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W. H. H. KELK ET AL

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ELECTROMAGNETICALLY OPERATED TIMING MECHANISM

Filed Aug. 3, 1945

2 Sheets-Sheet 1

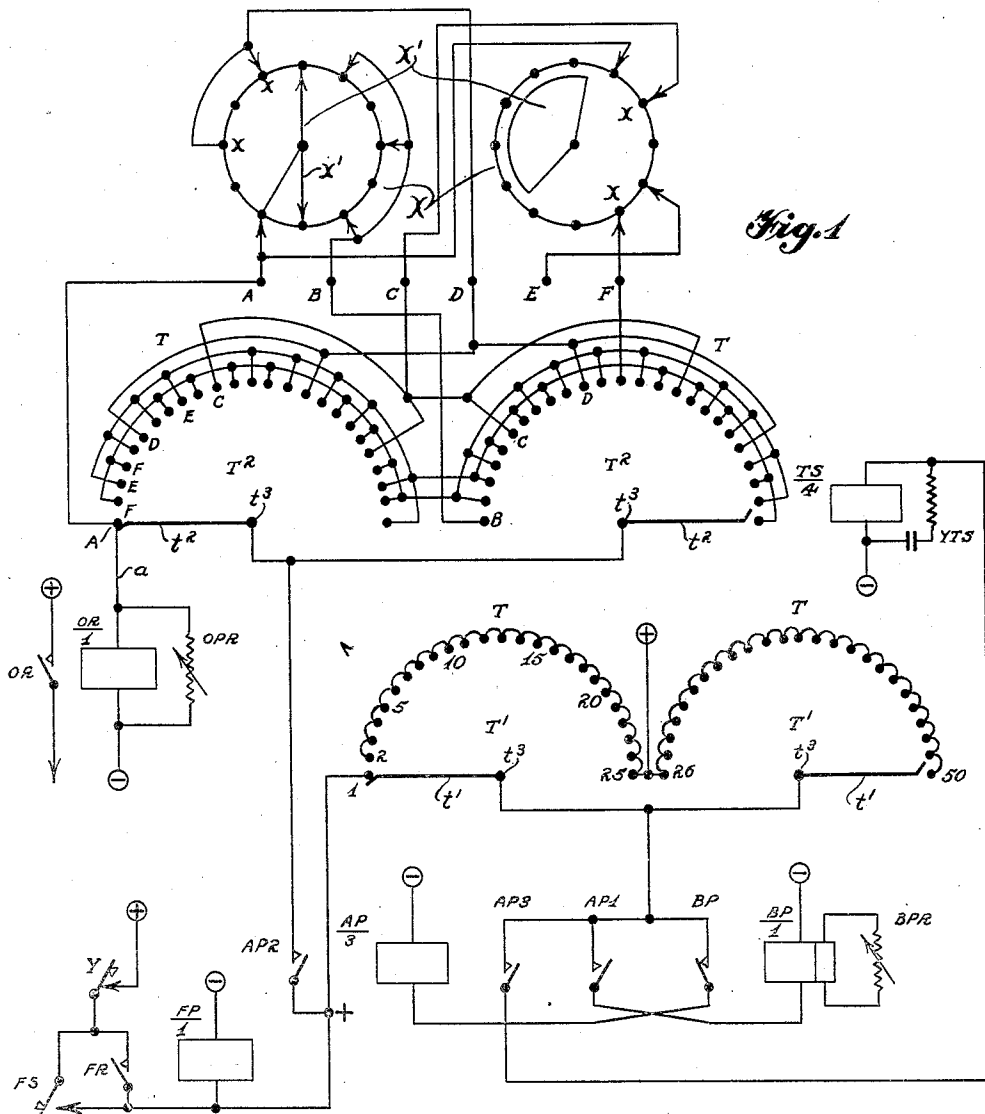


Fig. 1

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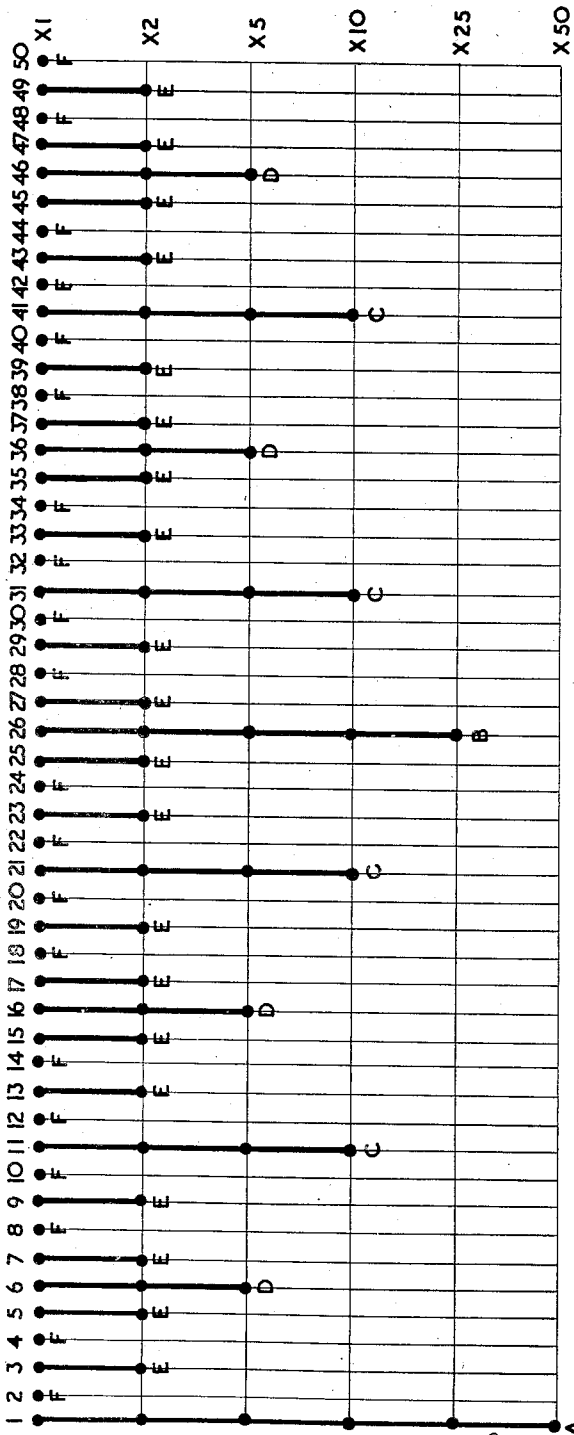


FIG.2

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ELECTROMAGNETICALLY OPERATED
TIMING MECHANISMWilliam Hyde Hastings Kelk and Denis Owen
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In Great Britain October 18, 1943

8 Claims. (Cl. 177—380)

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This invention relates to improvements in electromagnetically operated timing mechanisms.

The object of the invention is the generation of pulses at a predetermined fundamental frequency for distribution to a plurality of channels capable of preselection to provide output pulses at the preselected timing intervals in an output circuit.

The invention comprises generating pulses of a predetermined fundamental frequency, distributing the pulses through a plurality of channels, selectively connecting any one or more of said channels to an output circuit to obtain in said output circuit a range of pulse frequencies including the fundamental frequency and sub-multiples of the fundamental frequency and employing the pulses so obtained to actuate electrical devices in timed sequence.

The invention will be described with reference to the accompanying drawings which show schematically the arrangement of the circuits.

Fig. 1 is a diagrammatic view of a circuit for generating and distributing a fundamental pulse and pre-selecting one of a plurality of output pulses.

Fig. 2 is an expanded view of the grouping of contacts of banks T^2 of a rotary line switch or uniselector T to provide six sub-multiples of the fundamental pulse.

A fundamental pulse may be generated by the employment of two cross connected relays AP and BP. The relay AP provided with a coil

$$\frac{AP}{3}$$

has a normally open contact AP^1 and the relay BP provided with a coil

$$\frac{BP}{1}$$

has a single normally closed contact BP. The cross-connection of the two relays when current is supplied to the circuit generates a fundamental pulse, the frequency of which depends on the constants of the relays AP and BP and may be varied by altering such constants in known manner. For example the adjustment of the timing of the cross-connected relays may be carried out by a further winding on the core of the relay in series with a variable resistance BPR.

The pulses generated are fed through contacts AP3 to a magnet coil.

$$\frac{TS}{4}$$

preferably shunted by a resistance and capacity

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YTS to prevent sparking at the contacts, which operates a rotary line switch or uniselector T having a plurality of banks of contacts. In the arrangement shown in the drawing two banks T^1 each of 25 contacts are connected in series with the exception of contact 1, and a further two banks T^2 each of 25 contacts connected in groups receive the output pulses in succession through the contact AP2.

The rotary line switch or uniselector T is of known construction and comprises a stepping switch, used for switching impulses to a number of outgoing feeds consecutively, consisting of a magnetically operated spring returned pawl and ratchet mechanism operating on the reverse drive principle, i. e. the switch steps or moves to the next output contact when the magnet is de-energised. The fundamental pulse is transmitted to the two banks T^1 by two wiper arms t^1 mounted on a central spindle t^3 and arranged at 180° to each other, thus simulating a single bank of 50 contacts. The fundamental pulse is also transmitted to the two banks T^2 by two wiper arms t^2 similarly mounted on the spindle t^3 so that both pairs of arms t^1, t^2 step in unison on the closing of a control switch FS to operate a holding relay

$$\frac{FR}{1}$$

with contact FR.

The first contact 1 of the banks T^1 is connected in the circuit controlled by the switch FS and the remaining contacts 2-50 are connected in series and to an independent positive supply so that when the wiper arm t^1 has moved from contact 1 pulses will continue to be generated on the alternative positive supply line so that should an interrupter contact Y be actuated to open the relay FR the wiper arms will continue to step until the arm t^1 has homed to contact 1 where it is in position to restart the cycle on a subsequent closing of the switch FS. The arrangement of the grouping of the contacts of the banks T^2 , shown diagrammatically in Fig. 2, provides six output frequencies or pulses X1, X2, X5, X10, X25 and X50 all of which are sub-multiples of the fundamental frequency or pulse. Thus if the fundamental frequency is 0.06 sec. and an output pulse of 3 seconds is desired, timing multiple X50 which includes the first contact A alone, is selected by a rotary preselector switch X. Similarly, if an output frequency or pulse of 0.12 sec. is desired timing multiple X2 including contacts A, E and C, i. e., 25 alternate contacts, is selected.

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After the output circuit is broken by interrupter contact Y the wiper arms t^2 continue to step with the arms t^1 until the contact A is engaged thus resetting the arms for subsequent operation at any preselected available frequency.

The preselector switch X of the rotary type is provided with a number of stationary contacts x , in order to select the particular frequencies available, and with contacts x^1 arranged on a rotor to put in circuit any one of the stationary contacts. The moving contact system x^1 is provided with a pointer movable over a dial marked with the frequencies available. The selected output frequency or pulse is transmitted along a line a in each case since the contact A is common to all the frequencies or pulses.

An output relay

$$\frac{OR}{1}$$

with contact OR in the output line a transmits the pulses to the output circuit. This relay also influences the "on" to "off" ratio and in order accurately to follow the timing a low inertia relay should be employed. In order to adjust the "on" time of the contacts OR independently of the adjustment for the cross connected relays the output relay

$$\frac{OR}{1}$$

may be shunted by a variable resistance OPR.

The output pulses generated and selected at the required frequency as hereinbefore described may be employed for operating electrical circuits at predetermined intervals for controlling the release of stores from aircraft but the invention is not limited to such operation and may be employed for operating any mechanism in sequence at preselected intervals of time, and it will be evident that a large number of combinations of pulse generated rotary switches and frequency selector switches is possible to provide a large range of available frequencies.

What we claim as our invention and desire to secure by Letters Patent is:

1. Electromagnetic timing mechanism comprising a rotary switch; electromagnetic means for generating pulses at a predetermined frequency; electromagnetic means for actuating the rotary switch in steps, one step per pulse generated; a selector switch; a timing bank in the rotary switch including a series of contacts and a brush co-operating with said contacts in succession as the rotary switch is advanced in steps, one contact per step in succession; a connection to the timing bank brush from the pulse generating means whereby pulses are applied to the timing bank contacts one pulse per contact in succession; and said timing bank contacts being connected in groups to the selector switch; whereby output pulses are afforded at the selector switch at time intervals dependent on the setting of the latter.

2. Electromagnetic timing mechanism comprising a rotary switch; two cross-connected relays for generating pulses at a predetermined frequency; electromagnetic means for actuating the rotary switch in steps, one step per pulse generated; a selector switch; a timing bank in the rotary switch including a series of contacts and a brush co-operating with said contacts in succession as the rotary switch is advanced in steps, one contact per step in succession; a connection to the timing bank brush from the pulse

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generating means whereby pulses are applied to the timing bank contacts one pulse per contact in succession; and said timing bank contacts being connected in groups to the selector switch; whereby output pulses are afforded at the selector switch at time intervals dependent on the setting of the latter.

3. Electromagnetic timing mechanism comprising supply leads; two relays which are cross-connected for generating pulses at a predetermined frequency and have an additional pair of contacts which are opened and closed for every pulse generated; a rotary switch; means for advancing the rotary switch in steps one step per pulse generated; a selector switch; a timing bank in the rotary switch including a series of contacts and a brush co-operating with said contacts in succession as the rotary switch is advanced in steps; the timing bank brush being connected in series with the additional pair of contacts of the cross-connected relays with one supply lead whereby pulses are applied to the timing bank contacts one pulse per contact in succession; and said timing bank contacts being connected in groups to the selector switch; whereby output pulses are afforded as the selector switch at time intervals dependent on the setting of the latter.

4. Electromagnetic timing mechanism comprising supply leads; two relays which are cross-connected for generating pulses at a predetermined frequency and have an additional pair of contacts which are opened and closed for every pulse generated; a rotary switch; means for advancing the rotary switch in steps one step per pulse generated; a selector switch; a hold-in bank in the rotary switch including contacts which are connected together and to one supply lead and a brush co-operating with said contacts in succession as the rotary switch is advanced in steps; a timing bank in the rotary switch including a series of contacts and a brush co-operating with said contacts in succession as the rotary switch is advanced in steps; the timing bank brush being connected in series with the additional pair of contacts of the cross-connected relays with one supply lead whereby pulses are applied to the timing bank contacts one pulse per contact in succession; and said timing bank contacts being connected in groups to the selector switch, whereby output pulses are afforded at the selector switch at time intervals dependent on the setting of the latter.

5. Electromagnetic timing mechanism comprising supply leads; a rotary switch; two relays which are cross-connected for generating pulses at a predetermined frequency and have two additional pairs of contacts which are opened and closed for every pulse generated; a selector switch; a timing bank in the rotary switch including a series of contacts and a brush co-operating with said contacts; means including a magnet coil for advancing the rotary switch in steps one contact of said timing bank per step in succession; said magnet coil being connected in series with one of the additional pairs of contacts of the cross-connected relays with the supply leads, whereby the rotary switch is advanced one step per pulse generated; and the timing bank brush being connected in series with the other of the additional pairs of contacts of the cross-connected relays to one supply lead, whereby pulses are applied to the timing bank contacts one pulse per contact in succession; and said timing bank contacts being connected in groups

to the selector switch; whereby output pulses are afforded at the selector switch at time intervals dependent on the setting of the latter.

6. Electromagnetic timing mechanism comprising supply leads; a rotary switch; two relays which are cross-connected for generating pulses at a predetermined frequency and have two additional pairs of contacts which are opened and closed for every pulse generated; a selector switch; a hold-in bank in the rotary switch including contacts which are connected together and to one supply lead and a brush co-operating with said contacts in succession as the rotary switch is advanced in steps; a timing bank in the rotary switch including a series of contacts and a brush co-operating with said contacts; means including a magnet coil for advancing the rotary switch in steps one contact of said timing bank per step in succession; said magnet coil being connected in series with one of the additional pairs of contacts of the cross-connected relays with the supply leads, whereby the rotary switch is advanced one step per pulse generated; and the timing bank brush being connected in series with the other of the additional pairs of contacts of the cross-connected relays to one supply lead, whereby pulses are applied to the timing bank contacts one pulse per contact in succession, and said timing bank contacts being connected in groups to the selector switch; whereby output pulses are afforded at the selector switch at time intervals dependent on the setting of the latter.

7. Electromagnetic timing apparatus comprising supply leads; a starting and stopping circuit including means for closing and opening it and which is connected with one supply lead; two relays which are cross-connected to generate pulses at a predetermined frequency and have two additional pairs of contacts which are opened and closed for every pulse generated; a selector switch; a rotary switch having means including a magnet coil for advancing it in steps one step for each time said magnet coil is energised; a timing bank in said rotary switch including a series of contacts and a brush co-operating with said contacts in succession as the rotary switch is advanced; a hold-in bank in the rotary switch including contacts which are connected together and to said one supply lead, a contact which is connected via the starting and stopping circuit with said one supply lead and which is also connected via one of the additional pairs of contacts of the cross-connected relays with the timing bank brush and a brush co-operating with said contacts as the rotary switch is advanced and which brush is connected via the cross-connected relays with another supply lead; the magnet coil of the means for advancing the rotary switch in steps being connected in series with the other additional pair of contacts of the cross-connected relays between the hold-in bank brush and the other supply lead; and, the contacts of the timing bank being connected in groups with the selector switch; whereby when the starting and stopping circuit is closed pulses are generated by the cross-connected relays, the rotary switch is advanced one step per pulse generated, pulses are applied to the timing bank contacts in succession and these are afforded at the selector switch output pulses at time intervals dependent on which of the

groups of said timing bank contacts is selected by the selector switch and whereby when the starting and stopping circuit is open such operation will continue until and unless the hold-in bank brush is in co-operation with the hold-in bank contact which is connected via the starting and stopping circuit with a supply lead.

8. Electromagnetic timing mechanism comprising supply leads; a starting and stopping circuit including means for opening and closing it and a hold-in relay for holding it closed and which circuit is connected with one supply lead; two relays which are cross-connected to generate pulses at a predetermined frequency and have two additional pairs of contacts which are opened and closed for every pulse generated; a selector switch; a rotary switch having means including a magnet coil for advancing it in steps one step for each time said magnet coil is energised; a timing bank in said rotary switch including a series of contacts and a brush co-operating with said contacts in succession as the rotary switch is advanced; a hold-in bank in the rotary switch including contacts which are connected together and to said one supply lead, a contact which is connected via the starting and stopping circuit with said one supply lead and which is also connected via one of the additional pairs of contacts of the cross-connected relays with the timing bank brush and a brush co-operating with said contacts as the rotary switch is advanced and which brush is connected via the cross-connected relays with another supply lead; the magnet coil of the means for advancing the rotary switch in steps being connected in series with the other additional pair of contacts of the cross-connected relays between the hold-in bank brush and the other supply lead; and, the contacts of the timing bank being connected in groups with the selector switch; whereby when the starting and stopping circuit is closed pulses are generated by the cross-connected relays, the rotary switch is advanced one step per pulse generated, pulses are applied to the timing bank contacts in succession and these are afforded at the selector switch output pulses at time intervals dependent on which of the groups of said timing bank contacts is selected by the selector switch and whereby when the starting and stopping circuit is open such operation will continue until and unless the hold-in bank brush is in co-operation with the hold-in bank contact which is connected via the starting and stopping circuit with a supply lead.

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