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DRAWINGS ATTACHED

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(54) KEYBOARD ARRANGEMENT

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is directed to manually operated keyboards of the type in which the depression of a numerically valued key by an operator is translated into an electrical signal which may control, or be manipulated by an associated machine.

Keyboards designed for use in business machines are arranged in a format that differs from the push button dialling format used by the Bell Telephone System. Basically, the first and third rows of key board numerals, of the telephone dialling format are transposed to the third and first rows, respectively, in the business machine format. In prior art keyboards, the electrical connections between the keyboard switches and their associated transmission lines are soldered and relatively permanent. Therefore, the presently available keyboards do not readily lend themselves to alteration by the customer between business machine format and telephone format.

In accordance with the present invention there is provided a keyboard arrangement having a plurality of keys, a plurality of switches each of which is arranged to be actuated by a corresponding one of the keys, and connector means for connecting the switches to associated circuits, the connector means including co-operating coupling members which are arranged to co-operate in two different modes to interchange the connections of at least some of the switches to their associated circuits in accordance with a preselected arrangement.

It will be appreciated, of course, that it is also within the scope of the present inven-

tion to utilize the concept of the orientable connector for varying formats beyond two, i.e., by providing more than two orientations for the connector means.

In accordance with one preferred embodiment, the present invention provides a number of keyboard switches mounted in a predetermined array and electrically connected to conductors such as printed circuits on the mounting board that terminate at edge terminals. A corresponding number of output conductors are terminated in a connector which may be attached to the edge terminals in one of two orientations. An operator of the keyboard can alter the format of the switches in the array by reversing the orientation of the connector. The keys are thereafter renumbered to reflect the altered format.

The invention will be described further, by way of example, with reference to the accompanying drawings wherein:

Fig. 1 shows a keyboard in business machine format;

Fig. 2 shows a keyboard in telephone format;

Fig. 3 shows an arrangement of the printed circuit board and reversible connector according to the present invention.

The switches of a numerical keyboard are arranged in three rows and columns in a matrix array and designated by the numbers 1—9. The switch corresponding to the number 0 is added to the centre column.

Fig. 1 shows in block form the arrangement of switches 2, numbered 0—9, on a panel 1 in conventional business machine format. This format is in general use by the computer and business machine industry, and customers of such products have come to expect that all keyboards purchased for such use will conform to this format.

In the telephone industry, however, a second keyboard format is commonly used, that arrangement of switches 2, numbered 1—9 and 0, as shown in block form in Fig. 2. In telephone format, the first row of switches are

numbered 1—2—3 and the third row of switches are numbered 7—8—9. In the business machine format of Fig. 1, the numerical designations of the first and third row are

5 transposed.
Figure 3 shows in schematic form one preferred embodiment of the present invention that enables the user readily to select the format he desires. A printed circuit board 3 has mounted thereon the ten switches lettered

10 *a* to *k* in array corresponding to the array of the formats in Fig. 1 and Fig. 2. The switches can be of the normally open, single pole, single throw variety and have two terminals.
Electrically attached to the first terminal of all the switches is a common printed conductor 4 that terminates at connector pad *m'* of edge connector 5. The second terminal of switches *d*, *e*, *f* and *k* is attached to respective printed conductors that terminate in connector pads *d'*, *e'*, *f'* and *k'*, respectively, of edge connector 5. If additional switches are provided to perform functions other than those of the keyboard disclosed herein, they are connected to additional printed conductors on board 3 that terminate in additional connector pads *L'* of connector 5. A mating multi-contact, non-reversible, connector 6 attached to the edge connector 5 completes the connection of the output circuits *C*, 4, 5, 6, 0 to their respective switch terminals. Alternatively, the output circuits could be directly soldered to their respective connector pads. The switches *d*, *e*, *f* therefore remain connected to output circuits 4, 5, 6.

Electrically attached to the second terminals of switches *a*, *b*, *c* are respective printed conductors that terminate in connector pads *a'*, *b'*, *c'* of edge connector 7. In like manner, the second terminals of switches *g*, *h*, *j* are attached to respective printed circuits that terminate in connector pads *g'*, *h'*, *j'* of edge connector 7. A mating six-position, dual contact, connector 8 releasably attaches the output circuits numbered 3, 2, 1, 7, 8, 9 to edge connector 7.

When connector 8 is attached in the orientation depicted in Fig. 3, switches *a*, *b*, *c* are connected to output circuits numbered 1, 2, 3 respectively and switches *g*, *h*, *j* are connected to the output circuits numbered 7, 8, 9, respectively. Thus the keyboard is connected to operate in accordance with the telephone format of Fig. 2.

55 If the connector 8 is disconnected, inverted, and reattached, switches *a*, *b*, *c*, are connected to output circuits 7, 8, 9 respectively, and switches *g*, *h*, *j*, are connected to output circuits 1, 2, 3, respectively. Thereafter, the keyboard is connected to operate with the business machine format of Fig. 1.

65 The connector 8 can be a dual contact, six position connector such as is commercially sold by the Cinch Manufacturing Company of the

United States of America. On the appropriate opposite faces thereof may be stamped the inscription "Telephone" and "Business Machine" to ensure that the connector is properly oriented by the user.

In the operation of the invention, the keyboard format is selected by the user who attaches the connector 8 in the depicted or inverted orientation and rearranges the numbered keys to correspond with the selected format. Preferably the keys are readily removable by hand from their switch activating mechanism. An example of such a key and switch arrangement is the Honeywell, Inc., "Microswitch" Series KB reed switch.

In the manufacture of the keyboard, the electrical connections to the switch terminals may be effected by an automatic soldering machine. Thereafter, the wiring to the switch terminals need not be disturbed in changing formats.

WHAT WE CLAIM IS:—

1. A keyboard arrangement having a plurality of keys, a plurality of switches each of which is arranged to be actuated by a corresponding one of the keys, and connector means for connecting the switches to associated circuits, the connector means including co-operating coupling members which are arranged to co-operate in two different modes to interchange the connections of at least some of the switches to their associated circuits in accordance with a preselected arrangement.

2. A keyboard arrangement as claimed in Claim 1, wherein the switches comprise first and second groups and are mounted on a mounting board which carries conductors extending from the switches to edge terminals on the mounting board, the edge terminals constituting one of said coupling members and a connector co-operative therewith constituting the co-operating coupling member, the connector being arranged to have first and second groups of electrical output conductors connected thereto and being co-operative with the edge terminals in either of two orientations which connect the first and second groups of switches to the first and second or second and first groups of output conductors, respectively.

3. A keyboard arrangement as claimed in Claim 2, wherein the conductors carried by the mounting board are of the printed circuit type.

4. A keyboard arrangement as claimed in Claim 2 or Claim 3, wherein the switches are arranged in a matrix array and the first and second groups of switches correspond to different rows of the array.

5. A keyboard arrangement as claimed in Claim 4, wherein the array of switches consists of nine switches each having a different numbered one of said keys thereon; the first and second groups consisting of three switches

numbered 1—2—3 and the third row of switches are numbered 7—8—9. In the business machine format of Fig. 1, the numerical designations of the first and third row are transposed.

Figure 3 shows in schematic form one preferred embodiment of the present invention that enables the user readily to select the format he desires. A printed circuit board 3 has mounted thereon the ten switches lettered *a* to *k* in array corresponding to the array of the formats in Fig. 1 and Fig. 2. The switches can be of the normally open, single pole, single throw variety and have two terminals.

Electrically attached to the first terminal of all the switches is a common printed conductor 4 that terminates at connector pad *m'* of edge connector 5. The second terminal of switches *d*, *e*, *f* and *k* is attached to respective printed conductors that terminate in connector pads *d'*, *e'*, *f'* and *k'*, respectively, of edge connector 5. If additional switches are provided to perform functions other than those of the keyboard disclosed herein, they are connected to additional printed conductors on board 3 that terminate in additional connector pads *L'* of connector 5. A mating multi-contact, non-reversible, connector 6 attached to the edge connector 5 completes the connection of the output circuits *C*, 4, 5, 6, 0 to their respective switch terminals. Alternatively, the output circuits could be directly soldered to their respective connector pads. The switches *d*, *e*, *f* therefore remain connected to output circuits 4, 5, 6.

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If the connector 8 is disconnected, inverted, and reattached, switches *a*, *b*, *c*, are connected to output circuits 7, 8, 9 respectively, and switches *g*, *h*, *j*, are connected to output circuits 1, 2, 3, respectively. Thereafter, the keyboard is connected to operate with the business machine format of Fig. 1.

The connector 8 can be a dual contact, six position connector such as is commercially sold by the Cinch Manufacturing Company of the

United States of America. On the appropriate opposite faces thereof may be stamped the inscription "Telephone" and "Business Machine" to ensure that the connector is properly oriented by the user.

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2. A keyboard arrangement as claimed in Claim 1, wherein the switches comprise first and second groups and are mounted on a mounting board which carries conductors extending from the switches to edge terminals on the mounting board, the edge terminals constituting one of said coupling members and a connector co-operative therewith constituting the co-operating coupling member, the connector being arranged to have first and second groups of electrical output conductors connected thereto and being co-operative with the edge terminals in either of two orientations which connect the first and second groups of switches to the first and second or second and first groups of output conductors, respectively.

3. A keyboard arrangement as claimed in Claim 2, wherein the conductors carried by the mounting board are of the printed circuit type.

4. A keyboard arrangement as claimed in Claim 2 or Claim 3, wherein the switches are arranged in a matrix array and the first and second groups of switches correspond to different rows of the array.

5. A keyboard arrangement as claimed in Claim 4, wherein the array of switches consists of nine switches each having a different numbered one of said keys thereon; the first and second groups consisting of three switches



each and there being a third row of three switches interposed between the first and second groups.

5 6. A keyboard arrangement as claimed in Claim 4 or Claim 5, wherein each switch includes means for changing the numbered keys of the first and second rows to correspond to the orientation of the coupling members.

10 7. A keyboard arrangement as claimed in Claim 1, wherein the first orientation of the coupling members enables the keyboard to have a business machine format and the second orientation of the coupling members enables the keyboard to have a telephone
15 format.

8. A keyboard arrangement as claimed in any preceding Claim, including a plurality of said switches whose connection to their associated circuits is not interchanged when the coupling members co-operate in their two 20 different modes.

9. A keyboard arrangement substantially as hereinbefore described with reference to the accompanying drawing.

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