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[54] **MECHANICAL DOLLS WHICH ARE CONTROLLED BY SIGNALS ON A RECORDING MEDIUM**

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[21] Appl. No.: **439,691**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 335,173, Feb. 23, 1973, abandoned, which is a continuation of Ser. No. 166,555, July 27, 1971, abandoned.

[30] **Foreign Application Priority Data**

July 29, 1970 Argentina 182783

[52] **U.S. Cl.** ..... **360/79;** 46/232; 46/243 S

[51] **Int. Cl.²** **G11B 31/00**

[58] **Field of Search** ..... 360/79; 46/243 S, 232, 46/175 AR, 245, 247

[56] **References Cited**

UNITED STATES PATENTS

2,700,250	1/1955	Williams	46/232
3,131,497	5/1964	Rogers	46/232
3,199,248	8/1965	Suzuki	360/79
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FOREIGN PATENTS OR APPLICATIONS

528,749	6/1955	Italy	46/245

Primary Examiner—Alfred H. Eddleman
Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

The invention relates to mechanical dolls which may effect various coordinated movements, such as dancing, talking and other movements. An electronic circuitry is provided to control the mechanical movements of the dolls in a manner whereby a plurality of dolls appear to move in synchronism with each other.

4 Claims, 2 Drawing Figures

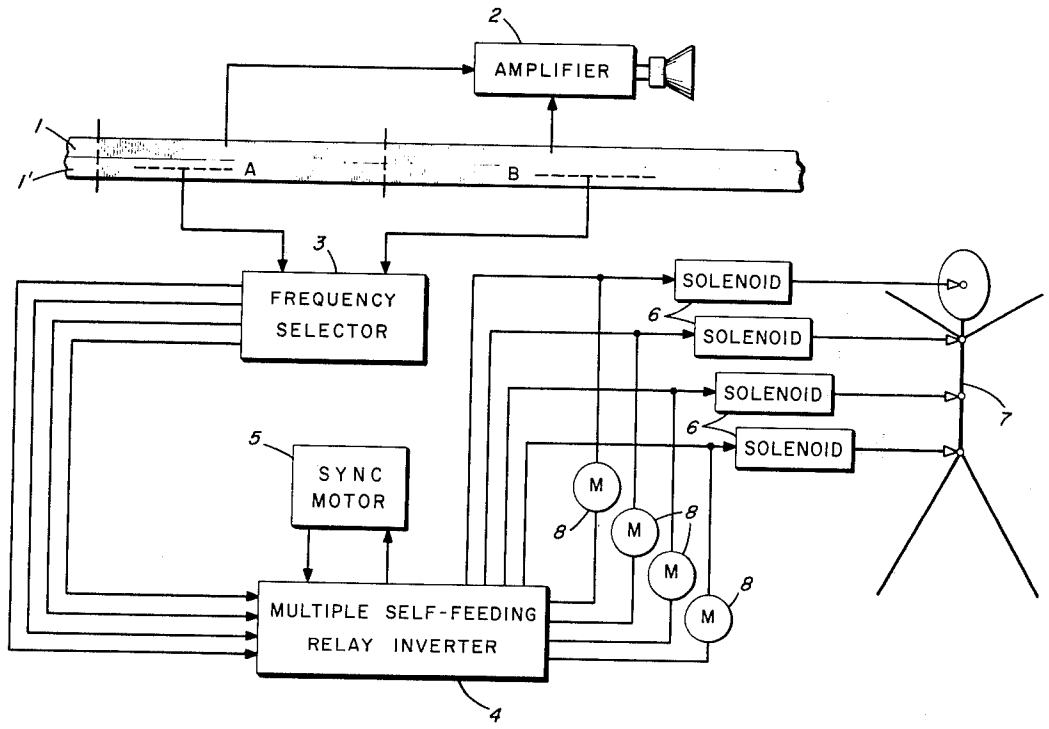
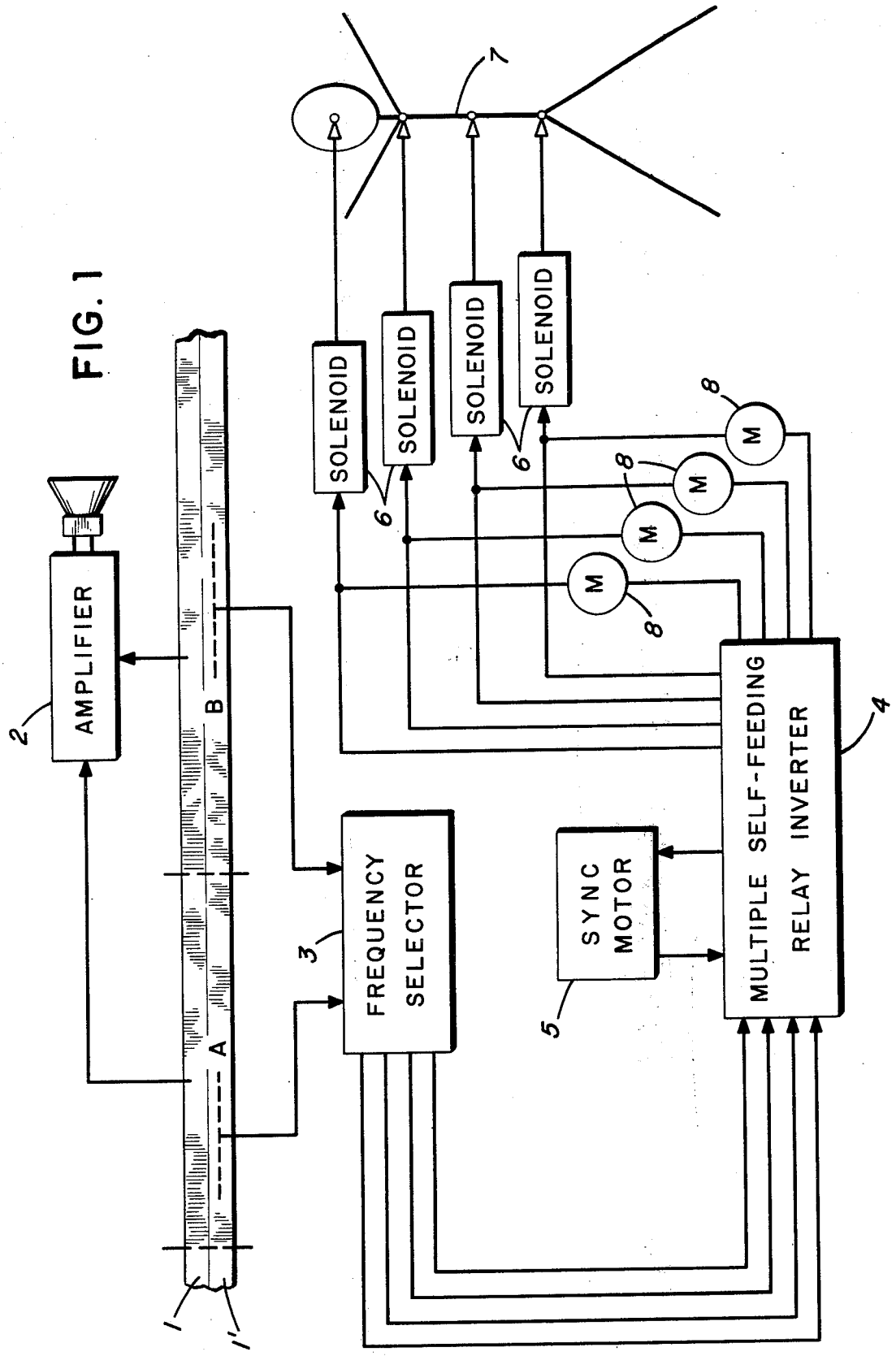


FIG. 1


AMPLIFIER
2
B
A
1
1'
FREQUENCY SELECTOR
3
SYNC MOTOR
5
MULTIPLE SELF-FEEDING RELAY INVERTER
4
SOLENOID
SOLENOID
SOLENOID
SOLENOID
6
6
7
M
M
M
M
8
8
8
8

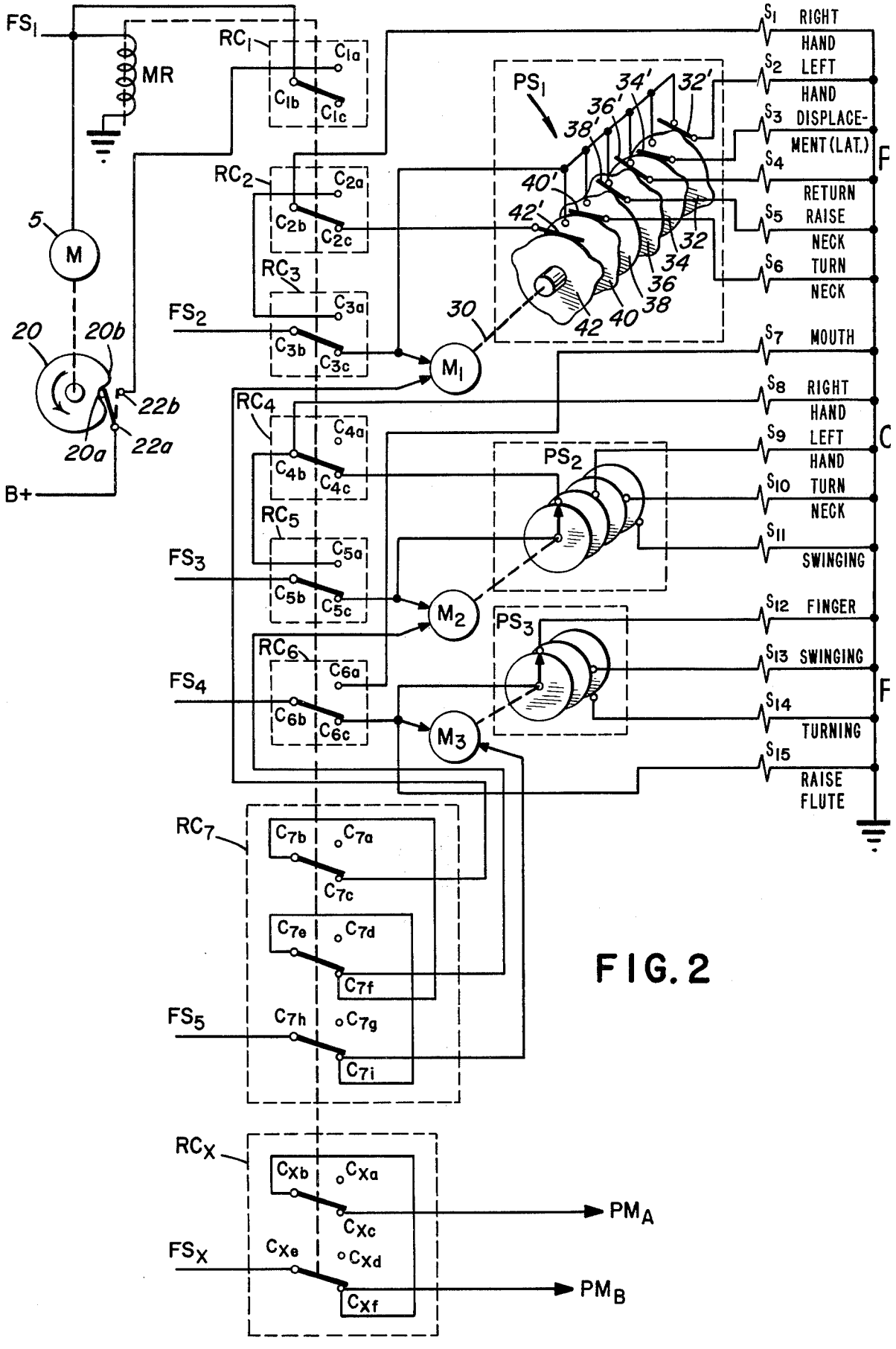

FS1
MR
RC1
C1a
C1b
C1c
RC2
C2a
C2b
C2c
RC3
C3a
C3b
C3c
FS2
5
M
20
20b
22b
20a
22a
B+
M1
30
PS1
34'
32'
36'
38'
40'
42'
32
34
36
38
40
42
S1 RIGHT HAND
S2 LEFT HAND
S3 DISPLACE-MENT (LAT.)
S4 RETURN
S5 RAISE NECK
S6 TURN NECK
F
S7 MOUTH
S8 RIGHT HAND
S9 LEFT HAND
S10 TURN NECK
S11 SWINGING
C
RC4
C4a
C4b
C4c
RC5
C5a
C5b
C5c
FS3
M2
PS2
RC6
C6a
C6b
C6c
FS4
M3
PS3
S12 FINGER
S13 SWINGING
S14 TURNING
S15 RAISE FLUTE
F
RC7
C7a
C7b
C7c
C7d
C7e
C7f
FS5
C7g
C7h
C7i
RCX
CXa
CXb
CXc
CXd
CXe
CXf
FSX
PMA
PMB

FIG. 2

MECHANICAL DOLLS WHICH ARE CONTROLLED BY SIGNALS ON A RECORDING MEDIUM

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of Ser. No. 335,173, filed Feb. 23, 1973, now abandoned, which in turn is a continuation of Ser. No. 166,555, filed July 27, 1971, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for controlling mechanical dolls of a kind which make a series of mechanical movements that appear to be perfectly synchronized with an audio signal to simulate dancing, talking or playing various instruments.

Such dolls are known to those skilled in the pertinent art and are therefore not described in great detail in this application. In one known embodiment, the internal skeleton of the puppet consists preferably of metallic rods that are interconnected by means of articulated joints in accord with elementary rules of osteology. The movement of the metallic rods is obtained by means of the electrically controlled solenoids. The body of the puppet consists of elastic flexible material, such as for example suitable synthetic resin, which covers the internal articulated skeleton, the related solenoids and control mechanisms. A doll of this type is shown and described in Italian Pat. No. 528,749, granted June 15, 1955.

Up till now it has been very difficult to obtain through common circuits an effect of perfect synchronization of several dolls with a musical score, whether the score is short or long. This does not mean that the problem is incapable of solution, but from a commercial viewpoint the synchronized operation of several dolls with one piece of music, e.g., to make one of them move its mouth when a voice signal is reproduced, to make the pianist touch the keyboard with both hands to the rhythm of the music, or to make the flute player seem to play the flute with graceful rhythmic movements when the sound of this instrument is being heard, also requires the following: there should be several dolls; there should be various scores in one and the same program; the program should be renewable; and operation should be automatic and not require maintenance or daily supervision.

In order to meet these requirements, recourse must be had to advanced techniques starting from an electronic memory with recordings, and the circuits necessary for efficient operation are so complex and expensive that they cannot be built commercially as they would practically form a small computer, the cost of which is quite out of proportion to the end use of this type of moving and speaking dolls which are being exploited by being formed into a band and exhibited in various public places where they are actuated by a simple coin.

The object of this invention is to apply a combination of electronic and electromechanical means that operate alternately, producing a strong effect and psychologically inducing the public to see complete synchronization when, as a matter of fact, synchronization is not consistent.

Specifically, the combination of means of this invention provides a series of stages that operate alternately

and always begin with what will hereinafter be called "tuning" and which consists in the perfect synchronization of dolls and sounds during a short period of time in order to rely then, without any appreciable transition, on electromechanical means which do not perfectly synchronize the movements but certainly do so with remarkable showing. In other words, by using a complex but limited electronic circuit, initial impact synchronization is obtained while for the major part of the musical score a much simpler but viable and modifiable circuit is sufficient, the primary electronic circuit being available for repetitions or refrains of a song; this ingenious combination of means reduces the cost of each set and thus increases marketing possibilities.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows an overall block diagram of this invention; and

FIG. 2 shows the multiple self-feeding relay inverter circuit in detail.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus of this invention is shown generally in FIG. 1. A magnetic tape having at least two tracks is recorded on a first track 1 with a musical score or other audio signals while the second track 1' is recorded with various pulse trains of different frequencies; in the mode contemplated by the inventors, these frequencies are in the audio frequency spectrum. The signals on track 1 are reproduced by conventional magnetic transducing heads, amplified in any known amplifier 2 and projected as audio signals through any well-known speaker system.

The pulse trains on track 1' are reproduced, again by any well-known magnetic transducing means and are fed to a frequency selector 3. The frequency selector consists of a number of selective filter and amplifying networks, corresponding to the number of types of command signals it is desired to have. The filter units are basically all of the band-pass type, each having a different pass band for passing a specific frequency or band of frequencies. The preferred embodiment utilizes eight types of commands; thus there are eight filter/amplifier units, all having essentially the same construction except for the response characteristics of the filter sections. For example, the filter sections can be designed to be responsive to signals of 1, 2, 3, 4, 5, 6, 7 and 8 KHz, respectively, ±0.1 KHz. In a minor variation, the two end filter networks can be high and low pass filters, respectively.

The respective outputs of the frequency selector 3 are coupled to corresponding inputs of a multiple self relay inverter unit 4, described in greater detail with reference to FIG. 2. The respective outputs of the frequency selector 3 (and the corresponding inputs of the relay device 4) will be designated as $FS_1, \ldots, FS_8$. The outputs of the frequency selector 3 consist of the command pulses recorded on track 1' reproduced by the conventional play-back mechanism, filtered by the appropriate band-pass filter section and amplified in the corresponding amplifier section, and transformed into D.C. voltage levels capable of operating various relays and solenoids These filter and amplifier units are well known to those skilled in this art and have been discussed in any number of textbooks relating to audio frequency reproduction techniques; they therefore

need not be described in great detail here, although it will suffice to note that examples can be found in Ryder, J., Electronic Fundamentals and Applications, 3rd Ed., Prentice-Hall, Inc., Englewood Cliffs, N.J., 1964, pp. 311 et seq.

The multiple self-feeding relay inverter **4** consists essentially of a master relay coil MR controlling the operation of several sets of relay contacts $RC_1 - RC_{10}$ (FIG. 2). These relay contacts are in turn coupled to one or more programming motors **8** and/or to individual selected solenoids **6.** The solenoids **6** comprise portions of the mechnical dolls and control the movements of the various appendages of the dolls. The individual doll solenoids are shown more particularly in FIG. **2** and labeled $S_1 - S_{15}$, respectively.

Only one doll **7** is shown in FIG. **1**; it will be understood, however, that this is merely representative of a plurality of dolls and that the interconnections between the motors **8** and solenoids **6** of the dolls **7** is a matter of choice, depending entirely on the type of functions to be controlled. The MSRI is also coupled to a synchronous motor **5** which functions to maintain the master relay coil MR energized for a predetermined period of time, after which the relay becomes deenergized in the absence of a control signal on lines FS_1. In the following description of the relay unit **4,** a particular relay contact C is designated by a subscripted numeral (representing the specific contact set) and letter (representing the specific contact in the designated set). The reference C followed by a subscripted letter (except *x*) only, refers generally to corresponding contacts in the several sets.

Referring now to the detailed diagram of FIG. **2,** the input signal to coil MR is a D.C. voltage provided from output FS_1 of the frequency selector sensitive to the corresponding command signal reproduced from track **1'** of the tape. The FS_1 input signal line is also connected to synchronous motor **5** to start it rotating at a speed of one revolution every 20 seconds (3 rpm). The synchronous motor **5** is provided with cammed disc **20** having a valley **20***a* and a raised portion **20***b*. Disc **20** is disposed adjacent a pair of switch contacts **22***a*, 22*b;* contact **22***a* is coupled to the line voltage B+ (or one terminal of a power supply) and contact **22***b* is connected to contact C_{1a} of the MSRI. Contact member C_{1b} is connected in common with motor **5** and relay coil MR. Contact C_{1c} is open.

Relay contact C_{2a} of the MSRI is connected to contact C_{3a}. Switchable contact member C_{2b} is connected directly to puppet solenoid S_1. Contact C_{2c} is connected to one switch terminal of a programming switch unit PS_1 coupled to a programming motor M_1; these elements will be described in greater detail below.

Movable contact member C_{3b} is connected to output FS_2 of the frequency **3.** Contact C_{3c} is connected to the junction of the operating coil of motor M_1 and the common terminal of switch unit PS_1.

Contact member C_{4b} is connected to puppet solenoid S_8 and also to relay contact C_{5a}. Contact C_{4c} is connected to one terminal of programming switch PS_2. Contact C_{4a} is open.

Movable relay contact C_{5b} is connected to output FS_3 of the frequency selector **3.** Contact C_{5c} is connected to the junction of the operating coil of motor M_2 and the common terminal of switch unit PS_2.

Relay contact C_{6a} is connected to puppet solenoid S_7. Movable contact C_{6b} is connected to output FS_4 of the frequency selector **3.** Contact C_{6c} is connected in common to puppet solenoid S_{15}, the operating coil of programming motor M_3 and to the common terminal of programming switch PS_3.

The set of relay contacts designated RC_7 comprises three sub-sets of contacts *a–c*, *d–f* and *g–i*, wherein within each set contacts *b*, *e* and *h* are all movable. Contact C_{7c} is connected to motor M_1. Contact C_{7b} is connected to C_{7f} which in turn is connected to motor M_2; contact C_{7e} is connected to C_{7i} which is connected to motor M_3. Contacts C_{7a}, C_{7d} and C_{7g} are all open. Contact C_{7h} is connected to output FS_5 of the frequency selector **3.**

The set of contacts generally designated RC_x and consisting of two sub-groups of contacts *a–c* and *e–f* represents three sets of contacts RC_8, RC_9 and RC_{10} which respectively control the operation of any two of the programming motors $M_1 - M_3$. Thus contact C_{xc} is connected to an operating coil of one programming motor and contact C_{xf} is connnected to a different programming motor coil. Movable contact C_{xb} is connected in common with contact C_{xf}; movable contact C_{xe} is connected to one of the outputs FS_6, FS_7 and FS_8, respectively; and contacts C_{xa} and C_{xd} are open.

In order to prevent undesirable feedback in controlling the operation of the programming motors, the various connections from relay contacts C_{3c}, C_{7c} and C_{xc} to motor M_1, for example, may be made through a multiple-input, single output logic OR gate of any well-known type. A similar arrangement would be made for each of motors M_2 and M_3 as well.

The programming motors M_1, M_2 and M_3 can be any well-known D.C. motor operated by the D.C. levels appearing at any one of the appropriate outputs $FS_2, \ldots, FS_8$ of the frequency selector **3.** The programming switches can be of any suitable type of switch which permits the doll solenoids connected to the several poles thereof to be operated in a predetermined manner. In one preferred embodiment, the programming motor M_1 is arranged to drive a shaft **30** on which a series of cammed discs **32–42** are mounted for rotation. A corresponding series of movable switch contacts **32'–42'** is located adjacent each disc. Contacts **32'–40'** are each connected to a corresponding doll solenoid $S_2 - S_6$, respectively. Contact member **42'** is connected (when MR_1 is deenergized) to solenoid S_1 through contact set RC_2. As each disc is rotated by motor M_1, the raised portions or ridges of the disc sequentially pushes the movable contact against a corresponding stationary contact (all of which are connected in common to contact C_{3c}) to complete an electrical circuit and energize the correspondingly connected solenoid. The operation is equivalent to that described above with respect to cam **20** and contacts **22***a* and **22***b*. This arrangement has the advantage of allowing more than one doll solenoid within a group to be operated simultaneously. Programming switches PS_2 and PS_3 are similar to switch PS_1 and are therefore shown only in block form.

The operation of the preferred embodiment of this invention will now be described. Essentially there are two operating states of the device of this invention, one wherein the master relay coil MR of the MSRI is deenergized and the other wherein the same coil is energized.

As the magnetic tape passes the reproducing station, the audio signal on track **1** is reproduced and fed to amplifier **2** from which an audio signal in the form of speech and/or music is derived and reproduced through the speaker at the output of amplifier **2**. The pulse train on track **1'** is reproduced and fed to the frequency selector **3**. In the frequency selector unit, the frequency of each pulse of the reproduced train is detected by the appropriate band-pass network; the detected signal is amplified and transformed into a D.C. level control signal which is then applied to the appropriate input of the multiple self-feeding relay inverter **4**.

In the first-mentioned state of the MSRI, switchable contacts C_b are disposed in contact with the corresponding contacts C_c. Similarly, the switchable contacts C_e and C_h, $C_{xe\ and\ f}$, $C_{7b\ and\ c}$, $C_{7e\ and\ f}$ and $C_{7h\ and\ i}$ are disposed in contact with corresponding contacts C_f and C_i, respectively. In this state, a command signal appearing at output FS_2 will only operate programming motor PM_1 and the corresponding doll control solenoids $S_1 - S_6$ in a sequence determined by the shapes of the cammed discs **32–42**. A command signal appearing at output FS_3 will operate doll control solenoids $S_9 - S_{11}$ and solenoid S_8, the latter through the circuit including the engaged relay contacts $RC_{4b\ and\ c}$, through programming motor PM_2. A command signal appearing at FS_4 will operate doll control solenoids $S_{12} - S_{14}$ through programming motor PM_3 and solenoids S_{15} directly. A command signal appearing at FS_x will operate the corresponding two of the three programming motors; and a command signal at FS_5 will cause all three programming motors to operate. This operating state is called the "standard movement" state since the operation of the solenoids in any one group is controlled, for example, by the preset patterns of the cammed discs rotated by the selected programming motor PM.

The second operating state of this apparatus is initiated upon detection of a prerecorded command signal having the appropriate frequency to generate a D.C. signal at output FS_1 of the frequency selector. This causes the master relay coil MR of the MSRI to become energized, thereby opening the connection between contacts C_b and C_c and closing the connection between contacts C_a and C_b. At the same time, since the synchronous motor **5** is connected in parallel with the coil MR, the signal at FS_1 causes the synchronous motor to begin operating. This causes disc **20** to begin rotating to close switch contacts **22***a* and **22***b*. A circuit is then completed between B+ and ground through switch contacts **22***a* and *b*, relay contacts C_{1a} and C_{1b} and the parallel combination of the sychronous motor operating coil and the master relay coil. The synchronous motor will keep rotating and the coil MR will remain energized as long as contacts **22**a and b remain closed, which occurs for the duration of one complete rotational cycle of the cammed disc **20**, which in the preferred embodiment, is of approximately 20 seconds' duration.

During the time that the MSRI remains energized, a signal at output FS_2 will operate only the solenoid S_1; a signal at FS_3 will operate only the solenoid S_8; and a signal at FS_4 will operate only solenoid S_7. Command signals appearing at frequency selector outputs FS_x or FS_5 will have no effect since the corresponding relay contacts will be open-circuited. This operating state is called the synchronized movement state because a single instrument is synchronized with the musical piece being reproduced to give the impression of a solo being performed.

At the end of the duration of the synchronized movement period, the MSRI becomes deenergized, in the absence of an overlapping command signal appearing at FS_1, and the apparatus then returns to the standard movement state. During this latter period, groups of the puppet solenoids are controlled in a preprogrammed manner by the rotation of the programming motors in response to command signals appearing at any of the outputs of the frequency selector **3** other than output FS_1.

The results achieved by this invention is a remarkably enhanced life-like performance by the puppets who appear to play or speak in synchronism with a particular audio portion reproduced from track **1** of the magnetic tape.

It is to be understood that various modifications in the structural details of the preferred embodiment described herein may be made within the scope of this invention and without departing from the spirit thereof. It is intended that the scope of this invention shall be limited solely by the hereafter appended claims.

What is claimed is:

1. An apparatus for selectively controlling a plurality of solenoids of at least one solenoid operated mechanical figure, comprising:

a recording medium having a first track on which audio information is recorded and a second track on which frequency dependent control information is recorded in the form of a train of frequency modulated pulses including at least two sets of pulses of different frequencies;

means for reproducing said train of pulses from said recording medium;

control signal generating means coupled to said reproducing means and having a plurality of outputs corresponding in number to the number of different frequencies with which said pulse train is modulated, and comprising,

means to detect the frequency of each pulse of a pulse train reproduced from said recording medium, and

means to generate a control signal at an output of said control signal generating means which corresponds to the detected frequency of a reproduced pulse; and

means coupling the outputs of said control signal generating means to corresponding ones of said mechanical figure solenoids to selectively operate said solenoids by said detected control signals.

2. The apparatus according to claim **1**, wherein:

said control signal generating means further comprises a plurality of band-pass filters each tuned to a different predetermined frequency range corresponding to said different pulse train modulating frequencies and a corresponding plurality of converting means to convert the alternating current output signal of a corresponding filter circuit into a direct current level control signal;

said relay operated switch means comprises a plurality of sets of relay contacts, each set having a movable contact member and first and second stationary contacts, at least some of said movable contact members being coupled to corresponding ones of

said converting means and at least some of said first and second stationary contacts being coupled to control the operation of said mechanical figure control solenoids.

3. The apparatus according to claim **1**, wherein said means coupling said control signal generating means outputs to said mechanical figure solenoids comprises:

a plurality of relay operated switch means each having first and second stationary contacts, and a movable contact coupled to a corresponding output of said control signal generating means and movable alternately into contact with said first and second stationary contacts,

said first stationary contact being coupled to at least one of said mechanical figure control solenoids; and

motor operated switch means coupled to said mechanical figure control solenoids for energizing said solenoids in a preselected manner, said second stationary contact being coupled to said motor operated switch means to control the energization thereof.

4. The apparatus according to claim **3**, further comprising further switch means connected between a power source and said relay operated switch means; and means coupled to said first output of said control signal generating means to energize said further switch means for a predetermined period of time when a control signal is generated at said first output of said control signal generating means, and further switch means maintaining said relay operated switch means energized for said predetermined period of time.

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