ABSTRACT: Keyboard apparatus for producing switch signal combinations in a code used in office machines includes a number of individual light beam producing means corresponding in number to the number of channels used in the code, and a number of individual keys, each of which carries one or more light-obstructing barriers, the number and position of the barriers on a particular key corresponding to the number and position of the channels used in the machine code system to indicate the signal combination associated with the key so that when a key is depressed the light beams will be selectively interrupted to thereby form a coded signal representing the depressed key.
Fig. 6
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KEYBOARD USING SWITCHES HAVING LIGHT OBLITERATING ELEMENTS

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates to office machines and more particularly to a keyboard arrangement for producing signal combinations in the code system used in machines which are associated with the respective key.

2. Description of the Prior Art
The German published patent application (DAS) 1,197,934 discloses a ten-key keyboard for telephone installations in which a light barrier is interrupted by depressing a key and thus a switching criterion is produced. In order not to require a separate light barrier for each key of this ten-key keyboard, the known arrangement employs a coordinate arrangement of the light barriers with which it is possible to produce 10 output signals with a total of seven light barriers.

In this known keyboard it is necessary, if it is to be used in a machine of a coding with a code, to additionally provide a coding device which converts the signals from the light barriers into signals according to this machine code.

It is the object of the present invention to provide a keyboard which makes possible, with as low a number of light barriers as possible, the emission of a substantially lower number of switching signals than the known keyboard and which requires only a few coding means.

SUMMARY OF THE INVENTION

Among the objects of the present invention is the provision of keyboard apparatus which produces signal combinations indicative of the particular key in the machine code system used which requires a minimum of switching signals, elements and coding means.

A further object is the provision of such apparatus which is reliable in operation.

A further object is the provision of such apparatus which is expensive to manufacture and permits generous production tolerances, and which can be operated with a minimum of finger pressure.

Briefly stated, these and other objects are achieved by the provision of a plurality of light paths whose interruption upon operation of a key initiates the switching signals. Moreover, a mechanical switching or triggering element is associated with each key in such a manner that, upon operation of a key, one or a plurality of the existing light paths are interrupted corresponding to the particular code used in the machine and that the pulse or corresponding pulses, respectively, represent the signal combination associated with the respective key.

According to a further development of the present invention, a plurality, e.g. a total of six, light paths corresponding in number to the number of channels in the machine code system. At one end are provided with each of these paths having a light source at one end and a photoelectric receiving element, particularly a photodiode, at the other end thereof and the mechanical switching elements are arranged such that each light path can be blocked by a plurality of such mechanical switching elements. It is particularly advantageous to arrange these paths alongside each other and to provide the switching element associated with a particular key with one or a plurality of light-obstructing barriers each of which is moved into one of these light paths when the respective key is operated i.e. depressed.

The present invention thus is based on a construction in which a plurality of paths along which a light beam passes are arranged adjacent each other and a mechanical switching element is operated by a key, the particular configuration of this switching element with respect to the machine code employed being such as to enable it to block or close one or simultaneously a number of these light paths. If, for example, a code having n channels is used where n equals 6, this means that one switching element is able to close at least one path or a maximum of all six light paths. With this code, a total of 63 switching signal combinations can be produced and it is thus possible to employ up to 63 keys in a keyboard while using only six light paths. Since the code employed in the keyboard is the same as that of the machine, further means for converting the signals to the machine code are unnecessary.

The present invention thus provides a keyboard in which easy operability by slight finger pressure is combined with an extremely low requirement for switching elements.

According to a particularly advantageous further development of the present invention, it is proposed to provide a further, i.e. a seventh, light path into which a further light obstructing barrier on each of the mechanical switching or triggering elements moves. This further light obstructing barrier interrupts its associated light path somewhat later than the other light-obstructing barriers of the same triggering element. An electric AND circuit is provided in which the output signals of all light paths are logically linked in such a manner that a signal is produced at the output of the AND circuit only when a signal from one or more of the light paths corresponding to machine code channels and a signal from the seventh light path are present at the same time.

With this further development of the present invention, a switching signal is emitted only when all light paths corresponding to signal combinations associated with the respective key are definitely closed. This permits generous production tolerances for guiding the switching element as well as for the light-obstructing barriers themselves. This results in a reduction in production costs.

It is, moreover, desirable to construct each key's mechanical element as a flat piece which is mounted for parallel movement. Such a flat piece can be manufactured in a simple manner as by stamping.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective representation of a keyboard according to the present invention.

Fig. 2 and 3 are enlarged views of mechanical switching elements used with particular keys.

Fig. 4 is a schematic representation illustrating the light paths, the means to interrupt them, and the circuit used for generation of the output signals.

Fig. 5 is a schematic representation similar to Fig. 4 of another embodiment of the invention including photoelectrically controlled bistable flip-flops.

Fig. 6 is a circuit representing in a schematic manner a photoelectrically controlled bistable flip-flop of Fig. 5.

DESCRIPTION OF A PREFERRED EMBODIMENT

In Fig. 1, a large number of keys 2 are arranged on a board 1, the keys being attached to key shafts or connectors 3 which extend through openings in the board 1. Below the board 1 there are a total of seven light paths or ducts 4, which are marked individually as 41 to 47. A bank 5 of light sources 51 to 57 is provided at one end of the ducts 4, a bank of photoelectric receiving elements 61 to 67, e.g., a flip-flop incorporating a light-sensitive member, is provided at the other end of the ducts 4 with one light source and one receiving element being associated with each of the ducts 41—47 respectively. Each key connector 3 forms the upper part of a mechanical switching element 7 constructed as a flat piece and extending underneath board 1 over its entire width and being provided, at its side away from the board, with at least two, but with a maximum of seven light-obstructing barriers or tabs 71 to 77 (Fig. 2) which can dip into the light paths or ducts 41 to 47 respectively. At the switching element 7 disposed up front there are, for example, six obstructing barriers, the barrier which would dip into light duct 42 being missing. The arrangement of these light barriers or tabs on switching element 7 is made according to a (.5) code where n equals 1 to 6. The barrier 77 of each switching element 7, which dips into light duct 47, is somewhat shorter than the
other barriers for the purpose of closing duct 47 only after it has been definitely established that one or a plurality of ducts 41 to 46 have been closed by the respective barriers 71 to 76. An output signal is considered to be present only when duct 47 is also closed. This has the advantage that no particularly high demands need be placed on the tolerances for the respective dimensions in the manufacture of the switching element 7 and its tabs since it does not matter whether paths 41 to 46 are closed exactly at the same time or not.

Each switching element 7 is preferably provided with a short arm member or shaft 8 at its left end and extends up through a slot in the board 1. The shaft serves to parallel-guide the switching element. Those keys, which are arranged at the left edge of the table board and on which this left arm member must serve as the key shaft 3, are provided at their right side with an arm member 8 which serves for parallel-guiding instead of shaft 8. For the purpose of good parallel-guiding there are also provided two key shafts 3 for particularly large keys, as for example, the addition or multiplication keys, etc. Such an arrangement of two key shafts 3 can be seen, for example, at the first switching element 7 in FIG. 1. The important element for parallel-guiding a switching element 7, however, is the vertical guide member 9 which slides in a guide groove not shown in the drawing for reasons of clarity.

The keys are operated against the force of a spring 10. In order to prevent a second key from being depressed before the previously depressed key has returned to its initial or rest position, a ball cage 11 is provided. Each switching element 7 has a tongue 12 which dips between two balls of the ball cage 11 when the key is being operated. This pushes all the adjacent balls toward the left and right so that these balls come to lie so closely together, due to the low amount of play provided, that tongue 12 of another switching element 7 can no longer dip into the ball cage.

The upper edge of tongue 12 and the edge 13 of the same switching element 7 facing this tongue serve to limit the upward and downward movement of the switching element 7 in cooperation with a flap 15 of synthetic material which is placed around the frame portion 14.

FIG. 2 shows a switching element 7 in an enlarged view. The shorter barrier 77 for duct 47 is here disposed on the extreme right. It is of course, also possible, within the sense of the present invention, to arrange the light ducts and barriers in a different way and particularly to dispose barrier 77 and light duct 47, for example, between the other barriers 71 to 76 or ducts 41 to 46. A particularly suitable arrangement is shown in FIG. 3 in which some of the barriers are disposed to the left and others to the right of the vertical guide member 9. This arrangement has the particular advantage that the torque applied to the vertical guide member 9 due to the asymmetry of the switching element is kept as low as possible.

FIG. 4 shows a schematic circuit diagram of the electric circuitry, the arrangement of the ducts as well as the position of the respective output signals. To the outputs of all photoelectric receiving elements 61—67, which are provided in the form of photodiodes, a total of seven amplifiers and inverter circuits 16 are connected at whose outputs appear the signal combinations 17, e.g., LLOOOOL, including the signal from light path 47. The photoamplifiers are here so constructed that the signals emitted from the photodiodes are inverted so that when one of the duct 4 is darkened or closed a signal is present at the output of the respective photoamplifier, whereas when a duct 4 is not closed, no signal is present at the output of the respective photoamplifier 16. The signals shown under 17 appear during the time when the respective ducts 4 are closed. This interval is somewhat shorter than the time during which the key is being operated. It can be clearly seen that the light duct 47 the corresponding output signal is substantially shorter than the ducts 41 and 42. To the output of the photoamplifiers 16 is connected a logic circuit 18 consisting of individual AND circuits 81 to 86 which are so interconnected that a transmission of the signals from ducts 41 to 46 is only possible when the signal from duct 47 is also present. Thus the normed signals of ducts 41 to 46 appear at the output of this logic circuit 18.

FIG. 5 shows a particularly advantageous further development of the present invention in which phototransistors are used as photoelectric receiving elements instead of photodiodes, which phototransistors are part of a normal bistable flip-flop. Instead of a bistable flip-flop it is also possible to use a Schmitt trigger or a circuit arrangement with similar switching characteristics. When the appropriate light duct 41 to 47 is closed, the phototransistor of the corresponding flip-flop 61 to 67 is blocked and thus the bistable flip-flop is put into one switching state. The resulting output signals of the seven light paths are further evaluated in the manner already described in the circuit 16. This arrangement has the advantage that the switching signal is present independent of the length of the time the key is operated. Since the phototransistors can emit a new signal only after the associated flip-flop has been reset, a resetting pulse is fed in on line 19. Such a resetting pulse may be derived at any suitable place in the machine.

The term “light” employed in the above description is not limited to visible light but is intended to apply to any other suitable radiation not detectable by the human eye.

Circuits with phototransistors or other light activated switches are well known to those skilled in the art. For example, such circuits are disclosed in "International Electronica," July 1964, pages 49 to 53, especially FIG. 5c.

If a normal NPN-transistor is substituted for one of the two light-activated elements in such a circuit as it is shown in FIG. 6 of the drawings, the resulting bistable flip-flop satisfies the requirements of an element 6 of FIG. 5. The bistable flip-flop is set by a signal from a light source 5 at element LAT and it is reset by a signal on line 19, which is fed to the base of transistor T.

A normal timing circuit 20 in the machine, which is activated by the signal on duct 47, generates the reset signal for flip-flops 61 to 67 on line 19 after a predetermined period of time—for example 40 msec.—this signal switching over transistor T and preparing element LAT of every flip-flop 61 to 67 for the next switching operation. The activating signal for timing circuit 20 can be taken off the input of flip-flop 67, this input, for example, being point 20 of a flip-flop like FIG. 6. The aforesaid period of time is determined by the time necessary for processing the data in the office machine, which was delivered on the respective key.

It will be readily apparent that there has been provided a keyboard circuit arrangement for producing signal combinations which are indicative of the particular key in the machine code used which requires a minimum of switching elements, is reliable in operation, inexpensive to manufacture, permits generous production tolerances and requires minimum finger pressure.

It will be understood that the above description of the present application is susceptible to various modifications, changes and adaptations.

We claim:

1. A keyboard apparatus for producing signal combinations indicative of particular keys in a multichannel office machine code system in which each channel may carry a signal, and particular keys are represented by the presence of signals on particular designated channels, the apparatus comprising in combination:

a. support means;
b. means for producing a plurality of light beams equal in number to the number of channels in the machine code system;
c. a like plurality of photoelectric receiving means, one for each of said light beams, arranged in designated positions on the support means for producing signals in respective ones of said channels in response to a change in the detected radiation;
d. a plurality of key members larger in number than said plurality of light beams, each of said key members being...
mounted on said support means for movement relative thereto from a rest position to a depressed position, each of said key members including means for selectively interrupting one or more of said light beams in accordance with the machine code associated with the respective key when said respective key is depressed, whereby the combination of the signals produced by said plurality of photoelectric receiving means as a result of the depression of a key is a coded representation of the depressed key.

2. The keyboard apparatus as defined in claim 1 including a plurality of light ducts, one for each of said light beams, mounted on said support structure, each of said light ducts having a respective one of said light beam producing means at one end thereof and a respective one of said photoelectric receiving means at the other end thereof; and wherein said means for selectively interrupting said light beams includes a number, from one to the number of said light beams, of light-obstructing tabs mounted on each key member for movement therewith, each of said tabs being positioned relative to said ducts so that upon depression of the respective key each of said tabs will extend into a respective one of said ducts and block the light beam passing therethrough.

3. Apparatus as defined in claim 2 wherein each of said photoelectric receiving means is a photosensitive semiconductor device.

4. Apparatus as defined in claim 2 wherein said light ducts and their associated light beam producing means and photoelectric receiving means are so positioned that the respective light paths are substantially parallel to each other.

5. Apparatus as defined in claim 4 including an additional light beam producing means and an associated photoelectric receiving means mounted on said support means to provide an additional light path which is substantially parallel to the other light paths; and wherein each key member carries an additional light obstructing tab means positioned on said key member for blocking the said additional light path at a somewhat later time during the movement of the key to said depressed position than the other tabs block their respective light paths; and logic circuit means for producing an output signal only when a signal from at least one of the first-mentioned photoelectric sources and a signal from said additional photoelectric light source are simultaneously present.

6. Apparatus as defined in claim 2 wherein each key member comprises a flat member having said light obstructing tabs extending from the body thereof and wherein the individual keys are mounted on said support means parallel to each other for movement in the plane defined by the flat body.

7. Apparatus as defined in claim 6 wherein each flat key member includes a guide member extending in the plane of the flat member and carrying two abutments for limiting its movement in opposite directions.

8. Apparatus as defined in claim 1 including means for preventing the depression of any key while another key is depressed.

9. Apparatus as defined in claim 8 wherein said means for preventing depression of any key while another key is depressed comprises: a ball cage means including a channel having stops at each end and a number of balls disposed therebetween, tongue means on each key member positioned for movement between individual balls upon movement of the key to the depressed position, the dimensions of said channel, its stop means and said balls being such that only one tongue means can fit between the balls at a time.

10. Apparatus as defined in claim 3 wherein each of said photosensitive semiconductor devices is a phototransistor which is a part of a respective bistable flip-flop circuit and which causes the respective flip-flop circuit to assume its set condition when the respective light beam is interrupted upon depression of a key; and wherein means are provided for generating a reset pulse for said flip-flop circuits.

11. Apparatus as in claim 10 including means for blocking the unoperated key means in response to the output signal of the set flip-flop circuit.

12. Apparatus as defined in claim 1 in which the machine code system uses six digits and there are six light beams and six output signal-producing means.