350-269. XR 3549827 SR

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Continuation-in-part of application Ser. No. 276,522, Apr. 29, 1963, now abandoned.

[54] DATA CONTROLLED VOICE UNIT

9 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **179/100.3,** 250/237; 340/173, 340/347; 350/269
[51] **Int. Cl.** **G11b 7/08,** H03k 13/02
[50] **Field of Search** 179/100.3B, 100.31; 250/235/6.5, 235/6.15, 235/6.2, 235/6.3, 237; 350/269, 270, 271, 272, 273, 274, 275; 340/347AD, 347DA, 173LM

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ABSTRACT: Compact apparatus controllable by binary coded electric signals for rapidly generating any desired succession of vocal or audio sounds from a repertory of recorded optical sound tracks. The individual sounds (words, phrases or the like) are recorded on individual peripheral tracks closely spaced along a transparent drum which is constantly rotating at the proper speed for sound reproduction, and these are illuminated by a single light source within the drum. An optical slit and light-tunnel unit extending closely along the outside of the drum conveys light modulated by any selected single track toward a photosensitive element beyond that unit. Selection of the individual tracks for reproduction is achieved by the setting of individual lengthy shutter blades having binary-coded apertures therein and arranged in a flat pileup in the light path. The shutter blades execute their small setting or selecting motions transverse to the slit direction, by virtue of their connection to the respective armatures of a set of conventional electromagnetic relays. Circuitry is provided to energize and deenergize the relay magnets selectively in accordance with the incoming successive binary-coded control signals or pulse groups, and at proper times during each drum rotation, for reproduction of the selected tracks in turn.

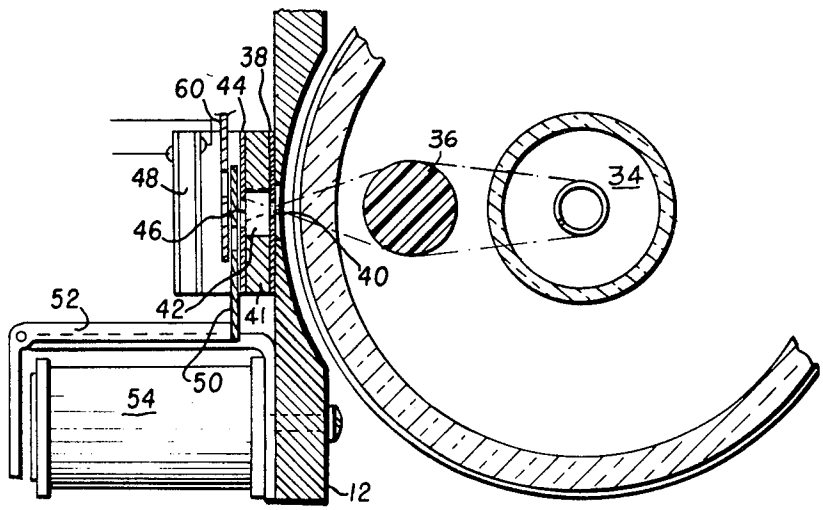


Fig. 1

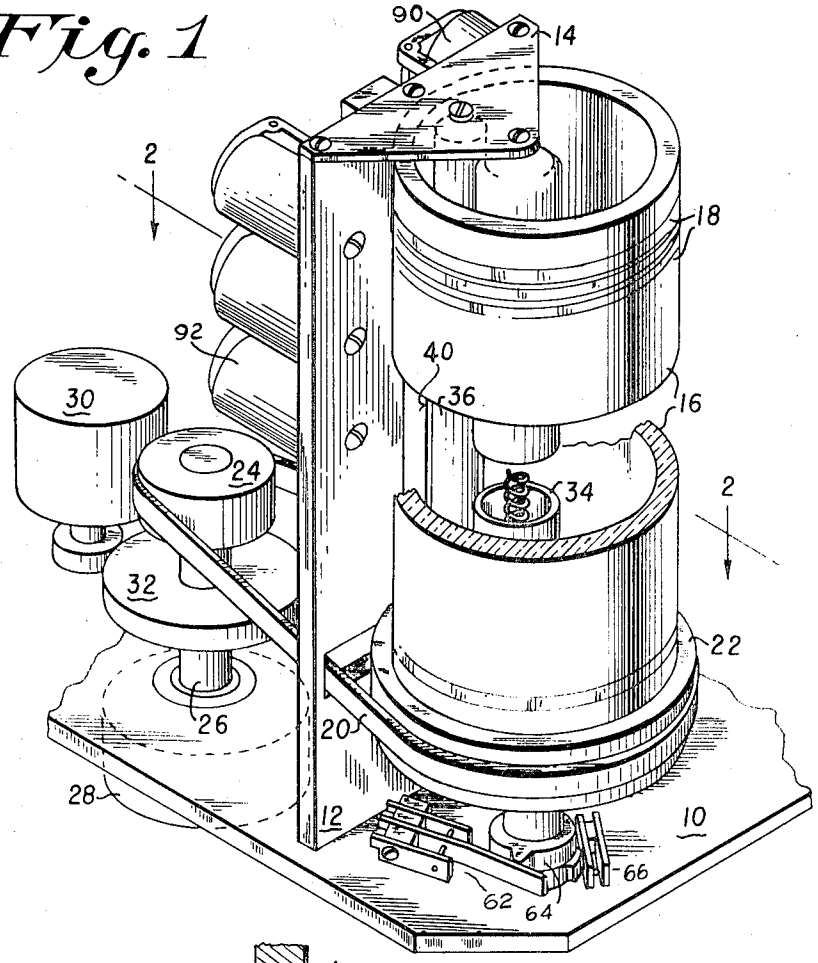
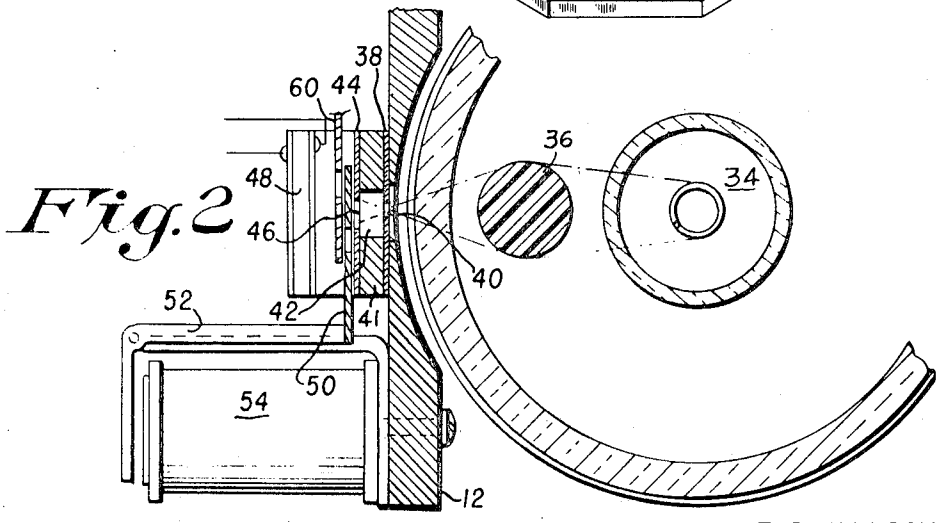


Fig. 2



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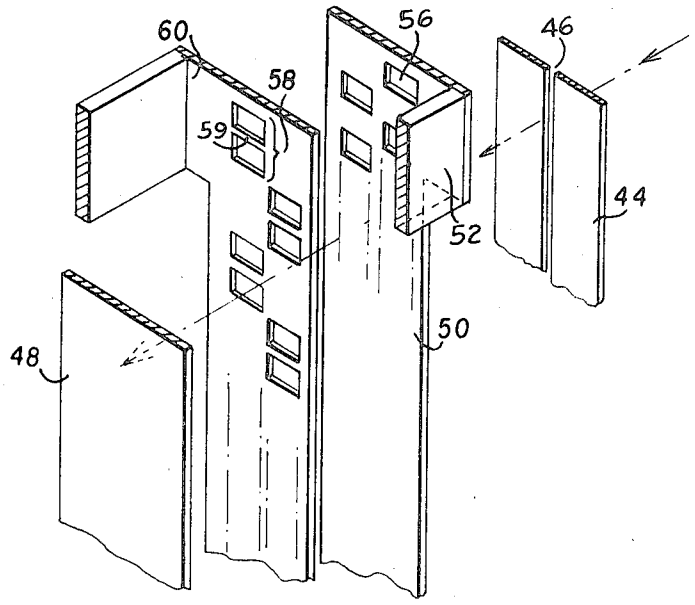

60
58
56
46
59
44
52
50
48

Fig. 3

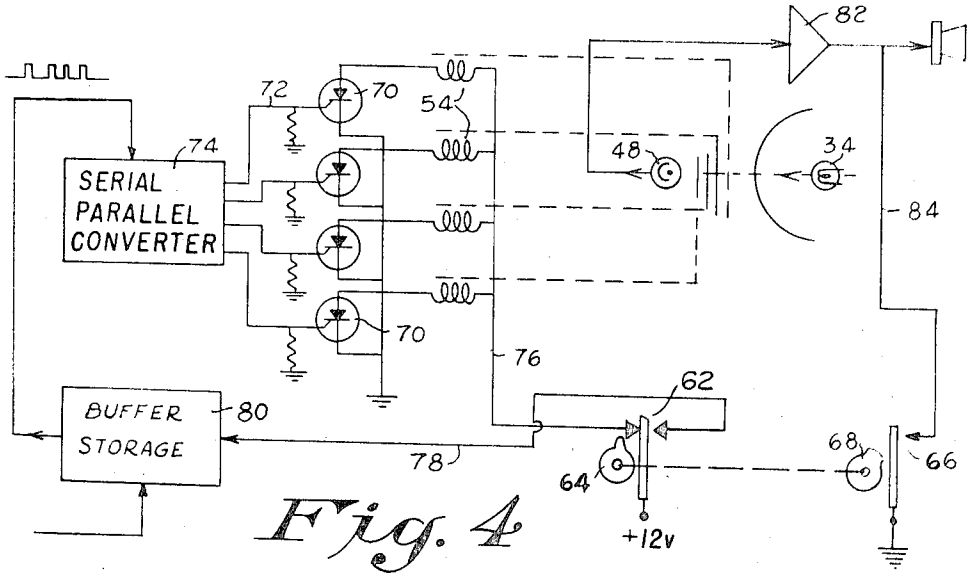
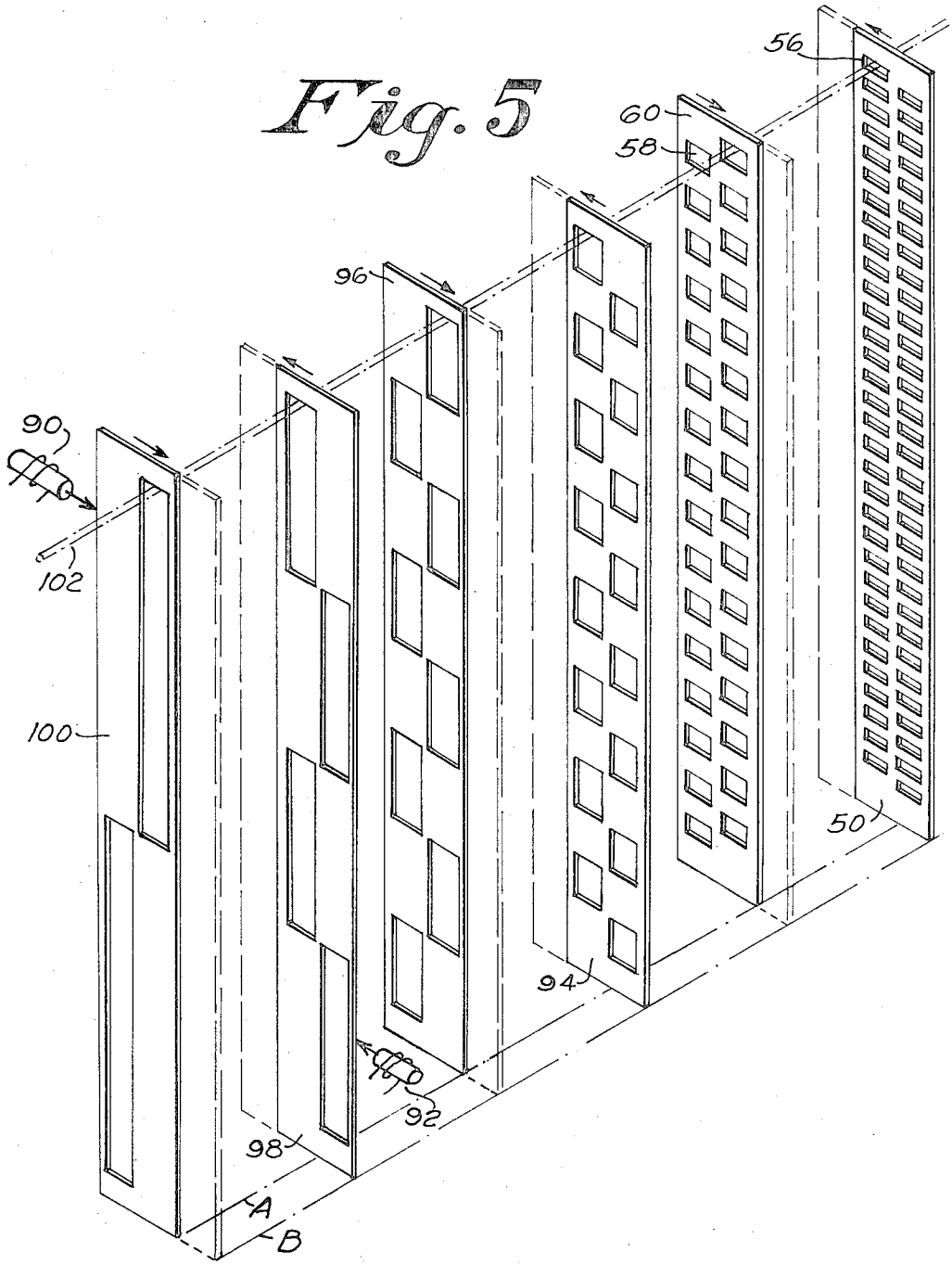

82
72
70
54
74
SERIAL
PARALLEL
CONVERTER
48
34
84
70
76
62
BUFFER
STORAGE
80
78
68
66
64
+12v

Fig. 4

Fig. 5



DATA CONTROLLED VOICE UNIT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 276,522, filed Apr. 29, 1963, now abandoned, in the names of the same inventors.

BACKGROUND OF THE INVENTION

This invention pertains to a device controllable by electric signals of coded or permutation form, and which will selectively produce speech signals or other signals of complex form in the audiofrequency range, such as voiced words, phrases or the like. In a typical form, such a device is capable of control by mark-and-space signal groups such as those used in teletypewriter systems, computers and the like, and of vocally reproducing the respective letters, numerals or signs for direct understanding by untrained personnel.

Data "talk-out" devices, though much less common than visual read-out systems employed with code communication systems, computers and the like (such as counters or printers) are not entirely unknown in the art. Specialized phonographs which will utter words or phrases on command have been proposed, as for military or naval commands, and the use of mechanized vocal signals or warnings for operators of aircraft or in other complex environments has been described. So-called time announcing systems are another example of the application of this broad concept, as are some forms of electric organs. All of these prior schemes have involved relatively large and complex equipment, and in general they have required elaborate switching circuitry to accomplish the control of selections from electrical signals, using for example extensive relay trees, transistor switching circuits or the like, as well as numerous individually controllable light sources, photocells, or shutters; for example, in numbers equal to the number of words, phrases or the like in the repertory. Such proposals have not therefore been practical for use where compactness and low cost are significant factors, as in mobile installations, small data terminal stations and the like.

The present invention aims to provide a highly flexible, very compact and low-cost apparatus of the type indicated, in which the prerecorded names of letters, figures, words or the like sounds can be rapidly reproduced in accordance with received sequential code groups, or in accordance with the selective energization of a limited number of control conductors. In addition to the phonographic or "talking" function, the equipment includes a very simple, reliable, but inexpensive electromechanical code converter which effects selective control of an extensive repertory recorded in the talk-out mechanism, directly from pulse-group types of input or control signals, or from the energization of a small number of permutated control conductors.

SUMMARY OF THE INVENTION

Basically, the invention utilizes a constantly-rotating drum of transparent material about which are girdled a considerable number of circumferential individual audio tracks of the optical (sound-on-film) type, each carrying its respective sound record of a word or words, letter, numeral and the like. Extending lengthwise in the drum are an elongated light source and a cylindrical condensing lens to cast a concentrated strip of light extending across all these tracks and thence into an external optical slit system, and in turn to a photoelectric cell in strip form. Between the slit system and cell are disposed a limited number of thin and lightweight optical shutters which are elongated in the slit direction but are relatively narrow in the transverse direction. These shutters are apertured according to a double row binary scheme for occluding all by one of the light paths (for each combination of operated and unoperated shutters) through the sound tracks, and the shutters are operated by a slight transverse motion between "open" and "closed" condition by the selective energization of simple electromagnetic relay mechanisms on whose armatures the shutters may be directly mounted. Accordingly, a particular track is selected for reproduction by mere energization of selected ones of the relay mechanisms, and no switching (or even wiring) of separate light sources, photocells or the like is involved.

The sound tracks are positioned about the drum with their "start" ends all aligned along one lengthwise drum strip or position, and a cam-operated switch associated with the drum drive activates the photoelectric cell output circuit at the proper instant, following each code-controlled selection operation, to allow the selected sound track to be reproduced from its beginning to its end.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partly broken away schematic perspective view of the unit.

FIG. 2 is an enlarged fragmentary horizontal sectional view, taken along line 2–2 of FIG. 1.

FIG. 3 is an enlarged and exploded perspective view of parts of a couple of the selecting shutters of the invention, with associated parts.

FIG. 4 is a schematic wiring diagram of the selection and control system.

FIG. 5 is a further exploded perspective view of a set of six of the shutters, illustrating the manner of their binary aperture coding, and including a couple of the operating (relay) magnets shown symbolically.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawings, numeral 10 designates a rigid main support or mounting plate from which extends a perpendicular support plate 12 having an upper bracket 14 which lies above the upper end of the hollow sound track cylinder 16, of transparent plastic, glass or the like. The lower end of cylinder 16 has a stub axle which is journaled in the main support plate 10. On the periphery of cylinder 16 are carried the plural sound tracks 18, typically strips of photographic sound film, each strip carrying the sound record of a letter, numeral, word or other useful combination of sounds. Obviously, the individual track strips may be replaced by a single wide photographically-reproduced film secured to the cylinder, or the images may be formed or printed directly on the material of such cylinder. It is a feature of the invention, related to the transverse selecting motion of the shutters, that these tracks may have little or no space between them, so that a considerable number can be accommodated per unit of length of the cylinder.

When the device is in use, the drum or cylinder 16 is constantly rotated at the proper speed for sound reproduction, by a drive belt 20 engaging a slightly enlarged cylinder hub 22, the belt passing through a slot in plate 12 and about the drive capstan 24 of a shaft 26 journaled in plate 10 and carrying a flywheel 28 preferably beneath plate 10. Shaft 26 is driven at constant speed by a motor 30 whose drive puck frictionally engages a disc 32 secured to the shaft 26.

Plate 12 is a relatively thick one, for reasons of structural rigidity, and is slotted (parallel to the axis of cylinder 16) to allow light from within the cylinder and sound tracks to pass through the slit system to be described below. To allow the slit system to be brought very close to the sound tracks, as is desirable for good sound quality, the slotted area of the plate 12 is arcuately recessed to receive the cylinder's periphery. Within the cylinder, and rigidly suspended from bracket 14, are the elongated light source such as extended-filament incandescent lamp 34 and a cylindrical condensing lens 36, these parts being arranged to direct a narrow, concentrated beam of light against the inner wall of cylinder 16 along an axial strip, and thence through that region of all of the sound tracks, and through the slot in plate 12.

On the opposite side of plate 12, and as clearly shown in FIG. 2, are arranged the parts for receiving and selecting the

light passing through the sound tracks. These parts include an optical tunnel unit comprising a thin plate 38 defining a first lengthwise slit 40 having a width of not over 0.001 inch and not more than about 0.005 inch from the surface of the sound tracks 18. Plate 38 is mounted along one face of a separator block 41 which is about 0.1 inch thick and is perforated by a series of circular holes 42, one being aligned with the center line of each sound track. Along the opposite face of block 41 is mounted a thin plate 44 defining a second lengthwise slit 46 having a width of about 0.001 inch.

The slit and tunnel system just described provides good reproduction of the sounds recorded on the tracks without cross talk between them, or noise due to surface reflections from the parts, and without the need for elaborate optical elements, lenses or the like.

The light passing through any "selected" sound track 18 goes through that track, the slit system (and the corresponding hole in separator block 41) and thence to a point on the elongated or strip-like photocell 48. Between the second slit 46 and the photocell 48 are disposed the coded track selecting shutter blades 50, whose number and aperture arrangement will depend upon the selection scheme desired, and the coding of the incoming control signals. Six binary-coded blades will provide for selection amongst 64 sound tracks, including a zero or dummy "track" corresponding to the unoperated condition of all six blades. This is because 2 to the sixth power is 64. Each shutter blade is secured to the pivoted armature 52 of an individual relay-type actuator including an electromagnetic coil such as indicated at 54 and the usual framework constituting the remainder of the magnetic path of the relay. The relays, herein six in number, are mounted on plate 12 in two rows of three each, lying on opposite sides of the slit system, so that the motions of the alternate shutter blades laterally of the slit position, from "open" to "closed" shutter conditions, are in opposite directions, as will appear more clearly below. The terms open and closed here refer, of course, only to those blade apertures which pass light when the corresponding magnet is deenergized.

In actual fact, each shutter merely effects a selection as between two groups of the sound tracks, and adjacent shutters then effect selection between two subgroups of each of the previous groups, and so on, until the last shutter effects selection of an individual track. Since the shutter blades have to be at least the length of the slit system in order to control all of the sound tracks, it is an important feature of the invention that they are moved in their narrow direction (transverse to the slit length direction), and by a very slight amount as compared with the longitudinal motions that would be involved otherwise in selectively covering or uncovering the individual tracks of so large an array.

In the six-bit binary selection scheme employed in the particular unit shown, the opaque shutter blades are selectively apertured in two rows as indicated in FIG. 3 of the drawings. Each blade can occupy either of two laterally-displaced positions, corresponding to the energized and deenergized conditions of the corresponding relay magnets. Blade 50 happens to be the "units" selecting shutter blade which selects a single track from a subgroup of two tracks, and hence has its apertures spaced alternately in the two rows, so that the lateral motion allows the light beam to pass through from one track, or an adjacent one, of each pair of tracks. Numeral 52 designates the operating connection from that blade to its relay armature. Blade 60 is the "2-bit" selecting shutter blade, and its alternately staggered apertures 58 are of double height in the slit-length direction, so that selection occurs as between successive sets of pairs of adjacent sound tracks. The narrow connecting-piece 59 illustrates how these double-height apertures (and all the apertures of greater height in the other blades) may be broken up into smaller units, the connecting-pieces being so located as not to interfere with light passing through any sound tracks; for example, aligned with the inter-track boundaries. As will appear later, in connection with FIG. 5, this feature is optional, but is useful for very long shutter blades which would otherwise be quite flimsy and have a tendency to catch on one another at their long-aperture margins. It will be understood that the thicknesses of the two blades 50 and 60 shown in FIG. 2 are exaggerated in the interest of clarity, and that a total of six blades (if that number is employed) or more can in actual fact fit into the space between plate 44 and the photoelectric cell 48.

The shutter blades and all necessary surfaces of the slit plates and separator block 41 are optically blackened to avoid random reflections, in one of the usual ways of the art. The "solar cell" photosensitive device 48 is, as stated above, common to all of the sound tracks, but for convenience of construction it may comprise several shorter strips connected electrically in parallel.

Since cylinder 16 rotates continuously at the proper speed for the reproduction of the track signals, it is necessary to incorporate a "1-revolution" control such that, in addition to individual track selection as described above, the actual production of output signals in only allowed to commence when the starting end of the selected track is arriving in the optical path. Also, the reproduction of those signals should be terminated at the completion of one revolution of the cylinder.

The above functions are conveniently accomplished under control of cylinder rotation by the scheme 49 in FIG. 4 of the drawings. Reference numeral 62 indicates a set of break-before-make contacts operated once during each revolution of drum 16 by a cam 64 secured to the drum shaft. While numeral 66 designates a set of normally-open contacts likewise operated by a cam 68 on the shaft. These switches are also shown in FIG. 1 of the drawings. To energize the selecting coils such as 54 of the track selecting shutter vanes or blades (of which only four are shown in FIG. 4), each coil is arranged to be energized by the anode-cathode current from a respective silicon-controlled rectifier switch 70 having a thyratron-like characteristic. That is the current through each switch is initiated by a gate or trigger signal pulse applied to its control electrode as at 72, from a serial-to-parallel converter 74; once conduction of the selected switches occurs, they remain conductive until the main direct current path 76 including the corresponding coil 54 is interrupted by the momentary opening of the normally-closed contact of the contact-set 62. All of the coil armatures are then released, and the normally-open contact of set 62 is closed to apply a momentary pulse of direct current over conductor 78 to the buffer storage device 80 (well known in the art) to deliver the next set of serial control pulses to the converter 74. When the relay magnets are released, the usual armature-restoring springs cause the shutter blades to return to their unoperated condition. This arrangement ensures the orderly arrival of incoming control pulses for track selection at the switches 70, and their resetting to nonconductive condition between pulse groups. For selection by a parallel-contact encoding keyboard, or other parallel data source, the contacts or conductors may directly fire the switches 70.

The normally-open contact 66 on the drum shaft is arranged to mute the output of the speech amplifier 82 controlled by photocell 48 during that period, after each word reproduction, when the selecting shutter blades are being returned to their non-selecting positions, and the selected set for the next word are being moved to their selecting condition. Thus, the cam switch contacts are operated during the "dead" interval of drum rotation, e.g. when the film splices are passing through the light beam, and the muting cam has a sufficient "dwell" to prevent audio reproduction during the time of movement of the shutter blades. Muting can, for example, be accomplished merely by shunting to ground, over conductor 84, the output of the amplifier 82.

FIG. 5 details an actual arrangement of shutter apertures for a typical case of six shutter blades (6-bit control data) and the maximum of 64 usable audio tracks thus selectable. Blades 50 and 60 correspond to those described above, but the apertures are here shown plain (without crossbars such as 59 of FIG. 3) both to illustrate the teaching that these are optional, and for greater clarity in the drawing.

Alternate blades in FIG. 5 are shown in laterally-staggered positions (note dotted lines A and B along the bottoms of the blades), and these are their unoperated positions (magnets not energized). All the blades which are selected for each control pulse group are moved laterally, as indicated by the arrows beside their top edges, by their respective magnets when energized. For identification, two particular magnets are indicated symbolically at 90 and 92, and these may be in the positions similarly numbered in FIG. 1. The extent of lateral motions of the blades is indicated by broken lines in a few instances to show the "energized" positions. As mentioned above, blade 50 is the "units" or 1-bit blade, and has apertures 56 of vertical height equal to the used width of one sound track, staggered in a double row left and right so that one track from each pair is selectable. Blade 60 is the 2-bit blade, and has double-height apertures similarly staggered (and see this blade in FIG. 3). Blades 94, 96, 98, and 100 are the 4-bit, 8-bit, 16-bit and 32-bit blades, and in each case the vertical heights of the staggered apertures are double those of the preceding blade in that order, as shown.

The reason for the alternation of the stagger patterns between adjacent blades is found, of course, in the fact that the magnets are conveniently arranged in two rows (as in FIG. 1), and their armature levers when they are energized move in opposite directions as between the two rows. The equivalence of various modifications of this kind, and their effect on the actual aperture pattern chosen, will be obvious from the above. It will be noted that one typical light-beam path from a record-track position is indicated at 102 merely by way of illustration, and while in the arrangement shown this path would always be open with all the shutter magnets deenergized, such patch may be masked off at either end if not desired, or it may provide a special signal (buzz track) for this condition, for some applications. Any other combination of energized and deenergized magnets will open up the light path from a unique one of the tracks. Obviously, if less than 64 tracks are needed, all of the shutter blades may be merely cut off or truncated to shorter length to accommodate the reduced number of tracks, or more blades may be used for greater numbers of tracks.

Relative to FIG. 4, other arrangements for holding the selecting magnets operated, for the duration of reproduction of each selected word, will be obvious; for example, a holding contact of each relay may be closed when the relay is operated, completing a holding circuit through the normally-closed contacts of set 62; this will permit elimination of the silicon switches where sufficient operating current is available from the converter 74, the keyboard, or other controlling agency. Similarly, the drum need not rotate constantly, but can be arranged to start rotation in advance of the reproduction of each selected track.

We claim:

1. A data-signal controlled audio unit for selectively generating audio speech signals in response to predetermined selecting codes, comprising:

a. a continuously rotating drum or cylinder carrying a multiplicity of side-by-side optical audio speech tracks about its periphery;

b. an optical system including a light source for illuminating an axially extending strip area of said drum, and thereby all of said tracks;

c. an optical slit system mounted adjacent the wall of said drum and extending in the axial direction so as to be able to receive light from all of said tracks;

d. photoelectric means positioned for energization by light passing from said tracks through said slit system;

e. a set of generally superposed movable shutter blades interposed between said light source and said photoelectric means, said shutter blades extending across all of said tracks and movable laterally of the slit direction in combination to pass light only through a selected one of said tracks for each combination; and

f. means for selectively moving said shutter blades.

2. Apparatus in accordance with claim 1, in which the means for moving said blades comprises a plurality of operating magnets.

3. Apparatus in accordance with claim 2, and means controlled by the rotating drum for maintaining the energization of the operated magnets throughout a major part of each drum rotation.

4. Apparatus in accordance with claim 1, including signal buffer storage means for energizing said selective moving means.

5. Apparatus in accordance with claim 4, and means controlled by the rotating drum for controlling said signal storage means to effect a subsequent selective movement of said blade-operating means.

6. Apparatus in accordance with claim 1, including means for muting the output of said photoelectric means during the movements of said shutter blades.

7. Apparatus in accordance with claim 1, in which said optical slit system comprises means defining a relatively narrow slit lying closely adjacent the wall of said drum, and means defining a relatively wider slit spaced from the first slit in the direction of light travel.

8. Apparatus in accordance with claim 1, in which said slit system, said shutter blades and said photoelectric cell means are mounted closely adjacent one another along the light path outside said drum, whereby the light from the selected track passes directly to said cell means without intermediate reflection or refraction.

9. A data-signal controlled audio unit for selectively generating audio speech signals in response to predetermined selecting codes, comprising:

a. a continuously rotating drum or cylinder carrying a multiplicity of side-by-side optical audio speech tracks about its periphery,

b. an optical system mounted within said drum, including a light source for illuminating an axially extending strip area of said drum, and thereby simultaneously illuminating all of said tracks,

c. an optical slit system mounted outside said drum and extending in the axial direction to receive light from all of said tracks,

d. photoelectric cell means positioned for energization by light passing from any of said tracks through said slit system,

e. a set of generally superposed movable shutter blades apertured in accordance with a multiple-order binary coding scheme and interposed between said light source and said photoelectric means, said blades extending across all of said tracks and movable laterally of the direction of length of said slit system in respective binary combinations to define a clear light-transmitting path only through a selected one of said tracks for each such combination, and

f. means for selectively moving said shutter blades.