May 7, 1940. H. M. BROCKWAY 2,199,948

MUSICAL INSTRUMENT

Filed April 8, 1938 5 Sheets-Sheet 1

Fig. 1.

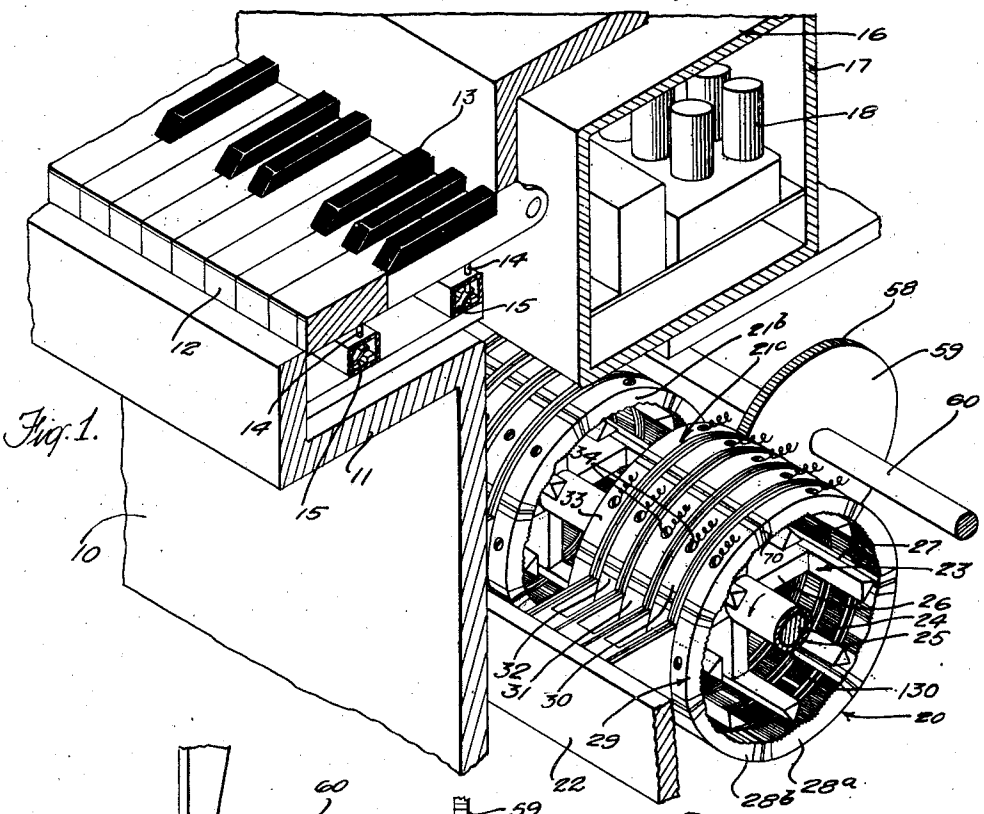


Fig. 2.

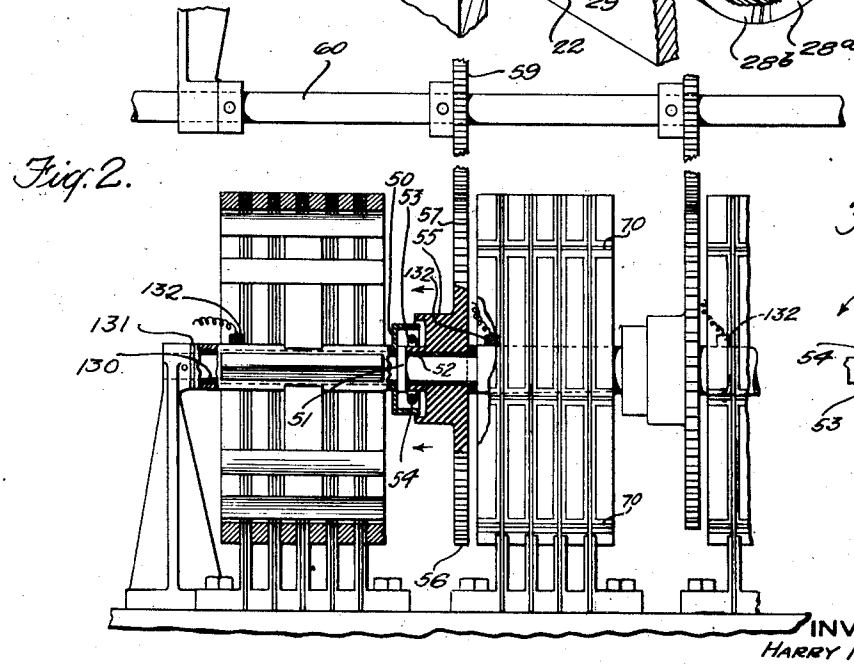
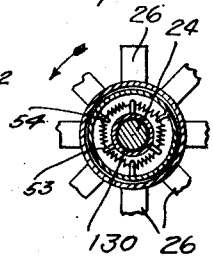


Fig. 3.



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MUSICAL INSTRUMENT

Filed April 8, 1938 5 Sheets-Sheet 2

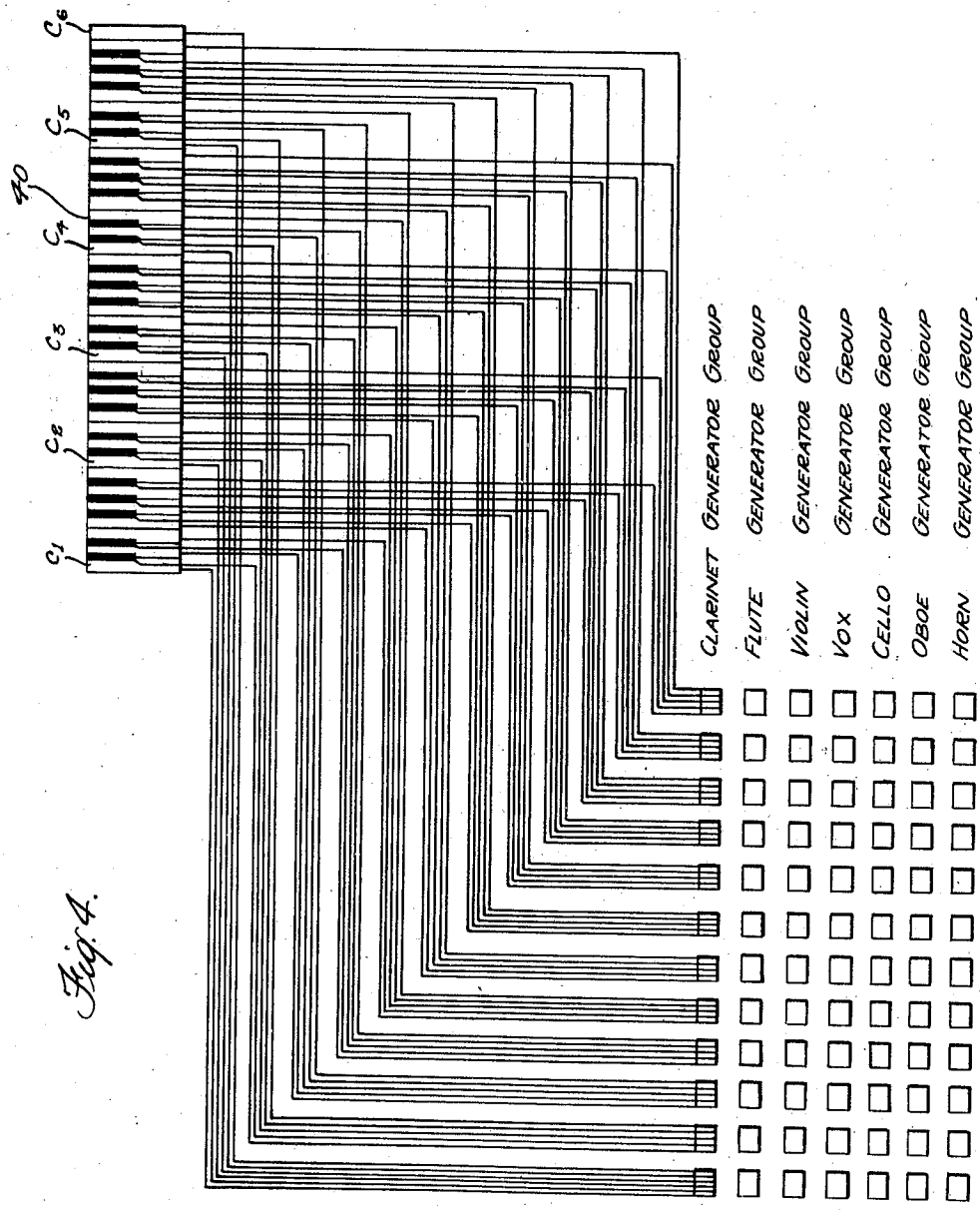

Fig. 4.

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MUSICAL INSTRUMENT

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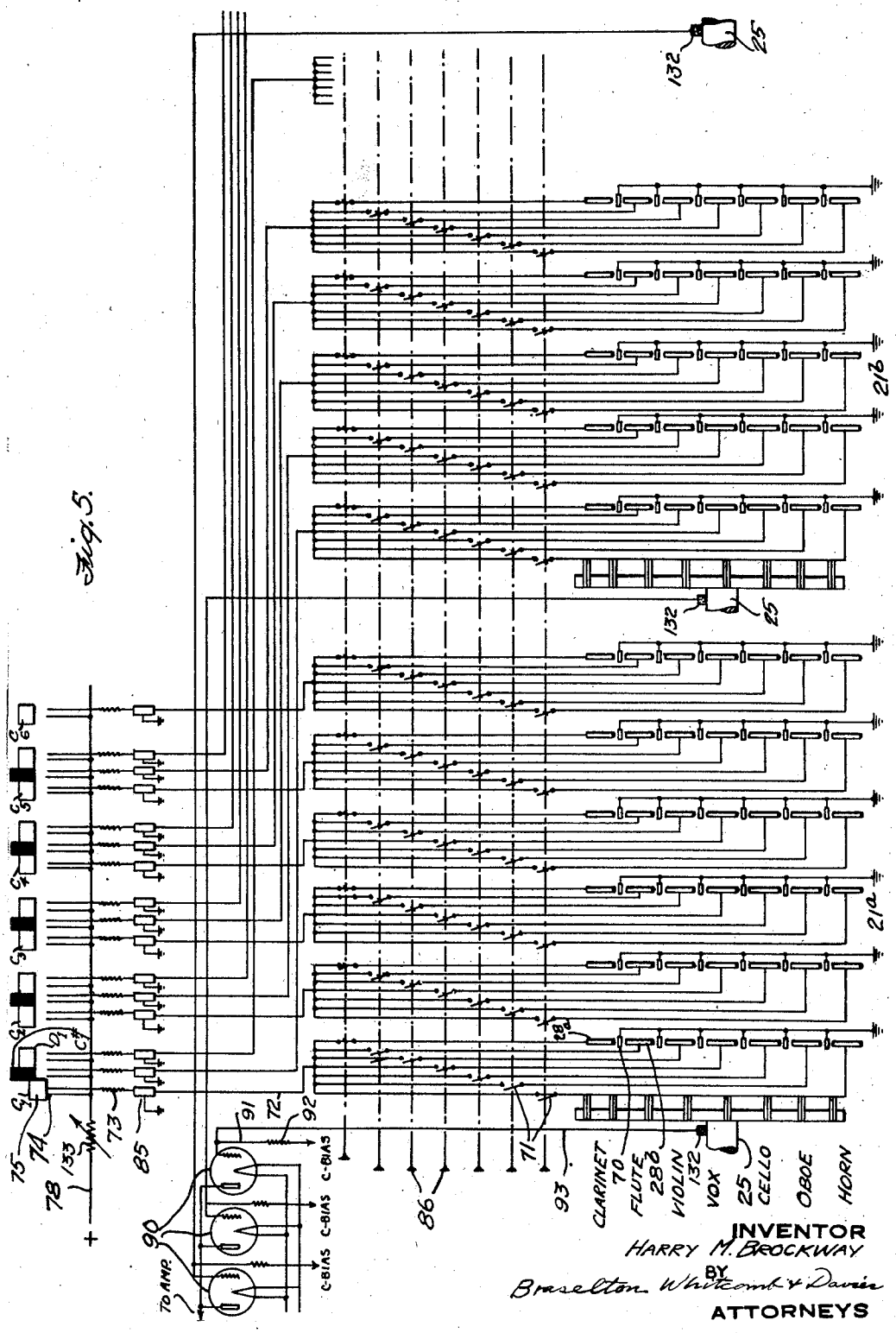

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MUSICAL INSTRUMENT

Filed April 8, 1938 5 Sheets-Sheet 4

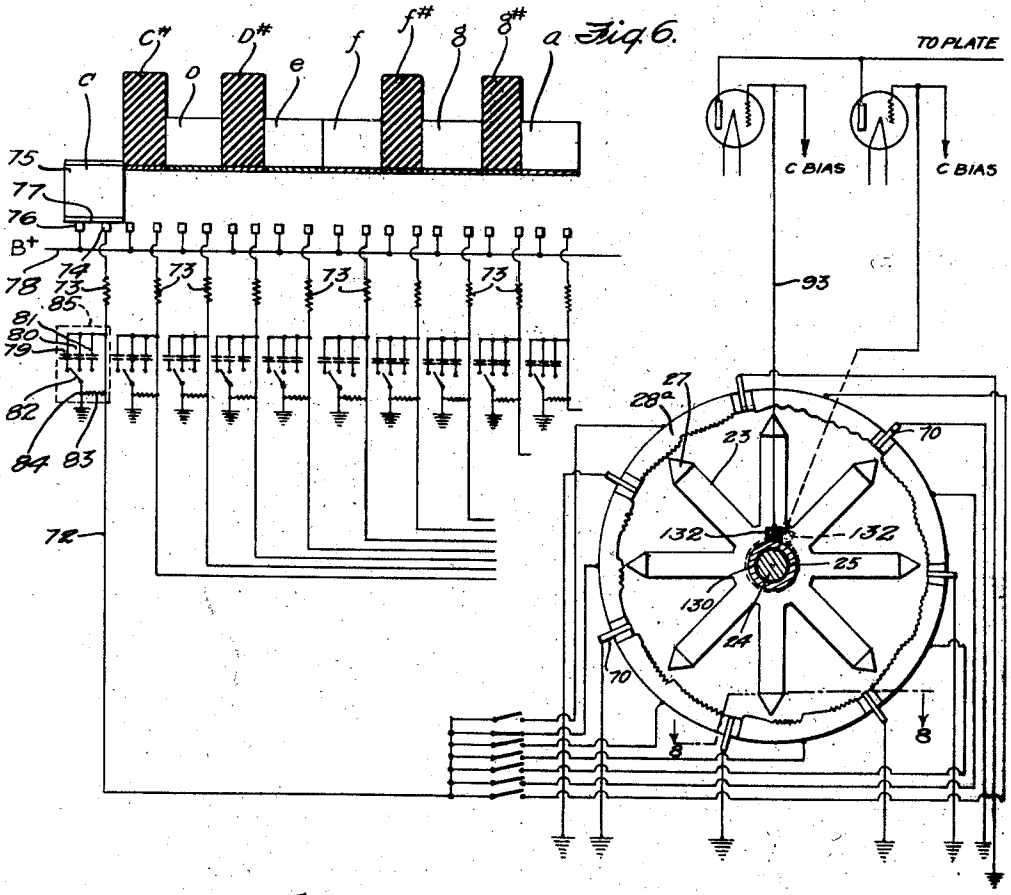

Fig. 6.

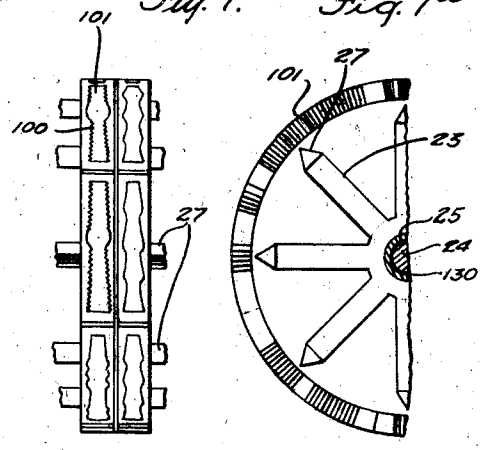

Fig. 7.

Fig. 7a

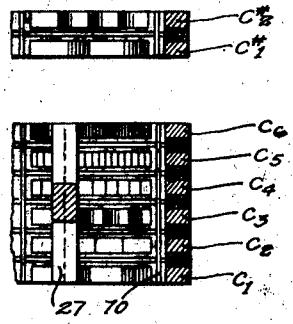

Fig. 8.

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MUSICAL INSTRUMENT

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Fig. 9.

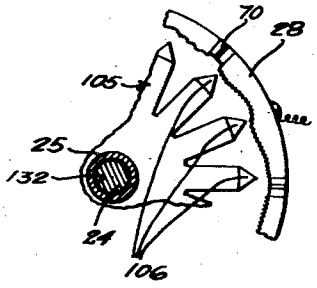


Fig. 10.

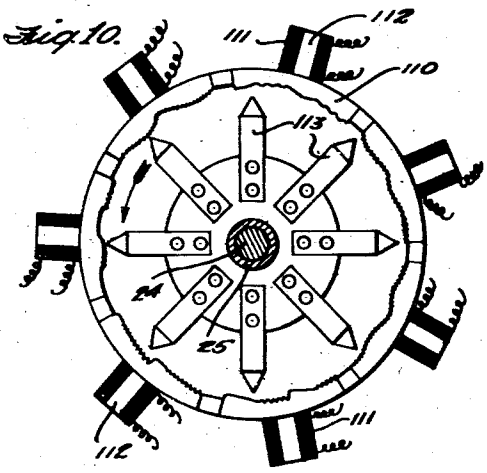


Fig. 11.

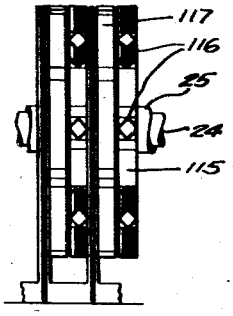


Fig. 12.

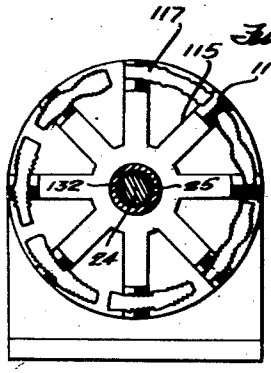
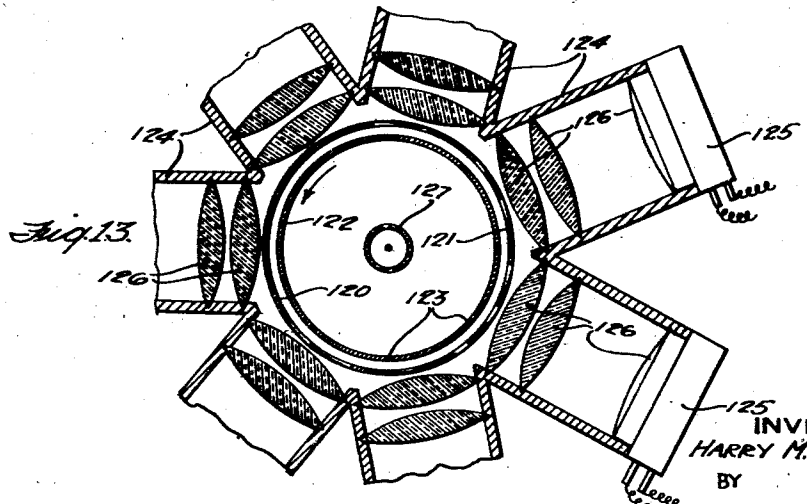


Fig. 13.



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Patented May 7, 1940

2,199,948

UNITED STATES PATENT OFFICE

2,199,948

MUSICAL INSTRUMENT

Harry M. Brockway, Waldwick, N. J., assignor of one-fourth to Chester H. Braselton, New York, N. Y.

Application April 8, 1938, Serial No. 200,870

13 Claims. (Cl. 84—1.14)

This invention relates to musical instruments of the type wherein the tones are produced by an electrical transposition from a previously fixed record of the note in metal or other satisfactory material. Because of the facility with which instruments of this type simulate the tone quality of an organ they are frequently referred to as organs.

In prior instruments of this type certain deficiencies have been noted which the invention of this application is intended to overcome. For example, the inventor is not aware of an instrument of this type wherein the true harmonics of the fundamental are combined to produce the tone without the use of an excessive number of movable parts. Further, instruments of this type which do not employ air pressure or suction systems do not duplicate accurately the pipe organ effect with its slow note attack and release arising from the use of vibrating air columns of the pipes.

It is accordingly one of the important objects of the present invention to provide a musical instrument which will permit the production of a musical tone formed of a fundamental and the exact harmonics of the fundamental. Another object of the invention is to provide an instrument in which the build-up and decay of the notes may at will be made either gradual or rapid. Still another object of the invention is to provide mechanism which will permit the production of tone combinations of complex tones from a single rotating element, thereby effecting the reduction of the number of moving parts in the instrument. Still another object is to utilize a single rotor to produce all of the octave notes of a given fundamental. An object also is to combine with a single rotor all of the modified tone qualities of the instrument such as flute, oboe, violin, etc.

An object also is to provide means for modifying at will the key click in the power circuit external to the tone circuit. An important object, also, is to utilize a continuous current in the instrument subject to variation by the tone producing rotor in distinction over arrangements wherein the rotor induces a current in the amplifying tone carrying circuits. Various other objects are contemplated such as the marked simplification of structure through the elimination of numerous rotatable members; the elimination of excessive circuits operated by the keys; the removal of the modulated current flow from the direct current keying or input circuit, i. e., from electrical connection to the keys of the manual; the provision of rotor combinations which greatly amplifies the true tone effects obtainable from the instrument; and various other objects which will become apparent on consideration of the following description and accompanying drawings, in which:

Fig. 1 is a detailed view in perspective of a portion of the manual keyboard, the amplifying unit, and the tone cylinder and rotor;

Fig. 2 is a horizontal section through the tone cylinder, showing also the driving connection to the rotor shaft;

Fig. 3 is a detail of the shock absorbing driving gear;

Fig. 4 is a view showing the relationship between the keyboard and tone blocks;

Figs. 5 and 6 are views illustrating the electrical circuits between the tone blocks;

Fig. 7 is a plan view of a modification of the tone cylinder;

Fig. 7a is a side view of the modification shown in Fig. 7;

Fig. 8 is a section through one of the tone cylinders, showing the various tone tracks for producing octave tones possessing the same tone qualities, drawn on lines 8—8 of Fig. 6.

Fig. 9 is a view showing the use of a rotor having an increased number of rotating arms;

Fig. 10 illustrates a modification showing a magnetic type generator unit associated with the various tone blocks;

Figs. 11 and 12 illustrate a modification employing rotating arms with side projections; and

Fig. 13 is a diagrammatic view of the principle of the invention applied to photo-electric cells.

Generally speaking, in its broader aspects, the invention has to do with novel means for reducing the movable parts and combining certain functions of an electronic sound producing mechanism and at the same time increasing the number of tones producible so that it is possible to obtain complex tones containing numerous harmonics which approach closely the natural quality of the note intended for duplication, such as a pipe organ note. This is accomplished by forming a modified reproduction of the wave pattern of a given note on an arcuate segmental base of such length as to include at least a single wave length of the note for the lowest frequency to be reproduced; forming a lateral bank of the octaves or whole number multiple frequencies of this note as, for example, the C octaves; assembling in drum or cylinder formation a plurality of aligned arcuate banks of these octave notes, each bank having a different timbre or quality; and applying a high voltage current to each of said blocks

while a conductor is allowed to sweep over the tone surface of the block in close proximity thereto. In this manner there is induced electrostatically—by capacity variation—a variation in the output circuit including the amplifier, thus reproducing the tone quality and frequency impressed on the block.

Referring to Fig. 1, there is illustrated by way of example a section of the front panel 10 of the console of a musical instrument, extending to the keyboard 11, on which are mounted the various diatonic and half-tone keys 12 and 13. Depending between each of these keys are pins 14 adapted to engage the spring elements 15 and close the electrical circuits when the keys are depressed. An amplifier unit 16 is positioned back of the keyboard including the metal casing 17 and the various amplifying tubes enclosed in the cylindrical containers 18.

Behind the front panel 10 and beneath the amplifying unit 16 is positioned the sound reproducing unit 20. This unit takes the form of a plurality of twelve cylinders 21 individually indicated by letters *a*, *b*, *c*, etc., fixedly positioned on the supporting member 22, and a gang of rotors 23 mounted on a shaft 24 lying on the axis of the sound cylinders 21, the various rotors being each fixedly connected to tubular hubs 25, there being one rotor and one hub within each tone cylinder 21. The various hubs 25 are insulated from each other and from the end supports by insulation washers 51 and 131 and from the shaft 24 by insulation sleeves 130 on which the hubs are freely rotatable.

Means are provided for driving the twelve rotors at different speeds to produce the approximate one-half note variation from rotor to rotor of the chromatic scale. To accomplish this result gear wheels 56 of insulation fibre are mounted on the shaft 24 at the end of each rotor. The hub 55 of each of these gears is provided with a sleeve 52 which carries at its end outwardly projecting lugs 53. Adjacent the sleeve 52 and spaced therefrom by insulation washer 51 is a cup 50 forming part of the hub 25 of the rotor. The cup 50 encloses the lugs 53 and on its inner surface is provided with inwardly projecting lugs 54 and between lugs 53 and 54 extend springs, a lug 54 being connected to two spaced lugs 53. It is thus apparent that a yielding drive connection is provided between the rotor hub 25 and gear wheel 56 which by virtue of the front and rear spring connection to each lug tends to lessen recoil as well as provide for smooth gradation to acceleration and deceleration of the power source.

The gear wheel 56 is provided with teeth 57 adapted to mesh with teeth 58 of the associated gear wheel 59 mounted on the power shaft 60. The power shaft is driven at a constant speed by a suitable power source such as a synchronous electric motor. In order to obtain the required scale tones in the various cylinder block units 21 the gear train including gears 56 and 59 have different speed ratios so that beginning with the end or C cylinder at the left of the keyboard the rotor speed changes by values giving increments of approximately one-half tone in the chromatic scale. While it would be possible to obtain the tone variation between cylinder units by modifying the sound tracks to increase the frequency of energization and the number of rotor arms without changing the rotor speeds, I prefer to obtain the variation by the speed-change method.

The cylinder 21, within which the rotor 23 has movement, consists of a plurality of elongated arcuate metal blocks 28 adapted to be placed end to end to form a ring, and a group of these rings 29, 30, 31, 32 and 33, in the example of Fig. 1, are placed edge to edge to form the cylinder 21, there being five rings in the cylinder as shown. Each block is circular in curvature on the inner concave surface except near each end where the curvature is somewhat flattened to reduce the end capacity effects. Each of the blocks also are electrically insulated from all of the other blocks of a ring and from the other rings and are provided with electric circuit terminals 34 on the convex sides thereof.

The inner concave surfaces of the cylinder blocks are formed with sound wave recordings, as shown for example in Fig. 8. Each block carries a sound wave designed to produce with a given speed of the rotor a note of a definite frequency, as for example the frequency 36.708 of the note D of the diatonic tempered scale. Assuming, for example, that the cylinder 21*c* of Fig. 1 is the D cylinder, then each block of ring 29 is recorded with the D wave form on its inner surface, the pitch being identical in each block but the timbre differing to simulate the different musical voices, as for example the clarinet, flute, violin, bass, cello, oboe and horn. The adjacent ring 30 in this example has recorded sound forms on the inner surfaces of the blocks corresponding to the next higher D octave note, parallel blocks of the two rings having the same tone timbre, such as flute. Similarly, in rings 31, 32 and 33, the octaves are increased regularly with the tone timbre remaining the same in parallel blocks, so that in the completed cylinder all of the D octaves are recorded on the adjacent rings and the cylinder segments formed of adjacent blocks are recorded to produce a given tone timbre. In the completed instrument twelve of these cylinders 21, as previously mentioned, are employed, each cylinder being a duplicate of the other except the ertreme left or C cylinder 21*a* which has six octave rings instead of five to provide for the limiting C on the right end of the keyboard. In this manner provision is made for the twelve notes of the chromatic scale.

While five rings are mentioned in the example of cylinder 21*c*, it is of course understood that additional rings may be added if the range of the instrument is extended below and above the manual keyboard, as will be described more fully hereinafter. In addition, one cylinder, that is the 21*a* cylinder, will always have one more ring than the other cylinders to provide for the upper limiting C of the keyboard.

In Fig. 4 of the drawings is diagrammatically illustrated the relationship between the keyboard and the sound cylinders in connection with a five octave manual keyboard 40. In the lower corner of the drawing is shown a plurality of rectangular squares indicating the various sound cylinders, there being seven rows of twelve cylinder segments, each for the various chromatic notes as applied to the different tone qualities. For purposes of illustration, each segment of each cylinder of the clarinet group is divided into a plurality of parts indicating the various sound blocks 28. Full lines are drawn from these various blocks to the manual keyboard. The lines joining each block connect keys corresponding to a given note of the scale or an octave note having a frequency equal to a whole number multiple of the lowest note connected to the block.

Cylinder 21c, for example, has five solid lines connected to the octave notes in the manual 40. If it is desired to increase the range of the instrument beyond the five octaves described, additional tone blocks with coupling circuits may be used to add higher and lower frequencies beyond the range of the keyboard. Attention is directed to the six full lines connecting the clarinet segment of cylinder 21a to the manual, thus joining the cylinder to the C notes of the five octaves, as well as the terminal upper C following the fifth octave. While the solid lines showing the connection between sound cylinders and keyboard are shown connected only to the clarinet group of blocks, it is understood that similar relationships are established between the various blocks of the flute, violin, bass, cello, oboe and horn groups, or in other groups that may be included in the sound cylinder.

Referring to Fig. 5 of the drawings, there is illustrated diagrammatically the electrical connections between the various blocks of a sound cylinder and the keyboard and amplifying unit. In this figure are illustrated two cylinders only, 21a and 21b, the circuits for the other cylinders being similar. The various groups of tone qualities are designated as in Fig. 4, in accordance with prior description, as clarinet, flute, etc., the various blocks 28a, 28b, 28c of the different groups being in vertical alignment as shown in the figure. Interposed between these blocks are the insulated metal plates 70 which are electrically connected and grounded. The purpose of these plates is to prevent carry-over of sound from one block to another. Conductors connect each of the blocks 28a, 28b through switches 71 to a common conductor 72 and thence through the inductive and variable resistance 73 to the contact 74 adjacent and responsive to movement of the key 75, as more clearly shown in Fig. 6 of the drawings. A second contact 76, positioned symmetrically to the contact 74, is adapted to be bridged by the conductor 77 when the key 75 is depressed, thereby closing a circuit from the high potential line 78 to the various circuit connections of the blocks 28 of the sound cylinder. The source of high potential direct current is of the usual type of rectifying transformer from an alternating current source. The potential employed is not critical and may be varied through a suitable range, but a value in the neighborhood of 200 volts has been found to give excellent results. As indicated in Fig. 6, there is a parallel circuit to ground adjacent the resistance 73, said parallel circuit passing through the condensers 79, 80 and 81, a switch 82 being employed to select one or the other of the various condenser circuits. An inductive resistance 83 connects the common ground wire 84 of the condensers to the common block wire 72.

The purpose of the condenser unit which serves in part as a ground and in part as a by-pass to the circuit 72 is to control the degree of attack and decay in the production of tone by the keyboard. In electrical instruments of this type where energization is instantaneous by means of electrical contacts, it is usual that the tones produced are too abrupt both in the attack and in the release. Consequently, the use of such an instrument in substitution for a pipe organ, for example, for sacred music or in music of the type as is produced by a pipe organ is somewhat limited. As is well known, the pipe organ tone has a fringe due to the natural slowness of initial response in the air chamber and the persistance in the resonance at the end of a note. By employing a by-pass as in the fringe control unit 85 including the various condensers 79, 80, and 81, and the resistance 83 in conjunction with the resistance 73, it is possible to secure definite variations in the tone attack and release. Condensers 79, 80 and 81 are graduated in capacity from minimum to maximum. When connection is made by switch 82 to condenser 79, the attach and release effect is less abrupt than when the fringe control is eliminated. The abruptness is still further ameliorated when the switch 84 is connected to the condenser 80, and the maximum variation is secured by connection to condenser 81. Fringe control units are of course applied to each block circuit and gang rods employed to operate switches 82 simultaneously. It is to be noted that the specific arrangement of the fringe control unit condenser and resistance is such as not to affect the volume of the instrument, since there is no appreciable variation of the applied potential through movement of the switches 82. Variation of the resistances 73 or 83, however, brings about a variation in tone volume, and hence these resistances are not varied except to establish a relatively permanent adjustment. The volume variation of tone is produced by variation of a resistance 133 in the input circuit 78.

Switches 71 in the block circuits of the various sound cylinders are joined to form gang switches as indicated, these switches being manipulated by the rods 86. In Fig. 5 these switches 71 are open with the exception of the switch closing the circuits to blocks 28a in cylinder 21a, and the corresponding blocks in cylinders 21b, 21c, etc.

The amplifying unit illustrated in perspective in Fig. 1 as 16, and in diagram in Fig. 5, includes the usual thermionic tubes 90 with the usual plates, grids and filaments. Circuits 91, including the resistance 92, are shown connected between the various grids and the appropriate C-bias. Each cylinder 21 is provided with a separate amplifying tube, as shown in Fig. 5, the various grids connecting the different cylinder circuits and the tube plates and filaments forming connected groups. The grid of the initial tube is connected by a circuit 93 to the tubular shaft 25 by means of the brush 132. Since the amplifier is of standard construction a further description thereof is not considered necessary. It is pointed out in connection with the electrical circuits that the same, including the grounds, provide paths for currents of measurable value and that the function of the rotor which will now be explained is primarily to vary these currents.

When the electrical circuits are energized and a key such as the C key depressed, as shown in Fig. 6, a potential will be impressed upon the block 28a in the sound cylinder. Assuming that the rotor 23 has attained its normal speed of rotation in the direction indicated in the figure, it will be apparent that as the T-bar 27 sweeps by the sound tracks formed in the block surface, a variation in capacity will occur arising from the difference of potential between the block 28a and the moving T-bar in conjunction with the wave variation of the contour of the sound track. This sound track is a reproduction of a given frequency with its fundamental and harmonics. The reproduction of the frequency on the sound blocks is not true but is modified to compensate for the fact that amplification depends on a power of the capacity which would give a distorted tone if the sound track were not modified. It is also noted that since capacity effects are

increased progressively with pitch, volume compensation must be introduced. This may be done either by increasing the block spacing from the rotors or increasing resistances 73 in the block circuits as pitch is increased, the latter method being preferred. Hence, as the T-bars 27 sweep successively past the block 28a with its corresponding key depressed the frequency will be clearly developed in the amplifying circuit and projected by the sound instrument. As each T-bar passes beyond the block limit the following T-bar is approaching the same block at the other end, and since the end of each block is slightly flattened, i. e., of decreased curvature, the diminution of sound due to the decreasing capacity effect of the leading bar is compensated by the progressive amplification of the tone produced by the following bar, thereby correcting for physical separation of block and rotor element. Correction of inter-block movement of the rotor arms may also be made by increasing the angular displacement of the T-bars slightly beyond that of the blocks, but I prefer to modify the block ends as described. The inter-block plates 76 absorb inter-block effects. Since the gang switch 86 (Fig. 5) is set for a given tone quality, as for example clarinet, the manual reproduces clarinet tones, the clarinet blocks in the sound cylinder only being in circuit and effective.

Inherent in the construction of the sound cylinder 21 with the T-shaped rotor is the production of all octave notes from a given sound cylinder, as for example, all of the C octave notes or the D octave notes. Consequently, it is thus possible to construct an instrument in which only twelve sound cylinders with their associated twelve rotors are necessary. This very materially diminishes the number of movable parts in the instrument, thus increasing the efficiency and diminishing the cost of manufacture. In the instrument as above described, for example, there is utilized twelve cylinders employing approximately 427 tone blocks, and twelve rotors. In order to obtain with a rotor for each block an equivalent tone variation producing seven different tone qualities in sixty-one different frequencies, 427 different rotors would be necessary, making the construction of such an instrument infeasible and impractical. Where coupled circuits are used, as is customary, the sound blocks may be readily increased by enlarging the twelve sound cylinders to take care of the added octaves.

A further apparent and highly important result of the sound cylinder arrangement as described lies in the facility by which different tone qualities may be reproduced in their true values. In instruments of the prior art, for example, in order to reduce the number of movable parts to a usable value it has been necessary to entirely eliminate a large number of true harmonic tone values and approximate a given quality tone by blending simple fundamentals of different frequencies with emphasis on a given fundamental; in other words, by combining a fundamental with different pitches rather than true harmonics. The result, especially for tone qualities rich in harmonics, such as the violin, has been markedly inadequate from the musical viewpoint. With the structural arrangement of the present invention, however, it is possible to secure the true harmonic values for any given tone quality, so that a true simulation of pipe organ effects, for example, is made possible. The fact that the tone fringe may be controlled and varied either to secure pipe organ effects or to secure an abrupt attack and release suitable for use in orchestras, adapts the instrument to a greater variety of uses than has been heretofore possible in instruments of this particular type. It is pointed out further that the means provided in the note control unit for eliminating note fringe also eliminates what is known as key plop or click, that is, the noises normally attendant upon the mechanical manipulation of the keys.

Various modifications may be made in the details of construction of the instrument as hereinabove described. For example, instead of forming the sound tracks on the inner face of the segments or blocks 28 of the hill and vale type, I may apply the sound track to the sides of the block adjacent the inner surface thereof, the indentation on opposite sides being identical so that a depression in the sound track brings about a narrowing of the inner block surface, as clearly shown at 100 in the blocks 101 of Fig. 7. In this construction there is greater uniformity of sound effect since the distance between the travelling T-bars 27 and the sound tracks is constant. The capacity change is due to the variation of the effective size of the inner block surface adjacent the T-bars 27.

In Fig. 9 of the drawings there is indicated a possible variation in the rotor with the object of reducing any possible variation in sound volume due to the passage of the rotor T-bars from block to block. In this figure is shown a rotor 105 in proximity to the sound blocks 28, said rotor having three radially mounted T-bars 106 adjacent a single block instead of the two T-bars of Fig. 1. The effect of any diminution of volume of the leading T-bar will be lessened since the total volume is dependent upon the sum of three rotor elements instead of two, as in the type of Fig. 1.

Fig. 10 illustrates a modification of the invention utilizing a current generator instead of a current varying device. The various blocks 110 are made of iron which are subject to magnetization by means of current coils 111 enclosing armatures 112. The movement of the twelve rotors 113 past the magnetized blocks 110 induces in the amplifying circuit attached to the rotor shaft a current variable in accordance with the sound track contour of the sound blocks 110, thereby reproducing the recorded sound.

Figs. 11 and 12 illustrate further modifications of the rotor-stator assembly. In this modification the rotor arms 115 are lengthened and instead of a T-shaped bar on the end of these rotor arms the arms themselves are formed at their ends in angular shape with the energizing edge 116 parallel to the arm axis and adjacent the side of the sound blocks 117. The sound tracks of the sound blocks 117 are formed in duplicate on the inner and upper sides of the blocks, as shown in Fig. 12, so that on rotation of the rotor arms, capacity variation in accordance with the variation in the contour of the sound tracks is produced.

Application of the photo-cell principle is made in the modification of Fig. 13. As shown in the figure, a cylinder 120 carrying a transparent film on which the sound track 121 is reproduced with seven different tone qualities represented. This cylinder encloses a second cylinder 122 provided with eight equally spaced apertures 123 which is adapted to rotate at uniform speed adjacent the sound track path. Positioned about the sound track cylinder 120 are seven photo-cell units 124 comprising the photo-cell 125 and lenses 126 for

converging the light upon the photo-cell. A light source 127 lies on the axis of the cylinders and when the device is in operation rotation of the apertured cylinder produces tone effects through the transformation of the modulated light effects on the photo-cell into electrical effects in the amplifiers.

The term "insulated" as used in the claims refers to electric insulation.

Other variations and modifications of the invention may be made by those skilled in this art, and hence I do not desire to limit my invention except as determined by the scope of the claims hereto appended.

I claim as my invention:

1. A tone generator comprising arcuate blocks assembled in ring formation having sound tracks inscribed in a metallic base on the curved surfaces thereof adapted to develop notes of the same pitch but different timbre, and a rotor having plural movable members positioned within said ring and adapted to rotate with the movable members in close proximity to the sound tracks on said sound blocks.

2. A tone generator comprising a plurality of sound blocks, said blocks having an elongated shape and being positioned side by side to form a lateral bank of parallel members, said sound blocks having sound tracks inscribed in metal bases on the surfaces thereof, a rotor having a member adapted to lie in proximity across said bank of blocks whereby in movement the member sweeps the block surfaces from end to end, and means for turning said rotor at a constant speed.

3. A tone generator comprising a plurality of sound blocks, said blocks having an elongated shape and being positioned side by side to form a lateral bank of parallel members, said sound blocks having sound tracks inscribed in bases on the surfaces thereof, a rotor having members adapted to move in proximity to and across said bank of blocks whereby the members sweep the block surfaces from end to end, and means for turning said rotor.

4. A tone generator comprising arcuate elongated blocks placed end to end to form rings, and side by side to form a cylinder of said rings, insulation spacing said blocks from each other, said blocks having sound tracks inscribed in metal bases on the surface of said blocks, a rotor having a shaft axially positioned within the cylinder, said rotor having plural arms terminating in end members lying parallel to the rotor axis and in close proximity to the sound track surfaces of the sound blocks of the cylinder, and means for rotating said rotor at a uniform speed rate.

5. A tone generator comprising a plurality of aligned cylinders, each cylinder being formed of arcuate insulated sections and each section being formed of arcuate metal blocks positioned side by side, the blocks of each cylinder being insulated from the other and having inscribed on their inner concave surfaces sound tracks of tones of predetermined frequency, shafts positioned within each of said cylinders, common means for rotating said shafts at a constant and different speed, and rotors mounted on said shafts, one within each of said cylinders, said rotors including radial arms and terminal bars lying parallel to the shaft and adapted in rotation to sweep over the surface of the sound blocks adjacent to but not contacting with said sound tracks.

6. A tone generator comprising a cylinder, said cylinder being formed of plural sectors placed end to end around the cylinder and insulated from each other and each sector being formed of plural arcuate metallic sound blocks placed side by side and insulated one from the other, sound tracks inscribed on the inner concave surface of each of said sound blocks, the sound tracks of the sound blocks of each sector differing in frequency successively from end to end of the sector by a full octave, and the sound tracks of the sound blocks of each sector at the same unit from the end of the sectors having identical frequencies but differing timbres, an amplifier unit, a sound transforming unit, a rotor having a shaft axially positioned within said cylinder, and plural radial arms terminating in end bars, said end bars being parallel to the shaft axis and adapted to move over the sound block surfaces in close proximity to the sound tracks.

7. A tone generator comprising twelve cylinders fixedly mounted in axial relationship one to the other, each cylinder comprising plural sectors positioned side by side to form the cylinder, said sectors being insulated from each other and consisting of plural aligned arcuate metallic sound blocks insulated one from the other, the sound blocks of each sector having sound tracks inscribed on the inner concave surface thereof, the frequency of adjacent sound tracks changing from one end of the sector to the other in octave steps, and the sound tracks in sound blocks spaced an equal number from one end of the sectors being identical in frequency but differing in timbre, a rotor positioned in each cylinder, said rotor comprising an axial shaft having radial arms and terminal bars, said arm having equal angular displacement and terminating in bars positioned parallel to the shaft axis and adapted to move in close proximity to the sound track surfaces of the sound blocks of each cylinder, and means for rotating said rotors in unison and each at a constant speed, said rotors being insulated from said rotating means.

8. A tone generator comprising twelve cylinders fixedly mounted in axial relationship one to the other, each cylinder comprising plural sectors positioned side by side to form the cylinder, said sectors being insulated from each other and consisting of plural aligned arcuate metallic sound blocks insulated one from the other, the sound blocks of each sector having sound tracks inscribed on the inner concave surface thereof, the frequency of adjacent sound tracks changing from one end of the sector to the other in octave steps, and the sound tracks in sound blocks spaced an equal number from one end of the sectors being identical in frequency but differing in timbre, a rotor positioned in each cylinder, said rotor comprising an axial shaft having radial arms and terminal bars, said arms having equal angular displacement and terminating in bars positioned parallel to the shaft axis and adapted to move in close proximity to the sound track surfaces of the sound blocks of each cylinder, and means for rotating said rotors in unison and each at a constant speed, said rotors being insulated from said rotating means.

9. In an electrical musical instrument comprising a keyboard having a plurality of keys, switches controlled by said keys, an amplifier unit, a sound transforming unit, circuits connecting the switches to a source of direct current potential, the sound transforming unit to the amplifier unit, and the switches to the amplifier unit, means interposed in said last named circuit for impress-

ing on said amplifier when one or more of the switches are closed, current variations of a predetermined frequency corresponding to a definite tone, said means comprising a plurality of arcuate metallic blocks insulated from each other and placed side by side and end to end to form axially extending sectors and transversely positioned rings of blocks respectively, sound tracks formed on the surfaces of said blocks, grounded metal plates interposed between the adjacent block ends of each ring, a rotor positioned with its shaft including the axis of the cylinder, said rotor having radial members terminating in bars lying parallel to the axis and adapted to move in proximity to the inner surfaces of said blocks, and means for rotating said rotor at a constant speed.

10. In an electrical musical instrument comprising a keyboard having a plurality of keys, switches controlled by said keys, an amplifier unit, a sound transforming unit, circuits connecting the switches to a source of direct current potential, the sound transforming unit to the amplifier unit, and the switches to the amplifier unit, means interposed in said last named circuit for impressing on said amplifier when one or more of the switches are closed, current variations of a predetermined frequency corresponding to a definite tone, said means comprising a cylinder formed of a plurality of arcuate metallic blocks insulated from each other and placed side by side and end to end to form axially extending sectors and transversely positioned rings of blocks respectively, sound tracks of predetermined and definite frequencies inscribed on the surfaces of said blocks, a rotor positioned within the cylinder with its shaft including the axis of the cylinder, said rotor having arms extending radially and in a common transverse plane from the shaft, the ends of said arms terminating in T-shaped bars of angular section, an angular edge of the bars being adapted to move in close proximity to the sound tracks of said sound blocks, and means for rotating said rotor at a constant speed.

11. In an electrical musical instrument comprising a keyboard having a plurality of keys, switches controlled by said keys, an amplifier unit, a sound transforming unit, circuits connecting the switches to a source of direct current potential, the sound transforming unit to the amplifier unit, and the switches to the amplifier unit, means interposed in said last named circuit for impressing on said amplifier when one or more of the switches are closed, current variations of a predetermined frequency corresponding to a definite tone, said means comprising a cylinder formed of a plurality of arcuate metallic blocks insulated from each other and placed side by side and end to end to form axially extending sectors and transversely positioned rings of blocks respectively, sound tracks of predetermined and definite frequencies inscribed on the surfaces of said blocks, a rotor positioned within the cylinder with its shaft including the axis of the cylinder, said rotor having arms extending radially at an angle including one of said arcuate metal blocks and in a common transverse plane from the shaft, the ends of said arms terminating in T-shaped bars of angular section, an angular edge of the bars being adapted to move in close proximity to the sound tracks of said sound blocks, and means for rotating said rotor at a constant speed.

12. In an electrical musical instrument comprising a keyboard having a plurality of keys, switches controlled by said keys, an amplifier unit, a sound transforming unit, circuits connecting the switches to a source of direct current potential, the sound transforming unit to the amplifier unit, and the switches to the amplifier unit, means interposed in said last named circuit for impressing on said amplifier when one or more of the switches are closed, current variations of a predetermined frequency corresponding to a definite tone, said means comprising a cylinder formed of a plurality of arcuate metallic blocks insulated from each other and placed side by side and end to end to form axially extending sectors and transversely positioned rings of blocks respectively, sound tracks of predetermined and definite frequencies inscribed on the surfaces of said blocks, a rotor positioned within the cylinder with its shaft including the axis of the cylinder, said rotor having arms extending radially at an angle including one of said arcuate metal blocks and in a common transverse plane from the shaft, the ends of said arms terminating in T-shaped bars of angular section, an angular edge of the bars being adapted to move in close proximity to the sound tracks of said sound blocks, means for rotating said rotor at a constant speed, and a yielding driving connection interposed between the rotor and driving means.

13. A tone generator comprising a plurality of insulated sound blocks each having sound tracks inscribed thereon and together forming a group of cylinders, a rotor for each cylinder comprising a hub, radial arms, end bars on the arms parallel to the hub and adapted to sweep over the block sound tracks, supports for said rotors, power means to drive the rotors, and gearing between the power means and rotors whereby each rotor is driven at a different speed to produce tones varying in pitch acccording to the chromatic scale, said rotors being insulated from the supports and power means.

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