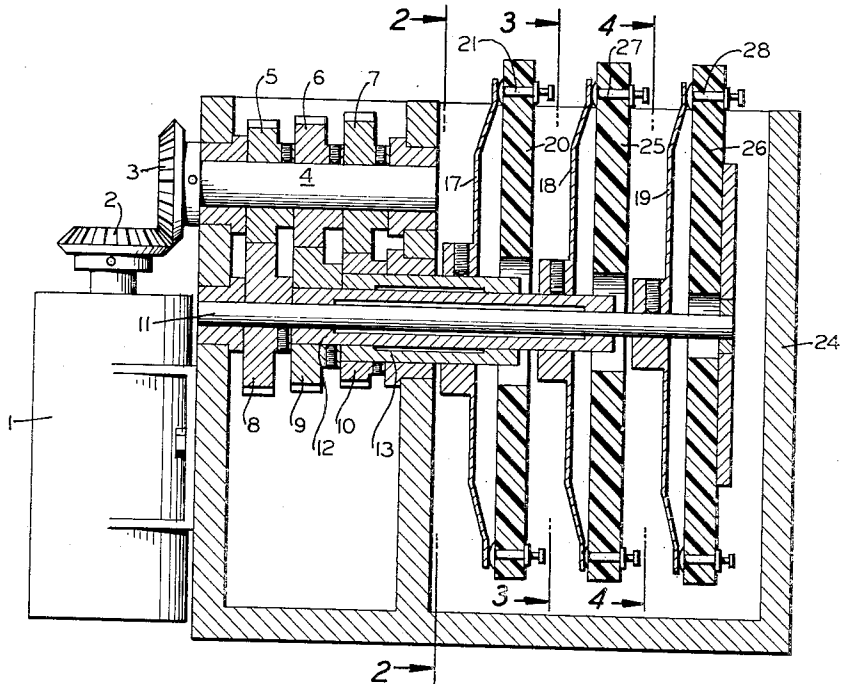
April 4, 1961 J. C. RUSSELL 2,978,552

TIMER

Filed June 10, 1958 3 Sheets-Sheet 1

FIG_1



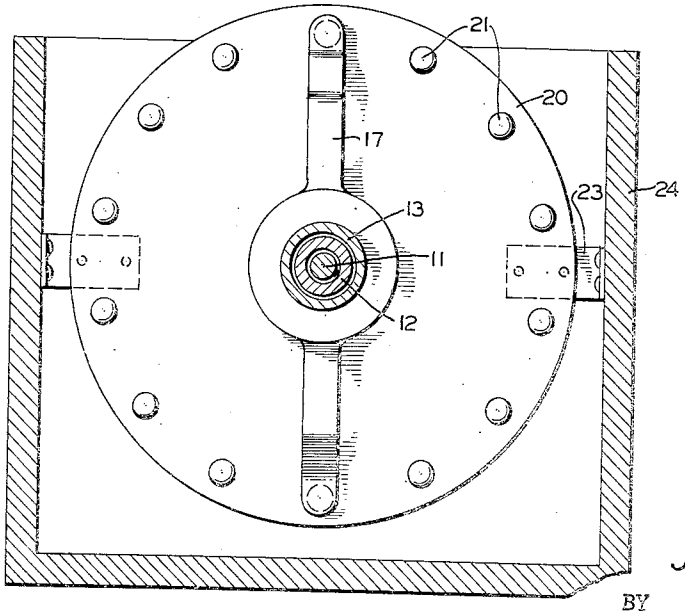


FIG_2

INVENTOR.
JAMES C. RUSSELL

BY

Boyken, Mollin & Wood
ATTORNEYS

April 4, 1961 J. C. RUSSELL 2,978,552

TIMER

Filed June 10, 1958 3 Sheets-Sheet 2

FIG_3

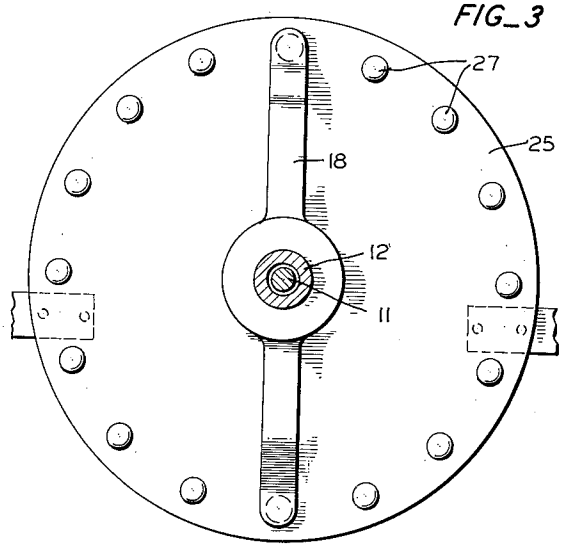


FIG_4

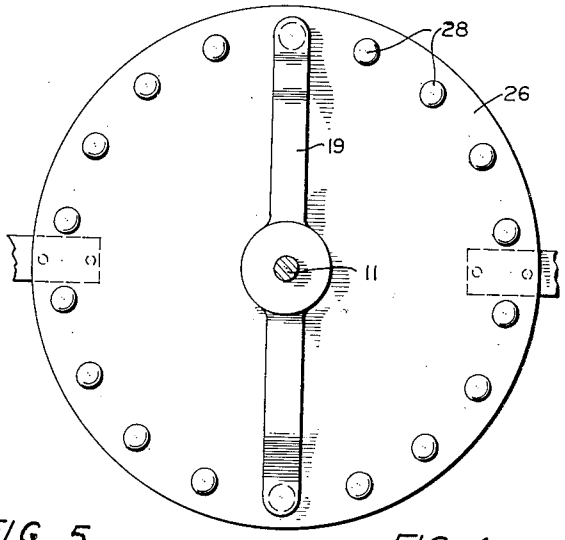


FIG_10_

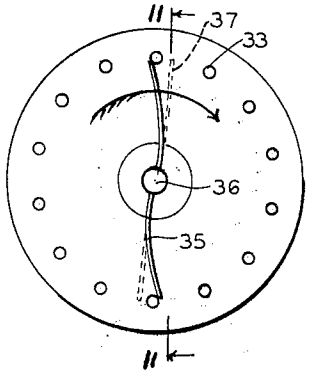


FIG_11_

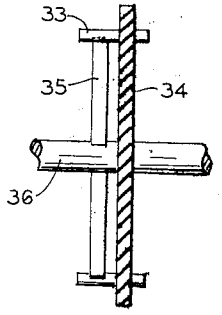


FIG_5

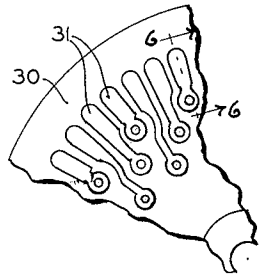
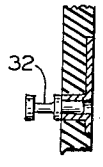


FIG_6



INVENTOR.
JAMES C. RUSSELL

BY

Boyken, Mohler & Wood

ATTORNEYS

April 4, 1961 J. C. RUSSELL 2,978,552

TIMER

Filed June 10, 1958 3 Sheets-Sheet 3

FIG_7_

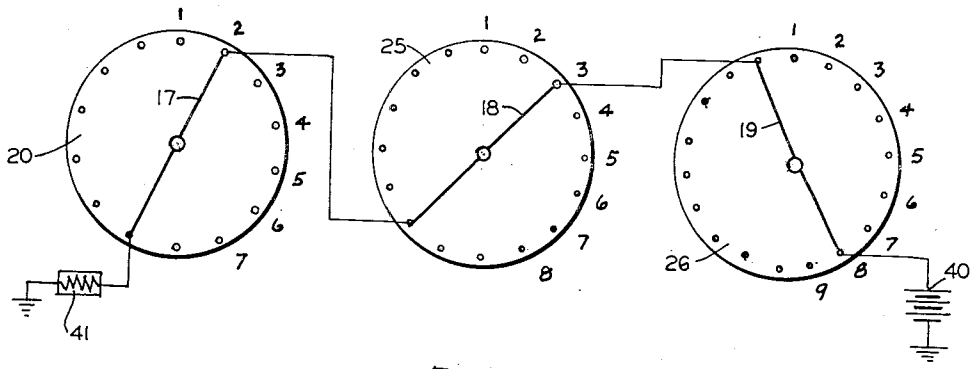


FIG_8_

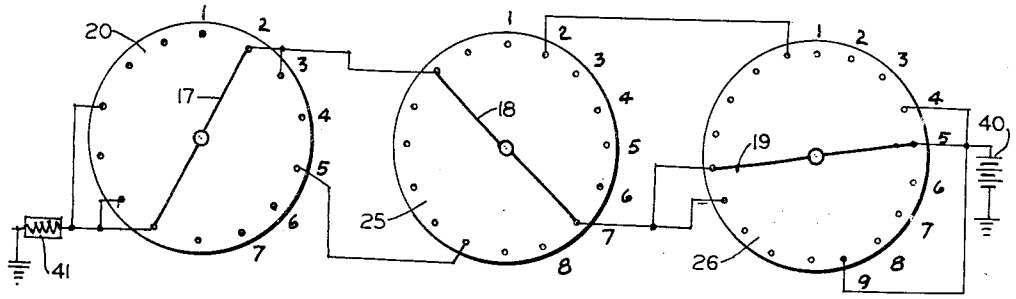
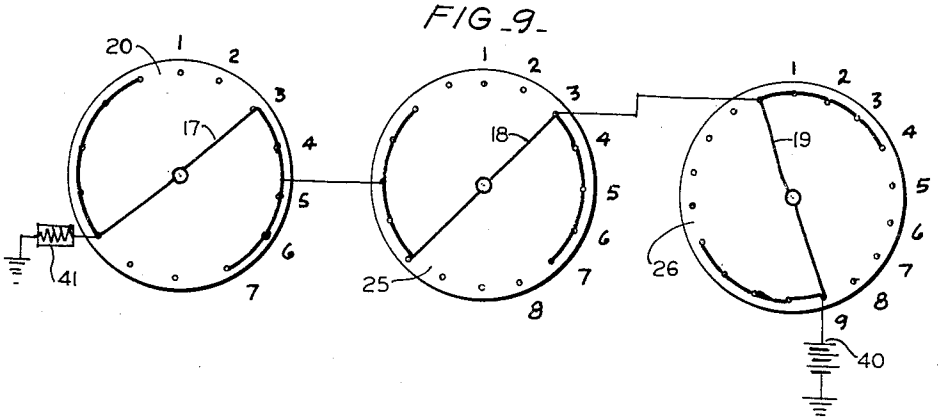


FIG_9_



INVENTOR.
JAMES C. RUSSELL
BY
Boylan Mobley & Wood
ATTORNEYS

United States Patent Office

2,978,552

Patented Apr. 4, 1961

2,978,552

TIMER

James C. Russell, 3616 San Jose Lane, Santa Barbara, Calif.; Helen T. Russell, administratrix of said James C. Russell, deceased

Filed June 10, 1958, Ser. No. 741,137

5 Claims. (Cl. 200—33)

This invention relates to a timer, and has for one of its objects the provision of a compact, reliable, economically made power-driven timer in an electrical circuit that is adapted to provide a substantially greater number of switching operations than has heretofore been possible in a timer of the same size.

Another object of the invention is the provision of a timer that is adapted for switching a large number of different circuits each cycle of the timer, such as D.C., 60 cycles, 400 cycles, square waves, etc., without interfering with each other, and in which the current carrying capacity is limited only by the design of the contacts.

A still further object of the invention is the provision of a timer of a character that is adapted to be quickly and easily modified to produce practically any arbitrary function required of a timer.

Other objects and advantages will appear on the description and in the drawings.

In the drawings, Fig. 1 is a vertical sectional view through a simple timer to illustrate suitable structure.

Fig. 2 is a sectional view as seen from line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken along line 4—4 of Fig. 1.

Fig. 5 is an enlarged, fragmentary view of a portion of a disc that may be used, illustrating structure and arrangement preferable for use in a timer.

Fig. 6 is an enlarged sectional view along line 6—6 of Fig. 5.

Figs. 7, 8 and 9 show, schematically, several different wiring arrangements for accomplishing different results.

Fig. 10 is a modified form of the switch disc and switch structure for producing a fast snap action.

Fig. 11 is a sectional view at line 11—11 of Fig. 10.

In detail, Figs. 1 and 2 illustrate a very simplified form of the invention, in which a motor 1 or power source is connected by bevel gears 2 and 3 with a shaft 4. Thus shaft 4 is supported for rotation in suitable bearings, and has coaxial gears 5, 6 and 7 secured thereto by set screws, or by any other suitable means.

Gears 5, 6 and 7 have their teeth in mesh with the teeth of gears 8, 9 and 10 respectively, the latter being respectively secured on coaxial shafts 11, 12, 13.

Shaft 11, in the illustration, is the central shaft, and shafts 12, 13 are rotable about the same axis as shaft 11, said shaft 12 being rotatably supported on shaft 11, and shaft 13 being rotatably supported on shaft 12.

The gearing illustrated is designed to provide different gear ratios on the same center distance between the axis of gears 5, 6 and 7 and the axis of gears 8, 9, 10.

Secured on shaft 13 is a switch member 17 rotatable with shaft 13. A corresponding switch member 18 is secured on shaft 12, and switch member 19 is secured on shaft 11. For purpose of illustration each of these switch members comprises a pair of oppositely outwardly extending conductor arms extending radially of the axis of rotation of the shaft to which each is secured.

Adjacent to switch member 17 is a stationary disc 20 (Figs. 1, 2) having an annular row of contracts 21 thereon, said row being coaxial with the shaft 13, and the contacts 21 are in pairs positioned diametrically opposite to each other around the disc. Brackets 23 (Fig. 2) may stationarily support disc 20 within a supporting housing 24 (Fig. 1) that also carries the bearings for shafts 4 and 11, and to which housing motor 1 may be secured.

Discs 25, 26 (Figs. 1, 4) are coaxial with the axes of rotation of switch members 18, 19 and are respectively adjacent thereto, being also stationary relative to said switch member, and so held by brackets in the same manner as disc 20. Switch 25 carries an annular row of contacts 27, and switch 26 carries an annular row of contacts 28.

The contacts 27 are in pairs that are diametrically opposite to each other and contacts 28 are also in pairs diametrically opposite to each other.

A feature of the present invention is that each of the discs has a different number of pairs of contacts thereon. Each diametrically opposite pair constitutes a single switching position, i.e., each opposite pair is simultaneously engaged in succession by the switch member adjacent thereto upon the latter making a revolution relative to the disc. In the example shown, there are seven switches on disc 20, or seven pairs of contacts that are adapted to be successively closed by connecting them through switch member 17 when the latter is revolved, and disc 25 has eight switches or eight pairs of contacts, while disc 26 has nine switches or nine pairs of contacts.

The gearing 4–10, herein employed by way of illustration, has already been generally described. This gearing is designed to provide different gear ratios on the same center distance, and this result is preferably accomplished by varying the helix angle of the gear teeth. The basic formula is: pitch diameter × diametrical pitch × cosine of helix angle equals number of teeth. Therefore by selecting the most convenient standard diametral pitch and the number of teeth in each mating pair of gears to obtain the proper ratios the pitch diameters can be adjusted by varying the helix angle so that all pairs of gears will have the same center distance.

Following this formula, with constant speed of shaft 4, the gears 5, 8 may rotate switch member 17 at a rate in which the seven different switching operations will occur each seven seconds, or in which the switch element traverses the distance between each adjacent pair of opposite contacts in one second, it being understood, of course, that the contacts in each row on each disc are equally spaced apart, although the spacing is different on the different discs.

The switch member 18 will rotate at a rate in which the eight different switching operations will successively occur each eight seconds, and switch member 19 will rotate at a rate in which the nine different switching operations will occur each nine seconds.

The foregoing is purely by way of example, and in order to simplify the explanation, since it is obvious that the switches may be rotated much faster or slower, and it is equally obvious that many more contacts may be used. Fig. 5, for example, illustrates a segment of a disc 30 of any suitable electrical insulation material in which a large number of contacts are shown and in which the contacts 31 have their switch engaging surfaces complanar with the material of the disc (Fig. 6) and in an annular row, with the terminals 32 adapted to be connected with the wires of the circuit or circuits.

Also, in the modified form of the invention as seen in Figs. 10, 11, the contacts 33 are in the form of cylindrical pins carried by the disc 34 of electrical insulating material.

The switch arms **35** are of flat spring material secured at one of their ends to the rotatable shaft **36**.

The outer ends of switch arms **36** will engage the pairs of opposite pins **33** for yieldable movement past the pins, and as soon as the pins release the arms the latter will quickly snap to the dotted line positions **37** (Fig. 10) preparatory to engaging the next pair of pins.

This modified structure is particularly useful when electrical loads, primarily inductive, are such that arcs may be formed. By the snap action, the likelihood of damage due to sustained arcs is avoided.

Generally a circuit (Fig. 7) incorporating this invention comprises a power source **40**, a load **41** through which it is desired to send a series of time-spaced signals from source **40** and the three switches **17**, **18** and **19**. The switches act as breakers in the circuit and are connected in series so that all must be "closed" at the same time to complete the circuit to send the desired signal.

The switches are "closed" with relation to any opposed pair of contacts on discs **20**, **25** and **26** when the switch arms **17**, **18** and **19**, respectively, extend across and connect said contacts, and the interconnection of contacts between switches determines the time interval, from an initial position, at which the signal is sent.

It can be shown that there is only one unique position of the several switch arms in relation to their contacts for each time interval desired, as long as there are no common factors among the number of switching positions of the several switches.

If N is the total number of pairs of opposed contacts connectable by a switching arm and the traverse between adjacent contacts is represented as a unit of time *t*, then the complete traverse of all switching positions or cycle at one switch will be N*t*. In the circular switches shown, one-half revolution of the switching arm will be a cycle accomplished in N*t* or a total time, T.

The number of switching functions or circuits closed by each switch is N; and one circuit is closed each *t* while the others remain open. The addition to the circuit of a second switch having a total number of switching functions, N′, each accomplished in *t*, creates a total combined number of switching functions which is the product of the two, e.g., NN′. The total time of a complete cycle, that is, for the switching arms to return to an initial position together, is NN′*t* or TT′.

The interval of time X between the initial position and the delivery of a signal is equal to the whole number of cycles traversed by one switching arm plus some remainder R. In other words, $X=AN+R$, where A is an integer. Hence, the position of the switching arm is R number of contacts beyond the intial position at signal delivery.

In the example disclosed, each of the three switches **17**, **18** and **19** is provided with a different number of pairs of contacts, seven, eight, and nine, respectively. Hence, $N=7$, $N'=8$, $N''=9$. Each switch arm traverses the distance between contacts in one second; hence, each switch makes one-half revolution or cycle in $Nt=7$ sec., $N't=8$ sec., and $N''t=9$ sec., respectively.

The total number of switching functions which this particular combination can handle, at the rate of one function each second, is $NN'N''=7\times8\times9=504$. Likewise, the total cycle time is 504 sec. That is, after 504 sec. all of the switch arms will again be in their initial positions.

Assuming that the initial position of the switch arms is vertical in Fig. 7, the position of each of the arms after the passage of the desired interval X is found by the formula $X=AN+R$. Assuming $X=107$ sec., for switch **17**, $107=15(7)+2$. Hence, the pairs of contacts numbered 2 will be closed after 107 sec. from the initial position. For switch **18**, $107=8(13)+3$, or the third pair of contacts are closed; and for switch **19**, $107=11(9)+8$, or the eighth pair of contacts are closed.

By wiring the three switches in series, as shown in Fig. 7, through each of the pair of contacts numbered 2, 3 and 8, respectively, a signal will be delivered by battery **40** to load **41** after 107 sec. from the initiation of the cycle With this partciular connection no other signal will be delivered during the 504 sec. cycle because the switch arms are in the above positions at only one time, the 107 sec. interval, during the complete cycle.

This unique position holds true for all intervals as long as there are no common factors between the number of switching functions of the various switches, that is, N of each switch is neither equal to, a multiple of, nor has a common factor with the N of any other switch.

In Fig. 8 the same three switches are illustrated in which repeating signals at 23 sec., 31 sec., and 306 sec. after initiation are delivered. The timing of the signal pulses are calculated in the same manner, that is, by dividing the desired time interval by the number of seconds in a cycle and using the remainder for the position of the contact to be connected in the circuit. For example, in switch **17**:

$$\frac{23}{7}=3$$

with a remainder of 2; so the number 2 contact is connected in series with the load. In switch **18**:

$$\frac{23}{8}=2$$

with a remainder of 7; so the number 7 contact is connected; and so forth.

Fig. 9 illustrates how the same switches may be used for delivering a signal of extended duration, for example, continuously from 171 sec. to 175 sec. from initiation, by connecting several contacts in parallel. One drawback to using the switch in this manner is that signals will also be delivered at other intervals with so many contacts wired together.

A preferable method for delivering an extended pulse would be to connect a holding relay in the circuit to be energized upon the switches reaching one set of contacts and released upon reaching a later set of contacts. For example (Fig. 9) in switch **17**, since the remainder on dividing 171 by 7 is 3, in switch **18** the remainder is 3, and in switch **19** the remainder is zero or 9, these pairs of contacts are wired in series to activate the relay. At 175 seconds the remainders are zero or 7 for switch **17**, 7 for switch **18**, and 4 for switch **19**. These pairs of contacts would be wired in series through the relay to release it.

Many other combinations of switch positions to provide a variety of unique signals are available even from the simplified structure shown. Other physical designs of the switches may also be employed to accomplish the results of this invention. It is to be understood, therefore, that the specific illustrations given are not intended to restrict the invention within the spirit and scope of the appended claims and equivalents.

I claim:

1. A timer comprising: a plurality of separate sets of contacts adapted to be connected in an electrical circuit, the contacts in each set being arranged in pairs of spaced contacts adapted to be successively connected by a conductor switch member, a conductor switch member for each set of contacts, means supporting each set of contacts and the said switch member therefor for relative movement to successively connect the said pairs of contacts in each set at uniformly spaced intervals in each set, each of said sets of contacts having a different number of pairs of contacts from the other of said sets, means for causing said relative movement between said sets and the switch member therefor at different uniform rates of movement for the different sets whereby pulses of various intervals may be obtained in a circuit according to the electrical connections between the sets of contacts, and means for connecting the sets of contacts in an electrical circuit.

2. A timer comprising: a plurality of coaxial, spaced, circular discs, an annular row of electrical contacts supplied on each disc concentric therewith and electrically insulated from each other, means stationary supporting said discs, said contacts on each disc being in pairs diametrically opposite to each other and equally spaced around the disc and equally spaced from the axis of each disc, the number of pairs of contacts on each disc being different, a conductor switch member adjacent to each disc adapted to connect each pair of contacts successively upon rotation of the switch member about the axis of each disc, means supporting each switch member of said rotation thereof and for successively connecting the pairs of contacts on the disc adjacent thereto, means for simultaneously rotating said switch members at different rates of speed, means for connecting certain of the contacts of said discs together and in an electrical circuit for producing pulses in said circuit at different intervals according to the contacts that are so connected.

3. A timer comprising: a plurality of coaxial, spaced, circular discs, an annular row of electrical contacts supplied on each disc concentric therewith and electrically insulated from each other, means stationary supporting said discs, said contacts on each disc being in pairs diametrically opposite to each other and equally spaced around the disc and equally spaced from the axis of each disc, the number of pairs of contacts on each disc being different, a conductor switch member adjacent to each disc adapted to connect each pair of contacts successively upon rotation of the switch member about the axis of each disc, means supporting each switch member for said rotation thereof and for successively connecting the pairs of contacts on the disc adjacent thereto, means for simultaneously rotating said switch members at different rates of speed and means for connecting certain of the contacts of said discs together and in an electrical circuit for producing pulses in said circuit at different intervals according to the contacts that are so connected, said means for supporting each switch member for rotation including a plurality of coaxial shafts disposed one within the other, the means for rotating said switch members means for rotating said switch members, said last mentioned means including a helical gear on each of said coaxial shafts, a second shaft parallel with the axis of said coaxial shafts supporting helical gears having their teeth on mesh with the teeth of the helical gears on said coaxial shafts, means supporting said second shaft for rotation, and power means connected with said second shaft for rotating the latter.

4. In an electrical circuit, a plurality of different sets of annular rows of contacts equally spaced apart in each set but the number of contacts in each set being different from the number of contacts in the others, the contacts in each set being in pairs diametrically opposite to each other, a conductor switch member for each annular row of contacts and means supporting each switch member for rotation about the axis of each row with said switch member adapted to simultaneously and successively connect each opposite pair of contacts during such rotation, means connected with said switch members for rotating them at different rates of speed, and means for connecting certain of the contacts of said different sets with each other and in an electrical circuit for simultaneously closing said circuit by all of said switch members at predetermined time intervals.

5. A timer comprising: a plurality of separate sets of contacts adapted to be connected in an electrical circuit, the contacts in each set being arranged in pairs of spaced contacts adapted to be successively connected by a conductor switch member, a conductor switch member for each set of contacts, means supporting each set of contacts and the said switch member therefor for relative movement to successively connect the said pairs of contacts in each set at uniformly spaced intervals in each set, each of said sets of contacts having a different number of pairs of contacts from the other of said sets, and means for causing said relative movement between said sets and the switch member therefor at different uniform rates of movement for the different sets whereby pulses of various intervals may be obtained in a circuit according to the electrical connections between the sets of contacts.

References Cited in the file of this patent

UNITED STATES PATENTS

2,471,873	Hunt	May 31, 1949
2,579,260	Horgan	Dec. 18, 1951
2,582,285	Schellens	Jan. 15, 1952
2,611,232	Wuischpard	Sept. 23, 1952
2,634,342	Baechler et al.	Apr. 7, 1953
2,664,473	Brown	Dec. 29, 1953
2,825,768	Beck	Mar. 1, 1958

FOREIGN PATENTS

287,400	Switzerland	Apr. 1, 1953