United States Patent

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[33] **Great Britain**
[31] **51,408/69**

[54] **ELECTRICAL SWITCHING APPARATUS**
7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **200/14,** 200/43, 200/172 R
[51] **Int. Cl.** **H01h 19/58,** H01h 27/10, H01h 3/02
[50] **Field of Search** ..... 200/11 R, 11 D, 11 DA, 14, 18, 42, 43, 153 R, 172 R

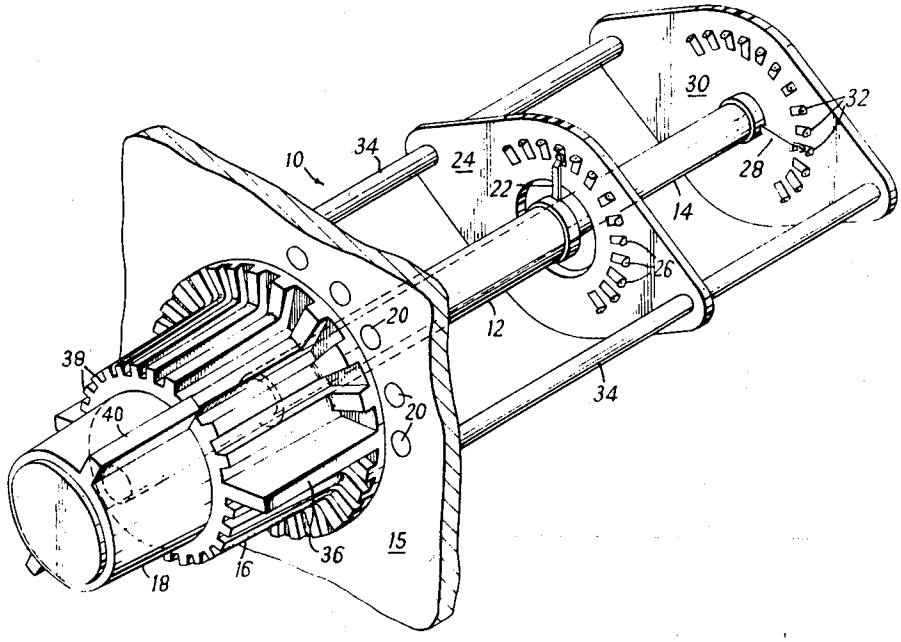
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ABSTRACT: The invention relates to a dual-function switching apparatus intended particularly for controlling the two time bases of a dual time base oscilloscope. This switching apparatus comprises two switch contact assemblies of the wafer type driven in rotation by two coaxial shafts respectively. Each shaft is independently rotated by its own knob, these two knobs also being mounted coaxially one in front of the other. The rear knob has a datum index by which its position can be read on scale markings on the oscilloscope front panel. The front knob also has a datum index used for determining the position of this front knob. But to avoid parallax errors in reading the position of this front datum index on the scale markings, the rear knob is provided with auxiliary indexes which extend from the datum index on the front knob to the scale markings on the panel. When the datum index on the front knob is aligned with any particular auxiliary index on the rear knob, the position of the front knob is read by sighting along that auxiliary index from the front datum index to the scale markings.



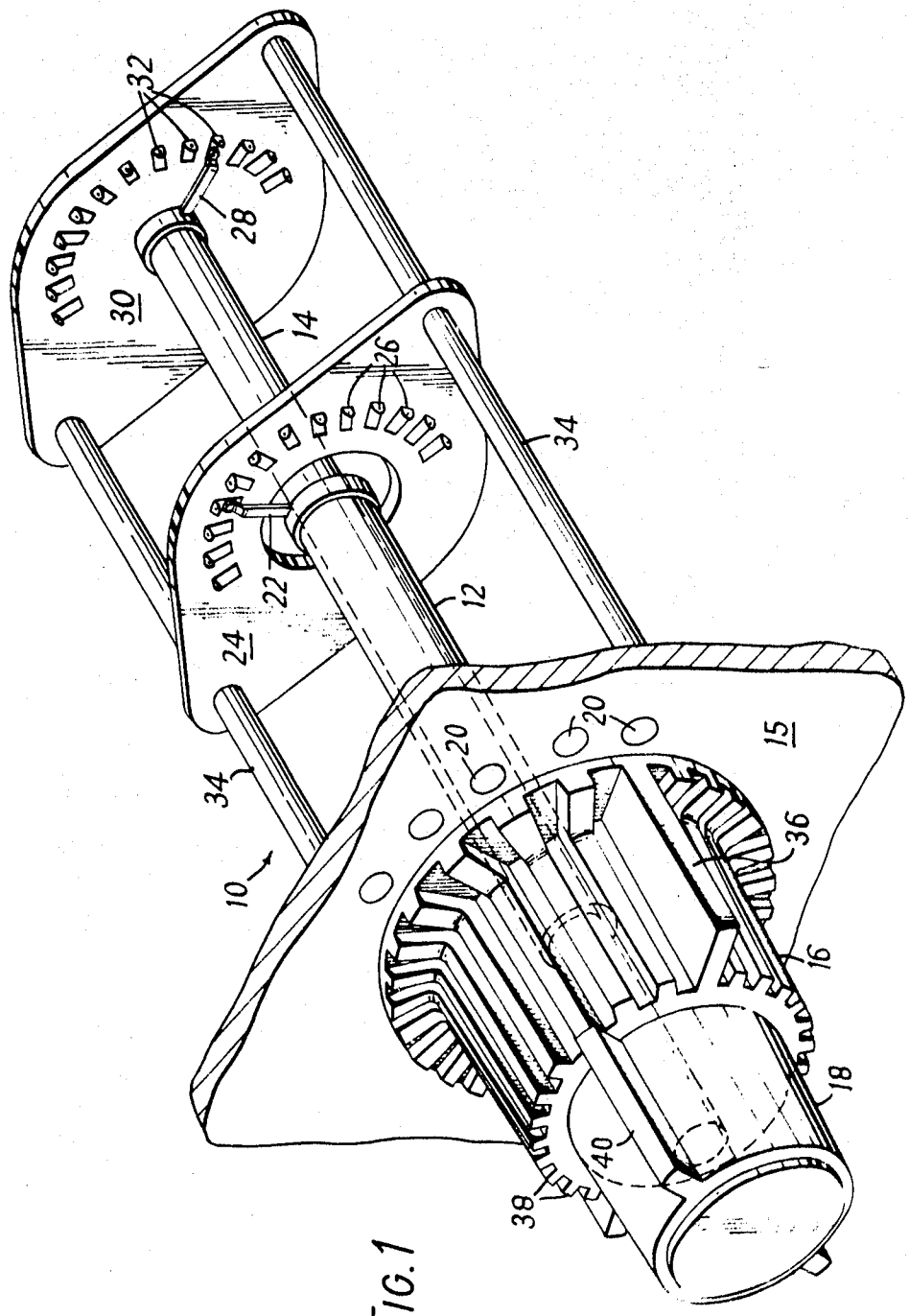


FIG. 1

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FIG. 2

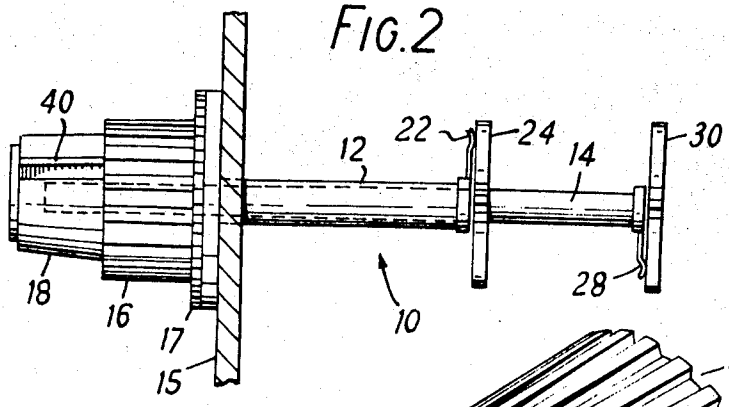


FIG. 3

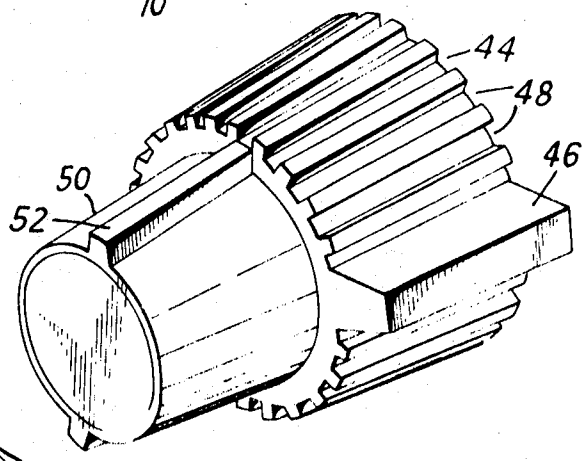
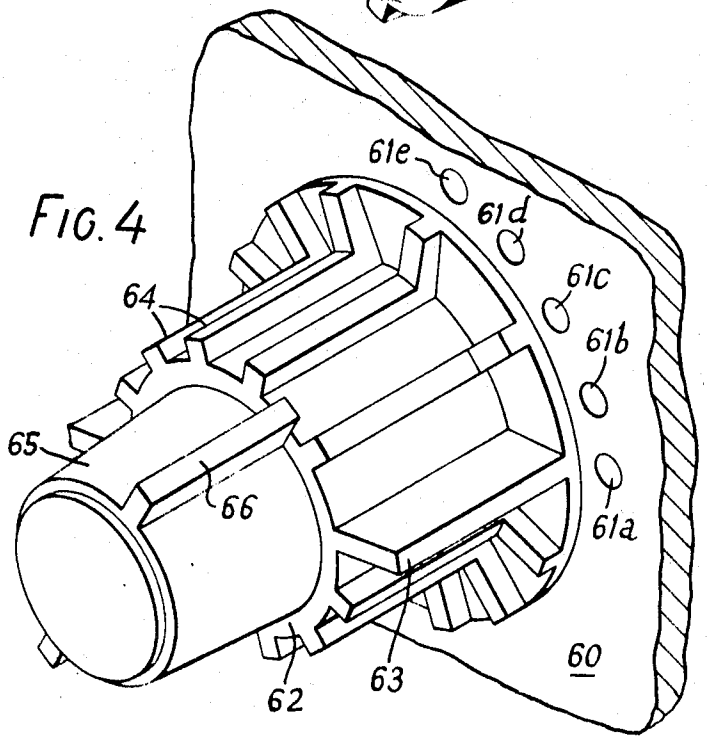


FIG. 4



ELECTRICAL SWITCHING APPARATUS

The present invention relates to electrical switching apparatus intended to be mounted on a panel bearing suitable scale markings for this switching apparatus. The panel may for example be the front panel of an electronic instrument.

More particular the invention is concerned with dual switching apparatus in which two switch contact assemblies are respectively set to their desired positions by two shafts, one of which extends through the other, driven in rotation manually by knob means located on the front of the panel. Generally the two shafts and the knob means are coaxial.

Connected to each of the shafts is a corresponding datum index. The positions of the two switch contact assemblies can be determined by reading the settings of their respective datum indexes on the scale markings on the panel.

Such switching apparatus is known and is particularly useful on a crowded instrument panel where the knob means, which are generally coaxial with the common axis of the two shafts, take up less space than would the two knobs of two entirely separate switches, place side by side. A dual switching apparatus of this type is especially appropriate where the two functions performed respectively by its two switch contact assemblies are related. Thus for example such switching apparatus is particularly suitable for controlling the two time bases of a dual time base oscilloscope. In this case, the respective positions of the two switch contact assemblies determine the horizontal sweep rates of the two time bases. The switching apparatus would be mounted with its two switch contact assemblies located inside the oscilloscope and electrically connected to the two time base circuits respectively, and the coaxial shafts of this switching apparatus would protrude through the control panel of the instrument with the knob means and their two datum indexes disposed in front of the control panel. In order to set the sweep rates of the two oscilloscope beams, the operator brings the two datum indexes to their correct positions with respect to the scale markings on the front panel, by operating the knob means.

Each switch contact assembly may be of the well-known wafer type which includes, typically, a moving contact member mounted for rotation on its associated shaft and fixed contact member having a plurality of contacts which are engaged sequentially by the moving contact member as the shaft is rotated. In the case of a wafer-type switch assembly the moving contact usually moves in stepwise fashion, stepping from one fixed contact to the next. Alternatively the switch contact assembly can move continuously. The term "switch contact assembly" is used in a broad sense and includes, for example, potentiometers.

In one known dual switching apparatus the knob means is in the form of just a single manually controlled knob. This knob is permanently connected to the inner shaft, and therefore rotates the inner shaft whenever it is rotated itself. However this knob, as it is the only knob, also serves for rotating the outer, tubular, shaft surrounding the inner shaft. To this end a disc is permanently mounted on the outer shaft and means are provided for releasably coupling or ganging the knob to this disc. When the knob is ganged to the disc, this knob drives both shafts together. When the knob is not ganged to the disc, it drives only its own associated inner shaft; the disc together with its associated outer shaft do not move.

The coupling or ganging means are relatively complex. They take the form of a spring-loaded pin mounted in the knob and adapted to engage a corresponding hole in the disc when the knob is in one particular predetermined position relative to the disc, thereby coupling the knob to the disc in that relative position. To release the coupling, the knob is withdrawn axially away from the disc against a spring bias, and when the pin has come free of the hole the knob is rotated so that the pin is no longer aligned with the hole and can no longer re-engage with the hole. Further rotation of the knob in the same direction is therefore independent of the disc. To recouple the knob and disc, the knob is rotated back to the particular predetermined position in which the pin reengages the hole.

Although the knob and its associated shaft and switch contact assembly can rotate independently of the disc and its associated shaft and switch contact assembly, the reverse is not true. The disc can only be rotated by and with the knob. To set the two switch assemblies, the knob is first coupled to the disc and rotated until the disc reaches its selected position, and then the knob is uncoupled from the disc and rotated alone until it reaches its own selected position; during this latter operation the disc remains stationary.

The disc and the knob each have a datum index by which their settings can be read on the scale markings on the front panel. The disc lies between the knob and the panel and is made of transparent material so that the scale markings, which lie behind the disc, can be read through the disc. The disc is very shallow so that the knob, which is located just in front of it, is still relatively near to the control panel. It is then easy to read on the scale markings the position of the datum index of the knob, and the detrimental effect of parallax is minimized.

It is an object of this invention to provide a dual switching apparatus which is relatively simple and in which each of the switch contact assemblies can be operated independently of the other and in which the two datum indexes can both be read easily and accurately on the scale markings provided on the mounting panel.

According to this invention there is provided electrical switching apparatus intended to be mounted on a panel bearing suitable scale markings on its front for the switching apparatus, this switching apparatus comprising: an independently rotatable rear knob connected to rotate a tubular shaft which drives a switch contact assembly, this rear knob, when the switching apparatus is mounted on the panel, being located with its rear near to the marked front of the panel and having a length in the direction of its axis of rotation sufficient to enable it to be conveniently grasped and rotated by hand, this rear knob further having a datum index located near its rear so that this datum index will lie near the marked panel and can be brought into register with any particular scale marking, by manually rotating the knob, in order to select that scale marking, which then indicates the position of the rear knob and hence of its associated switch contact assembly; and an independently rotatable front knob connected to rotate another shaft which is located inside the tubular shaft and which drives another switch contact assembly, the front knob being located in front of the rear knob and having a length in the direction of its axis of rotation sufficient to enable it to be conveniently grasped and rotated by hand, this front knob further having a datum index located near the rear of the front knob hence near the front of the rear knob; the rear knob further comprising auxiliary indexes extending substantially from the front of the rear knob to substantially the rear of this rear knob, these auxiliary indexes extending sufficiently close to the front knob so that any particular auxiliary index can easily be selected by the datum index of the front knob, by rotating the front knob until its datum index comes into register with that auxiliary index, whereby, when the switching apparatus is mounted on the panel, the position of the front knob and hence of its associated switch contact assembly can be read by following the selected auxiliary index from the datum index on the front knob to the scale markings on the panel.

The terms "front" and "rear" are relative to the panel on which the switching apparatus is intended to be mounted. It is assumed that the panel faces the front, so that the rear knob is nearer the panel (farther away from the operator) and the front knob is farther from the panel (nearer the operator).

Preferably the rear knob together with its associated switch contact assembly rotates in regular stepwise fashion and advantageously the front knob and its associated switch contact assembly likewise rotate in stepwise fashion. The size of the steps of the front knob would normally be the same as that of the steps of the rear knob, but it can also be a multiple or submultiple thereof.

The indexes on the rear knob should preferably be spaced apart by one step or by a multiple or possibly a submultiple of

a step of this rear knob. The scale markings on the instrument panel should also be spaced apart by one step of the rear knob or by a multiple or possibly a submultiple of such a step. The scale markings are placed so that when the rear knob is set at any of its stepped positions the indexes of this rear knob are aligned in register with the scale markings.

The datum index of each knob may take any convenient form such as a pointer or lug or may be simply a line painted or engraved along the length or part of the length of the knob.

The auxiliary indexes on the rear knob may similarly take any convenient form, provided they can be differentiated from the datum index, such as channels, grooves, ribs, lines or the like formed along the full length of the knob.

In one embodiment of the apparatus wherein the datum index of the front knob is in the form of an upstanding lug, the lug is so dimensioned that its radius adjacent the rear knob is substantially equal to the common radius of the auxiliary indexes adjacent the front knob on the rear knob.

The width of the auxiliary indexes may be made substantially equal to the width of the datum index on the front knob, and may be of the same differentiating color.

The invention will now be described, solely by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of one embodiment of an electrical switching apparatus in accordance with the invention,

FIG. 2 is a side elevation, to a reduced scale of part of the switching apparatus of FIG. 1,

FIG. 3 is a perspective view of part of another embodiment of a switching apparatus in accordance with the invention, and

FIG. 4 is a perspective view of part of still another embodiment of a switching apparatus according to this invention.

Referring to FIGS. 1 and 2 there is shown switching apparatus 10 having outer and inner coaxial shafts 12 and 14, mounted for rotation on an instrument panel shown in part at 15 by mounting means (not shown). The shafts 12 and 14 are independently rotatable by rear and front knobs 16 and 18 respectively to a plurality of predetermined settings corresponding to calibrated scale markings 20 on the front of the panel 15. The knobs are secured to their associated shafts by grub screws (not shown). Alternatively, they can be secured by other known methods such as collets.

The shafts are arranged to be rotatable in a stepwise fashion to a plurality of predetermined settings by providing each shaft with a step-detent mechanism. For simplicity, the step-detent mechanisms are not shown as they are well known in the art.

Associated with the shaft 12 is a wafer switch assembly comprising a moving contact member 22 mounted for rotation with the shaft and a fixed contact member 24 having a plurality of contacts 26 which are engaged sequentially by the moving contact member 22 as the shaft 12 is rotated.

Associated with the shaft 14 is another wafer switch assembly comprising a moving contact member 28 mounted for rotation with this shaft 14 and a fixed contact member 30 having a plurality of contacts 32 which are engaged sequentially by the moving contact member 28 as the shaft 14 is rotated.

The fixed contact members 24 and 30 of the wafer switching assemblies are mounted nonrotatably around the shafts by support rods 34 firmly secured to the mounting means (not shown). The wafer switch assemblies are shown purely schematically as many variants are known in the art.

The rear knob 16 is formed with a flared skirt 17 at its rear end and has a datum index in the form of an integral upstanding rectangular lug 36 the radial dimension of the outer surface of which is equal to the radius of the skirt. This rear knob 16 also has a plurality of auxiliary indexes in the form of integral upstanding rectangular lugs 38 which extend along its full length from the front to the rear of this knob 16. To differentiate between the lug 36 and the lugs 38 the radial dimension of the outer surfaces of the latter are made less than that of the former. They could also be colored differently. The circumferential spacing between the scale-marked positions 20 and the predetermined settings are so arranged that the lugs 36 and 38 line up with the positions 20.

The front knob 18 has a datum index in the form of an upstanding lug 40 the radial dimension of the outer surface of which, at least at the rear end of the knob 18 adjacent the front of the rear knob 16, is equal to the radial dimension of the outer surfaces of the auxiliary indexes 38 at the front end of the knob 16 adjacent the knob 18.

The angular settings of the inner shaft 14, and hence of the front knob 18, are arranged such that the lugs 38 provide an aligned and smooth extension for the lug 40.

In operation, the angular setting of the outer shaft 12 can be read off the scale markings directly by means of the lug 36 on the rear knob 16 and the angular setting of the inner shaft 14 can be ready off the scale markings by sighting along the auxiliary index 38 which forms an aligned extension for the lug 40 of the front knob 18.

FIG. 3 shows a perspective view of an alternative arrangement for the knobs of the invention. The rear knob 44 has a datum index in the form of an upstanding lug 46 and a plurality of auxiliary indexes in the form of rectangular grooves 48.

The front knob 50 has a datum index in the form of an upstanding lug 52, the radial dimension of the outer surface of which is equal to the radial dimension of the flat bottom surface of the grooves 48.

As described, in relation to FIGS. 1 and 2, the auxiliary indexes 48 of the knob 44 provide an aligned extension of the datum index 52 of the knob 50.

FIG. 4 shows a perspective view of still a further arrangement for the knobs in accordance with this invention, these knobs being shown mounted on an instrument panel. The panel, which is referenced 60, bears scale markings 61*a*–61*e*. The rear knob 62 has a datum index 63 in the form of an upstanding lug and auxiliary indexes 64 also in the form of upstanding lugs. The auxiliary indexes 64 are regularly spaced around the knob 62 at an angular interval equal to twice the angular interval separating the scale markings 61*a*–61*e*. Thus the knob 62 of FIG. 4 is similar to the knob 16 of FIG. 1 but with every second auxiliary index lug missing.

In the embodiment of FIG. 4 the rear knob 65 with its datum index 66 in the form of an upstanding lug, is identical to the rear knob 18 with its datum index lug 40, shown in FIG. 1.

Thus the rear end of the datum index lug 66 has a height or radial dimension equal to the radial dimension of the auxiliary lugs 64 of the rear knob 62. When the datum lug 66 is brought into register with any particular selected auxiliary lug 64, that auxiliary lug 64 forms an aligned, continuous, smooth extension of the datum lug 66.

Assuming that the front knob 65 (as well as the rear knob 62) moves in stepwise fashion, with each step corresponding to the spacing between the scale markings 61*a*–61*e*, the datum index lug 66 will be either aligned with one of the lugs 63, 64 or else midway between two adjacent lugs. In the case in which the lug 66 is aligned with one of the lugs 63, 64 the setting of the front knob is read by sighting along the aligned lug on the rear knob to read the appropriate scale marking on the panel. This of course is the same as in the embodiment of FIG. 1. In the case in which the datum lug 66 lies midway between two lugs, as shown in FIG. 4, the setting of the front knob can be read by reading the scale marking which is midway between the two lugs in question. Thus in FIG. 4 the front knob 65 is set at scale position 61*d*. The rear knob is of course set at scale position 61*a*.

If desired, instead of merely leaving the rear knob 62 completely blank and unindexed between adjacent index lugs 63, 64, an intermediate index can be provided midway between two adjacent lugs, this intermediate index having some form other than that of a lug. These intermediate indexes may for example be in the form of straight lines engraved or traced on the knob 62.

In the embodiment of FIG. 1, the index lugs 36, 38 are regularly spaced apart around the circumference of the rear knob 16, and this knob 16 moves in steps of angular distance equal to the angular spacing of these indexes. Similarly the front knob 18 moves in steps of the same angular distance and the scale markings 20 are spaced apart by this same angular

distance. The switching apparatus **10** and the scale markings **20** are arranged so that when the rear knob **16** is in any one of its stepped positions the index lugs **36**, **38** are in register with the scale markings respectively, and so that when the front knob **18** is in any of its stepped positions its index lug **40** is aligned with one of the lugs **36**, **38** of the rear knob and hence with one or other of the scale markings **20**.

In the embodiment of FIG. **4**, the steps of the front knob **65** are still equal in angular distance to the steps of the rear knob **62** and to the angular spacing of the scale markings **61***a*–**61***e*, but in this case the index lugs **63**, **64** to the rear knob are spaced apart by a multiple of the spacing between the scale markings **61***a*–**61***e*, this multiple being two. A multiple other than two could also have been chosen, or indeed the angular spacing between the index lugs **63**, **64** could be a submultiple of the spacing between the scale markings.

The front knob **18** (FIG. **1**) or **65** (FIG. **4**) does not have to move in stepwise fashion. If it does not it is then of course necessary to interpolate between two indexes of the rear knob **16** or **62**. It is thus possible to drive a potentiometer for example by the front knob of such switching apparatus.

Furthermore, it is not absolutely essential, although it is certainly preferable, that the rear knob **16** or **62** move in stepwise fashion. However it is only possible to read the position of the front knob **18** or **65** easily when the index lugs of the rear knob **16** or **62** are aligned with the scale markings, and if the rear knob moves in stepwise fashion this alignment can be ensured in the manner described above.

I claim:

1. Electrical switching apparatus intended to be mounted on a panel bearing suitable scale markings on its front for the switching apparatus, the switching apparatus comprising:

an independently rotatable rear knob connected to rotate a tubular shaft which drives a switch contact assembly, this rear knob, when the switching apparatus is mounted on the panel, being located with its rear near to the marked front of the panel and having a length in the direction of its axis of rotation sufficient to enable it to be conveniently grasped and rotated by hand, this rear knob further having a datum index located near its rear so that this datum index will lie near the marked panel and can be brought into register with any particular scale marking, by manually rotating the knob, in order to select that scale marking, which then indicates the position of the rear knob and hence of its associated switch contact assembly;

and an independently rotatable front knob connected to rotate another shaft which is located inside the tubular shaft and which drives another switch contact assembly, the front knob being located in front of the rear knob and having a length in the direction of its axis of rotation sufficient to enable it to be conveniently grasped and rotated by hand, this front knob further having a datum index located near the rear of the front knob hence near the front of the rear knob;

the rear knob further comprising auxiliary indexes extending substantially from the front of the rear knob to substantially the rear of this rear knob, these auxiliary indexes extending sufficiently close to the front knob so that any particular auxiliary index can easily be selected by the datum index of the front knob, by rotating the front knob until its datum index comes into register with that auxiliary index, whereby, when the switching apparatus is mounted on the panel, the position of the front knob and hence of its associated switch contact assembly can be read by following the selected auxiliary index from the datum index on the front knob to the scale markings on the panel.

2. Switching apparatus according to claim **1**, wherein the rear knob together with its associated switch contact assembly rotates in regular stepwise fashion and the indexes of the rear knob are regularly spaced apart by one step or by a multiple or possibly a submultiple of a step.

3. Switching apparatus accordance to claim **2**, wherein the front knob together with its associated switch contact assembly rotates in regular stepwise fashion and the indexes on the rear knob are regularly spaced apart by one step of the front knob or by a multiple or possibly a submultiple of a step of the front knob.

4. Switching apparatus according to claim **1**, wherein the auxiliary indexes on the rear knob are in the form of radially upstanding lugs and the datum index on the front knob is also in the form of a radially upstanding lug, these lugs being positioned and dimensioned so that when the front datum lug is in register with a selected rear auxiliary lug, that auxiliary lug forms a smooth extension of the front datum lug.

5. Switching apparatus according to claim **1**, wherein the auxiliary indexes on the rear knob are in the form of radial grooves and the datum index on the front knob is in the form of a radially upstanding lug, this lug and the grooves being positioned and dimensioned so that when the front datum lug is in register with a selected groove, the bottom of the selected groove forms a smooth extension of the top of the front datum lug.

6. Switching apparatus according to claim **2** including the scale-marked panel on which it is mounted, wherein the scale markings are spaced apart by angular distances which are equal to or multiples of or possibly submultiples of the angular spacings of the indexes on the rear knob.

7. Switching apparatus according to claim **6**, wherein when the rear knob is in any of its stepped positions, at least some of the indexes of this rear knob are aligned in register with scale markings on the panel.

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