

Jan. 16, 1940.

V. H. SEVERY

2,187,251

ELECTRICAL MUSICAL INSTRUMENT

Filed July 13, 1936

4 Sheets-Sheet 1

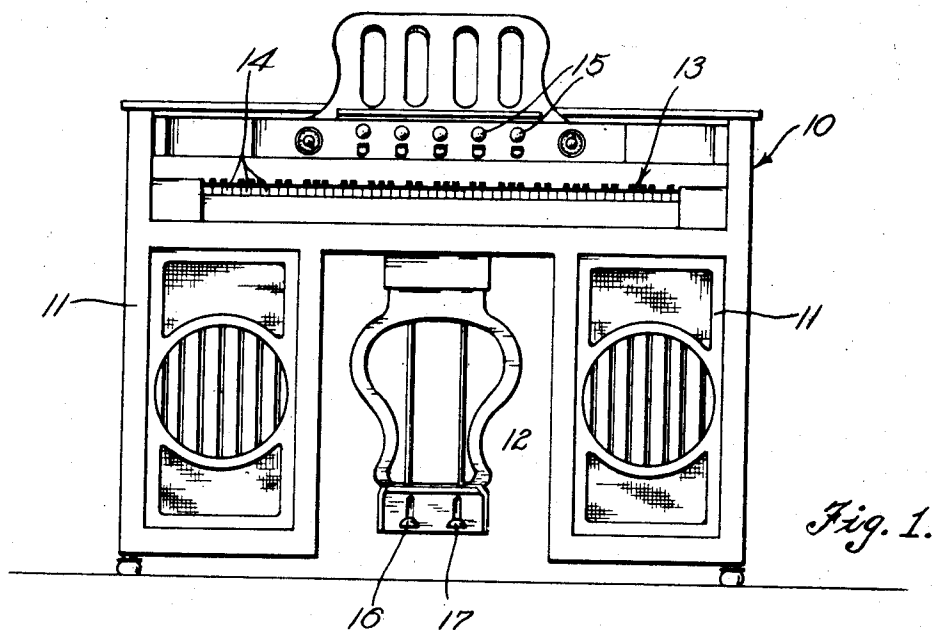


Fig. 1.

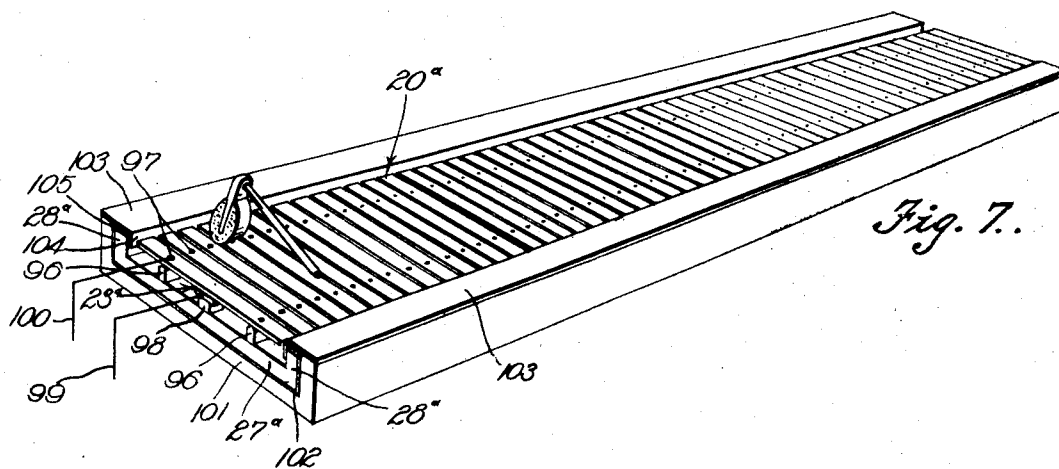


Fig. 7.

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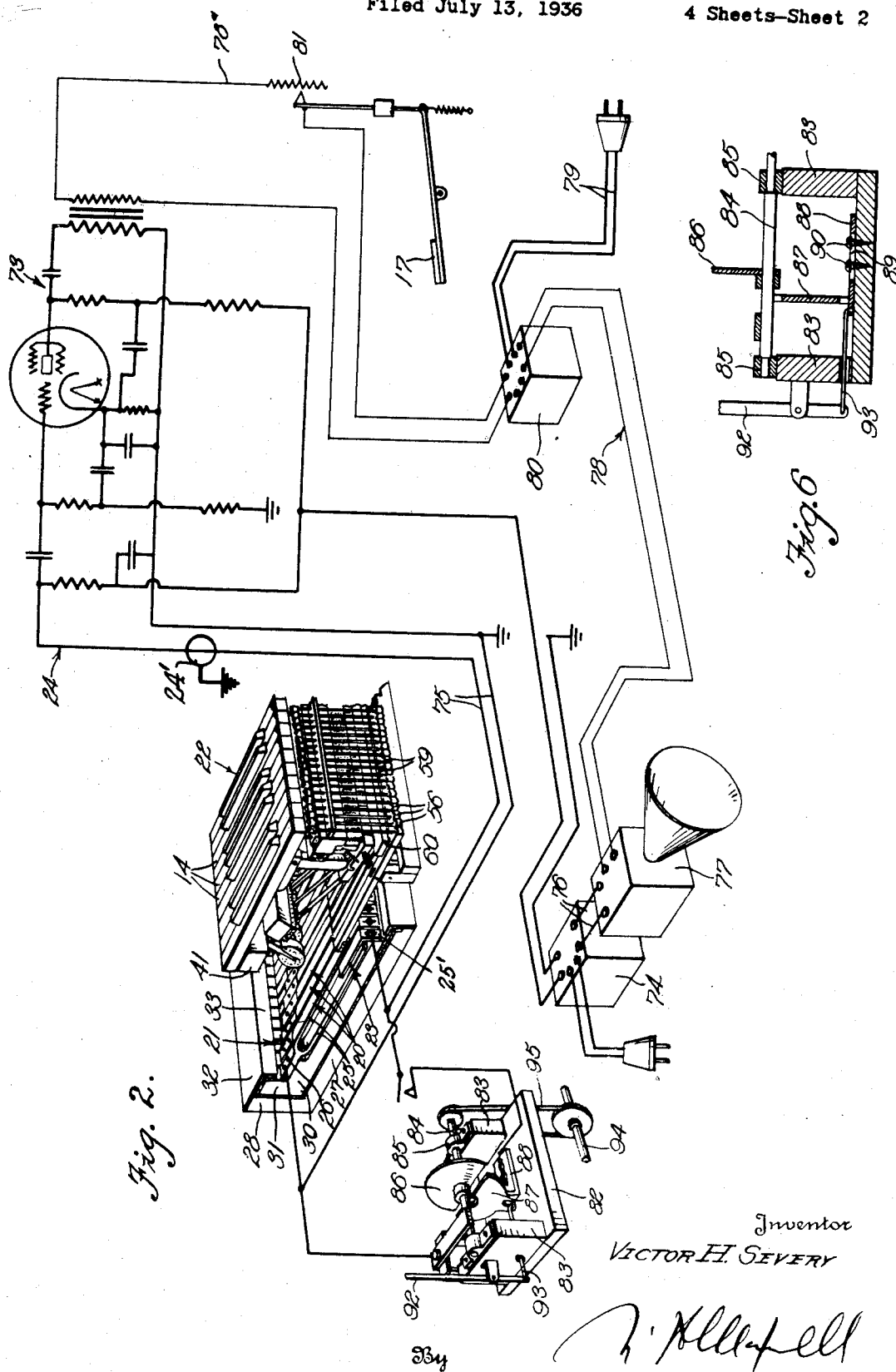
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ELECTRICAL MUSICAL INSTRUMENT

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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

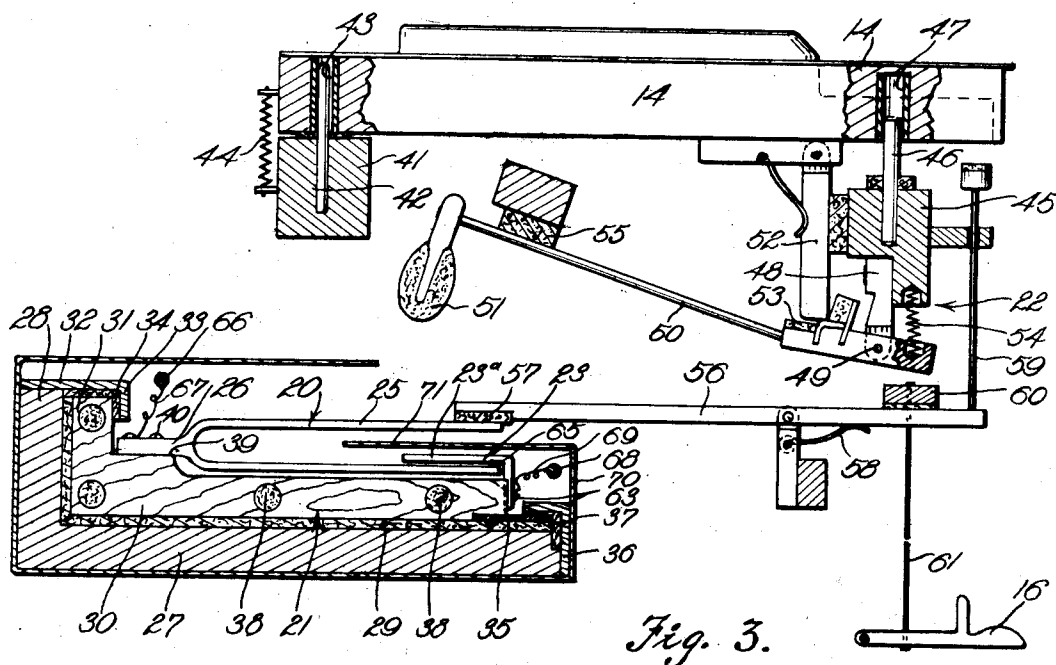


Fig. 3.

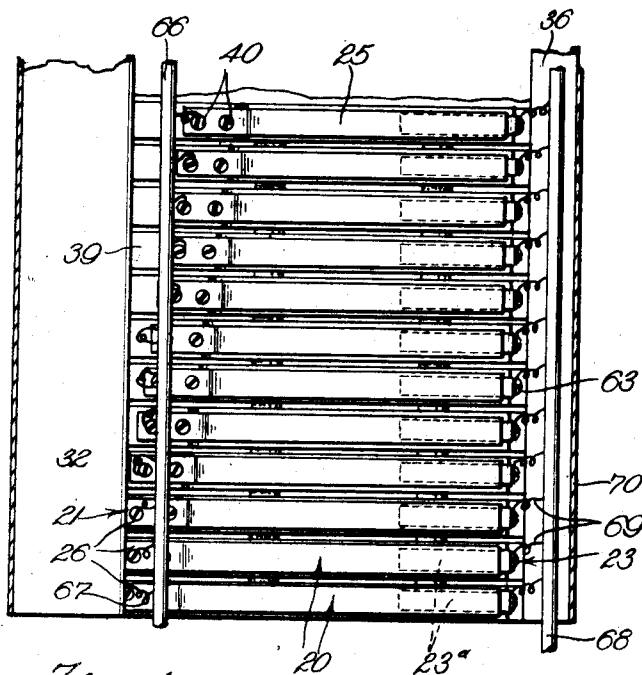


Fig. 4.

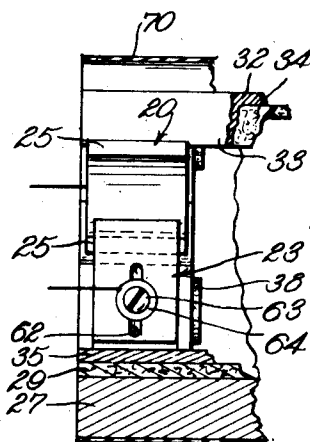


Fig. 5.

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Filed July 13, 1936

4 Sheets-Sheet 4

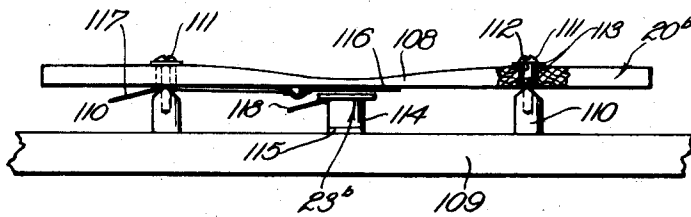


Fig. 8.

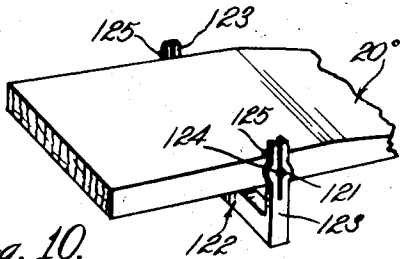


Fig. 10.

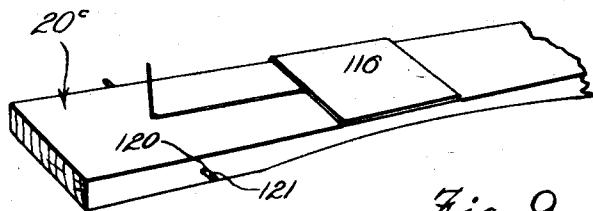


Fig. 9.

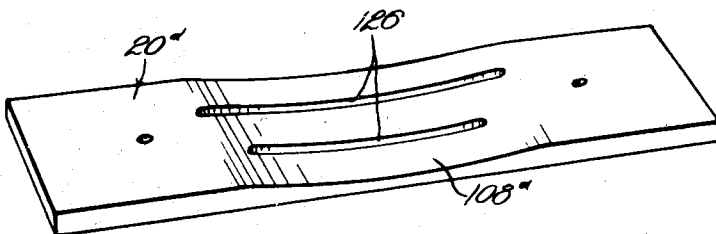


Fig. 11.

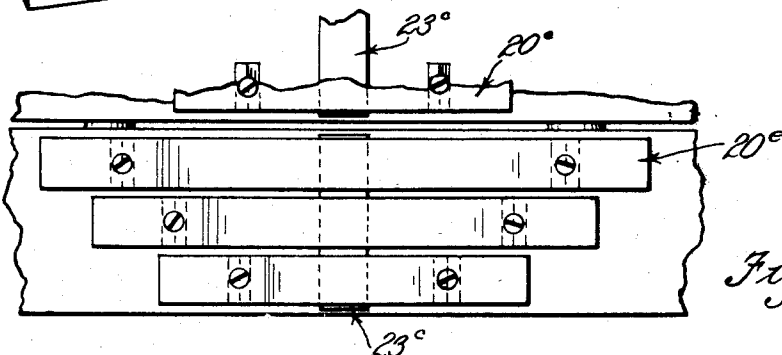


Fig. 12..

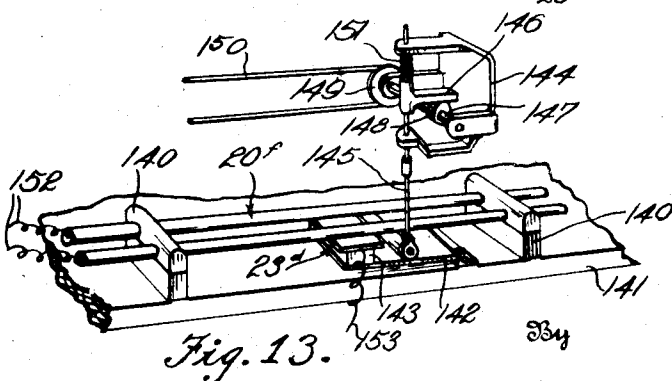


Fig. 13.

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UNITED STATES PATENT OFFICE

2,187,251

ELECTRICAL MUSICAL INSTRUMENT

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Application July 13, 1936, Serial No. 90,273

2 Claims. (Cl. 84—1)

This invention relates to musical instruments and relates more particularly to musical instruments embodying electrostatic pick-ups responsive to or receptive to the vibration of vibratile sounders such as bars, forks, or the like. A general object of the invention is to provide a practical effective electrostatic musical instrument of the character just mentioned capable of producing clear, pleasing, true musical tones.

Another object of this invention is to provide a musical instrument embodying a multiplicity of tuned vibratile sounders each capable of fluctuating or varying the potential of its respective electrostatic pick-up, which variations in potential are in turn imposed on a loud speaker circuit whereby the vibrations of the individual sounders are electrically converted into sound.

Another object of this invention is to provide an electrostatic musical instrument of the character mentioned in which the vibrators or sounders are arranged in a compact relation and are acoustically insulated one from the other so that there is little or no interference of vibration or transference of vibration from one sounder to the other.

Another object of this invention is to provide an electrical musical instrument of the character mentioned embodying simple, effective means for producing a tremolo effect.

Another object of this invention is to provide an improved electrical musical instrument of the character mentioned that may be played and manipulated in the same manner as a typical musical instrument such as a piano, organ, or the like.

Another object of this invention is to provide an electrical musical instrument of the character mentioned embodying a novel relationship between the vibratile sounders and the electrostatic pick-ups whereby the vibrations of the sounders are properly and fully imposed on the pick-ups without danger of direct physical contact between the sounders and the stationary field members of the pick-ups.

Another object of this invention is to provide an instrument of the character mentioned embodying a novel device or attachment for rapidly moving the electrostatic pick-ups toward and away from the vibratile sounders to produce a variable tremolo effect.

Another object of this invention is to provide an electrical musical instrument of the character mentioned in which the vibratory sounding bars are supported by novel means at their nodal

points to be free to vibrate in their characteristic manners.

A further object of this invention is to provide an electrical musical instrument of the character mentioned embodying means for governing the intensity of the musical tones and for independently governing the intensity of the tremolo effect.

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

Fig. 1 is a front elevation of a case or cabinet in which the instrument may be housed. Fig. 2 is a wiring diagram and fragmentary schematic view illustrating the electrical circuits and their relationship to the other parts. Fig. 3 is an enlarged vertical detailed sectional view of the instrument illustrated in Fig. 2 illustrating one of the sounders, the adjacent pick-up and the means for vibrating the sounder. Fig. 4 is a fragmentary top or plan view of a group of the sounders and their pick-ups. Fig. 5 is an enlarged fragmentary vertical detailed sectional view illustrating one of the sounders and its pick-up. Fig. 6 is an enlarged vertical detailed sectional view of the variable condenser for producing the tremolo effect. Fig. 7 is a perspective view of a group of sounders of a different character and their associated pick-ups. Fig. 8 is a fragmentary side elevation illustrating another form of sounder and pick-up with a portion broken away to appear in vertical cross section. Fig. 9 is a fragmentary perspective view of still another form of sounder. Fig. 10 is a fragmentary perspective view of a sounder illustrating an improved manner of supporting the same. Fig. 11 is a perspective elevation view of another form of vibratile sounder. Fig. 12 is a plan view of a set or series of bar sounders and their electrostatic pick-up and Fig. 13 is a fragmentary perspective view illustrating a pair of vibratile bars and means for moving the electrostatic pick-up to produce a tremolo effect.

The instrument provided by the present invention may take various forms and may be varied considerably to produce tones of various qualities. In the following detailed disclosure I will describe several different forms and applications of the invention, 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.

Fig. 1 of the drawings illustrates a cabinet or case 10 of the character in which the parts and mechanisms of any one of the various forms of the invention may be housed in the event the instrument is to be under direct manual control and manipulation. The case 10 illustrated includes two lower side portions 11 adapted to contain various mechanisms such as the loud speaker, the tremolo producing mechanism and the like. The space 12 occurring between the side portions 11 is adapted to receive the knees of the musician. A keyboard 13 extends horizontally across the upper forward face of the case 10. The keyboard 13 may comprise a multiplicity of depressible keys 14 of the same character and arrangement as the keys of a piano or organ. A series of pull knobs 15 is provided above the keyboard 13 for the control of certain instrumentalities of the instrument. A pair of pedals 16 and 17 is provided in the space 12 to govern certain controls to be hereinafter described. It is to be understood that the case 10 illustrated in the drawings is merely typical in design and that the instrument may be housed in cases or cabinets of various designs and constructions.

The form or embodiment of the invention illustrated in Figs. 2 to 7, inclusive, of the drawings, includes, generally, a multiplicity of tuned vibrators or sounders 20, means 21 individually supporting the sounders 20 for independent vibration, means 22 for actuating or vibrating the sounders 20, electrostatic pick-ups 23 receptive to vibrations of the sounders 20 and an amplifying and loud speaker circuit 24 for converting variations in the potentials of the pick-ups 23 into sound. The conductors in this circuit are preferably shielded by grounded shields as indicated diagrammatically at 24' at the left of the circuit in Figure 2.

The vibratile elements or sounders are adapted to be vibrated to vary the potentials of the fields of the pick-ups 23 and thus produce modulations in an electrical current which modulations are translated into sound by the speaker circuit 24. In the particular form of the invention being described the sounders 20 are in the form of bifurcated metal bars or forks each having a pair of spaced tines 25. Each fork or sounder 20 has a shank 26 projecting longitudinally from the point of juncture of its tines 25. The sounders 20 may be similar in shape and construction although they are of different lengths and proportions to produce vibrations corresponding to or proportional to the vibrations of various tones. In practice the sounders 20 are graduated in length and are formed and tuned to be capable of producing a full scale or at least a musical scale of substantial range. The tines 25 of each sounder are preferably substantially parallel. The sounders 20 are preferably, though not necessarily, formed of steel or other electrical conducting material. The shanks 26 of the sounders 20 are comparatively heavy or thick to be subject to a minimum of vibration. The shanks 26 of the several sounders 20 may be of substantially the same length.

The means 21 mounting or supporting the sounders 20 supports the sounders for independent vibration and in an orderly and compact relation. The means 21 includes a suitable carrier 27. The carrier 27 is an elongate member of substantially L-shaped transverse cross section having a longitudinal flange 28 projecting upwardly along one edge. Where the instrument is housed in a case similar to the case

10 the carrier 27 is preferably arranged in a horizontal position in the main upper portion of the case. A covering or layer 29 of vibration dampening and acoustical insulating material is provided on the upper surface of the carrier 27 and the inner side of its flange 28. The means 21 further includes blocks 30 for independently or individually supporting the sounders 20. There is a block 30 provided for carrying each sounder 20. The blocks 30 are formed of wood or the equivalent. In accordance with the invention the blocks 30 are supported on the layer 29 of acoustical insulation and each block 30 has a flange 31 at one end bearing against the flange 28 through the medium of the insulation layer 29.

A plate 32 extends along the upper edge of the flange 28 and has a lip 33 extending downwardly at the inner side of the flange 31. Acoustical insulating material 34 is interposed between the plate 32 and the lip 33 of the plate and the opposing surfaces of the flange 31. An anchoring plate 35 may be suitably secured to the outer or plain end portion of each block 30 and an angle iron 36 may extend along the plain end of the carrier 27 to engage downwardly against the plates 35. Acoustical insulation 37 is interposed between the opposing surfaces of the plates 35 and the angle iron 36. The plate 32 and the angle iron 36 secure the several blocks 30 against excessive movement and displacement. In accordance with the invention the blocks 30 are insulated from one block to the other. Spaced buttons 38 are provided between and space the opposing surfaces of the blocks 30 and their flanges 31. The buttons 38 are formed of vibration absorbing and acoustical insulating material. The plurality of blocks 30 may be of the same length to have their plain or unflanged ends in alignment. In practice the plain end or edge portion of the carrier 27 projects beyond the adjacent ends of the blocks 30.

In accordance with the invention an upwardly facing shoulder or seat 39 is provided on each block 30. The seats 39 occur adjacent the flanges 31 and are elevated above the principal upper surfaces of the blocks. The spacing of the seats 39 from the outer or plain ends of the blocks 30 is graduated in direct proportion to the lengths of the graduated tuned sounders 20. The shanks 26 of the sounders 20 rest on the seats 39. Screws 40 or the like, may secure the shanks 26 to the seats 39. The seats 39 support the sounders 20 so that their tines 25 are spaced one above the other with the lower tines 25 spaced a sufficient distance above the blocks 30 so that they cannot contact the blocks when vibrating. The sounders 20 are supported on the graduated seats 39 so that the outer ends of their tines 25 are in alignment adjacent the outer ends of the blocks 30. The sounders 20 individually mounted as just described may vibrate with a minimum of vibratile interference.

The means 22 for vibrating the sounders 20 may be varied in character without departing from the broader aspects of the invention. In the particular case illustrated the means 22 for actuating the sounders 20 includes the keys 14 of the key-board 13. The keys 14 have their inner ends pivotally supported on a suitable horizontal support 41. Pivot pins 42 project from the support 41 into lined openings 43 in the inner portions of the keys 14. Springs 44 are connected with the inner ends of the keys 14

to return the keys and to normally retain them in their horizontal positions. A horizontal support 45 is spaced below the forward end portions of the keys 14. Guide pins 46 project from the support 45 and extend into lined openings 47 in the keys 14. Brackets or hangers 48 depend from the support 45 and pivot pins 49 pivotally secure hammers 50 to the hangers 48. The hammers 50 have heads 51 of felt or the like for striking against the upper tines 25 of the sounders 20. It is to be understood that there is one key 14 and one hammer 50 for each sounder 20. The parts are related so that the hammers 50 are adapted to strike the upper tines 25 of the sounders 20 adjacent their outer ends to effect proper vibration of the sounders. Push rods 52 are pivoted at the under sides of the keys 14 and are adapted to cooperate with felt cradles 53 on the hammers 50 to actuate the hammers when the keys 14 are depressed. Springs 54 are connected with the hammers 50 and normally hold them in their retracted positions against felt stops 55.

A pivotally supported lever 56 is provided below each hammer 50. The levers 56 carry felt pads 57 for contacting the upper tines 25 of the sounders 20 to dampen the vibration of the sounders. Springs 58 act on the levers 56 to hold their felts or pads 57 against the tines 25. Push rods 59 are engageable by the keys 14 when the keys are depressed to pivot the levers 56 and move their felt pads 57 out of contact with the tines 25 so that the sounders 20 may be free to vibrate. A control bar 60 extends horizontally above the outer arms of the levers 56. A link 61 operatively connects the pedal 16 with the bar 60. When the pedal 16 is depressed the bar 60 is moved downwardly to pivot the several levers 56 to positions where their felt pads 57 are clear of the tines 25. Thus depression of the pedal 16 operates to sustain the tones produced by vibration of the sounders 20. It is obvious that various changes may be made in the mechanism just described, for actuating the sounders 20, without departing from the invention.

The electrostatic pick-ups 23 are operable to convert vibrations of the sounders 20 into modulations in the potential of an electrical current which modulations are in turn translated into sound by the amplifying and loud speaker circuit 24. In accordance with the invention a separate or individual pick-up 23 is provided for each vibratile sounder 20. The pick-ups 23 may be simple integral members of suitable electrical conducting non-magnetic material. In the preferred construction the pick-ups 23 are secured to the plain or outer ends of the blocks 30. The pick-ups 23 are preferably adjustably secured to the blocks 30 so that they may be adjusted relative to the tines 25 of the sounders 30. Each pick-up 23 is provided with a vertical slot 62 and screws 63 pass through the slots 62 and are threaded into the blocks 30 to secure the pick-ups to the blocks. Washers 64 may be provided under the heads of the screws 63. When the screws 63 are loose or loosened the pick-ups 23 may be adjusted vertically. The screws 63 may be tightened down to rigidly secure the pick-ups 23 in their adjusted positions.

Each pick-up 23 has a laterally or horizontally projecting arm 23^a. The arms 23^a are positioned above and are substantially parallel with the lower tines 25 of the sounders 20. The arms 23^a are located so that they are not contacted by the tines when the sounders 20 are vibrated. Being

located above the lower tines 25 there is little or no danger of the arms 23^a being contacted by the tines when the sounders are struck by the hammers 50. The invention, however, preferably provides a pad 85 of felt, or the like, on each pick-up arm 23^a above the outer extremity of the adjacent lower tine 25 to positively prevent the tine from contacting the pick-up arm in the event the sounder is excessively vibrated.

In the preferred construction the lower tines 25' of the pick-ups 23 constitute the movable elements or armatures of the pick-ups. A common conductor or bus rod 66 is provided above or adjacent the shanks 26 of the series of sounders 20 and leads 67 electrically connect the individual sounders 20 with the bus rod 66. A common conductor or bus rod 68 extends horizontally adjacent the series of pick-ups 23 and leads 69 electrically connect the individual pick-ups with the rod 68. In accordance with the invention the assembly of the series of sounders 20 and their pick-ups 23 is shielded against external movements and disturbances. A shield 70 of magnetic iron or soft iron extends around the carrier 27 and has its upper portion extending over the major portion of the assembly. The shield 70 preferably has a web 71 extending horizontally between the upper and lower tines 25 of the sounders 20. The shield 70 thus encloses or substantially encloses the sounders 20, the pick-ups 23, the rods 66 and 68 and the leads 67 and 69. The upper tines 25 of the sounders 20 project outwardly above the shield web 71 to be engageable by the hammers 50 and the dampening pads 57.

The amplifying and loud speaker unit or circuit 24 is subject to variations in the potentials in the electrostatic pick-ups 23 produced by vibrations of the sounders 20 and translates or converts the fluctuations or variations into sound. In accordance with the broader aspects of the invention the unit or circuit 24 may be varied considerably in character. The particular system or circuit 24 illustrated includes an amplifying circuit 73 supplied with electrical current through the medium of a suitable transformer 74. Leads 75 electrically connect the bus rods 68 and 66 with the amplifying circuit 73. Electrical conductors 76 extend from the transformer 74 to a suitable loud speaker 77. The invention provides a secondary circuit 78 supplied with current by lines 79 through a transformer 80. The circuit 78 is electrically connected with the speaker unit or speaker 77. A variable rheostat 81 is interposed in one lead 78^a of the circuit 78. The movable element of the rheostat 81 may be controlled or moved by the pedal 17 as diagrammatically illustrated in Fig. 2 of the drawings. The rheostat 81 is adapted to govern the intensity or volume of the sound produced by the speaker 77. It will be apparent how variations in the potentials of the pick-ups 23 produced by vibrations of the sounders 20 are transmitted to the speaker 77 through the amplifying circuit 73 to be produced as sound or musical tones. The musician may control the volume of the sound thus produced by manipulation or control of the pedal 17.

The invention may include a means for producing a tremolo effect in the sound or musical tones produced by the speaker 77. The tremolo producing means may include a base 82 provided with a pair of upstanding standards 83. A shaft 84 is rotatably supported by bearings 85 on the standards 83. The tremolo producing means is

in the nature of a variable condenser and includes a rotor 86 fixed on the shaft 84 and a relatively stationary stator 87. The rotor 86 and the stator 87 are in the form of semi-discs or partial discs. A foot flange 88 is secured to the stator 87 and may rest on the base 82. An elongate slot 89 is provided in the flange 88 and pins or screws 90 extend through the slot 89 into the base 82. The flange 88 carrying the stator 87 is adjustable or shiftable on the base 82 and the pins 90 serve to guide the flange and prevent it from lifting from the base. The stator 87 is adapted to be manually shifted or controlled from a remote point. A lever 92 is suitably pivotally mounted on one of the standards 83 and is connected with the flange 88 by a suitable link 93. The lever 92 may be pivoted by manipulation of one of the pull knobs 15 through a suitable control mechanism to effect shifting of the stator 87 axially relative to the rotor 86.

The rotor 86 is intended to be rotated at a constant speed to produce the tremolo effect. In the typical arrangement illustrated a driven shaft 94 driven by a suitable power means (not shown) is arranged in spaced parallel relation with the shaft 84. A belt and pulley drive 95 operatively connects the shaft 94 with the shaft 84. The power means driving the shaft 94 may be controlled or energized by the musician so that the tremolo producing means may be employed at his option. It will be apparent how constant rotation of the partially disc shaped rotor 86 relative to the partially disc shaped stator 87 effects a regular surge or variation in the potential of the circuit to produce a tremolo effect on the tones emitted by the speaker 77. The intensity of this tremolo effect may be readily governed by shifting the stator 87 relative to the rotor 86.

In the operation of the instrument the musician may depress or manipulate the keys 14 in the same manner as the keys of an organ or piano. Depression of the keys causes their respective hammers 50 to strike the aligned upper sounder tines 25 to vibrate the sounders. The vibrating lower tines 25 of the sounders 20 vary the electrical potentials of the fields at the pick-ups 23 to produce variations or modulations in the electrical circuit in which the pick-ups are connected. These fluctuations or variations are amplified by the circuit 73 and are translated into sound by the speaker 77. The sound produced by the speaker 77 is thus truly representative of the physical vibrations of the sounders 20.

The sounders 20 are mounted or supported by the means 21 for independent vibration so that the vibration of one sounder does not produce sympathetic vibrations of the adjacent sounders. Accordingly, there is little or no interference of vibration to the sounders. The instrument embodies several controls whereby the intensity, duration and character of the tones may be readily governed by the musician. The pedal 15 may be manipulated to control the time or periods the tones are sustained. The pedal 17 may be manipulated to readily govern the intensity of the tones produced by the speaker 77. The tremolo producing device may be employed at the option of the musician. When it is desired to produce tremulous tones the motor or power means driving the shaft 94 is energized to effect constant rotation of the rotor 86 and one of the pull buttons 15 may be shifted as desired, to control the intensity of the tremolo effect. The instrument is capable of producing clear pleasing

musical tones and may be easily played and manipulated by the musician.

Fig. 7 of the drawings illustrates a group of sounders 20^a in the form of bars of rectangular transverse cross section. The sounders 20^a are formed of steel or the like and are preferably arranged horizontally and in parallelism. In accordance with the invention the sounders 20^a are formed and proportioned to produce vibrations of various frequencies and thus produce various musical tones and the group of sounders 20^a may be capable of producing a complete musical scale. A carrier 27^a is provided to support the sounders 20^a. The carrier 27^a is an elongate trough-like structure having parallel flanges 28^a projecting upwardly along its longitudinal edges. Two spaced strips 96 are arranged on the upper surface of the carrier 27^a between its flanges 28^a. The upper edges of the strips 96 are bevelled to relatively sharp ridges. The bars or sounders 20^a are supported at their nodal points on the ridges or strips 96. Pins 97 may be provided on the strips 96 to cooperate with openings in the bars or sounders 20^a to hold the sounders in place.

An electrostatic pick-up 23^a is provided for each bar sounder 20^a. The pick-ups 23^a may comprise blocks or members of electrical conducting non-magnetic material. The pick-ups 23^a are preferably supported on the carrier 27^a. In the arrangement illustrated the pick-ups 23^a are each supported on a block 98 which in turn rests on the upper surface of the carrier 27^a. The pick-ups 23^a are located substantially midway between the nodes of the sounders so that there is no physical contact between the sounders and pick-ups when the sounders are in vibration. A common lead or conductor 99 is electrically connected with the several pick-ups 23^a. The metal or steel sounders 20^a preferably comprise the movable armatures of the electrostatic pick-ups 23^a. A common lead or conductor 100 is electrically connected with each of the several sounders 20^a, being connected with each sounder at one of its nodal points where there is a minimum of vibration. The bars or sounders 20^a are adapted to be actuated or vibrated by hammers similar to the hammers 50 described above. It is to be understood that there may be one hammer for actuating each sounder 20^a.

The carrier 27^a described above is preferably nested in a correspondingly shaped bed 101. Acoustical insulation 102 is interposed between the surfaces of the carrier 27^a and its bed 101. Plates 103 preferably extend along the upper edges of the bed 101 and have flanges 104 extending downwardly at the inner sides of the flanges 28^a to hold the carrier 27^a in place. Acoustical insulation 105 is interposed between the surfaces of the flanges 28^a and the plates 103 and their flanges 104.

The assembly illustrated in Fig. 7 of the drawings may be embodied in the musical instrument in substitution for the sounders 20 described above, or may be embodied in the instrument with suitable actuating hammers in addition to the sounders as shown whereby the instrument is adapted to produce musical tones of a different quality. It will be apparent how the assembly illustrated in Fig. 7 may be readily arranged in a cabinet similar to the cabinet or case 10 to have its sounders 20^a actuated by key controlled hammers.

Fig. 8 of the drawings illustrates a bar type sounder 20^b formed of wood. The sounder 20^b is an elongate member preferably of rectangular

cross section. The lower side of the sounder 20^b is preferably flat while the upper side of the sounder is transversely grooved or provided with a depression 108 at a point midway between its nodes. The depression 108 is provided to tune the sounder and to give the sounder the desired quality of tone. A suitably insulated base 109 is provided to support the sounder 20^b. Two spaced strips or posts 110 project upwardly from the base 109. The upper ends of the posts 110 are bevelled to present relatively sharp ridges. The bar sounder 20^b is supported at its nodal points on the ridges of the posts 110 to be free to vibrate in its characteristic manner. Pins or screws 111 pass through openings 112 in the sounder 20^b and are threaded into the posts 110 to retain the sounder in position. Acoustical insulating material 113 lines the openings 112 and is provided under the heads of the screws 111 to prevent direct physical contact between the sounder 20^b and the screws.

An electrostatic pick-up 23^b is provided for the sounder 20^b. The pick-up 23^b is in the nature of a disc of electrical conducting non-magnetic material. The pick-up 23^b is supported on the upper end of a post 114 which rests on the base 109 through a washer 115 of insulating material. The disc pick-up 23^b is arranged in horizontal position and is spaced below the sounder 23^b. The pick-up 23^b is located substantially mid-way between the nodal points of the sounder 20^b.

The pick-up 23^b further includes an armature 116 on the under side of the sounder 20^b. The armature 116 is preferably in the nature of a piece of foil of electrical conducting non-magnetic material. The armature 116 is secured to the flat under side of the sounder 20^b to be immediately above the disc pick-up 23^b. An electrical lead 117 is connected with the armature 116 and extends along the under surface of the sounder 20^b to one of its nodal points. The conductor 117 may extend freely from one of the posts 110 to be directed to the desired point. A lead or conductor 118 is connected with the disc pick-up 23^b. The leads 117 and 118 are adapted to be connected in a suitable amplifying and loud speaker circuit.

The musical instrument of the present invention is adapted to be provided with a multiplicity of sounders 20^b of different or graduated pitch, which sounders may be actuated or vibrated by suitable key controlled hammers similar to the hammers 50. The group of sounders 20^b may be substituted for the sounders 20 or 20^a. When a sounder 20^b, 20^c or 20^e is vibrated by means of a hammer or the like the armature 116 on its under side moves or vibrates relative to the stationary disc pick-up 23^b to produce variations in the potential of the pick-up field. Thus the electrical circuit in which the pick-up is connected is subjected to fluctuations or variations which are imposed on the amplifying and loud speaker circuit to be translated into sound. The wooden sounders 20^b of course produce tones of a different character and quality than the metallic sounders 20 and 20^a.

Figs. 9 and 10 of the drawings illustrate an improved manner of mounting a bar type sounder 20^c similar in character to the sounder 20^b. Transverse openings 120 are provided in the sounder 20^c exactly at its nodal points. A pivot pin 121 preferably of catgut, or the like, is passed through each opening 120 to have its opposite end portions project from the sides of the sounder. A cradle 122 is positioned below each

nodal point of the sounder 20^c and has two up-standing arms 123. The arms 123 project upwardly at the opposite longitudinal edges of the sounder 20^c and their upper portions are slit or bifurcated. A transverse opening 124 is provided in each arm 23 in the plane of and in communication with its slit or bifurcation. The openings 124 receive the projecting portions of the pivot pins 121. Screws 125 are provided to clamp the slit portions of the arms 123 together to retain the pivot pins 121 in the openings 124. The sounder 20^c supported in the manner just described is free to vibrate at will in its characteristic manner to produce sustained vibrations of a peculiar character. It is to be understood that the sounder 20^c may be provided with an armature 116 to be associated with a pick-up 23^b in the manner described above. The sounder 20^b and the sounders illustrated in Figs. 11 and 12 of the drawings may be mounted in any suitable manner.

Fig. 11 illustrates a sounder 20^d of the general character illustrated in Figs. 8, 9 and 10. The bar sounder 20^d may be employed or utilized in the same manner as the sounders 20^b and 20^c. The sounder 20^d may be provided with a transverse groove or depression 108^a between its nodal points. In accordance with the invention one or more elongate slits 126 are provided in the sounder 20^d. The slits 126 extend longitudinally of the sounder and occur in the portion of the sounder between the nodal points. The slits 126 thus occur in the portion of the sounder made thin by the presence of the depression 108. The slits 126 divide the sounder into three integrally connected portions, one being adapted to produce fundamental tone vibrations, and the other two portions being adapted to produce partials or harmonics of said fundamental. The slotting of the bar tends to allow more freedom of vibration where the slots occur at the middle of the bar. The provision of slots of different lengths tends to cause the bar to vibrate at more than one periodicity due to its breaking into a natural movement over each section on account of its elasticity. This causes a harmonic movement superimposed upon the fundamental movement such as happens in the vibration of a piano string and results in a composite tone. The slots or slits 126 are proportioned to give the bar or sounder 20^d the desired pitch and the desired quality of tone. The type of sounder illustrated in Fig. 11 of the drawings may be associated with an electrostatic pick-up in the same manner as the sounders 20^b and 20^c and may be mounted for vibration in any suitable manner. When the sounder 20^d is vibrated it produces a pleasing compound tone.

Fig. 12 of the drawings illustrates a plurality of adjacent bar sounders 20^e adapted to be vibrated simultaneously to produce a compound tone. In the arrangement shown the total width of the three bars 20^e in one group is intended to be substantially the same as the width of one of the bars or forks 20^a or 25 so that a hammer such as 51 will strike all of the bars in the set simultaneously. This is similar to the manner in which the hammer of a piano strikes the three strings of a middle register simultaneously. In the particular arrangement illustrated there are three toned vibratile bar sounders 20^e graduated in length. The longest sounder 20^e may be considered the fundamental sounder capable of vibrating to produce a fundamental tone while the other two sounders 20^e may be capable of vibrat-

ing to produce harmonics of the said fundamental. Thus when the three sounders 20^a are struck simultaneously by a hammer or the like they produce vibrations adapted to be translated into a compound musical tone by a suitable amplifying and loud speaker circuit. The sounders 20^a may be mounted or supported at their nodal points in any suitable manner. A single stationary pick-up 23^c extends transversely below the set of sounders 20^a substantially midway between their nodes. Individual movable armatures similar to the armature 116 described above are provided on the under sides of the sounders 20^b to be directly above and spaced from the pick-up 23^c. Upon simultaneous vibration of a group of sounders 20^a the potential of the pick-up field is varied and the resultant modulations in the electrical current may be converted into sound by a suitable amplifying and loud speaker circuit. It will be apparent that the instrument may be provided with a series of groups of sounders 20^a to be vibrated by key controlled hammers to produce compound tones.

Fig. 13 illustrates another means for producing a tremolo effect. In the structure illustrated in Fig. 13 two bar sounders 20^f are supported at their nodes by suitable supports 140. The supports 140 are carried by a base 141 spaced below the sounders 20^f. The sounders 20^f may be steel bars of different diameters whereby they are capable of producing vibrations of different frequencies. The sounders 20^f may be vibrated simultaneously or individually by means of hammers similar to the hammers 50 described above. It is to be understood that there may be any desired number of sounders 20^f.

An electrostatic pick-up 23^d is provided for the sounders 20^f. The pick-up 23^d may comprise a member of electrical conducting non-magnetic material arranged transversely below the sounders 20^f at their points of maximum vibration. In accordance with the invention the electrostatic pick-up 23^d is supported for movement relative to the vibratile bar sounders 20^f. A member 142 is pivotally supported on the base 141 below the sounders 20^f. A block 143 is arranged on the member 142 and carries the electrostatic pick-up 23^d.

Means is provided to regularly oscillate or move the pivoted member 142 to constantly change the position of the electrostatic pick-up 23^d relative to the sounders 20^f. A suitable bracket 144 is located above the assembly of sounders 20^f. A substantially vertical rod 145 is guided for vertical movement by the bracket 144 and has its lower end pivotally connected with the member 142. An arm 146 is fixed to and projects from the rod 145. A transverse or horizontal shaft 147 is rotatably supported by the bracket 144. A cam 148 is fixed to the shaft 147 and cooperates with the arm 146 to move the rod 145 vertically. A pulley 149 is fixed on the shaft 147 and a driven belt 150 operates over the pulley 149 to rotate the shaft 147. The shaft 147 is preferably rotated at a constant speed. A

spring 151 is preferably associated with the shaft 145 to urge its arm 146 against the cam 148 and to positively return the rod and the member 142 to their lower positions. A common lead or conductor 152 is connected with the several sounders 20^f. A similar conductor 153 is connected with the electrostatic pick-up 23^d. The leads 152 and 153 are adapted to be connected in a suitable amplifying and loud speaker circuit.

In the operation of the apparatus illustrated in Fig. 13 of the drawings the shaft 147 may be constantly rotated by the belt 150 so that the pick-up 23^d is moved toward and away from the bar sounders 20^f at a relatively rapid rate. When a sounder 20^f is vibrated its vibration varies the potential in the electric field of the pick-up 23^d to produce modulations or fluctuations in the electrical current of the pick-up circuit, which fluctuations may be translated into sound by the amplifying and loud speaker circuit. The driven cam 148 effects continuous reciprocation of the rod 145 to move the pick-up 23^d toward and away from the sounders 20^f. Accordingly, the intensity of the variations in the potential of the pick-up field is constantly varied and the tones produced by the loud speaker are tremulous. It is to be understood that the belt 150 need not be continuously driven but may be driven at the option of the musician. When the cam 148 is idle the pick-up 23^d is stationary relative to the sounders 20^f so that no tremolo effect is produced. The tremolo producing means illustrated in Fig. 13 of the drawings may be employed in conjunction with other forms of the invention.

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 an electrical musical instrument, a vibratile sounder, an electrostatic pick-up coacting with said sounder, means supporting the pick-up for movement toward and away from the sounder, and power driven cam means for moving the pick-up to produce a tremolo effect.

2. In an electric musical instrument, the combination of a metallic shield, a support mounted in the shield, a plurality of blocks carried by the support, means for insulating said blocks one from another, a vibrating fork mounted on each block, manually operable means for vibrating the respective forks, an electrostatic pick-up mounted on each block to coact with the fork on said block, a bus bar, electrical connections from said bus bar to each fork, a second bus bar, electrical connections from said second-named bus bar to each pick-up, said bus bars being connected with sound translating means, including a loud speaker, as and for the purposes described.

VICTOR H. SEVERY.