Feb. 11, 1936. I. EREMEEFF 2,030,248

APPARATUS FOR PRODUCING SYNTHETIC ELECTRONIC SOUND

Filed Nov. 10, 1933 3 Sheets-Sheet 1

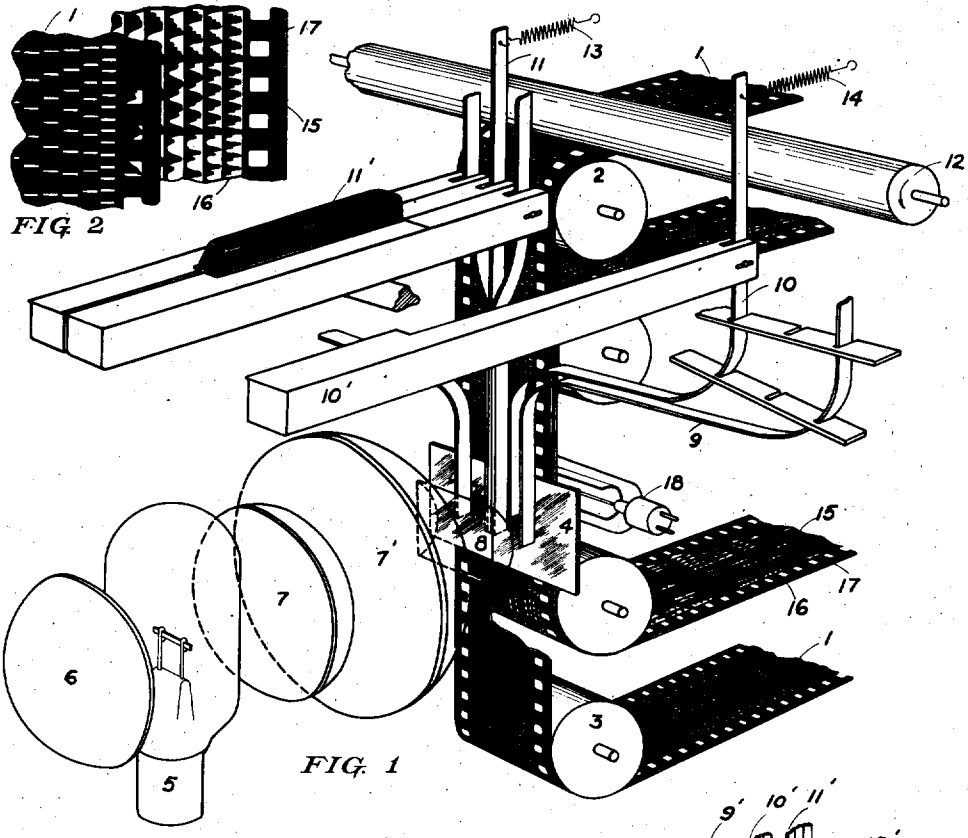

FIG. 2

FIG. 1

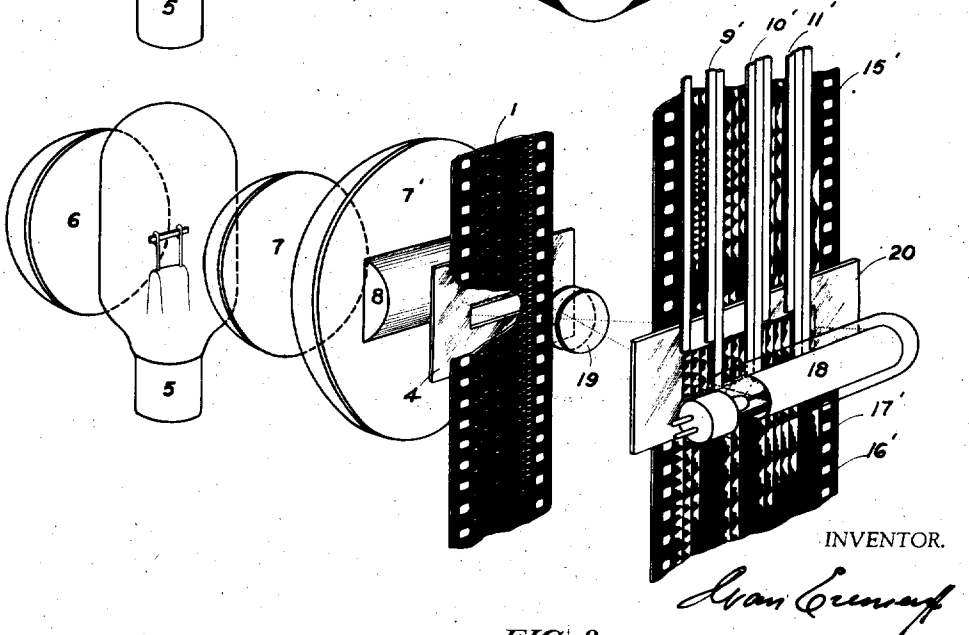

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FIG. 3

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APPARATUS FOR PRODUCING SYNTHETIC ELECTRONIC SOUND

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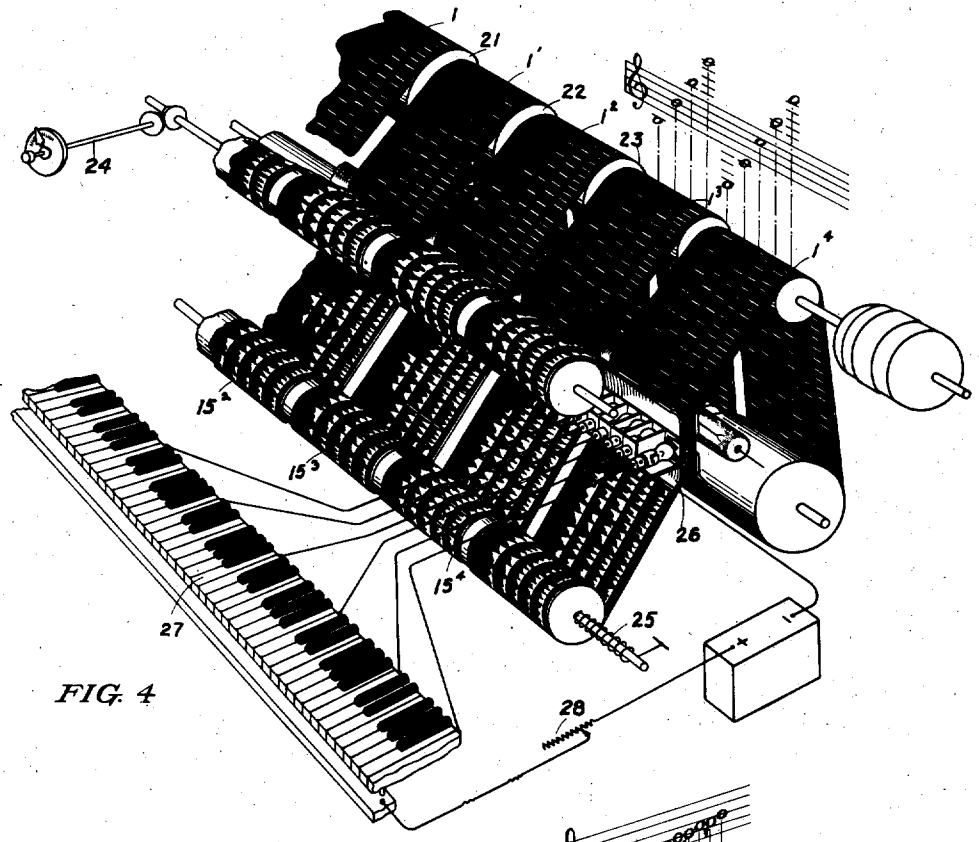

FIG. 4

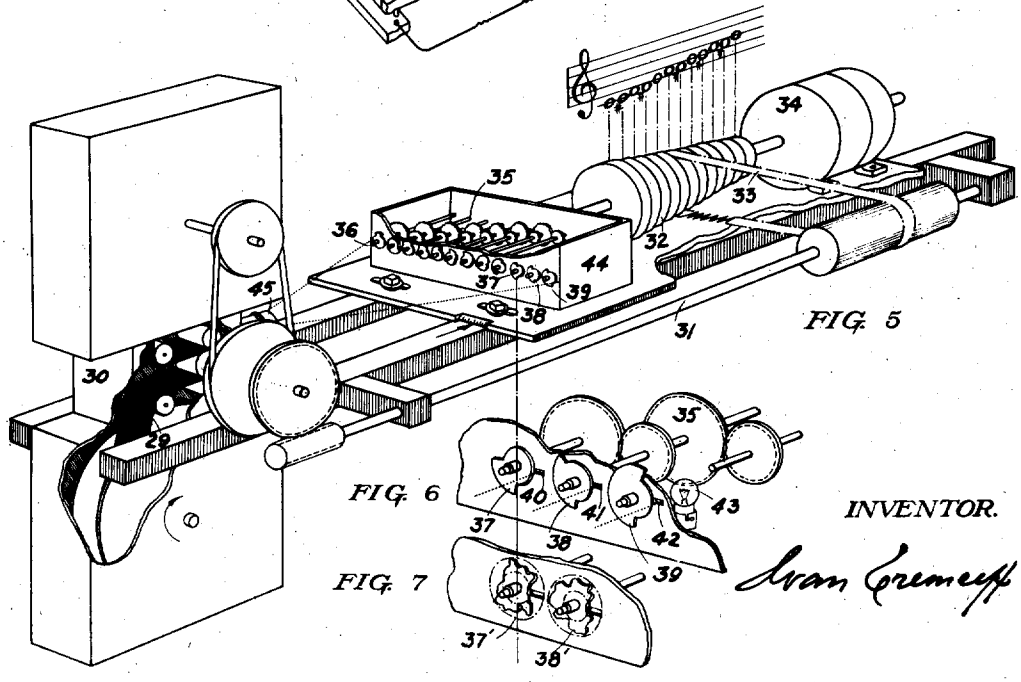

FIG. 5

FIG. 6

FIG. 7

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APPARATUS FOR PRODUCING SYNTHETIC ELECTRONIC SOUND

Filed Nov. 10, 1933 3 Sheets-Sheet 3

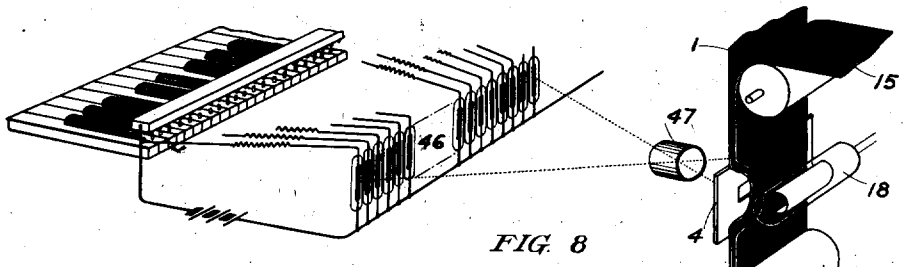

FIG. 8

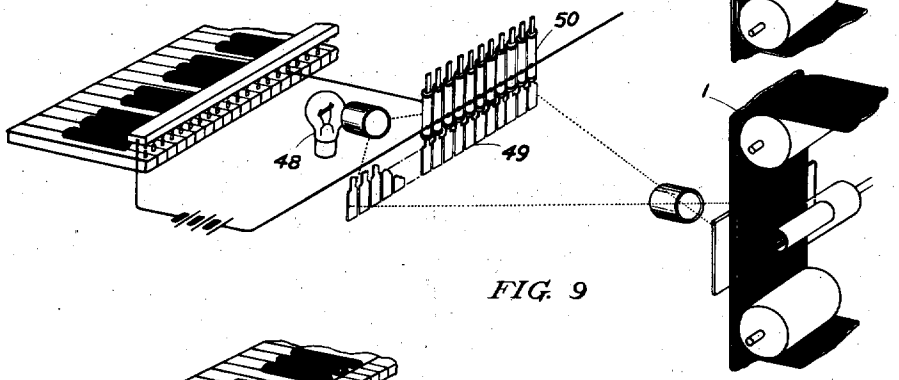

FIG. 9

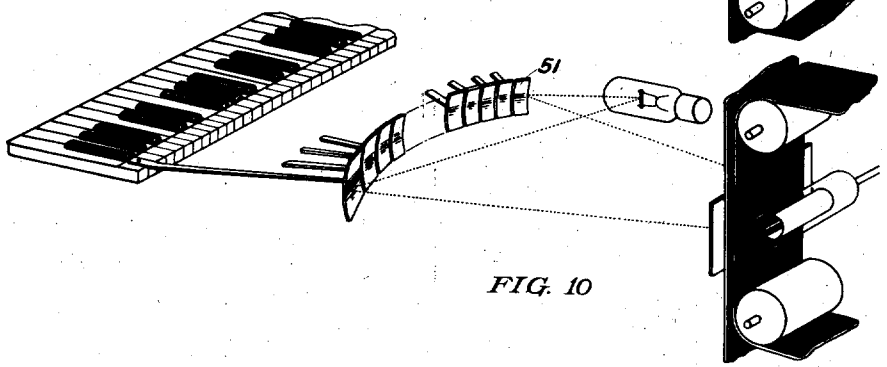

FIG. 10

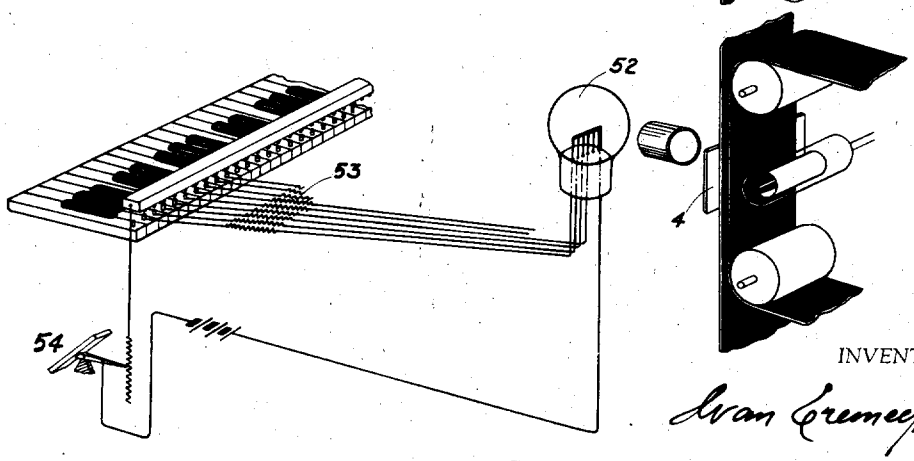

FIG. 11

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Patented Feb. 11, 1936 2,030,248

UNITED STATES PATENT OFFICE

2,030,248

APPARATUS FOR PRODUCING SYNTHETIC ELECTRONIC SOUND

Ivan Eremeeff, Philadelphia, Pa.

Application November 10, 1933, Serial No. 697,458

17 Claims. (Cl. 84—1)

My invention relates to a method of producing predetermined patterns for the production of synthetic electronic sound. It is an object of my invention to devise a method for producing records of predetermined patterns of definite and correct size and repetition number, for the production of musical sounds which maintain accurate tuning in order to abide by the requirements set forth in the tuning profession, as disclosed in my copending patent application Serial Number 686,361, filed August 23, 1933.

Another object of my invention is to devise a method of producing records which will give all kinds of qualities of sound, such records being changeable easily and quickly, at desired intervals. A further object of my invention is to produce records of definite patterns which permit of creating sustained and percussion sound effects in addition to sounds of predetermined tone quality. It is another object of my invention to provide a method of multiple recording and multiple sound production. It is also an object of my invention to show novel and suitable means for carrying out the method here disclosed, in different applications.

Still another object of my invention is to devise a method for the production of a plurality of pulsating electric currents of predetermined frequencies, predetermined intensities, and predetermined wave forms, at predetermined fractions of time, which are controllable either by keying means or by the different lengths of interrupted and uninterrupted record tracks, the volume of the entire output of said pulsating electric currents being made visible to the performer by novel means, with sensitivity and damping, said means indicating the loads of all ranges.

In preparation of the above-mentioned records of predetermined patterns, the waves which represent the desired synthetic sounds are first calculated theoretically or by means of plotting on paper, then transferred to the records, and then scanned step by step in the manner disclosed in my copending patent applications, Serial Number 466,980, filed July 10, 1930, Serial Number 453,090, filed May 16, 1930, and Serial Number 527,391, filed April 3, 1931, since allowed. In the present invention, a plurality of frequency waves are plotted on paper and added into a resultant curve, the shape of which is transferred onto the record. To obtain the correct resultant curve, I employ methods of wave synthesis as disclosed in my copending patent applications Serial Number 686,361, filed August 23, 1933, Serial Number 615,307, filed June 4, 1932, since allowed, and Serial Number 544,821, filed June 16, 1931, since allowed. However, the difference between the present invention and the above-mentioned last three patent applications involving wave synthesis is that the latter provides that the frequency waves are first produced and added, and then simultaneously impressed on the output, as also disclosed in my copending patent application Serial Number 258,466, filed March 2, 1928, at present allowed, while in the present invention, the frequency waves are first plotted, placed on the record, and impressed step by step on the output.

The methods of synthesis disclosed in 686,361 include, among others, the addition of fundamentals to harmonics and subharmonics. For example, the fundamental A–440 at an intensity of 65% is added to harmonic 880 at 10% intensity, to harmonic 1,760 at 15% intensity, and to the subharmonics 220, 110 and 55 at 20%, 45%, and 30% intensity, respectively. Other more intricate synthesis methods are also disclosed in application Number 686,361.

These are the combination, at predetermined intensities, of fundamentals with multiples of the fundamentals, with multiples of the fractions of the harmonics, with multiples of the fractions of the multiples, with divisions of the fundamentals, with fractions of the fundamentals, with fractions of the subharmonics, with fractions of the divisions of the fundamentals, with divisions of the fractions of the subharmonics, and with divisions of the divisions of the fundamentals. The many combinations produced by these methods of synthesis permit of producing records of any desired waves, for the production of synthetic sound of any tone quality, and at any chosen degree of volume within the limits permitted by the apparatus utilized for the purpose.

In cases of producing sounds which are unknown, or of which there is no material record, a peripherial wave cam, as will be described later, is made for trial, and tested by rotating in the path of light which is projected through an aperture to a light sensitive element for conversion into sound energy. The wave form which has been transferred to the cam is then altered as desired until a satisfactory sound is procured.

The waves which are on the records in the present invention are uniform or repetition waves. That is, the units representing the wave lengths repeat themselves endlessly.

It is known that at different frequencies, the tone qualities resulting from waves of the same uniform wave form distort themselves to some

extent. In order to avoid this, in preparation of the records, partials are added or deducted, and the wave cams are changed to correspond with the changes thus made, so that the recorded waves are altered in their characteristics to such an extent that, throughout the entire keyboard, the tones of any quality are recognizably similar at all pitches. For example, if the quality selected is that of a flute, that particular timbre will lend itself as readily at frequency 280 as it will to frequency 1,920. Thus, the recorded patterns are not absolutely the same at different octaves of the musical scale, although they are provided for the production of the same quality.

In the present invention, it is not of prime importance to synthesize waves by combining a fundamental of predetermined frequency and intensity with a group of partials of much lower intensity so that the fundamental predominates in the final sound production. Instead, groups of partials of different frequencies and similar or different intensities are combined so that the blended combination is perceived, in place of one strong tone which is modified by its partials. For example, by the present invention it is possible to produce the sound of the general din of a city street at high or low pitches of the musical scale. However, this sound is so complicated that when heard apart, it is not recognized as having any definite pitch. But when that sound is carried over different pitches of the musical scale, it is heard as having a main pitch, when comparison is shown between the sounds at higher and lower pitches. The keyboard used in this sound production is tempered uniformly, so that all of the tones which are produced simultaneously are approximately uniform in volume.

Provision is made to produce records which do not have errors or additional periodical harmonics, due to shape and dimensions. This point has been explained in my copending patent application Serial Number 686,381, filed August 23, 1933. These records can be made, for example, in microscopic size and are reproduced by simple projection devices.

The objects of my invention will be more fully understood from the following specification and claims, reference being had to the accompanying drawings, in which:—

Fig. 1 illustrates a method of producing synthetic electronic sound by two specially prepared records of the same dimensions. These are a pitch record and a quality record.

Fig. 2 is a detail of a part of Fig. 1.

Fig. 3 illustrates a method of producing synthetic electronic sound by two specially prepared records of different sizes. These are a small pitch record and a larger quality record.

Fig. 4 illustrates a method of producing synthetic electronic sound from a multiple pitch record and a multiple quality record.

Fig. 5 illustrates a method of producing records of predetermined pitches and records of waves of predetermined qualities.

Fig. 6 and Fig. 7 show detail views of part of Fig. 5.

Figs. 8, 9, 10, and 11 show different projection means.

In Fig. 1, 1 represents a pitch record which moves at constant speed over the rollers 2 and 3. The aperture shield 4 permits the passage of light from the source 5 with aid of the optical system as 6, 7, 7', and 8 when one or more of the flexible shutters as 9, 10, 11, etc. is raised by action of the keys as 10', 11', etc. The diminisher roller 12 lowers the keys automatically at pedal controlled speed, after they have been depressed. Friction is maintained between the roller 12 and the shutters as 9, 10, 11, etc. by means of the springs as 13 and 14.

The pitch record 1 has a plurality of tracks of different numbers of apertures, corresponding to the frequencies of the tones of a musical scale, which, for accuracy, are carried in number to at least two decimal places, for example, $A\sharp^5$, frequency 466.17. The pitch is maintained so perfect that the tones may be checked by beat numbers, as done in the tuning profession.

The width of the flexible shutters as 9, 10, 11, etc., is the same as the length of the apertures in the pitch record 1. The quality record 15 is stationary unless moved to different portions at desired intervals. These portions, as 16, 17, etc., carry wave patterns of different wave lengths, to correspond to the distances between the apertures in the pitch record 1, and 100% amplitude of said waves is equal to the length of the corresponding apertures in the pitch record.

The light passing from source 5 is always cut off by the shutters as 9, 10, 11, etc., excepting at times when they are lifted as explained. Said shutters also act as heat absorbers to protect the records 1 and 15. The light sensitive element 18 converts the light energies from source 5 into electrical energies.

In Fig. 2, the pitch record 1 and the quality record 15 are illustrated in larger size. For the purpose of gaining volume at high frequencies, numerous apertures pass before as many wave lengths as can be repeated in a portion such as 16, 17, etc., on the quality record 15. The amount of light passing through the tracks is controlled by the width of the portions and by the width of the aperture in shield 4 as disclosed in my patent application 686,361.

In Fig. 3, the stationary quality record 15' is larger than the record shown in Figs. 1 and 2, for the purpose of working with wave forms in larger scale. The light passing from source 5 through the apertures in the pitch record 1 is projected and magnified by the projection lens 19 for the purpose of scanning the corresponding wave forms on the record 15' when the shutters as 9', 10', 11', etc., allow light to reach the light sensitive element for conversion into electrical energy and for indication of its amounts.

Fig. 4 shows a plurality of multiple pitch records as 1, 1', 1^2, 1^3, 1^4, etc., which are driven by means of the pulleys as 21, 22, 23 etc., respectively, at different speeds, to conform with the pitches of a musical scale, as indicated by the small diagram shown. The pitch records 1, 1', 1^2, etc., are all the same, and each has a plurality of rows of apertures of increasing numbers. The length of the said apertures is equal to the width of the wave patterns, as shown in the quality records as 15^2, 15^3, 15^4, etc., at the highest points. For the purpose of more perfect scanning, the apertures in the pitch records may be a trifle larger than the width of the waves in the quality records.

The quality records 15^2, 15^3, 15^4, etc., are all the same. They are manually moved, simultaneously or independently, before their corresponding apertures by aid of 24 and 25, for the selection of desired qualities. Instead of the shutter action as described with regard to Fig. 1, individually controlled light sources are provided before each aperture in the shield 26, so that by the depression of the keys in 27, the corresponding lamps flash

and project light onto the co-operative record tracks. The volume control **28** is provided for controlling the intensity in all of the keys in **27**.

Fig. 5 depicts a recording device in which **29** represents a fine grain photographic film which is fed at different speeds in the camera **30**, said speeds depending on which of the pulleys as **32** the flexible non-slipping elastic belt **33** is made to co-operate with. The ratios between the diametral sizes of the pulleys **32** are made to correspond precisely to the ratios between the frequencies of a musical scale, with accuracy carried to not less than two decimal places in frequency numbers, conforming with the requirements of the tuning profession.

The motor **34** which drives the pulleys **32** also turns the gear train **35**. Each individual set of gears carries a shaft and a cam shutter such as **36**, **37**, **38**, **39**, etc. The gears of the train **35** double in speed so that the cam shutters as **36**, **37**, **38**, **39**, etc., revolve each at twice the speed of the one preceding it.

The cam shutters **37**, **38**, **39** are shown more clearly in Fig. 6, with their co-operative apertures as **40**, **41**, **42**, etc., and the lamp for battery current **43**, of which there is one placed behind each aperture as **40**, **41**, **42**, etc. The lamps are so positioned as to have the filaments focused on the exposure point of the film **29**. The cam shutters are so designed as to produce slot shaped apertures on the film **29** for producing a pitch record as **1**, shown in Fig. 1. Behind each aperture as **40**, **41**, **42**, etc. a shield of predetermined degree of translucency is placed for the purpose of producing sharp images without haloation.

The device shown in Fig. 5 produces several pitch tracks simultaneously. In the case of an eight octave musical instrument, eight pitch tracks are produced at one recording shift. When eight tracks have been recorded, the flicker box **44** is displaced and eight additional tracks are recorded, said box being displaced eleven times, during which the space between the tracks is taken up. For example, if the wave track is .010'' in width, then the space is .110'', so that each displacement is 1/11 of the space between the tracks. The belt **33** must be placed at the correct sections of the pulleys **32** for producing higher or lower frequencies.

In Fig. 7, the cam shutters as **37'**, **38'**, etc. are provided for the purpose of producing quality records, such as **15**, shown in Fig. 1. The portions of the quality record as **16** and **17**, as seen in Figs. 1, 2, and 3, are prepared by being drawn on or glued on a preliminary record which is composed of sections of waves, and then reprinted in order to have a smooth surface. The cam shutters are cut along the periphery to predetermined shapes. These quality shutters operate in the same manner in connection with the apparatus in Fig. 5 as do the cams shown in Fig. 6. That is, the filaments of the lamps behind the apertures are focused on the exposure point of the film **29** with the aid of a suitable lens as **45**. The flicker box **44** is displaced as described, and waves are projected on film **29** at desired speeds, due to the pulleys **32** and the position of the belt **33**.

The type of construction of the various parts shown, such the shutters, gear train, and flicker box, has been used for the sake of simplicity, and I do not wish to be limited to the exact details of structure, since these may differ according to application. For example, the shutters as shown in Fig. 7 may be knife edged, with predetermined waves cut thereon, such shutters having reciprocating motion in closing and opening the apertures as **40**.

The shutters may be made in the form of mirrors for deflecting the images of the filaments of the lamps, or an interrupter may be used for diminishing the light, as explained in my copending patent application Serial Number 559,209, filed August 25, 1931, and allowed.

In Fig. 8 the row of light sources **46** is provided with individual resistances for intensity adjustment throughout the entire keyboard. The objective lens **47** focuses a row of light from the sources **46** through the aperture shield **4** to the pitch film **1** and the quality film **15**.

In Fig. 9 a single light energy from the source **48** is spread over the row of shutters as **49**. **50** represents a row of magnets which lift the shutters as **49** selectively upon pressure of any of the keys. The shutters are made to move up and down in the cores of the magnets. Light from the source **48** passes through selective openings made by the shutters when they are lifted and is focused on its corresponding track on the pitch record and the quality record.

Fig. 10 is similar to Fig. 9, expecting that in Fig. 10 the objective lens is eliminated and is replaced by moving focusing mirrors such as **51**, each of which is connected to its own corresponding key in the keyboard.

Fig. 11 shows a novel unit of a light source **52** which permits of projection of light through the aperture shield **4** in the form of one or more images of the filaments of said light source. The said filaments are of such size that each projects light which is as long as the width of the aperture in the shield **4** and as wide as the individual tracks on the pitch record, so that a plurality of filaments together project light which is the size of the aperture in shield **4**. Each filament is under its own resistance such as **53**, so that the intensities of said light is preadjusted and can be fixed or regulated from the movement of the keys, similar to a rheostat. **54** shows a pedal control for regulating volume.

For explanatory purposes, I have shown photographic film, but I do not wish to limit myself from using other modifications, such as metal or fibre perforated pitch records co-operating with printed quality records from which light is reflected to the light sensitive element instead of being permitted to pass through.

Having thus described my invention, what I claim as new and useful is:—

1. An electronic musical instrument comprising a plurality of light sources, objective means for focusing said plurality of light sources on a stationary belt masking means, selective and independent keying means for controlling the passage of said light energies through predetermined portions of said belt masking means, and adjustable means of a keyboard for raising and lowering the output of said electronic musical instrument.

2. An electronic musical instrument, comprising a moving belt mask, a stationary preadjustable belt mask, a light energy, a plurality of shutters co-operating with keys, a keyboard means for selectively and optically focusing one or more light energies in successive areas of a predetermined said preadjusted stationary belt masking means with translucent areas of different shapes, each said translucent area of predetermined shape being predeterminedly prepared for the

electrical production of a musical tone of predetermined pitch, volume, and timbre.

3. An electronic musical system comprising a moving pitch belt mask with a plurality of parallel rows of pitch tracks, each of said tracks representing a predetermined frequency of a musical scale, and each of said pitch tracks having a plurality of slit apertures of predetermined equal widths, said slit apertures being equally spaced at a predetermined distance from each other, said distance governing the pitch of the musical tone which said track represents, the adjacent pitch tracks representing different predetermined pitches of musical tones, governed by the equally spaced predetermined different distances of the slit apertures in said tracks, said distances being proportional to predetermined pitches of a musical scale which said pitch tracks represent, a stationary preadjustable quality belt mask comprising different sections of wave form patterns, each of said sections comprising parallel rows of wave form patterns of predetermined wave lengths, each said wave length and the amplitude of said predetermined wave form pattern being proportional to the distance between and the length of the slit apertures of the corresponding pitch track of said moving pitch mask, means for sharply registering said moving pitch slit apertures on their co-operative wave form patterns, a source of light, means for manually controlling the passage of light energy through predetermined tracks of said pitch mask and their co-operative wave form patterns of selected sections of said wave form track mask, to a photosensitive element for conversion into pulsating electrical energy.

4. An electronic musical instrument for the synthetic production of sound of predetermined pitch and predetermined quality, comprising means for predeterminedly passing light energies through a synthetically prepared moving pitch belt mask and a synthetically prepared wave track belt mask, said pitch mask comprising a plurality of rows of pitch slit apertures, and said wave track mask comprising a plurality of sections of wave form patterns, means for driving said pitch mask at predetermined different speeds, means for simultaneously selecting different sections of said wave track mask, a keyboard for controlling the passage of light energy through said pitch mask and said wave track mask, and common means for controlling the intensity of light energy from said keyboard.

5. A synthetic electronic musical instrument comprising a plurality of identical moving pitch belt masks, all of said pitch masks having a predetermined number of parallel rows of slit apertures of predetermined width and length, each row of said slit apertures being a multiple and a division, in number, of the adjacent rows of slit apertures, a plurality of different sections of preadjustable normally stationary quality belt masks, each said section having a predetermined number of rows of apertures of uniformly repeating wave forms, each of said wave form apertures having predetermined wave length, amplitude, and wave form, each row of wave form apertures being a multiple and division, in number, of the adjacent wave form apertures, the rows of slit apertures in said pitch mask and the rows of the wave form apertures of said quality mask being predeterminedly prepared at uniform repeated order, with accuracy in said order to avoid distortion from mismatching, means for driving a plurality of said identical pitch masks at different predetermined speeds in predetermined register with a corresponding plurality of quality masks, common means for selectively positioning in front of light sources predetermined sections of a plurality of quality masks, a plurality of light sources, one of said sources being provided for each row of wave form apertures of selected sections of said quality masks, a keyboard for controlling the turning on and off of said predetermined light sources, and common means for said keyboard for controlling the intensity of said light sources.

6. In an electronic musical system, comprising: a light source, stationary and moving belt masks, and a keyboard co-operating with shutters, means for manually opening and automatically closing predetermined portions of a light-gauging mask, means for focusing a light source filament slightly over the area of the aperture of said light-gauging mask, a pitch belt mask which is moving at a predetermined uniform rate of speed, said pitch mask comprising a plurality of rows of uniformly spaced slit apertures of predetermined widths and predetermined lengths, each individual row of slit apertures being of uniform width and uniform length, the uniform spacing of apertures in the rows of said pitch mask being of different sizes and being precisely prepared to correspond proportionally to the frequencies of the musical tones which said rows represent, a stationary quality belt mask comprising a plurality of sections, each section of said quality mask having a plurality of rows of apertures, the number of rows of apertures in said quality mask being the same as the number of rows of apertures in said pitch mask, each row of said quality mask comprising a predetermined number of wave form apertures of predetermined wave length, predetermined amplitude, and predetermined wave shape, said rows of wave form apertures being precisely prepared to correspond proportionally to the frequencies of the musical tones which said rows represent, means for registering said pitch mask with said quality mask, so that the rows of slit apertures of the pitch mask are made to pass over corresponding rows only of wave form apertures of said quality mask, the sections of said quality mask being individually and selectively positioned with the aperture of said light-gauging mask.

7. An electronic musical system, comprising: a plurality of light source filaments of predetermined width and predetermined length, each of said light source filaments being individually connected to its corresponding key in a keyboard, a key action, individual adjustment for controlling the intensity of each of said light filaments, and camera means for projecting light from predeterminedly lighted filaments of said plurality of light source filaments, through a specially prepared moving pitch belt mask and through a specially prepared normally stationary quality belt mask, onto a photosensitive element.

8. In an electronic musical instrument comprising: means for the production of one and more pulsating light energies of predetermined frequency, predetermined intensity, and predetermined cyclic orders of intensity variations, for conversion into electric and sound energy, a light source, a belt which is moving at a predetermined uniform rate of speed, said belt comprising a plurality of light choppers for breaking the light energy of said light source passing through them, into a plurality of pulsating light energies, the

frequencies of said pulsating light energies corresponding precisely to the frequencies of the tones of a musical scale, common means for focusing and projecting each of said interrupted light energies through a predetermined corresponding row of wave form apertures of a selected section of a normally stationary quality belt mask, onto a photosensitive element, and means for individually and predeterminedly controlling the passage of said projected pulsating light energies.

9. An electronic musical instrument comprising: belt means for producing a plurality of pulsating light energies, each of said pulsating light energies having a predetermined number of cycles per the same fraction of time, belt means for modulating said pulsating light energies in predetermined orders of intensity variation, manual means for controlling the passage of a predetermined number of said modulated light energies, onto a photosensitive element, and means for automatically discontinuing at a predetermined rate of speed, the passage of said pulsating light energies onto said photosensitive element.

10. An electronic musical instrument, comprising: a belt pitch mask which is moving at a predetermined uniform rate of speed, and a normally stationary quality belt mask, said pitch mask comprising a plurality of rows of slit apertures, said quality mask comprising a plurality of wave form apertures, the number of slit apertures of said pitch mask being equal to the number of wave form apertures of said quality mask, the spacing between said pitch slit apertures and the lengths of said pitch slit apertures corresponding respectively to the lengths of said wave form apertures and the amplitudes of said wave form apertures, in the same proportion as the focal lengths of the common objective registering means between said pitch mask and said quality mask.

11. In a photo-electric musical organ comprising: an optical system for registering one moving and one stationary, multi-sound track light masking elements of predetermined design and shape, in conjunction with the light source and the photo-electric element, for the production of musical tones photo-electrically.

12. In a photo-electric organ comprising: two multi-sound track belt masks, one stationary and one uniformly moving, for scanning and modulating the light energies, a photo-mechanical means for synthetically producing said belt masks, an optical system, a light source, a keyboard, a set of shutters, a uniform drive for said moving mask, and a photo-electric element.

13. In an electronic organ comprising: a multi-sound track belt record, a uniform speed drive for said record, means for synthetically preparing said record, an optical system for all of said sound tracks of said record, a set of shutters, a keyboard, a light source with a single filament, and a photo-electric element.

14. An electronic musical instrument, comprising a uniformly moving belt mask with rows of slits and a stationary belt quality mask with rows of wave form apertures, said uniformly moving mask comprising a plurality of rows of slit apertures with predetermined uniform spaces between slits and between each row, means for producing a plurality of rows of slits for said moving mask so that the distance between the center line of said slits in one row is more and less than the distance between the center lines between two slits in predetermined rows of slits, being mathematically proportional to the frequency of musical tone which said row of slits represents, distances between slits in each row being equal, a stationary belt mask comprising a plurality of sections, each section consisting of predetermined number of rows of apertures of wave form shape, the shape of aperture in one predetermined row representing a quality of musical tone, the wave length of said aperture representing a predetermined frequency of musical tone, the amplitude of said wave aperture representing full volume of a musical tone, means for producing one and more sections of wave form apertures, interchangeable common means for the production of a moving belt mask and a stationary belt mask with apertures in the form of slits and wave patterns, means for projecting light energy through said moving belt mask, means for directing, projecting, and focussing light energies coming from said moving slit belt on said stationary preadjustable belt mask on its cooperative wave form apertures, a manually and automatically operated keyboard for opening and closing at a predetermined fraction of time a plurality of independent keying means for controlling the passage of light energy through said stationary preadjustable belt mask on a photo-electric element which converts said light energies into electric energy, said electric energy later being utilized for the production of sound energy.

15. A synthetic electronic musical instrument for the production of musical tones electrically with the aid of a light source and photo cell comprising: a moving belt mask, the rate of speed of movement of said belt mask being proportional to the fraction of time in which impulses of alternating current are occurring which are utilized for driving said moving belt mask with the aid of a constant speed motor, said moving belt mask having a plurality of parallel rows of apertures, each of said apertures in said rows having predetermined width and length, the distance between said apertures in a row being uniform and proportional to the frequency of the musical tone which said distance is representing, said moving belt being supported and driven by rollers of predetermined diameter which journal at uniform and fixed speed for maintaining international pitch A 440, without variation of the flat or sharp side, a stationary preadjustable belt mask comprising a plurality of horizontally spliced sections, all of said sections having vertical rows of apertures of predetermined wave forms and predetermined wave lengths, the number of rows of said wave apertures being the same in all sections, the wave lengths in each row of wave patterns and all sections also being equal, the wave patterns in each section of said belt mask in a single row being different, the lengths of said apertures in a predetermined row in said stationary belt mask being proportional to the frequency of the musical scale which each row of apertures represents, a plurality of flexible shutters, one for each row of wave form apertures for closing and opening light energy passing in a predetermined section through said belt mask, each said individual flexible shutter being connected to its own corresponding key in the keyboard of said instrument, a keyboard, a diminishing roller for independently closing said shutters when said shutters are being opened by the action of each corresponding key of said keyboard, a friction means for holding each individual shutter against a diminishing roller, a light source with filament to correspond with

the predetermined projected size of image, an optical system for projecting said light source on said uniformly moving belt mask and through a row of apertures of said belt mask and row of wave apertures of said stationary preadjustable belt mask on the photo-sensitive element when said flexible shutters are being raised and lowered by selective predetermined keys of said keyboard, a stationary mask with a fixed aperture of predetermined dimension on the front of said moving and stationary belt masks for dissipating heat and limiting projection of said light energy on a predetermined area of said moving belt mask and on a predetermined area of said stationary preadjustable belt mask, and a photo-electric element for converting said light energy which passes through said moving belt mask and stationary preadjustable belt mask and through openings made by raised shutters, into electrical energy which later is converted into sound energy by sound emitting means.

16. An electronic musical instrument for the production of tones electrically, comprising: a keyboard for lighting a predetermined number of light sources, each key in said keyboard having an individual electrical circuit with an individual adjustment for the intensity of the current flowing through it to its own individual filament in a multifilament electric light bulb, an electric light bulb with the filaments predeterminedly positioned, each of said filaments being lit by its own cooperative circuit and a switch of its cooperative key in said keyboard, a swell pedal for each keyboard for increasing and decreasing the intensity of the light in all of the filaments simultaneously in said electric light bulbs, said swell pedals being especially adaptable when a plurality of said keyboards is used simultaneously, one for playing solo, and the others for playing accompaniments, a lens for focusing light from one or more filaments simultaneously on predetermined rows of parallel slits on said moving pitch belt mask, a stationary shield mask with an aperture of predetermined dimension for limiting the light projected by a light source on a predetermined area of said moving belt mask with said rows of slits, a stationary preadjustable belt mask with parallel rows of apertures of predetermined wave form, wave length, and amplitude, the amplitude of said wave apertures in said stationary belt mask being equal and less than the width of the slits in the corresponding row of slits of the moving belt mask, and a photo-sensitive cell for impressing light energy from predetermined light sources which pass through said moving belt mask and said stationary preadjustable belt mask with the aid of said projecting and focusing lens.

17. A synthetic electronic musical instrument for the production of music electrically in conjunction with a light source and a photo-cell, comprising: a scanning belt uniformly moving in one direction with a plurality of parallel rows of slits all of said slits in said rows having a predetermined fixed width and length, and at a predetermined distance between each row of slits, the distance between said slits in a single row of said slits being uniform and proportional to one predetermined frequency of the musical scale which said distances are made to represent, the said uniformly moving belt with rows of slits being supported by rollers of a predetermined diameter and said rollers being journalled at a predetermined uniform fixed invariable speed for the purpose of maintaining the predetermined and international pitch A 440, a stationary and preadjustable belt mask positioned at a predetermined distance from said moving belt mask, comprising a plurality of sections, all sections of said preadjustable belt mask having vertical parallel rows of openings of a predetermined wave form and predetermined wave lengths, the number of wave openings in the vertical and parallel rows in each section of said stationary belt mask being the same in all sections per same predetermined area, the wave lengths in each row of wave openings in said stationary belt mask in each section being the same in their corresponding rows in all the sections of said stationary belt mask, the wave openings in each section of said stationary belt mask in a single row being different in regard to each adjacent row, the lengths of said wave openings in a predetermined row in said stationary belt mask being proportional to the frequency of the musical scale which said row is representing, a plurality of shutters one for each row of openings for a stationary belt mask, for closing and opening a passage of light energy through said wave openings of said stationary belt mask in the predetermined section, said shutters being connected each with its own corresponding key in the keyboard of said instrument, a keyboard, a friction means for holding each individual shutter means against a diminishing roller for the purpose of closing the individual shutter with its own cooperative individual key at a predetermined rate of speed controllable by the revolutions of said diminishing roller, a light source with a predetermined size of filament for projection through said moving and stationary belt masks, an optical system for projecting and focusing the light of said light source from the apertures of the moving belt mask on selected sections of a stationary preadjustable belt mask, a photo-sensitive element for common conversion of light impulses into electrical energy, a stationary shield for limiting and dissipating heat from said light energy in front of said moving belt mask, a stationary shield between the stationary preadjustable belt mask, and key shutters for predeterminedly gauging a selected section of said preadjustable stationary belt mask through which said light energy is projected.

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