical musical instrument of the character mentioned that is simple and inexpensive.

The various objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a plan elevation of one form of musical instrument provided by this invention. Fig. 2 is an enlarged fragmentary longitudinal detailed sectional view taken substantially as indicated by line 2—2 on Fig. 1. Fig. 3 is a fragmentary longitudinal or horizontal detailed sectional view taken substantially as indicated by line 3—3 on Fig. 2. Fig. 4 is a transverse detailed sectional view taken as indicated by line 4—4 on Fig. 3. Fig. 5 is a schematic wiring diagram of the circuit embodied in the instrument illustrated in Figs. 1 to 4. Fig. 6 is a plan elevation of another embodiment of the invention. Fig. 7 is an enlarged transverse detailed sectional view taken substantially as indicated by line 7—7 on Fig. 6. Fig. 8 is a longitudinal fragmentary detailed sectional view taken as indicated by line 8—8 on Fig. 7. Fig. 9 is a fragmentary vertical detailed sectional view of a slightly modified form of the invention.

The present invention is adapted to be employed in stringed musical instruments of various characters. In the following disclosure I will describe the invention embodied in two instruments of the guitar class; it being understood that the invention is not to be construed as limited or restricted to the specific forms or applications about to be described.

The form of the present invention illustrated in Figs. 1 to 5, inclusive, of the drawings, includes, generally, a body 10, a plurality of vibratory

strings 11 on the body 10, an electro-magnetic pick-up 12 on the body 10, and means 13 for regulating or adjusting the pick-up 12.

The instrument body 10 may be varied considerably in shape and construction without departing from the broader principles of the invention. The instrument illustrated in Figs. 1 to 5, inclusive, of the drawings, is in the nature of a guitar and the body 10 has a projecting elongate neck 14 over which the strings 11 are strung. In accordance with the invention the neck 14 may be integral with the body 10 and the instrument body may be a one-piece casting. The body 10 is preferably formed of a non-magnetic material such as aluminum or the like. The main portion of the body 10 may be of any suitable or convenient shape. In the particular case illustrated the body 10 has a rounded or curved side 15, a flat bottom 16 and a top 17 which is generally parallel with the bottom 16. The body 10 is preferably hollow or provided with an opening 18 whose walls may follow generally the sides 15, the bottom 16 and the top 17. The bottom 16 is in the form of a closure closing the lower end of the body opening 18. The bottom 16 may be secured to the body 10 by screws 19 or other suitable means. The neck 14 projects substantially radially from the body 10 and may be substantially rectangular in transverse cross section. A fingerboard 20 is provided on the upper side of the neck 14 and has the usual spaced frets 21. A key-box portion or peg-box portion 22 is provided on the outer end of the neck 14. The body 10 and its neck 14 may be finished and ornamented as desired. The outer surface of the bottom 16 and the lower surface of the neck 14 are covered with felt 23, or the like. The felt 23 prevents the instrument from slipping on the musician's lap and protects his clothing. As illustrated in Figs. 2 and 4 the edge portion of the felt 23 is received or recessed in a groove 8 in the lower edge portion of the body side 15. Fig. 9 illustrates a construction wherein the fabric or felt 23a covers the under surface of the body 10a and substantially covers the outer surface of the side 15a. A rim 100 is provided on the side 15a adjacent its upper edge. The edge of the felt 23a contacts the rim 100 so that the surface of the felt is substantially flush with the surface of the rim.

The strings 11 are the sound or vibration generating elements of the instrument. The strings 11 extend longitudinally over the upper surface of the neck 14 and extend across the body top 17. The strings 11 are preferably arranged in parallelism in a common plane suitably spaced above the surfaces of the body and neck 14. In the particular instrument illustrated there are seven spaced substantially parallel strings 11, it being understood that the instrument may embody as many strings as desired or necessary. The strings 11 are graduated in diameter and some of them may be wound to produce the proper tones or vibrations. In accordance with the invention the strings 11 are of greater or less magnetic permeability than the air through which they pass. In practice, the strings 11 may be the usual steel strings commonly employed on guitars and similar instruments. Tensioning keys or pegs 22a are provided on the peg-box portion 22 and the outer end portions of the strings 11 are wound upon the pegs. The body 10 is provided with a tail piece 24 and the strings 11 are arranged under tension between the tail piece 24 and the pegs 22a. The tail piece 24 is in the nature of an integral ridge on the body top 17 provided with spaced slots 25. The strings 11 pass through the slots 25 and the usual blocks or spools 26 on the strings cooperate with the rear side of the tail piece 24. The tensioned vibratory strings 11 engage or bear on a bridge 27 on the body top 17. The bridge 27 may be secured in a slot 28 in an integral elevated portion of the top 17. In practice the bridge 27 may be spaced a short distance forwardly from the tail piece 24. The body top 17 has an integral elevated portion 17a through which the pole pieces of the pick-up unit project. It is to be noted that the tail piece 24, the bridge carrying portion, and the elevated portion 17a are integral parts of the rigid one-piece body 10. The strings 11 may be tuned or tensioned by the pegs 22a, as desired. The particular instrument illustrated in the drawings is in the nature of a steel guitar or Hawaiian guitar and the strings 11 are spaced a substantial distance above the fingerboard 20 and its frets 21.

The pick-up 12 is operable to convert the vibration of the strings 11 into an electrical current which in turn may be converted into sound or musical tones by a suitable amplifier and speaker circuit or unit 29. The pick-up 12 is in the nature of an electromagnetic means providing a magnetic field through which the strings 11 pass and is responsive to variations in the reluctance of said field caused by vibration of the strings. The pick-up 12 includes a magnet 30. The magnet 30 is preferably in the nature of a permanent magnet whereby the pick-up 12 produces a minimum of hum. The magnet 30 is of the horse-shoe type having spaced substantially parallel arms 31 constituting the magnetic pole parts. The magnet 30 is arranged in the opening 18 of the body 10 and is preferably positioned so that its arms 31 are substantially horizontal and parallel with the strings 11. It is a feature of the invention that the magnet 30 may be permanently or at least rigidly mounted in the body 10. The means for supporting or mounting the magnet 30 may comprise a clamp plate 32 engaging against the lower sides of the magnet arms 31. The plate 32 is preferably formed of non-magnetic material and is shaped to extend or fit between the arms 31 as best illustrated in Fig. 4 of the drawings. Screws 33 pass upwardly through openings in the plate 32 and thread into openings 34 in a downwardly projecting box 35 on the under side of the top 17. The screws 33 bear upwardly against the plate 32 so that the magnet 30 is clamped upwardly against the under side of the top 17.

The electro-magnetic pick-up 12 includes an induction coil C in the body 10. The coil C comprises a form or spool 36 and a winding 37 on the spool 36. The coil C is located at or adjacent the pole ends of the magnet arms 31. In accordance with the invention the coil C may be rigidly secured to the body 10. In the simple preferred arrangement illustrated, a recess 38 is provided in the under surface of the body portion 17a and the coil C is arranged within the recess 38. The upper end of the spool 36 is adapted to bear upwardly against the upper wall of the recess 38. The lower end of the coil spool 36 is engaged or clamped against the wall of the recess by the arms 31 of the magnet 30. The magnet 30 clamped or held upwardly by the plate 32, bears against the spool 36 to hold the spool in position. In accordance with the invention the coil spool 36 is elongated diametrically of the axis of the winding 37 and the coil C is positioned so that the opposite end portions of the elongated spool extend laterally beyond the arms 31 of the magnet 30. An elongate open-

ing or slot 39 extends vertically through the spool 36. The slot 39 occurs at the pole ends of the magnet arms 31 and extends laterally or horizontally beyond the outer sides of the arms 31. In practice the opposite ends of the elongated slot 39 are in planes spaced outwardly from the vertical planes of the outermost or end strings 11.

The improved electro-magnetic pick-up 12 of the invention includes pole pieces 40 for the magnet 30. The pole pieces 40 are flat plate-like parts. One pole piece 40 engages against the pole end of each arm 31 of the magnet 30. The inner opposing edges of the pole pieces 40 are preferably spaced apart and may be downwardly divergent. The pole pieces 40 are formed of magnetic material and are held against the ends of the magnet arms 31 by the magnetic attraction. The adjusting means 13 also operates to assist in holding the pole pieces 40 in cooperation with the magnet arms 31 as will be hereinafter described. The pole pieces 40 are provided to carry the magnetic circuit or flux through the coil C and to concentrate the magnetic field about the vibratory strings 11. The pole pieces 40 extend upwardly or outwardly from the magnet arms 31 to project through the slot 39 in the coil spool 36. The pole pieces 40 thus form core elements of the coil C. A slot 41 is provided in the portion 17^a of the instrument body 10 in alignment and communication with the slot 39 and the upper end portions of the pole pieces 40 are adapted to extend through the slot 41. The slots 39 and 41 are sufficiently large to receive the pole pieces 40 with suitable clearance. In the preferred form of the invention the portion 17^a of the top 17, provided with the recess 38 and the slot 41, is elevated so that the pole pieces 40 emerging from the slot 41 are adjacent the strings 11 as illustrated in Figs. 2 and 4 of the drawings. The pole pieces 40 are disposed transversely of the series of strings 11 and lie in a common plane substantially normal to the plane of the strings 11. The pole pieces 40 are sufficiently wide to extend to or slightly beyond the end strings 11 and are sufficiently long to project downwardly beyond the magnet arms 31 when projecting from the slot 41. The upper edges 42 of the pole pieces 40 are preferably inclined downwardly from the inner edges of the pole pieces to the outer edges of the pole pieces. The pole pieces 40 are related to the strings 11 so that the space between the inner edges of the pole pieces is in a plane spaced between the longitudinal plane of two adjacent strings 11. Where there are seven strings, as illustrated, one pole piece 40 is wider than the other to extend transversely below four of the strings 11, while the said other pole piece is disposed transversely below three of the strings. This relationship is best illustrated in Fig. 4 of the drawings.

The pole pieces 40 engaging against the ends of the magnet arms 31 carry the magnetic flux or circuit to their upper edges 42. These edges 42 have limited areas providing a transverse concentrated magnetic field. The concentrated magnetic field arches from the edge 42 of one pole piece to the edge 42 of the other pole piece. Thus the pole pieces 40 are related to the magnet 30 and the strings 11 to provide a concentrated non-uniform magnetic field through which the strings 11 pass. When I employ the expression "non-uniform magnetic field" I mean a magnetic field in which the lines of magnetic force are distinctly non-parallel. When the strings 11 vibrate in this concentrated non-uniform magnetic field they vary the reluctance of the magnetic field space about them regardless of the direction of such vibration. The magnet arms 31 and the pole pieces 40 are related so that the pole ends of the arms 31 are substantially equally spaced between the vertical edges of their respective pole pieces 40.

The means 13 for adjusting the pick-up 12 supports the pole pieces 40 for manual adjustment relative to the series of strings 11 to vary the spaces between the edges 42 of the pole pieces of the strings and thus vary the action of the pick-up 12. The adjusting means 13 includes a shiftable carrier member 43 arranged substantially horizontally in the body opening 18. The carrier member 43 carries the pole pieces 40 for adjustment relative to the relatively stationary magnet 30 and strings 11. The carrier member 43 is elongate and its end portions may curve rearwardly. The member 43 is disposed transversely of the series of strings 11. The intermediate or middle portion of the member 43 is preferably broadened vertically to carry the plate-like pole pieces 40. It is preferred to form the member 43 of non-magnetic material. Bolts or screws 44 secure the pole pieces 40 to the rear side of the member 43. Spring means may be provided to assist the action of the magnetic attraction in holding the pole pieces 40 in proper full cooperation with the pole ends of the magnet arms 31. An opening 45 is provided in the middle portion of the member 43 and a pin 46 extends through the opening 45. An extensible coiled spring 47 has one end connected with the pin 46 and its other end connected with one of the screws 33. The spring 47 is under tension and urges the member 43 rearwardly to hold the rear surfaces of the pole pieces 40 in even contact with the flat ends of the magnet arms 31.

In accordance with the invention the carrier member 43 of the adjusting means 13 is adjustably supported at its opposite ends for even vertical adjustment throughout its length or for adjustment from one end or both ends individually. The means for adjustably supporting the member 43 and the pole pieces 40 carried thereby includes screws 48 threaded through openings 49 in the opposite end portions of the member. The screws 48 extend outwardly or upwardly to shiftably pass through openings 50 in the top 17. The portions of the screws 48 passing through the openings 50 are preferably smooth and unthreaded so that the screws may readily shift through the openings with suitable clearance. Heads 51 are provided on the outer ends of the screws 48 and are adapted to bear or react against the upper surface of the top 17. The screw heads 51 are preferably knurled for easy manual turning. Helical springs 52 surround the screws 48 and are arranged under compressure between the member 43 and the top 17. The springs 52 act downwardly on the member 43 to hold the screw heads 51 in engagement with the body top 17 so that threading of the screws 48 in either direction results in shifting of the member 43. The screws 48 may be simultaneously adjusted to shift the pole pieces 40 uniformly toward or away from the strings 11 or only one screw 48 may be adjusted or one screw 48 may be adjusted more rapidly than or in the opposite direction to the other to effect the desired unequal spacing of the pole piece edges 42 from the strings 11. The screws 48 may be turned or adjusted in opposite directions to effect the unequal spacing of the edges 42 from the strings 11 or to equalize the

spacing of the edges from the strings when the pole pieces have been in non-uniform positions.

Conductors 52 in the body opening 18 are connected with the terminals of the winding 37 and extend to a receptacle or socket 53 in the rear wall of the body 10. A jack or plug 54 is adapted to be inserted in the socket 53. Leads or conductors 55 extend from the plug 54 to the loud speaker unit 29. In the drawings I have shown a typical amplifying or loud speaker circuit or unit 29, it being understood that the sound producing and amplifying apparatus shown is merely typical of the class of apparatus that may be employed with the invention. It is to be understood that the sound producing and amplifying unit 29 may be at a suitable remote point. The invention preferably includes a volume control 56 and a tone control 57 suitably connected in the leads or conductors 52. The volume control 56 and the tone control 57 are arranged in the body opening 18 and may be readily governed or regulated by suitable knobs 56a and 57a projecting from the upper surface of the body top 17.

When the instrument is to be played the musician may adjust the volume control 56 and the tone control 57 to his liking. The pick-up unit 12 may be adjusted by manually turning the knobs or heads 51 of the screws 48. As above described, the screws 48 may be turned to shift the pole pieces 40 uniformly toward or away from the strings 11 or to bring the edge 42 of one pole piece 40 closer to the strings than the edge 42 of the other pole piece. In this manner the action of the pick-up means 12 may be governed or regulated by the musician to change the tone of the instrument as a whole or to render the tones of either the higher or the lower strings more brilliant, as desired. The pole pieces 40 of the pick-up provide a concentrated arched or non-uniform magnetic field through which the strings 11 pass. Vibration of the strings 11 varies the reluctance of the magnetic field space about the strings to induce a current in the coil C. It will be apparent that the pole pieces 40 extending through the spool coil 36 link the magnetic flux or circuit with the winding 37 of the induction coil C. The vibration of one or more strings 11 in the non-uniform concentrated magnetic field at the upper edges of the pole pieces 40 varies the reluctance of the magnetic flux or circuit. Variation of the reluctance of this magnetic circuit or flux linked with the coil winding 37 sets up or induces an electrical circuit in the winding. This electrical current is carried to the speaker unit 29 where it is converted into musical tones. It will be apparent that the current induced in the coil winding 37 has the characteristics of the string vibrations which produce it so that the tone generated by the unit 29 is truly representative of the actual sound producing vibration of the strings 11. The tones produced by the speaker of the instrument are clear musical tones free of crackle, hum and other noise, and are sustained by a stringed instrument of the guitar type. It is to be noted that the pick-up 12 does not involve any parts touching the strings 11 or obtaining vibration of the strings by mechanical means. The pole pieces 40 may be easily and conveniently adjusted manually at any time without disturbing or shifting the magnet 30 or the induction coil C.

Figs. 6, 7 and 8 of the drawings illustrate the invention embodied in an instrument having a wooden body 60. The instrument illustrated in Figs. 6, 7 and 8 is of the guitar type and the body 60 involves the usual sound box 61 and neck 62. Tensioned vibratory strings 11a extend over the neck 62 and the sound box 61. The construction of the sound box 61 and the neck 62, and the manner of supporting and tensioning the strings 11a may be typical. The invention provides an improved pick-up 12a and means 13a for regulating the pick-up 12a.

The pick-up 12a includes a bracket 63 carried by the sound box 61 of the instrument body 60. The bracket 63 is substantially T-shaped having its major part disposed transversely under the strings 11a and having a part 64 extending rearwardly and substantially longitudinally of the strings. The bracket 63 is preferably formed of non-magnet material. An opening 65 in the sound box 61 is provided under the bracket 63 and may be of substantially the same shape as the bracket. The lower surface of the bracket 63 may bear on the top of the sound box 61 along the edge of the opening 65 and the bracket 63 may be secured to the sound box by screws 66 or the like. The bracket 63 is provided with a part 67 which projects upwardly or outwardly toward the strings 11a. The elevated part 67 is elongate and is disposed transversely of the strings 11a. A recess 68 occurs in the under side of the bracket part 67.

The pick-up 12a includes a permanent magnet 69. The magnet 69 may be identical with the above described magnet 30. The magnet 69 is arranged within the sound box 30 in a substantially horizontal position where its arms 70 extend in substantially the same direction as the strings 11a. The magnet 69 is secured or clamped to the bracket 63. Spaced lugs or bosses 71 are provided on the under side of the bracket and the upper side of the magnet 69 bears on these bosses 71. A clamp plate 72 of non-magnetic material engages against the lower sides of the magnet arms 70. Screws 73 extend through openings in the clamp plate 72 and thread into openings 74 in the bracket 63. The screws 73 operate to clamp the magnet 69 upwardly against the bosses 71.

The improved pick-up 12a includes an induction coil C1 arranged in the recess 68. The coil C1 includes a spool 75 of insulating material and a winding 76 of suitable wire. The spool 75 is horizontally elongated and is arranged in the recess 68 so that its principal horizontal axis is substantially transverse of the direction of the strings 11a. The upper end of the spool 75 bears against the upper wall of the recess 68. The upper surfaces of the magnet arms 70 bear against the lower side of the spool 75 to clamp the spool in the recess 69 and thus hold the spool in position.

Magnetic pole pieces 77 are included in the pick-up 12a. The pole pieces 77 are flat plate-like members bearing against the pole ends of the magnet arms 70. A slot 78 is provided in the spool 75 and the pole pieces 77 project upwardly through the slot 78. A slot 79 is provided in the bracket part 67 to register with the slot 78. The pole pieces 77 are adapted to project through the slot 79 to have their upper edges 80 adjacent the strings 11a. The pole pieces 77 are disposed transversely of the strings 11a and engage against the magnet arms 70 to provide an arched or non-uniform magnetic field through which the strings 11a pass. The inner edges of the pole pieces 77 are spaced apart and may be downwardly divergent.

The means 13a for adjusting the pick-up 12a is manually operable to shift the pole pieces 77 to

vary the spacing of their edges 80 from the strings 11a. The adjusting means 13a includes a carrier member 81 arranged in the sound box 61 at the under side of the bracket 63. Screws 82 secure the pole pieces 77 to the member 81. A spring 83 is connected with the member 81 to urge the pole pieces 77 into proper contact with the pole ends of the arms 70. Adjusting screws 84 are threaded through openings in the opposite end portions of the member 81 and extend upwardly through openings 85 in the bracket 63. Knobs or knurled heads 86 are provided on the projecting upper ends of the screws 84. Springs 87 surround the screws 84 and are arranged under compression between the bracket 63 and the member 81. Turning of the screws 84 effects shifting of the member 81 to adjust the pole pieces 77 relative to the vibratory strings 11a. The member 81 may be readily adjusted to space the edge 80 of one pole piece 77 closer or farther away from the strings than the edge 80 of the other pole piece.

Conductors or leads 88 extend from the terminals of the winding 76 to a receptacle or socket 89 in the wall of the sound box 61. A suitable volume control 90 and a tone control 91 may be properly connected in the leads 88. The controls 90 and 91 may have handles or knobs projecting from the sound box 71 whereby they may be readily adjusted or controlled by the musician. Conductors (not shown) may be plugged into the socket 89 to connect the pick-up 12a with an amplifier or loud speaker unit. In practice the loud speaker unit may be similar to the unit 29 employed with the previously described form of the invention.

The pick-up 12a of the instrument illustrated in Figs. 6 to 8, inclusive, of the drawings operates in the same manner as the pick-up 12. The pick-up 12a may be easily and conveniently adjusted by means of the screws 84 to have the desired action. The unit or pick-up 12a may be readily embodied in an instrument having a wooden body or sound box with a minimum of alteration and modification. The principal parts of the pick-up 12a and its control or adjusting means 13a are enclosed within the sound box 61.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. In a pick-up for use on a musical instrument having a vibratory string, the combination of, a relatively stationary magnet on the instrument, a relatively stationary induction coil, shiftable magnet pole pieces engaging the magnet and extending through the coil to provide a concentrated magnetic field about the string, and means for shifting the pole pieces.

2. A pick-up for a musical instrument having a vibratory string, the pick-up including a stationary horseshoe magnet, an induction coil, pole pieces shiftable relative to the magnet and coil engaging the poles of the magnet and extending through the coil toward the string to provide a magnetic field through which the string passes, and means for shifting the pole pieces relative to the magnet and string.

3. A pick-up for use on a musical instrument having a body and vibratory strings on the body, the pick-up including a magnet, an induction coil, a pole piece engaging each pole of the magnet and extending through the coil toward the magnet to provide a magnetic field at the strings, the pole pieces being shiftable relative to the magnet, coil and strings, and means for shifting the pole pieces relative to the magnet and strings to vary the spacing of the strings and pole pieces.

4. A pick-up for a musical instrument having a vibratory string comprising, a stationary magnet, an induction winding, members shiftable relative to the string and magnet engaging the pole portions of the magnet and extending through the winding to have ends adjacent the string, and means operable to shift the members relative to the magnet and string to vary the magnetic field space between the said ends and the string, said means including, a shiftable part carrying the members, and screw means for shifting the part.

5. A pick-up for a musical instrument having vibratory strings comprising, a stationary magnet, an induction winding, pole pieces movable relative to the strings and magnet engaging the pole portions of the magnet and extending through the winding to have ends adjacent the strings, said pole pieces being transverse of the strings and providing a magnetic field about the strings, and means for shifting the pole pieces through the winding to vary the magnetic field spaces between their ends and the strings including a movable member connected with the pole pieces, and manually operable means for moving said member.

6. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary permanent magnet, movable pole pieces disposed transversely of the series of strings and cooperating with the pole portions of the magnet, the pole pieces having surfaces of limited area spaced from the strings providing a concentrated magnetic field space through which the strings pass, an induction coil surrounding the pole pieces, and means supporting the pole pieces and operable to move the pole pieces relative to the magnet to vary the field spaces between the strings and the said surfaces.

7. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary permanent magnet, movable pole pieces disposed transversely of the series of strings and cooperating with the pole portions of the magnet, the pole pieces having surfaces spaced from the strings to provide a magnetic field around the strings, a tiltable carrier carrying the pole pieces, and manually operable adjusting means for tilting the carrier to vary the spaces between the strings and said surfaces.

8. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary permanent magnet, movable pole pieces disposed transversely of the series of strings and cooperating with the pole portions of the magnet, the pole pieces having surfaces spaced from the strings to provide a magnetic field around the strings, a carrier carrying the pole pieces, and spaced screws carrying the carrier and the pole pieces thereon for adjustment relative to the strings whereby the spaces between the strings and said surfaces may be varied.

9. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the

pick-up including a stationary permanent magnet, movable pole pieces disposed transversely of the series of strings and cooperating with the pole portions of the magnet, the pole pieces having surfaces spaced from the strings to provide a magnetic field around the strings, a movable carrier carrying the pole pieces and arranged transversely of the series of strings, and means supporting the opposite ends of the carrier for adjustment whereby the spaces between the strings and said surfaces may be varied.

10. In a pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary permanent magnet, movable pole pieces disposed transversely of the series of strings and cooperating with the pole portions of the magnet, the pole pieces having surfaces spaced from the strings to provide a magnetic field around the strings, a movable carrier carrying the pole pieces and arranged transversely of the series of strings, and manually adjustable screws supporting the opposite ends of the carrier for adjustment whereby the spaces between the strings and said surfaces may be varied.

11. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary magnet, movable magnetic plate members cooperating with the pole portions of the magnet and extending toward the strings, the members lying in a plane transverse of the strings and each having an edge surface spaced from a number of adjacent strings to provide a magnetic field at the strings, an induction winding around the members, and means for adjusting the members bodily toward and away from the strings and for tilting the members to vary the spaces between said surfaces and the adjacent strings.

12. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary permanent magnet, movable pole pieces disposed transversely of the series of strings and shiftably cooperating with the pole portions of the magnet, the pole pieces having surfaces of limited area spaced from the strings providing a concentrated magnetic field space through which the strings pass, an induction coil surrounding the pole pieces, means holding the movable pole pieces in cooperation with the pole portions of the stationary magnet, and means for moving the pole pieces relative to the magnet to vary the field spaces between the strings and the said surfaces comprising a carrier for the pole pieces, and screws for shifting the carrier.

13. A pick-up for use on a musical instrument having a series of spaced vibratory strings, the pick-up including a stationary magnet, movable magnetic plate members cooperating with the pole portions of the magnet and extending toward the strings, the members lying in a plane transverse of the strings and each having an edge surface spaced from a number of adjacent strings to provide a magnetic field at the strings, an induction winding around the members, a movable carrier carrying the members, and means supporting the carrier for bodily movement and tilting movement operable to vary the spacing of said surfaces and the adjacent strings.

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