AUTOMATIC PLAYER FOR ELECTRONIC MUSICAL INSTRUMENT

INVENTORS

RONALD GLASS
CHARLES F. FUECHSEL, III

BY

ATTORNEY.
AUTOMATIC PLAYER FOR ELECTRONIC MUSICAL INSTRUMENT

Ronald Glass, Hyattsville, Md. (5809 King Arthur Way, Gladys, Md. 20769), and Charles J. Fuechsel III, 3421 Memphis Lane, Bowie, Md. 20715

Filed Oct. 21, 1965, Ser. No. 499,855

U.S. Cl. 84—1.03
Int. Cl. G10h 3/00; G10h 3/06

15 Claims

ABSTRACT OF THE DISCLOSURE

An automatic player for an electronic musical instrument includes an elongated strip having markings representing musical notes transversely disposed thereon, said strip being driven at constant speed past a light source, the light which penetrates through the markings enables it to actuate a plurality of aligned photocells, one for each note in the strip, thereby controlling a circuit and switch system to simulate the action of a key switch in the electronic musical instrument.

This invention relates to automatic players for musical instruments and particularly for electronic instruments, such as electric organs of the type having generators, producing tone signals at the vibration frequencies of the notes of the chromatic scale, and means for translating said signals into audible sounds of any desired quality and volume.

Because of the richness and variety of the tones produced by electronic instruments such as electric organs, they have become extremely popular and have been purchased by individuals having very little background, or formal education, in music but who nevertheless are able to pick out the notes of a simple melody and produce a reasonably pleasing effect due to the richness of the tone of the instrument itself, rather than the ability of the musician. With passage of time, however, such purchasers lose interest in the instrument as their ability to play does not improve. It would, therefore, be highly desirable to provide an apparatus capable of playing any selection on the instrument automatically. To further preserve the interest of the purchaser in the instrument and to cater to his ego, it is desirable that the automatic player utilize in some measure his efforts and abilities at least in reading and transcribing the notes of a selected composition to a control sheet for the automatic player.

In light of the above brief remarks, it is a primary object of the present invention to provide an automatic player, for an electronic instrument, which will enable an unskilled musician to chart a musical composition and subsequently use the chart to play the composition automatically and without fingering as often as desired. To this end the automatic player features a strip on which the notes of a composition may be charted by merely marking areas of the strip, corresponding to the notes of the selected musical composition, with pencil, crayon, ink or the like. The strip in combination with a drive, and photo cell controlled switching means plays the organ. With such apparatus, the user need not play or even have the ability to play the organ to play the latter without requiring excessive, or time consuming, electrical connections or circuit alterations of the organ.

Yet another object of the invention is to provide an automatic player, having the above described characteristics, which is of simple design, easy and inexpensive to fabricate and easy to use.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, wherein like reference characters indicate like parts throughout the several figures and in which:

FIG. 1 is a perspective view of an automatic player according to the invention, with both the lamp bearing cover and the sheet drive roller carriage tilted upwardly and a portion of the music chart sheet broken away to reveal photo cells therebeneath.

FIG. 2 is a longitudinal sectional view taken centrally of FIG. 1;

FIG. 3 is a fragmentary plan view of a music chart sheet;

FIG. 4 is a schematic block diagram of the player and its connections to the organ;

FIG. 5 is a circuit diagram showing the motor drive for the music sheet together with circuit elements for control of the speed of said drive.

utilizing a plurality of photo electric cells subject to the incidence of light through said chart strip and each cell combined with electric switching means for simulating the operation of the corresponding key switch, or coupler, of the organ, or other instrument, to sound the notes charted on the strip.

A further object of the invention is to provide an elongated charting or recording strip of paper, or the like, having a pattern of areas delineated thereon, the lateral position of each representing a note of the musical scale and the length of each area representing the time for which each note is to be sounded. With a strip of this nature, the notes of a selected melody may be charted on the strip, which may be translucent, by opaquely marking the appropriate areas to prevent transmission of radiant energy such as light, to photo cells. Conversely the strip may be opaquely marked and in this manner serve as a sort of light to the photo cells. Similarly the markings may be reflective, instead of conductive, so as to reflect light to the photo cells.

Yet another object of the invention is to provide an automatic player for an electronic organ, utilizing a light obliterating recording strip having the characteristics described above and mounted in an accessory cabinet which may be placed directly on the organ, separated therefrom, and connected thereto by a cable, the accessory box including supply and take up rollers, a bank of photo cells, switching means for controlling the signal tone generator outputs of the electric organ and means for adjusting the recording strip drive means to vary the speed, whereby the melodies recorded on the strip may be played at varying tempo or speed.

A still further object of the invention is to provide an automatic player, for an electric organ, of the above described characteristics, which enables the organ to be played either automatically or by hand, as by manipulating the instrument's keyboard, or both simultaneously.

Still another object of the invention is to provide an automatic player, of the above described characteristics, which may be connected to an organ to the latter without requiring excessive, or time consuming, electrical connections or circuit alterations of the organ.

Yet another object of the invention is to provide an automatic electronic instrument player, having the above described characteristics, which is of simple design, easy and inexpensive to fabricate and easy to use.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, wherein like reference characters indicate like parts throughout the several figures and in which:

FIG. 1 is a perspective view of an automatic player according to the invention, with both the lamp bearing cover and the sheet drive roller carriage tilted upwardly and a portion of the music chart sheet broken away to reveal photo cells therebeneath.

FIG. 2 is a longitudinal sectional view taken centrally of FIG. 1;

FIG. 3 is a fragmentary plan view of a music chart sheet;

FIG. 4 is a schematic block diagram of the player and its connections to the organ;

FIG. 5 is a circuit diagram showing the motor drive for the music sheet together with circuit elements for control of the speed of said drive;
FIG. 4 illustrates schematically the various elements utilized in the automatic player and partly described above. The Chart 10 is guided over spool 26 and driven at constant speed by drive means 30. A light source 25 is disposed above the chart and a bank 40 of light sensitive detectors or photo cells is disposed under the chart. A panel 50 of switching circuits include the cells and in turn are connected by a cable 60 to the organ 70 which is to be played. A conventional power supply 80 is incorporated in the player to supply power for biasing the light sensitive detectors and the semiconductor switching elements of the switching circuits.

Referring now more particularly to FIGURES 1 and 2, the player, as briefly described in the preceding paragraph, is incorporated in a cabinet 90 open at the top, but partially closed by a short cover member 92 which houses the lamp 28. Cover 92 is hinged to the cabinet at 94 to permit upward tilting for access to lamp 28 which is illustrated as being a fluorescent tube which may be covered by different color filters, not shown, and which is powered by any suitable fluorescent lamp power and starting circuit. The music sheet 10 rolled on a supply spool 25 is led over a tension roll 96 and onto a takeup spool 26. The drive 30 for the music sheet comprises a D.C. motor 32 housed within the cabinet 90 whose output shaft 33 is connected through reduction gears 34 to a pulley 35. A friction drive roller 36 journaled in a hinged member 37 is adapted to be swung into engagement with the music sheet 10 on takeup roll 26 to drive the sheet onto the roll at a constant speed. Drive roll 36 is connected by means of chains or belts 38, 39 and additional pulleys to the pulley 35.

One possible drive circuit subject to speed variation control is shown in FIG. 5 wherein the motor is connected through the emitter and collector of transistor T1 across a source of D.C. potential. In parallel with the subcircuit is resistor R1 and potentiometer P1 controlled by knob K in series. Rotations of the potentiometer adjustment control knob K will modify the armature current of the motor changing its speed up or down. In this manner the speed of passage of the music sheet from roll 25 to roll 26 may be adjusted so that the composition charted thereon can be played at any desired speed from very slow to very fast. In FIG. 5, as well as in FIGS. 6 and 7, the potentials indicated as plus and minus V are obtained from power supply 80, not visible in FIGS. 1 and 2 but which may be of any suitable type and a rectifier bridge connectable to a source of A.C. voltage through a cord 82. FIG. 1, to convert the A.C. potential to D.C. potentials of proper magnitude. It should be further recognized that although the simple drive for the music sheet illustrated in FIG. 2 is suitable to accomplish the intended purpose, many other types of drives may be utilized including gear and clutch drives directly to the takeup spool with compensating means for changes in the diameter as the sheet is wound on the spool.

Forty-five photo cells 41 are shown aligned in a bank 40 comprising a bar-like housing having separate pockets for each photo cell opening to the top toward which the sensitive upper surfaces of the photo cells face. Photo cells 41 may be of any suitable type. In the illustrated example the photo cells are preferably semiconductors of cadmium selenide, lead sulphide, or the like, whose resistivity changes in the order of many times dark to the order of several kilohms when light is incident upon their sensitive surfaces. Each photo cell is connected in a switching circuit, a block of forty-five such circuits being diagrammed at 50 in FIGS. 2 and 4. These circuits are connected through leads in cable 60 to the signal sources of the organ 70 to be played.

Most electronic organs comprise a plurality of tone signal generators which are constantly energized and operated to produce electrical oscillations having frequencies corresponding to the desired tones. The outputs of the generators are connected to the key switches, or con-
ners, operated manually by depressing the keys of the organ keyboard to send the outputs to voicing circuits, amplifiers and speakers wherein the electric signals are combined and processed to sound the corresponding frequency. In one type of organ, the output signals from the tone generators are conducted through the closed key switches directly to the voicing circuits. In another popular type of organ, closing of the key switch applies potential to the appropriate voicing circuit already connected to a corresponding tone generator. Two switching circuits, suitable for the above described organs, either of which may be utilized in the accessory player to simulate the operation of the key switches of the organ to which the player is connected, are shown in FIGS. 6 and 7.

In FIG. 6 each photo cell 41 is connected in series with resistors R2, R3 and potentiometer P2 across the appropriate D.C. potential. The base of emitter T2 is tapped to this series subcircuit between the photo cell and the resistor R2 and its collector is connected to one side of the appropriate organ key switch, while its emitter is connected to the other side of the same key switch by leads S2 and S4 within cable 60. When the photo cell is subjected to light through the music sheet its resistance is low placing a high negative bias on the base of the transistor T2 preventing the transistor from conducting. When however, an open mark corresponding to a note to be played passes between the photo cell and the light source, the photo cell resistance increases causing the bias on the base of the transistor T2 to move toward positive and rendering it conductive whereby the leads S2, S4 being across the contacts of the associated key switch in effect short the key switch connecting the tone generator output to the voicing circuit and simulate the exact action of the key in closing the key switch contacts. Accordingly, the appropriate note is sounded in the organ.

In FIG. 7 is shown a control circuit suitable for organs of the second type mentioned above. In this circuit, the photo cell 41 in series with resistor R2 and potentiometer P2 is connected across the source of D.C. potential and the base of transistor T2 is again tapped into said series circuit adjacent the photo cell. The emitter of transistor T2 is connected through a resistor R5 to a common ground with that of the organ and the collector is connected through resistor R6 to the base of a second transistor, T3. Resistor R4 biases the base of transistor T3 whose emitter is connected to the positive D.C. potential (approximately 18 volts). The collector of transistor T3 is connectable through lead S6 to one side of the appropriate organ key switch. When light strikes photo cell 41 its resistance is low and the current correspondingly high so as to bias transistor T2 to non-conducting state. When photo cell 41 is darkened by passage of an opaque marking on the music sheet, its resistance is increased raising the bias on the transistor T2 and causing it to conduct. When transistor T2 conducts, current flows from the positive source through R4, R6 the collector and emitter and R5 to ground, which lowers the bias on the base of transistor T3 causing it also to conduct. In this state the positive 18 volts from the power source of the player is applied directly to one side of the corresponding organ key switch to enable a gating circuit between the tone generator and the voicing circuit thus simulating the action of the key switch when its key is normally depressed by fingering. Accordingly the appropriate sound is produced in the organ.

In both circuits of FIGS. 6, 7 the potentiometer provides an adjustment of the current flowing through the photo cell to adjust the sensitivity thereof to the particular paper or other material constituting the music sheet and to the lamp or other means utilized for illuminating the photo cell through the sheet.

It will be apparent from the above description that the described player operates very simply and easily to simulate the action of key switches, or couplers, on organs when played by fingering of their keyboards without the necessity for actually fingering the keyboard. However, nothing prevents the musician from playing the composition manually and automatically at the same time, to observe and correct deviations by his fingering and the notes sounded by the music sheet through the intermediary of the photo cells and switching circuits of the player. While only two switching circuits have been illustrated these would apply to most of the electric organs on the market. Variations in the switching circuits may obviously be made as a matter of design once the action of the particular organ keyboard is ascertained. A number of unrefereced switches are shown on the player in FIG. 1 which are usable to provide other photo cell switching circuits or to combine the actions of a number of key switches automatically.

As described it is further apparent that applicant's device enables anyone having minimum of familiarity with musical notes to quickly and easily chart the notes from a selected melody onto the music sheet, requiring as a tool only a pencil and the described accessory device. It is equally obvious that if a purchaser of an accessory player does not wish to or does not have the time to actually chart a composition, premarked music sheets with popular compositions already charted thereon can be made and sold to be played at will by the purchaser. The player for the first time provides an attractive accessory device which may be placed on or adjacent to an electronic organ and which may be used by unskilled musicians easily to play favorite selections automatically, thereby providing many hours of enjoyment despite the lack of ability of the musician to play the organ manually with appropriate skill and dexterity.

Although certain specific embodiments of the invention have been shown and described, it is obvious that many modifications thereof are possible. The invention, therefore, is not to be restricted except so far as is necessitated by the prior art and by the spirit of the appended claims.

What is claimed is:
1. An automatic player for an electric musical instrument, comprising an elongated strip having markings representing musical notes transversely disposed and whose lengths denote time for which the note is to be sounded, means for driving said strip at a constant speed, a source of energy rays disposed on one side of the strip and a plurality of energy sensitive cells aligned transversely of said strip to receive energy rays under control of said markings, a circuit for each of said cells including the cell and switch means controlled thereby operative to simulate action of a key switch of the instrument for the note corresponding to the marking associated with said cell when the switch means is connected to the key switch and a marking on the strip is interposed between the source of energy rays and its corresponding cell.
2. An automatic player, for an electric musical instrument of the type having a plurality of tone signal generators whose power outputs are connected to volume circuits actuated by manual manipulation of the key switches of a keyboard, comprising an elongated strip having transversely disposed areas, markings representing musical notes and whose length denote time for which the note is to be sounded in certain of said areas, one of said strip and its markings being opaque to passage of radiant energy and the other being at least partially transparent to such passage, means for driving said strip at a constant speed, a source of radiant energy disposed on one side of the strip and a plurality of aligned photo cells, one for each note represented transversely of the strip, disposed on the opposite side of the strip, a circuit for each of said photo cells including the photo cell and switch means controlled thereby and operative to simulate the switching action of an associated key switch on the instrument to which it may be connected when a marking on
the strip is interposed between the source of radiant energy and its corresponding photo cell.

3. An automatic player according to claim 2 wherein said strip is formed of translucent material and said markings are opaque.

4. An automatic player according to claim 3 wherein said source of radiant energy is an electric lamp for generating light.

5. An automatic player according to claim 2 in combination with a musical instrument having a plurality of tone signal generators, voicing circuits, means for coupling said signal generators and voicing circuits, a manual keyboard and key switches operated by the keys of said keyboard to actuate the voicing circuits, said switch means of the automatic player being connected to said key switches and being operative to simulate action of said key switches to play a composition independently of the keys of the keyboard.

6. An automatic player according to claim 2 wherein said circuits each comprise a source of electric energy connected in series with one of said photo cells, a resistor means and a potentiometer for controlling flow of current and the resultant sensitivity of the photo cell, there being further included a semiconductor switching device biased by a tap on said series circuit and operative to simulate the switching action of a key switch of a musical instrument.

7. An automatic player according to claim 6 wherein said semiconductor switch device is a transistor having one element connected to said series circuit, a second element for connection to one side of the key switch, and a third element for connection to the other side of the key switch.

8. An automatic player according to claim 7 wherein said semiconductor switching device is a transistor whose base is connected to said series circuit and whose collector and emitter are connectable to the said sides of the key switch.

9. An automatic player according to claim 7 wherein said semiconductor switching device comprises a pair of transistors so connected to each other and a source of electric energy as to cause conduction of the second transistor when the first transistor conducts by reason of change of bias on its base when the associated photo cell fails to receive radiant energy, said second transistor having a collector for connection to one side of an instrument key switch.

10. An automatic player according to claim 9 wherein the base of said first transistor is connected to said series circuit, the collector of said first transistor being connected in series with a resistor to the base of said second transistor, and the emitter of said second transistor being connected to the positive terminal of said source of electric energy.

11. An automatic player according to claim 2 wherein said means for driving the strip includes means for changing the drive speed comprising an electric motor having its armature current variably controlled by a transistor and a variable resistor connected to a source of electric energy whereby to change the tempo of a musical selection being played.

12. A roll of material for charting a musical composition to automatically play said composition on an electronic musical instrument, comprising an elongated sheet, wound in a roll and formed of a material having a given characteristic conduction for a selected type of energy ray and adapted to receive markings having a substantially different conduction characteristic for the selected type of ray, longitudinal and transverse lines on said sheet dividing the sheet into a transverse column of areas repeated for substantially the length of the sheet, the position of each area of each said transverse column representing a note of the musical scale and the length of said areas being equal and representing a unit of time for sounding of the notes, and a transverse column of indicia at one end of the sheet juxtaposed an adjacent transverse column of areas and indicating the notes of the musical scale, said areas being adapted to receive said markings by application of a marking instrument.

13. A roll for automatically playing an instrument according to claim 12 wherein said material is paper translucent to light rays and is adapted to receive markings in said areas which are opaque to light rays.

14. A roll for automatically playing an instrument according to claim 13 wherein appropriate ones of said areas bear markings corresponding to the notes of a musical composition.

15. A roll for automatically playing an instrument according to claim 12 wherein said column of indicia is repeated at uniformly spaced intervals throughout the length of said sheet.

References Cited

UNITED STATES PATENTS

3,141,056 7/1964 Kisker 84—1.03
3,267,196 8/1966 Welsh et al. 84—1.18
3,309,454 3/1967 Cutler et al. 84—1.18

ARTHUR GAUSS, Primary Examiner.
DONALD D. FORRER, Assistant Examiner.
U.S. Cl. X.R.
84—1.18; 307—253, 311