B. F. LIEFIELD.

MUSIC RECORDER.

APPLICATION FILED MAR. 30, 1914.

1,194,302.

Patented Aug. 8, 1916.

4 SHEETS—SHEET 1.

Fig. 1.

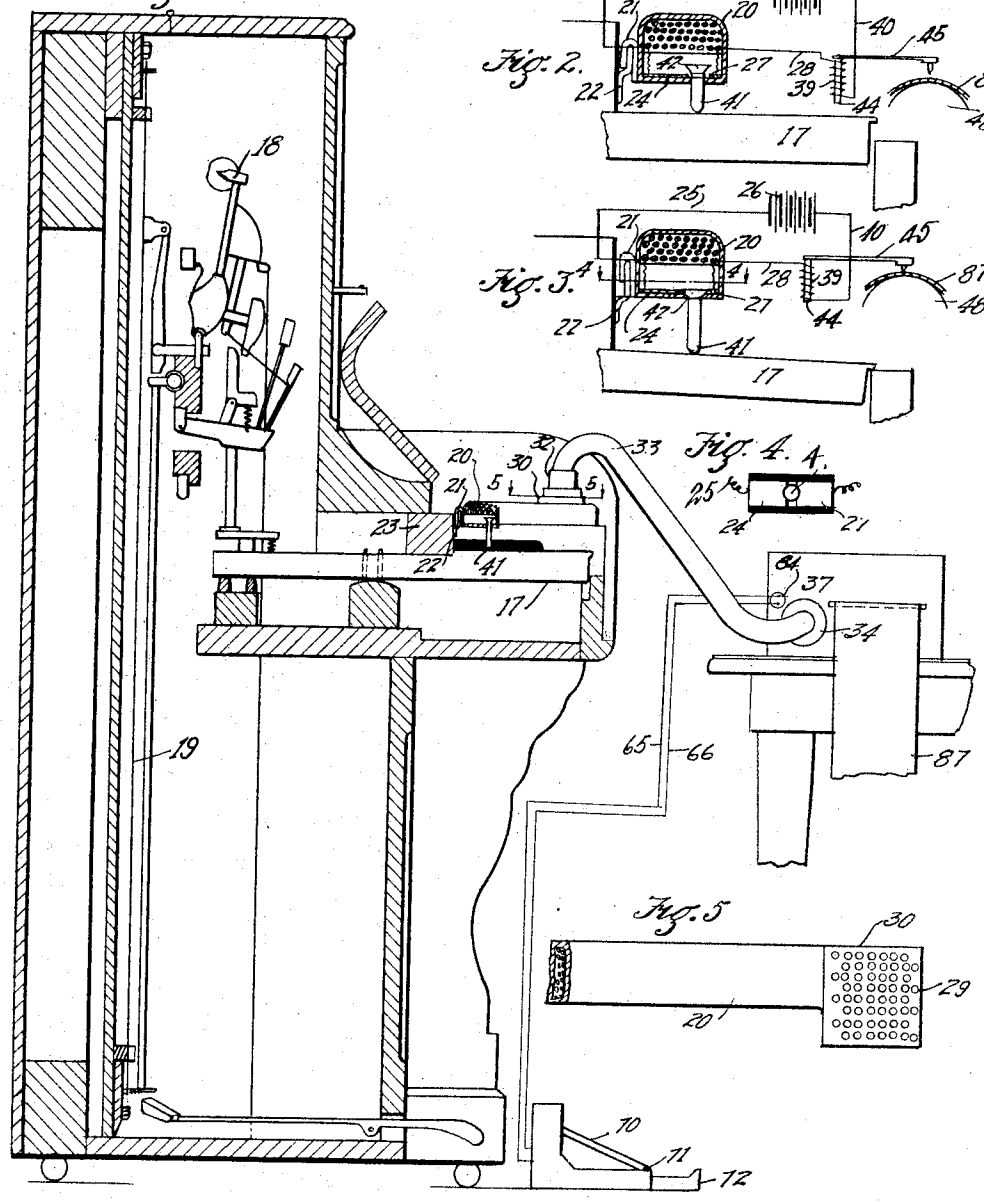


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5

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Marguerite Bates

By

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B. F. LIEFIELD.

MUSIC RECORDER.

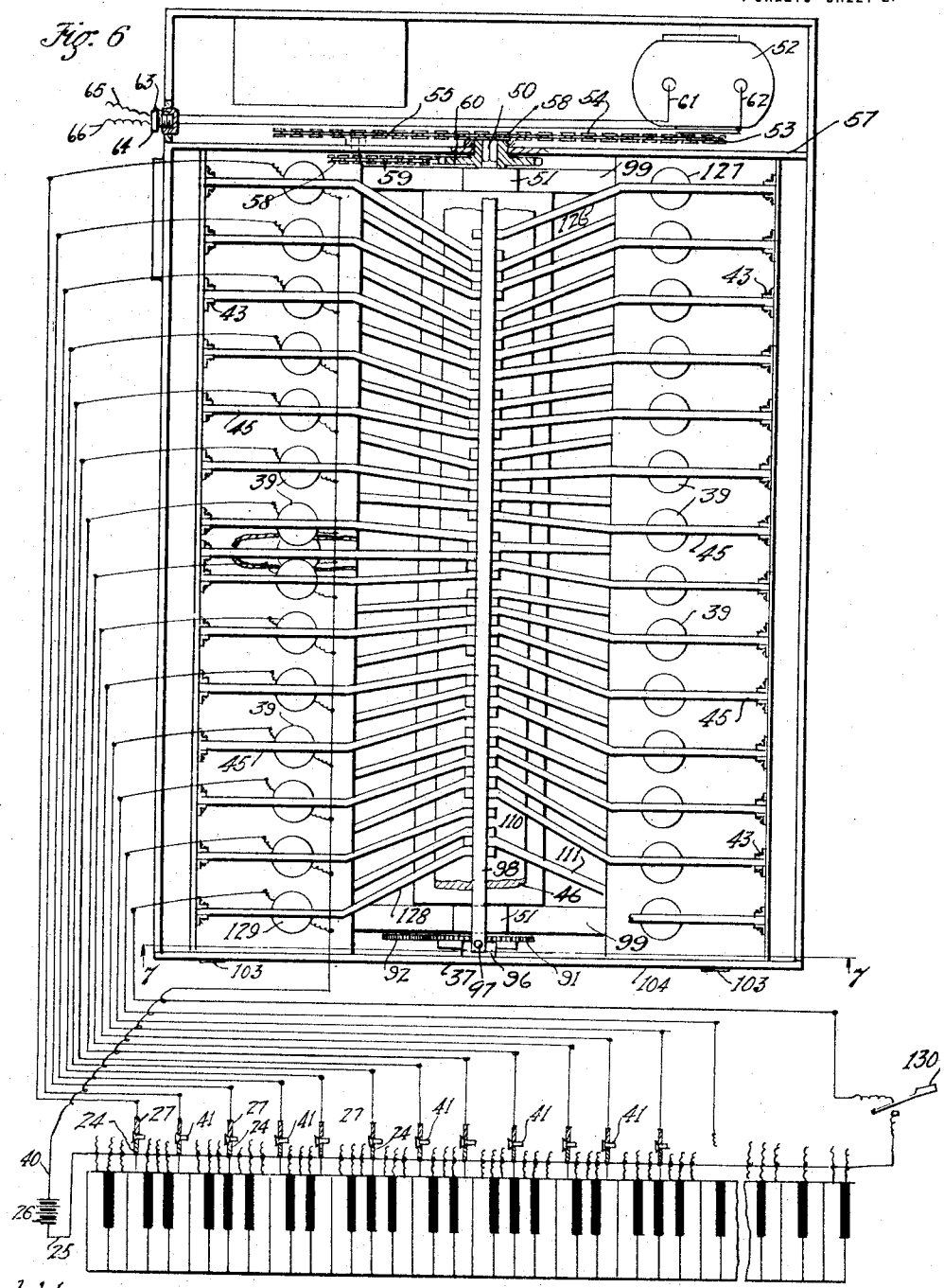
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4 SHEETS—SHEET 2.

Fig. 6



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4 SHEETS—SHEET 3.

Fig. 7.

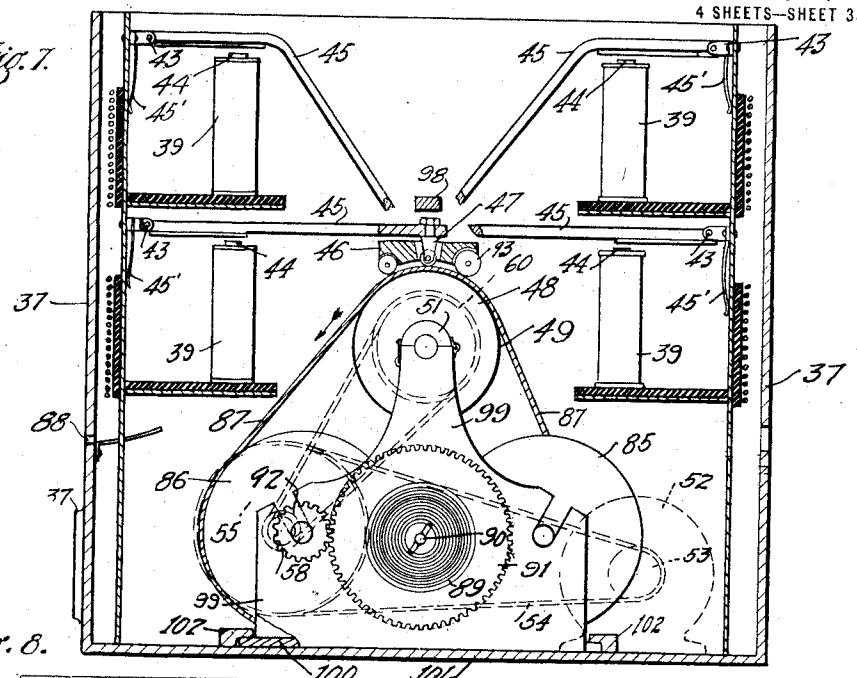


Fig. 8.

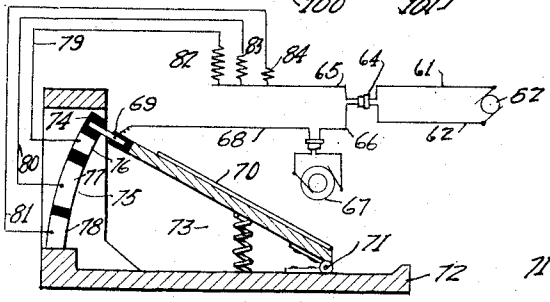


Fig. 9.

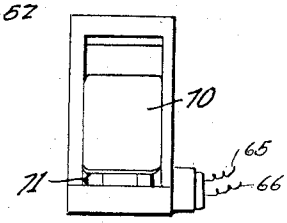


Fig. 11.

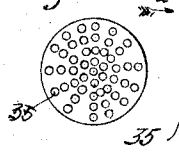


Fig. 10.

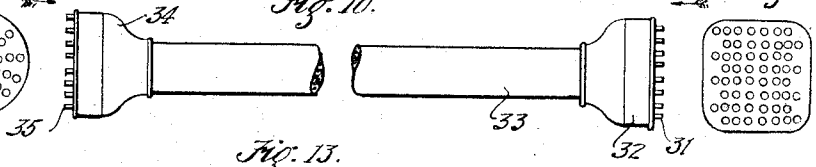


Fig. 12

Fig. 13.

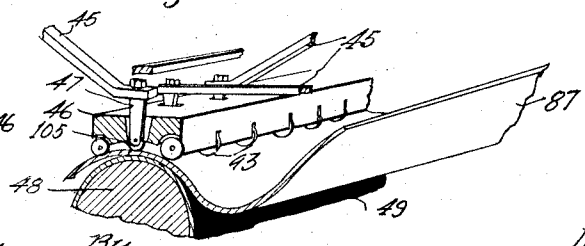
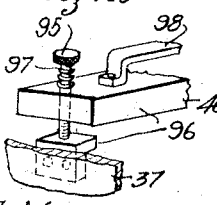


Fig. 19



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4 SHEETS—SHEET 4.

Fig. 14.

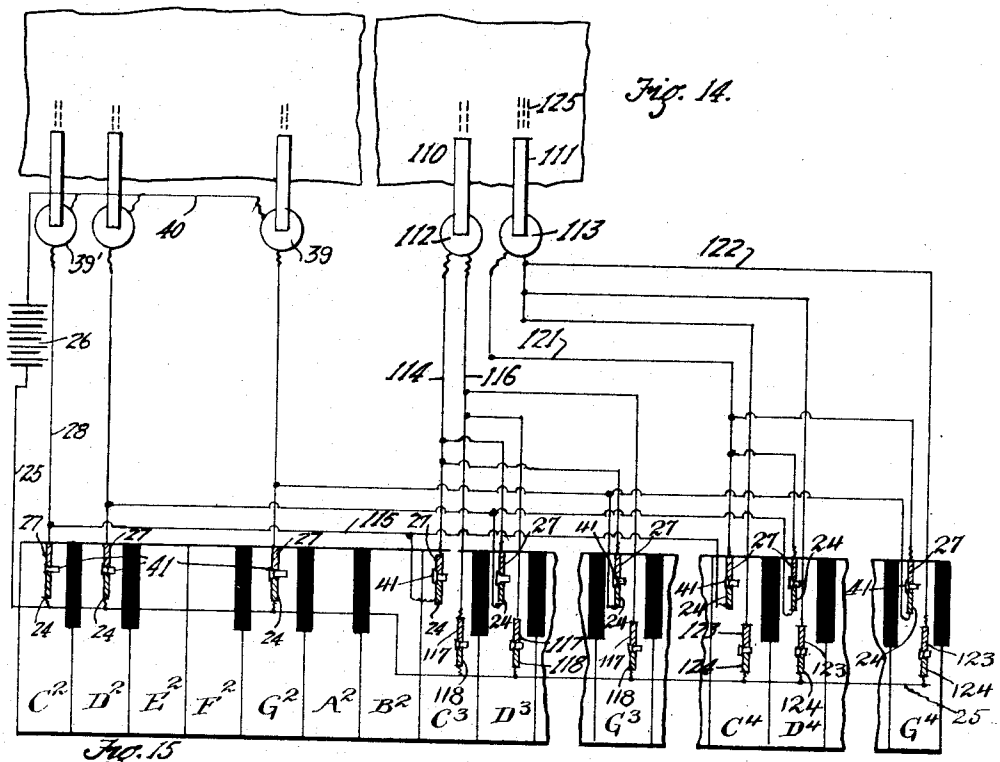


Fig. 15

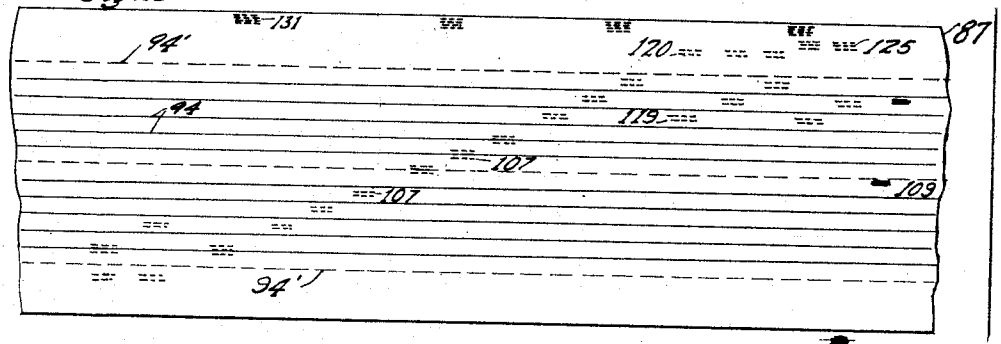


Fig. 16.

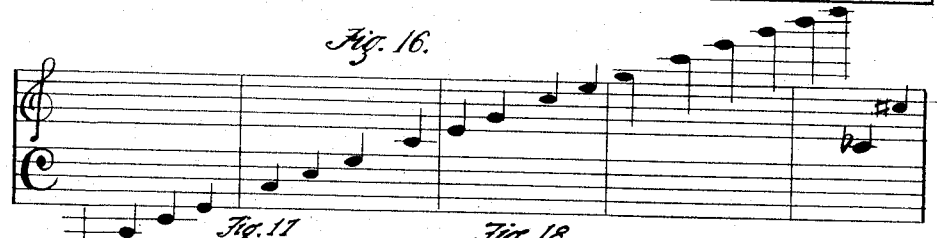


Fig. 17

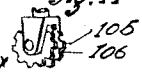


Fig. 18



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UNITED STATES PATENT OFFICE.

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MUSIC-RECORDER.

1,194,302. Specification of Letters Patent. Patented Aug. 8, 1916.

Application filed March 30, 1914. Serial No. 828,150.

To all whom it may concern:

Be it known that I, BENJAMIN FREDERICK LIEFIELD, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Music-Recorders, of which the following is a specification.

This invention relates to a tone recording apparatus and particularly pertains to an attachment for pianos, organs and like keyed musical instruments for indicating and recording tones played thereon.

It is the object of this invention to provide a mechanism which is adapted to be attached to most pianos and organs now generally in use by means of which the tones played on the instrument may be recorded.

Another object is to provide a mechanism of the above character which is electrically operated and to provide a simple means actuated by the keys for controlling electrical circuits which means can be readily attached to the key-board and removed therefrom without the use of direct connections to the keys.

A further object is to provide a music recorder with electrically operated devices controlled by the keys of a certain range of octaves, preferably four, for recording tones played on the instrument in the form of dots; dashes or lines on a recording sheet.

A still further object is to provide a means for indicating notes played outside of a range of octaves preferably four so as to simplify the construction and render it unnecessary to provide individual recording devices for the notes above the treble staff and below the bass staff.

This invention is illustrated in the accompanying drawings, in which:

Figure 1 is a view of a piano in vertical section showing the invention as applied. Fig. 2 is a detail transverse section of the piano key-board showing the switch for completing the electrical circuit by the depression of a piano key, and illustrating in diagram the circuits controlled thereby. Fig. 3 is a similar view showing a piano key as depressed, and the circuit closed to perform the note recording operation. Fig. 4 is a detail in plan of the circuit makers controlled by the keys of the instrument, as seen on the line 4—4 of Fig. 3. Fig. 5 is a detail in plan of the cable receiving plug as seen on the line 5—5 of Fig. 1. Fig. 6 is a plan view of the tone recording mechanism showing a portion of the connections to the piano key-board in diagram. Fig. 7 is a view in vertical section and elevation on the line 7—7 of Fig. 6 as viewed in the direction indicated by the arrows; parts being broken away to show the staff and note recording devices. Fig. 8 is a detail vertical section of the motor speed control treadle by which the recording strip can be caused to travel at various speeds, showing the electrical connections thereto in diagram. Fig. 9 is a front elevation of same. Fig. 10 is a detail in elevation of the cable for connecting the electrical devices and the recording mechanism to the circuit controlling mechanism on a piano key-board. Fig. 11 is an end elevation of the cable end as seen in the direction of the arrow —*a*— in Fig. 10. Fig. 12 is a view of the opposite end of the cable as seen in the direction indicated by the arrow —*b*— in Fig. 10. Fig. 13 is a detail in perspective illustrating the manner of forming the staff lines and recording the tones on the recording strip. Fig. 14 is a diagram illustrating the manner of recording the notes above the treble staff and below the bass staff. Fig. 15 is a view of the recording strip showing the manner of indicating the tones and measures thereon. Fig. 16 is a view showing the notes and measures as transcribed from the recording sheet, shown in Fig. 15. Figs. 17 and 18 are details in perspective of the recording disks. Fig. 19 is a detail in perspective view illustrating the manner of mounting the impression disk bar.

More specifically, 17 indicates the key-board of a piano, 18 denotes the piano action controlled thereby, and 19 represents the strings which are supported on the piano frame in the usual manner.

In carrying out the present invention a series of circuit controlling switches or circuit makers are removably attached to the piano casing in such manner as to be actu-

ated by the keys of the piano key-board, and which switches and their mounting are so constructed as to not necessitate attachments to the keys or changes in the piano case construction in applying the invention thereto.

The switch construction is particularly shown in Figs. 2, 3 and 4 and includes a casing 20 having downturned clips 21 thereon adapted to be engaged by upturned fingers 22 mounted on the rail 23 at the back of the key-board 17, which casing 20 extends throughout the length of the key-board and has a series of horizontally extending contact members 24 therein insulated therefrom and from each other and connected to a conductor 25 leading from a battery 26, or other suitable source of electrical power; a contact member 24 being arranged above each key of the key-board.

A series of horizontally extending contact members 27 are arranged on the casing 20 opposite the ends of the contact members 24 and are insulated from the latter and from each other; the outer ends of the contact members 24 being spaced a short distance from the contact members 27. Leading from each of the contact members 27 is a conductor 28 which leads to and terminates in a socket 29 formed in a rectangular plate 30 at one end of the casing 20; a socket being provided for each conductor 28. These sockets 29 are designed to receive plugs 31 on the end 32 of a cable 33, the opposite end 34 of which is fitted with studs 35 adapted to be inserted in corresponding sockets in a circular plate 36 on a portable casing 37, which sockets 36 connect with conductors 38 leading to a series of magnets 39, the opposite terminals of which lead to the battery 26 through a conductor 40. A magnet 39 is provided for each switch 24—27 controlled by each key within the range of four octaves; that is, two octaves above and two octaves below middle C. The switches actuated by the remaining keys, control another set of magnets as will be later described.

The magnets 39 are designed to be energized by the depression of the piano keys which control the switch members 24 and 27, the closing of which is effected by means of loose pins 41 of suitable non-conducting material, which are slidable between the ends of the contact members 24 and 27 and normally rest on the upper faces of the piano keys with conducting heads 42 on their upper ends positioned out of contact with the contact members 24 and 27, as shown in Fig. 2, but which pins will gravitate on the depression of a piano key to position the heads 42 in contact with the contact members 24 and 27 as illustrated in Fig. 3 to complete a circuit through the corresponding magnets 39 as will be later described.

In order to render the recording mechanism compact, the magnets 39 are arranged in superposed rows on opposite sides of the casing 37 as particularly shown in Fig. 7; a magnet being provided for each key of the instrument within a range of two octaves above and two octaves below the middle C. Pivoted at 43 and extending above the cores 44 of the magnets 39 are armature arms 45 which extend toward the center of the case 37 and terminate above a horizontally extending rail 46 supported in the case 37 and having a row of alined perforations formed therein, in which perforations a series of vertically disposed stems 47 are mounted; the stems 47 being connected at their upper ends to the outer ends of the arms 45. The underside of the rail 46 is curved transversely throughout its length on an arc of a circle and is positioned to extend parallel with an impression roller 48 concentric therewith.

The roller 48 is covered with a suitable impression material such as carbon paper 49 and is provided with trunnions 50 at its ends which are journaled in bearings 51. The roller 48 is designed to be rotated continuously in one direction at various predetermined speeds and is rotated by means of a motor 52 having a sprocket wheel 53 on its drive shaft, which sprocket wheel meshes with a chain 54 leading around a sprocket wheel 55 mounted on a stud shaft extending through a partition 57 in the case 37, and which stud shaft carries a small sprocket wheel 58 around which a sprocket chain 59 passes; the sprocket chain 59 engaging a sprocket wheel 60 on the trunnion 50 at one end of the roller 48.

The electric current for operating the motor 52 is supplied through conductors 61 and 62 leading from sockets 63 in the case 37 which sockets are designed to receive plugs 64 having conductors 65 and 66 connected thereto. The conductor 66 leads to one terminal of a generator 67 of any suitable type; the other terminal 68 of which connects with a wiper contact 69 on a treadle 70 pivoted at 71 to a portable base 72, as particularly shown in Fig. 7, and which base is adapted to be placed in convenient reach of the foot of the operator. The treadle 70 is normally disposed in an uppermost position by means of a spring 73 in which position the wiper contact 69 will be disposed on an insulated member 74 on a commutator segment indicated at 75, which segment comprises a series of contact plates 76, 77 and 78 insulated from each other, arranged in arcuate alinement and adapted to be traversed by the wiper 69. The contact plates 76, 77 and 78 connect with conductors 79, 80 and 81 which lead to resistance coils 82, 83 and 84, respectively, of gradually decreasing resistance which coils connect with the conductor 65. The treadle 70 is provided

for the purpose of controlling the speed of rotation of the motor 52 by permitting more or less current to flow therethrough as desired to vary the speed of rotation of the roller 48.

Mounted within the case 37 below the roller 48 and extending longitudinally therewith on opposite sides thereof is a feed reel 85 and a take-up reel 86, which reels are provided with trunnions at their ends journaled in suitable bearings. The feed reel 85 is designed to receive a recording strip 87 of paper or similar material which is passed from the reel 85 up and over the roll 48 and on to the take-up reel 86. If desired, the recording strip 87 may be directed exteriorly of the case 37 instead of wound on the reel 86, for which purpose a discharge slot 88 is formed in the case 37 through which the recording strip can be passed, as shown in Fig. 7. The take-up reel 86 is designed to be rotated independent of the roller 48 when it is desired to wind the recording strip 87 thereon. For this purpose a spiral spring 89 is provided, which spring is of the clock type and adapted to be wound by means of a stem 90 to cause it to actuate a gear 91 which meshes with a pinion 92 on a trunnion on the take-up reel 86. The spring 89 is only of such tension as to take up the slack of the recording strip 87 as it is advanced by the roller 48 and is not designed to wind the recording strip from one reel to the other *per se* but only in coöperation with the roller 48.

Revolubly mounted on the rail 46 is a series of spaced impression disks 93 which are caused to bear against the recording strip 87 to press the latter against the impression roll at spaced intervals throughout the width of the recording strip with sufficient pressure to form continuous staff lines 94 on the underside thereof. Broken staff lines 94′ are formed below and between the treble and bass staves, as shown in Fig. 16 by forming the impression disks, by which said lines are formed, with serrated edges. As the direct range of the recording instrument is confined to four octaves less the two outer C's, only one added line above and below the staves is required; such notes as are played out of the range of the four octaves being indicated by octave marks formed adjacent the marginal edges of the recording strip as will be later described.

The pressure of the impression disks 93 on the strip 87 is regulated by means of thumb-screws 95, which pass through perforations in the rail 46 adjacent the ends of the latter and are screwed into brackets 96 placed on the inner walls of the casing; coiled springs 97 bearing between the upper face of the rail 46 and the heads of the thumb-screws 95 to exert a resilient pressure on the rail 46, as particularly shown in Fig. 19. By adjusting the thumb-screws 95 the degree of pressure exerted on the rail 46 may be varied as occasion may demand.

Mounted on the rail 46 and extending longitudinally thereof above the ends of the arms 45 is a stop bar 98 for limiting the upward movement of the outer ends of the arms 45 when the latter are restored to normal by means of springs 45′ thereon; the underside of the bar 98 being preferably lined with felt to obviate noise when the arms 45 impact thereagainst.

For the purpose of facilitating the insertion and removal of the recording strip 87 the roller 48 and the rails 85 and 86 are mounted on connected end standards 99 formed on base-plate 100 adapted to be seated on the bottom 101 of the case 37 and slidably engaged at its edges in channels 102. The outer end 104 of the case 37 is hinged at 103 to permit its being swung outwardly to give access to the interior of the case. The standards 99 and base-plate 100 can thus be inserted and removed from the case as desired; the trunnion 50 engaging with the sprocket 60 being squared to slidably engage a corresponding axial opening in the sprocket 60 to permit its being moved in and out of engagement therewith on withdrawing and replacing the standards 99 and the mechanisms carried thereby.

In the operation of the invention the casing 20 is placed in position above the piano key-board and held in place by means of the plates 21 and 22 as shown in Figs. 1, 2 and 3 with the pins 41 resting on the upper faces of the keys and with the conducting heads 42 out of contact with the contact members 24 and 27. The end 32 of the cable 33 is then attached to the plate 30 with the terminal plugs 31 extending into the terminal sockets 29 therein. The opposite end 34 of the cable 38 is then connected to the plate 36 on the case 37 with the terminal plugs 35 connecting with corresponding sockets in the plate 36; the case 37 being disposed on any suitable support, as on a table, as shown in Fig. 1. The treadle 70 is then placed in convenient reach of the foot of the operator and the conductors 66 and 68 are connected to the source of electrical supply 67 and the conductors 65 and 66 connected to the conductors 61 and 62 leading to the motor 52. The operator, on depressing the treadle 70 to move the wiper contact 69 into electrical connection with the contact member 76, sets the motor 52 in operation at a slow speed which speed can be increased as occasion demands by moving the wiper contact 69 into connection with the contact members 75 and 78. The operation of the motor 52 rotates the impression roll 48 thereby advancing the recording strip 87 beneath the rail 46 whereupon the staff lines 94 will be formed by the action of the impression disks 93, as before

described. On the depression of any of the piano keys within a range of two octaves above and two octaves below the middle C, a circuit will be completed from the battery 26 through the contact members 24 and 27 and the intermediate conductor 42 which conductor will gravitate to complete the circuit on the depression of the key. The circuit thus completed will pass through the particular magnet 39 controlled by the operator key, which magnet on being energized will depress the arm 45 adapted to be operated thereby to move an impression disk 105 on the lower end of the stem 47 attached thereto into contact with the recording strip 87, thereby pressing the latter against the impression roll 49 and forming a line on its underside as the strip advances to a length proportional to the duration of the depression of the piano key. The recorded line will be formed in such relation to the staff lines 94 as to indicate the pitch of the note played; the time of the note being denoted by the length of the line, and its relation to other notes being indicated by the beginning and ending of the line.

As a means for distinguishing the natural keys from the sharps and flats, the impression disks 105 controlled by the natural keys are formed with peripheral serrations 106, as shown in Fig. 17, so as to form a plurality of parallel lines 107 on the recording strip, as shown in Fig. 15. For indicating sharps or flats the impression disks 105 are formed with a single broad peripheral face, as indicated at 108 in Fig. 18, so as to form heavy solid lines as indicated at 109 in Fig. 15. For the purpose of denoting such tones as are played above the second octave above middle C and below the second octave below middle C, means are provided whereby the operation of anyone of the piano keys outside of the range of the four octaves before mentioned will act to operate the recording mechanism controlled by the corresponding key in the second octave above or below middle C and at the same time effect the operation of a recording device which is adapted to be operated by a plurality of keys. This arrangement does away with the necessity of providing a separate magnet for each piano key and enables the recording of all notes played on a comparatively narrow strip within the range extending from the second added line below the bass staff and the second added line above the treble staff inclusive; the notes outside of this range being indicated by companion lines formed adjacent the margin of the recording strip parallel with lines formed by a recording device controlled by the corresponding key in the companion octave. This means is particularly shown in Fig. 14 and consists of recording arms 110 and 111 corresponding to the arms 45 and adapted to be operated by magnets 112 and 113 and arranged to form lines on the recording strip 97 adjacent the margin thereof, and above the treble staff. In addition to contact makers 24—27, a second contact maker is provided for each key above the second octave above middle C, and below the second octave below middle C. The second contact makers are of the same construction as contact makers 24—27 and are indicated in the third octave above middle C by 117—118, and the fourth octave above middle C by 123—124.

One terminal of a magnet 112 connects with a conductor 114, connected with a contact member 27 on each of the keys in the third octave above middle C; the contact members 24 of which are connected to conductors 115 which connect with the conductor 28 leading from the contact member 27 of the corresponding key in the second octave above middle C. The other terminal of the magnet 112 connects with conductor 116 which leads to and connects with the contact member 117 on each of the keys within the third octave above middle C.

One terminal of a magnet 113 is electrically connected through conductor 121 with a contact member 27 on each of the keys in the fourth octave above middle C. The contact makers 24 are connected to the conductors leading from corresponding keys of the second octave above middle C. Thus, the contact maker 24 on key C^4 is connected to the conductor 115 which leads to conductor 28 and magnet 39′. The other terminal of magnet 113 is connected by conductors to contact members 123 on each of the keys in the fourth octave above middle C. Contact members 124 are each connected to a common bus 25. If key C^2 is struck a circuit is completed from battery 26 through contact 24, pin 41, contact 27, conductor 28, magnet 39′ to the other side of battery 26, thereby causing an impression to be made on the record. If key C^3 is struck, a circuit is completed from battery 26 through conductor 25, contact 118, the contact making pin, contact 117, conductor 116, magnet 112, conductor 114, contact 27, pin 41, contact 24, conductor 115, conductor 28, magnet 39′ to the other side of the battery. The closing of the circuit last described causes magnet 39′ to actuate the recording mechanism which indicates the note, and magnet 112 to actuate the octave recording mechanism which indicates the octave.

The arm 110 which is actuated by magnet 112 is fitted with an impression disk corresponding to the disk 105 so as to form a double dotted line on the recording sheet. When anyone of the keys in the third octave

above middle C is depressed a circuit to the magnet 112 is closed and a circuit leading to the magnet 39 in circuit with the corresponding key in the second octave above middle C. A double record will therefore be made at this time as indicated at 119 and 120 in Fig. 15, which record will designate that in inscribing from the record the note indicated as the first C above middle C should be written in second C above middle C and so on as illustrated in Figs. 15 and 16. In like manner the magnet 113 as well as one of its terminals connecting to the conductor 121 leading to the contact members 27 on all the keys of the four octaves above middle C and has its other terminal connecting with conductors 122 leading to contact members 123 adapted to be connected with contact members 124 connected to the conductor 25 so as to complete a circuit through the magnet 113 to energize the latter when anyone of the keys of the four octaves above middle C is depressed, and at the same time energize the magnet 39 controlled by the corresponding key in the second octave above middle C so as to form a double record. As a means for distinguishing the records made by the arm 6 the arm 110 or arm 111, the indicating disk thereon is so designed as to form a triple line 125 as indicated in Figs. 14 and 15. By this arrangement all the keys played in the four octaves above middle C will be recorded on the sheet in the second octave above middle C and will have the companion mark 125 parallel therewith to indicate to the transcriber that the note played belongs in the fourth octave above middle C. In like manner the notes played in the third octave below middle C will be recorded; the arm 126 and magnet 127 as shown in Fig. 6 being provided for this purpose.

As a means for indicating the measures, an arm 128 and a magnet 129 is provided, which magnet is adapted to be energized by a depression of a treadle 130 which closes a circuit through the magnet 29 and thereby causes the arm 128 to be operated to move a recording disk on the arm 128 in contact with the strip 87 to form a mark consisting of a series of four dotted lines on the strip as indicated at 131 in Fig. 15. The treadle 130 is operated according to the time of the music being recorded; the bar 30 being depressed at every point where a bar would be indicated.

What I claim is:

1. In a music recorder, the combination of branch electrical circuits each controlled by a key in an octave of a musical instrument, a plurality of magnets one in each branch circuit, a tone recording means operated by each of the magnets, means by which each of said magnets and its tone-recording means will be operated by the depression of a corresponding key in another octave of the instrument, a separate magnet, and a recording device operated by said separate magnet energized by the depression of anyone of the keys in said other octave.

2. In a music recorder, the combination of branch electrical circuits each controlled by a key of an octave in a keyed musical instrument, a series of electrically operated tone recording devices, one in each branch circuit, means by which each of the keys in another octave of the instrument will actuate the corresponding tone recording device in the first mentioned octave, and an octave recording device operated upon the depression of anyone of the keys in the last mentioned octave but not operated upon the depression of any one of the keys in the first mentioned octave.

3. In a music recorder, the combination of means for feeding a recording strip, movable marking members normally out of contact with said recording strip, electrically actuated means for moving said marking members into contact with said strip, a pair of electrical control means connected to each electrically actuated means, one electrical control means being located so as to be operated by a key of one octave and the other by the corresponding key of a second octave, a movable octave marking member, electrically actuated means for moving said octave marking member, and electrical control means located so as to be operated by each key of the second octave, and electrically connected to the last mentioned electrically actuated means.

4. In a music recorder, the combination of a circuit closing device comprising a casing shaped to fit over a piano keyboard; a pair of electrical conducting strips for each key of an octave; a pair of electrical conducting strips for each key of a second octave; a contact maker for each pair of said strips located so that each contact maker engages with one key; a second pair of electrical conducting strips for each key of the second octave, a contact maker for each second pair of strips located so that each of said contact makers engages with one key of said second octave; a tone recording device comprising electrically actuated tone markers, one terminal of each connected electrically with a strip of a pair of strips for each key of the first mentioned octave, the other terminal of each tone marker connected to a source of electrical energy, the other strip of each pair of strips for each key of the first mentioned octave connected electrically to said source of electrical energy; an octave-recording device

comprising an electrically actuated octave marker, one terminal thereof connected electrically with a strip of each pair of strips for each key of the second octave, the other strip of each of said pairs being connected to a terminal of a tone marker connected to a corresponding key in the first mentioned octave, the other terminal of said octave marker electrically connected with a strip of each second pair of strips for each key of the second octave, the other strip of each of said pairs being connected to the other terminal of said source of electrical energy.

In witness that I claim the foregoing I have hereunto subscribed my name this 4th day of March, 1914.

BENJAMIN FREDERICK LIEFIELD.

Witnesses:

EDMUND A. STRAUSE,

MARIE BATTEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."