United States Patent [19]

Kimura et al.

[11] **3,756,016**

[45] **Sept. 4, 1973**

[54] **DEVICE FOR GENERATING TIME PULSES**

[75] Inventors: **Sachio Kimura, Yoshiaki Aoki,** both of Tokyo, Japan

[73] Assignee: **Kabushikikaisha Copal,** Tokyo, Japan

[22] Filed: **May 30, 1972**

[21] Appl. No.: **257,864**

[52] **U.S. Cl.** ..... **58/50 R,** 340/338

[51] **Int. Cl.** **G04b 19/30**

[58] **Field of Search** ..... 58/23 R, 50 R; 200/38 C; 340/336, 338, 309.4, 309.5, 347

[56] **References Cited**

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Primary Examiner—Richard B. Wilkinson
Assistant Examiner—Edith C. Jackmon
Attorney—Kurt Kelman and Hans Berman

[57] **ABSTRACT**

Device for generating time pulses to be supplied to a binary circuit as binary code signals to digitally indicate the time in terms of hour and minute. The device has an hour shaft rotated intermittently at intervals of an hour so that it rotates one complete revolution during 24 or 12 hours, and a minute shaft rotated by one revolution per 60 minutes. Two sets of cams are fixedly secured to the hour shaft and the minute shaft, respectively, and a switch is operatively coupled to each of the cams so as to be opened and closed as the shafts rotate. The cams are so profiled that the pulses generated by the opening and closing of the respective switches are used as binary code signals supplied to the binary circuit so as to digitally indicate the time in terms of hour and minute.

4 Claims, 8 Drawing Figures

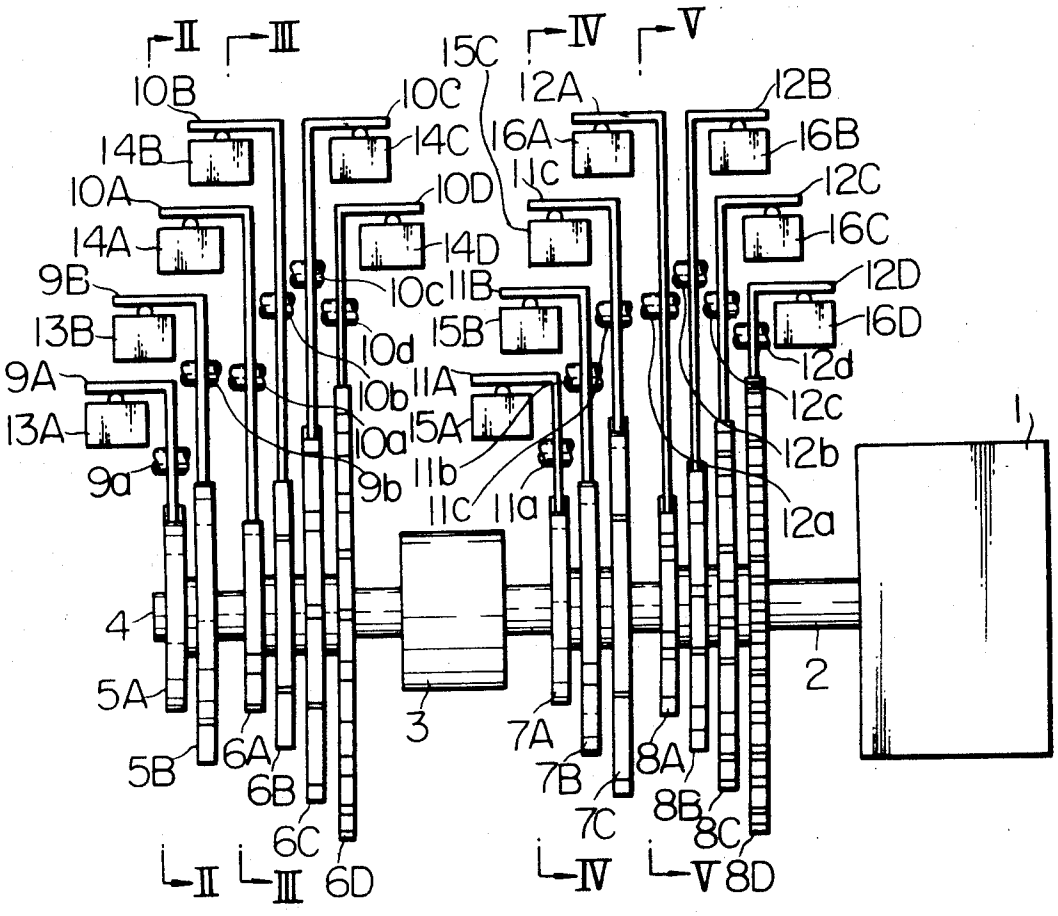


Fig. 1

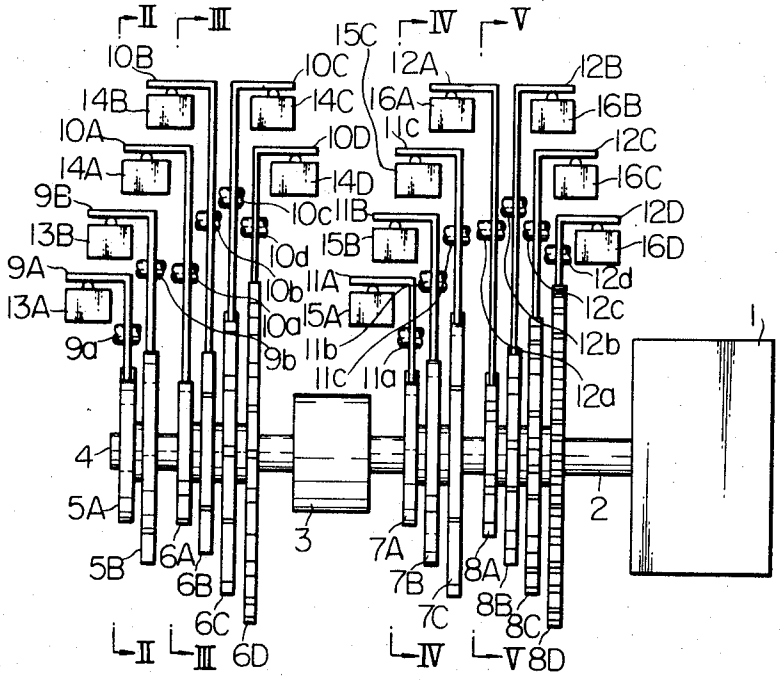


Fig. 2

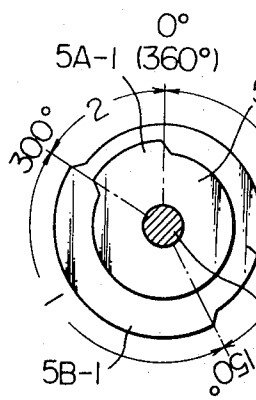


Fig. 3

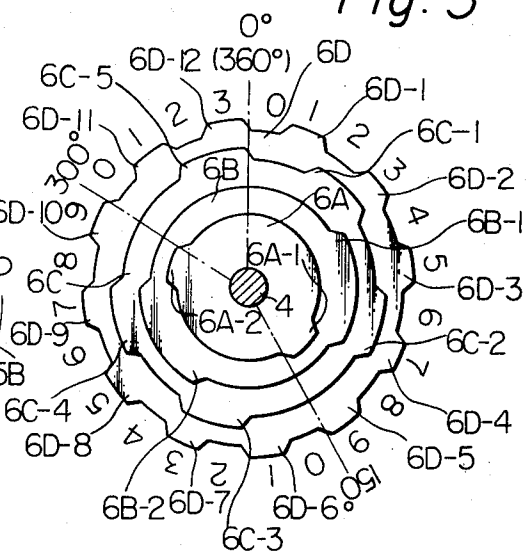


Fig. 4

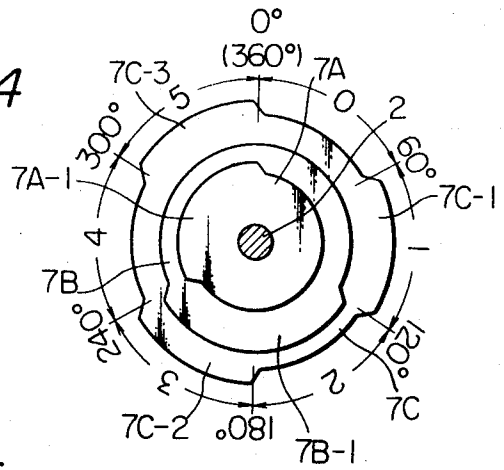


Fig. 5

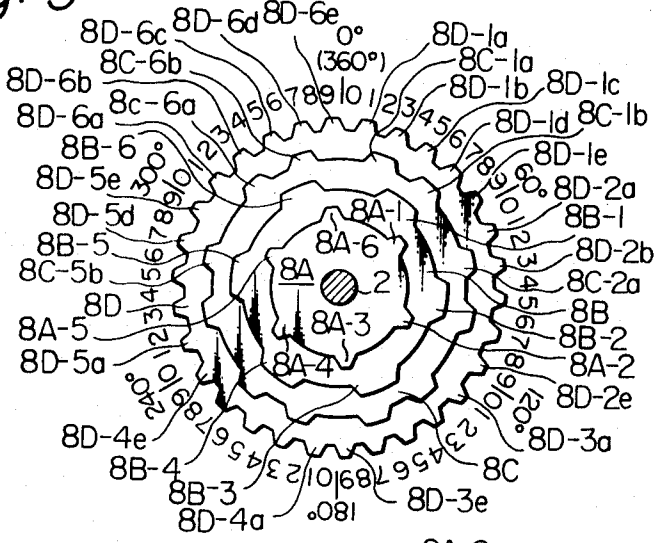


Fig. 6

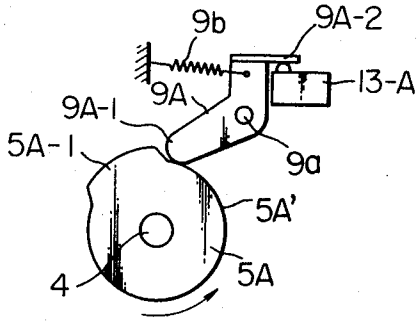


Fig. 7

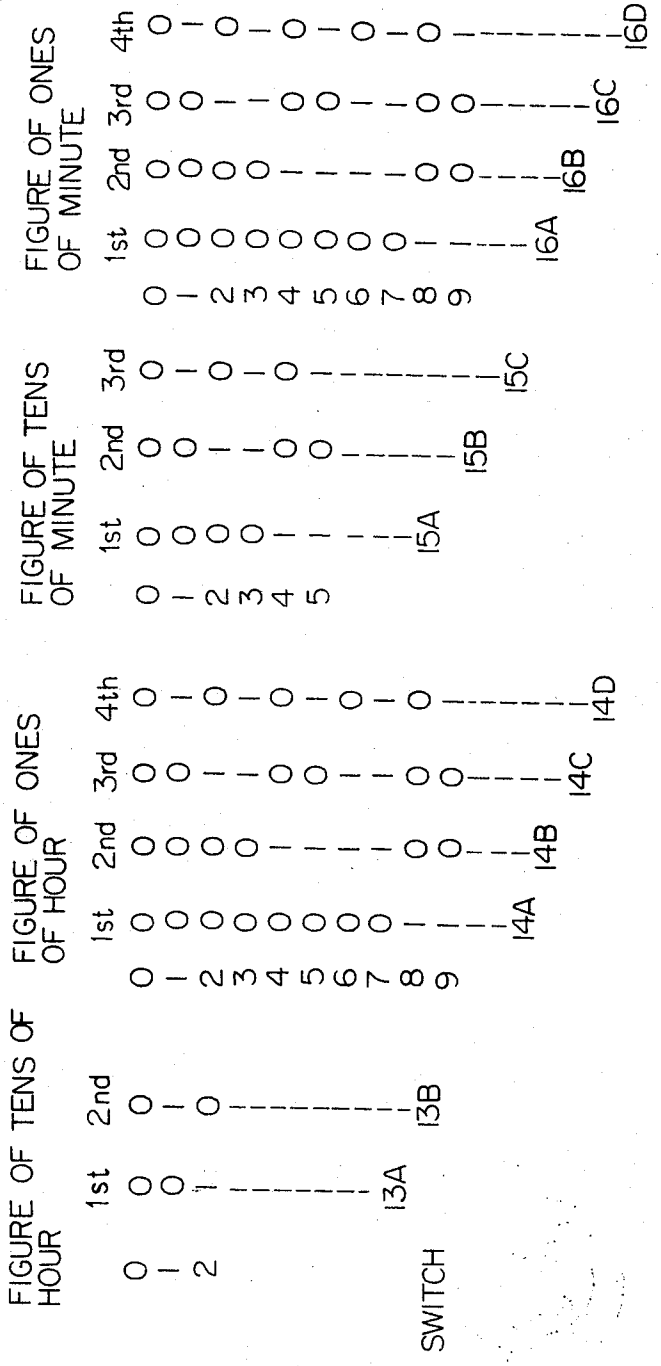
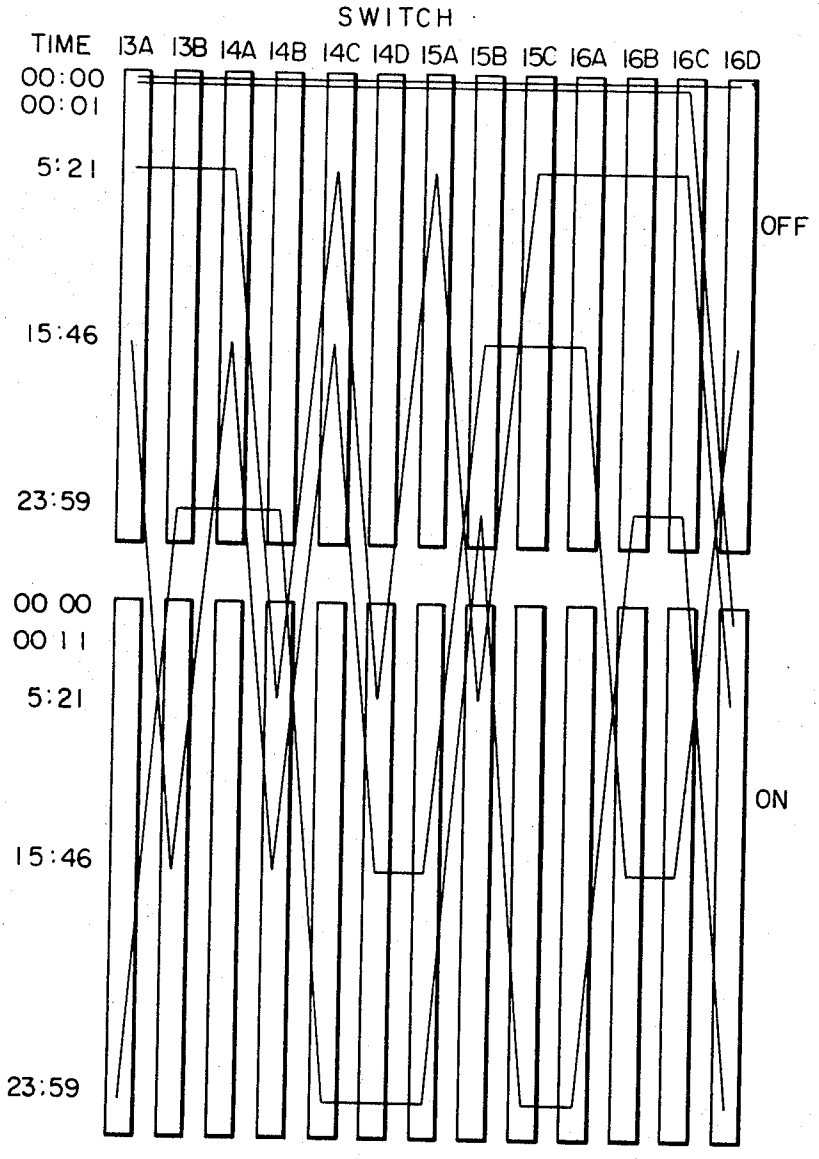


FIGURE OF TENS OF HOUR
1st
2nd
0 – 2
13A
13B
SWITCH
FIGURE OF ONES OF HOUR
1st
2nd
3rd
4th
0 – 9
14A
14B
14C
14D
FIGURE OF TENS OF MINUTE
1st
2nd
3rd
0 – 5
15A
15B
15C
FIGURE OF ONES OF MINUTE
1st
2nd
3rd
4th
0 – 9
16A
16B
16C
16D

Fig. 8


SWITCH
TIME
13A
13B
14A
14B
14C
14D
15A
15B
15C
16A
16B
16C
16D
00:00
00:01
5:21
15:46
23:59
OFF
00 00
00 11
5:21
15:46
23:59
ON

DEVICE FOR GENERATING TIME PULSES

BACKGROUND OF THE INVENTION

The present invention relates to a device for generating time pulses to be used as binary code signals supplied to a binary circuit so as to digitally indicate the time in terms of hour and minute,

Heretofore, various devices have been proposed to digitally indicate the time in terms of hour and minute. However, the prior art devices of the type described above are complicated in construction, inaccurate in operation, expensive and suffer various deficiencies.

The present invention is directed to improvements in the device for generating time pulses to be used to digitally indicate the time in terms of hour and minute.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a novel and useful device for generating time pulses to be supplied to a binary circuit as binary code signals so as to digitally indicate the time in terms of hour and minute.

The above object is achieved in accordance with the present invention by providing a device characterized by an hour shaft rotated intermittently by an angle at intervals of an hour so that it rotates by one complete revolution during the time period intended to be digitally indicated in terms of hour, i.e., 24 hours or 12 hours, a minute shaft rotated by one complete revolution per 60 minutes, a set of hour indicating cams fixedly secured to the hour shaft, a set of minute indicating cams fixedly secured to the minute shaft, a first group of switches each operatively coupled with the respective hour indicating cam so as to be closed and opened to produce time pulses used as binary code signals supplied to a binary circuit, for indicating the time in terms of hour, and a second group of switches each operatively coupled with the respective minute indicating cam so as to be closed and opened to produce time pulses used as binary code signals supplied to the binary circuit for indicating the time in terms of minute.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side view showing an embodiment of the device for generating time pulses constructed in accordance to the present invention;

FIG. 2 is a fragmentary view taken along line II — II of FIG. 1 and showing the hour indicating cams for indicating the numeral in the figure of second order, i.e., the figure of tens of hour including 0, 10 and 20;

FIG. 3 is a fragmentary view taken along line III — III of FIG. 1 and showing the hour indicating cams for indicating the numeral in the figure of first order, i.e., the figure of ones of hour including **0, 1, 2, – 9**;

FIG. 4 is a fragmentary view taken along line IV — IV of FIG. 1 and showing the minute indicating cams for indicating the numeral in the figure of second order, i.e., the figure of ones of minute including **0, 1, 2, – 5**;

FIG. 5 is a fragmentary view taken along line V — V of FIG. 1 and showing the minute indicating cams for indicating the numeral in the figure of first order, i.e., the figure of ones of minute including **0, 1, 2, – 9**;

FIG. 6 is a fragmentary view showing the arrangement of one of the hour indicating cams and the switch corresponding thereto which is operatively coupled through a swingable lever;

FIG. 7 is a table showing the relationship between the binary code signals and the numeral indicating the time in terms of hour and minute as well as the corresponding switches giving the respective binary code signals; and

FIG. 8 is a diagram showing the operation of the switches for digitally indicating the time.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the device constructed in accordance with the present invention is provided with a driving source such as an electric motor **1**, a minute shaft **2** driven by the motor **1** at a speed of one revolution per 60 minutes, an intermittent driving mechanism **3** connected to the minute shaft **2** so as to be actuated thereby, and an hour shaft **4** connected to the intermittent driving mechanism **3** so as to be driven thereby intermittently at an angle at intervals of an hour so that the shaft **24** is rotated by one revolution during 24 hours.

As shown in FIGS. **1** and **2**, cams **5A**, **5B** are fixedly secured to the hour shaft **4** which serve to indicate the numeral in the figure of second order, i.e., the figure of tens of hour including **0**, **10** and **20** as described below.

Switches **13A**, **13B** are arranged adjacent to the cams **5A**, **5B**, respectively, and swingable switch levers **9A**, **9B** pivoted by pivot shafts *9a*, *9b*, respectively, operatively couple the cams **5A**, **5B** with the respective switches **13A**, **13B** as shown in FIG. **1**. As shown in FIG. **6**, the lever **9A** is urged in the anti-clockwise direction by a spring *9b* secured at its one end to the lever **9A** and at its other end to a stationary portion in the device, and keeps the switch **13A** in opened state insofar as the recessed portion **5A'** of the cam **5A** contacts with the arm **9A-1** of the lever **9A**, but, when the raised portion **5A-1** of the cam **5A** comes to contact with the arm **9A-1** of the lever **9A** as the cam **5A** rotates in the anticlockwise direction as indicated by the arrow, the lever **9A** is rotated in the clockwise direction and the arm **9A-2** thereof abuts against the actuator of the switch **13A** so as to close the switch **13A**.

In the similar manner, the switch **13B** is closed when the raised portion **5B-1** of the cam **5B** actuates the lever **9B** as the cam **5B** rotates, while the switch **13B** is kept in opened state by a spring (not shown) urging the lever **9B** in the anticlockwise direction insofar as the recessed portion of the cam **5B** contacts with the lever **9B**.

As shown in FIGS. **2** and FIG. **7**, the contour of the cam **5A** is so determined that the switch **13A** is kept opened correspondingly to the indication of the numeral **0** and **1** in the figure of tens of hour so that the binary code signal in the first row in the figure of tens of hour is set to **0**, while the switch **13A** is closed correspondingly to the indication of the numeral **2** in the figure of tens of hour so that the binary code signal in the first row is set to **1**. To this end, the cam **5A** is formed with the raised portion **5A-1** in the range between 300° and 360° corresponding to four twenty-fourths of one revolution of the cam **5A** at the end of one complete revolution, assuming that the arm **9A-1** of the lever **9A** is located at the top 0° of the cam **5A** in FIG. **2** and the cam **5A** is rotated in the anticlockwise direction.

In the similar manner, the contour of the cam **5B** is so determined that the switch **13B** is kept opened correpondingly to the indication of the numeral **0, 2** in the

figure of tens of hour so that the binary code signal in the second row in the figure of tens of hour is set to 0, while the switch 13B is closed correspondingly to the indication of the numeral 1 in the figure of tens of hour, so that the binary code signal in the second row is set to 1. To this end, the cam 5B is formed with the raised portion 5B-1 in the range between 150° and 300° corresponding to ten twenty-fourths of one revolution of the cam 5B at the intermediate portion of one complete revolution thereof.

In the similar manner, cams 6A, 6B, 6C and 6D are fixedly secured to the hour shaft 4 as shown in FIGS. 1 and 3 and operatively coupled with switches 14A, 14B, 14C and 14D through swingable levers 10A, 10B, 10C and 10D, respectively. These cams 6A, 6B, 6C and 6D serve to select the numeral to be indicated in the figure of first order, i.e., the figure of ones of hour including 0, 1, 2, – 9.

As shown in FIG. 3, the cam 6A is formed with two raised portions 6A-1, 6A-2 in the ranges between 120° and 150° and between 270° and 300° so that the switch 14A is kept opened correspondingly to the numerals 0 to 7 to be indicated in the figure of ones of hour so as to set the binary code signal in the first row in the figure of ones of hour in FIG. 7 to 0, while the switch 14A is closed correspondingly to the numerals 8, 9 in the figure of ones of hour so that the binary code signal in the first row is set to 1.

The cam 6B is formed with two raised portions 6B-1, 6B-2 in the ranges between 60° and 120° and between 210° and 270° so that the switch 14B is kept opened correspondingly to the numerals 0 to 3 and 8, 9 to be indicated in the figure of ones of hour so as to set the binary code signal in the second row in the figure of ones of hour in FIG. 7 to 0, while the switch 14B is closed correspondingly to the numerals 4 to 7 to be indicated in the figure of ones of hour so as to set the binary code signal in the second row in the figure of ones of hour in FIG. 7 to 1.

In the similar manner, the cam 6C is formed with five raised portions 6C-1, 6C-2, 6C-3, 6C-4 and 6C-5 in the range between 30° – 60°, 90° – 120°, 180° – 210°, 240° – 270° and 330° – 360°, so that the switch 14C is kept opened correspondingly to the numerals 0, 1, 4, 5, 8 and 9 to be indicated in the figure of ones of hour so as to set the binary code signal in the third row in FIG. 7 to 0, while the switch 14c is closed correspondingly to the numerals 2, 3, 6 and 7 to be indicated in the figure of ones of hour in FIG. 7 so as to set the binary code signal in the third row to 1.

In like manner, the cam 6D is formed with twelve raised portions 6D-1, 6D-2, – 6D-12, each in the range of 15° at intervals of 15° from each other, so that the switch 14D is kept opened correspondingly to the numerals 0, 2, 4, 6 and 8 to be indicated in the figure of ones of hour in FIG. 7 so as to set the binary code signal in the fourth row in the figure of ones of hour to 0, while the switch 14D is closed correspondingly to the numerals 1, 3, 5, 7 and 9 to be indicated in the figure of ones of hour so as to set the binary code signal in the fourth row to 1.

In the similar manner, cams 7A, 7B and 7C and cams 8A, 8B, 8C and 8D are fixedly secured to the minute setting shaft 2 as shown in FIGS. 1, 4 and 5.

The cams 7A, 7B and 7C are operatively coupled with switches 15A, 15B and 15C through swingable levers 11A, 11B and 11C in like manner as in the case of the cams 5A, 5B and serve to determine the numeral selected from 0, 1, 2, – 5 to be indicated in the figure of second order, i.e., the figure of tens of minute including 0, 10, 20 – 50 as shown in FIG. 7.

The cam 7A is formed with a raised portion 7A-1 in the range between 240° and 360° as shown in FIG. 4 so that the switch 15A is kept opened correspondingly to the numerals 0 to 3 to be indicated in the figure of tens of minute in FIG. 7 so as to set the binary code signal in the first row to 0, while the switch 15A is closed correspondingly to the numerals 4 and 5 to be indicated in the figure of tens of minute so as to set the binary code signal in the first row to 1.

In the similar manner, the cam 7B is formed with a raised portion 7B-1 in the range between 120° and 240° so that the switch 15B is kept opened correspondingly to the numerals 0, 1 and 4, 5 to be indicated in the figure of tens of minute so as to set the binary code signal in the second row in the figure of tens of minute to 0, while the switch 15B is closed correspondingly to the numerals 2, 3 to be indicated in the figure of tens of minute so as to set the binary code signal in the second row to 1.

The cam 7C is formed with three raised portions 7C-1, 7C-2 and 7C-3 each having the range of 60° at intervals of 60° from each other beginning at 60° from the top 0° of the cam 7C so that the switch 15C is kept opened corresondingly to the numeral 0, 2 and 4 to be indicated in the figure of tens of minute so as to set the binary code signal in the third row to 0, while the switch 15C is closed correspondingly to the numerals 1, 3 and 5 so as to set the binary code signal in the third row to 1.

In the similar manner, the cams 8A, 8B, 8C and 8D are formed with raised portions as shown in FIG. 5 so that the corresponding switches 16A, 16B, 16C and 16D are actuated so as to set the binary code signals as shown in the figure of the first order, i.e., the figure of ones of minute including 0, 1, 2, – 9 in FIG. 7. The cam 8A has six raised portions 8A-1, – 8A-6 each having the range of 12° and arranged at intervals of 48° from each other beginning at 48° from the top 0° of the cam 8A. Thus, the switch 16A is actuated by the cam 8A so as to be opened correspondingly to the numerals 0 to 7 to be indicated in the figure of ones of minute so that the binary code signal in the first row is set to 0, while the binary code signal in the first row is set to 1 correspondingly to the numerals 8, 9 to be indicated in the figure of ones of minute. The cam 8B has six raised portions 8B-1, – 8B-6 each having the range of 24° and arranged at intervals of 36° from each other beginning at 24° from the top 0° of the cam 8B. Thus, the switch 16B is actuated so as to be opened correspondingly to the numerals 0 to 3, 8 and 9 to be indicated in the figure of ones of minute in FIG. 7 so that the binary code signal in the second row is set to 0, while the binary code signal in the second row is set to 1 correspondingly to the numerals 4 to 7 to be indicated in the figure of ones of minute.

The cam 8C has twelve raised portions 8C-1*a*, 8C-1*b*, 8C-2*a*, 8C-2*b*, – 8C-6*a*, 8C-6*b*, in the ranges of 12° – 24°, 36° – 48°, 72° – 84°, 96° – 108°, 132° – 144°, 156° – 168°, 192° – 204°, 216° – 228°, 252° – 264°, 276° – 288°, 312° – 324°, and 336° – 348° from the top 0° of the cam 8C as shown in FIG. 5 so that the switch 16C is opened correspondingly to the numerals 0, 1, 4, 5, 8 and 9 to be indicated in the figure of ones of minute in

FIG. 7 so as to set the binary code signal in the third row to 0, while the switch 16C is closed correspondingly to the numerals 2, 3, 6 and 7 to be indicated in the figure of ones of minute so that the binary code signal in the third row is set to 1.

The cam 8D has 30 raised portions 8D-1*a*, – 8D-1*e*, 8D-2*a* – 8D-2*e*, – 8D-6*a* – 8D-6*e* each having the range of 6° and arranged at intervals of 6° from each other beginning at 6° from the top 0° of the cam 8D so that the switch 16D is opened correspondingly to the numerals 0, 2, 4, 6 and 8 to be indicated in the figure of ones of minute in FIG. 7 so as to set the binary code signal in the fourth row to 0, while the binary code signal in the fourth row is set to 1 correspondingly to the numerals 1, 3, 5, 7 and 9 to be indicated in the figure of ones of minute.

As described above, since the hour shaft 4 is rotated intermittently so as to complete one revolution during 24 hours and the minute shaft 2 is rotated by the revolution per 60 minutes, the pulses generated by the opening and closing of the respective switches 13A, 13B – 16C, 16D as effected by the respective cams are used as binary code signals as shown in FIG. 7 which are supplied to the binary circuit so that the time in the range of 24 hours is indicated digitally by the binary codes 00 – 10 determining the numeral in the figure of the second order of hour, the binary codes 0000 to 1001 determining the numeral in the figure of the first order of hour, the binary codes 000 – 101 determining the numeral in the figure of the second order of minute and the binary codes 0000 – 1001 determining the numeral in the figure of the first order of minute.

The operation of the respective switches 13A, – 16D for digitally indicating the time in terms of hour and minute is shown in FIG. 8. Thus, all the switches are opened at the time of 00:00, i.e., zero hour and zero minute, while only the switch 16D is closed at the time of 00:01. At the time of 5:21, the switches 13A, 13B, 14A, 14C, 15A, 15C and 16A – 16C are opened, while switches 14B, 14D, 15B and 16D are closed.

In like manner, the time 15:46 is digitally indicated when the switches 13A, 14A, 14C, 15B, 15C, 16A and 16D are opened while the switches 13B, 14B, 14D, 15A, 16B and 16C are closed.

When the switches 13A, 14C, 14D, 15A, 15C, 16A and 16D are closed and the remaining switches are opened, the time 23:59 is digitally indicated.

In FIG. 1, the cams 5A, – 8D are shown as having different dimensions from each other. However, they may be the same dimensions with each other according to the design. Further, the angular position each of the cams may be varied insofar as the cooperating lever is angularly shifted so as to maintain the same relative angular position with respect to the raised position cooperating therewith.

In the above described embodiment, the time is indicated in the range of 24 hours. However, the present invention also applies to the digital indication of the time in the range of 12 hours. In this case, the cam 5B is dispensed with and the cams for setting the numeral to be indicated in the figure of the first order of hour are modified so that only the portion in the range between 0° and 180° of the contour each of the cams illustrated is extended over the entire periphery each of the cams, while the hour shaft is rotated by one revolution during 12 hours.

The digital indication of 00:00 may be modified to be 24:00 or 12:00 by appropriately modifying the contours of the cams setting the numeral to be indicated in the figure of the second order of hour and the cams setting the numeral to be indicated in the figure of the first order of hour.

As described above, desired time pulses are easily obtained by the simple combination of the cams with the switches in accordance with the present invention so that the time pulses when generated in a master clock, can be utilized to drive slave clocks. Further the time pulses can be utilized in the operation of time division in an electronic computer or in the automatic control of various electric devices at a predetermined schedule.

We claim:

1. Apparatus for generating binary-encoded time signals, which comprises:

a motor, connectable to an external source of power for energizing same;

a first shaft, operably connected to, and driven by, said motor, said first shaft being rotated through 360° once every hour;

intermittent drive means connected to said first shaft;

a second shaft, operably connected to, and driven by, said intermittent drive means, said second shaft being intermittently rotated through 360° once every 24 hours;

a first and a second group of cams fastened to, and rotated by, said first shaft;

a first and second group of cam-followers respectively associated with said first and second groups of cams;

a first and second group of normally-open switches respectively associated with, and actuated by, said first and second group of cam-followers, said first group of switches generating binary-encoded signals representative of the units digit of the minute portion of said time signals and said second group of switches generating binary-encoded signals representative of the tens digit of the minute portion of said time signals;

a third and fourth group of cams fastened to, and rotated by, said second shaft;

a third and fourth group of cam-followers respectively associated with said third and fourth groups of cams; and

a third and fourth group of normally-open switches respectively associated with, and actuated by, said third and fourth group of cam-followers, said third group of switches generating binary-encoded signals representative of the units digit of the hour portion of said time signals and said fourth group of switches generating binary-coded signals representative of the tens digit of the hour portion of said time signals.

2. The apparatus according to claim 1, wherein said first group of cams comprises four cams, each of said four cams generating one binary digit of the four binary digits required to represent the decimal digits 0 – 9 (0000– 1001);

said second group of cams comprises three cams, each of said three cams generating one binary digit of the three binary digits required to represent the decimal digits 0 – 5 (000 – 101) ;

said third group of cams comprises four cams, each of said four cams generating one binary digit of the

four binary digits required to represent the decimal digits **0 – 9 (0000 – 1001)**;

said fourth group of cams comprises two cams, each of said two cams generating one binary digit of the two binary digits required to represent the decimal digits **0 – 2 (00 – 10)**.

3. The apparatus according to claim **2**, wherein the cams of said first through fourth groups of cams have raised portions according to the following table:

Group	Cam	Raised Portion Dwell	Raised Portion Spacing	Beginning
First	One	6×12°	48°	48° from top 0°
First	Two	6×24°	36°	24° from top 0°
First	Three	12×12°	12°&24°	12° from top 0°
First	Four	30×6°	6°	6° from top 0°
Second	One	1×120°	—	240° from top 0°
Second	Two	1×120°	—	120° from top 0°
Second	Three	3×60°	60°	60° from top 0°
Third	One	2×30°	120°	120° from top 0°
Third	Two	2×60°	90°	60° from top 0°
Third	Three	5×30°	30°&60°	30° from top 0°
Third	Four	12×15°	15°	15° from top 0°
Fourth	One	1×60°	—	300° from top 0°
Fourth	Two	1×150°	—	150° from top 0°

4. The apparatus according to claim **2**, wherein, to generate digital signals representative of a 12 hour clock, said second shaft is rotated through 360° once every 12 hours, and said fourth group of cams comprises a single cam having a raised portion extending over 180°, starting 180° from the 0° top position.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,756,016 Dated September 4, 1973

Inventor(s) SACHIO KIMURA ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, after line /21/ insert --

/30/ Foreign Application Priority Data

June 8, 1971 Japan 40328/71

Signed and sealed this 18th day of December 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

ORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

UNITED STATES PATENT OFFICE

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RENE D. TEGTMEYER
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FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
☆ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.