July 14, 1931. C. W. HOUGH 1,813,929

ELECTRICAL SWITCHING SYSTEM

Filed Aug. 5, 1926 2 Sheets-Sheet 1

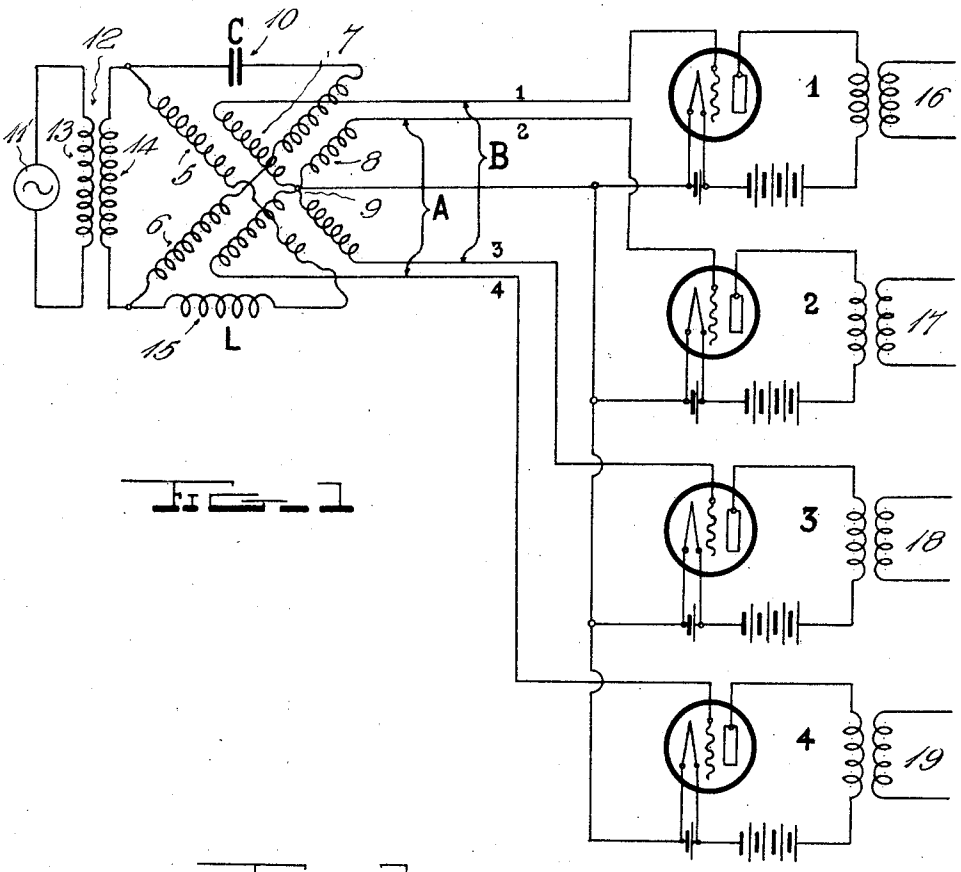


Fig. 1

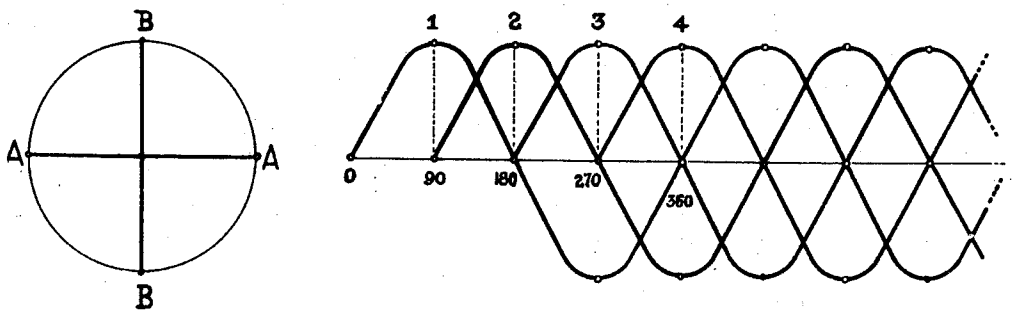


Fig. 2

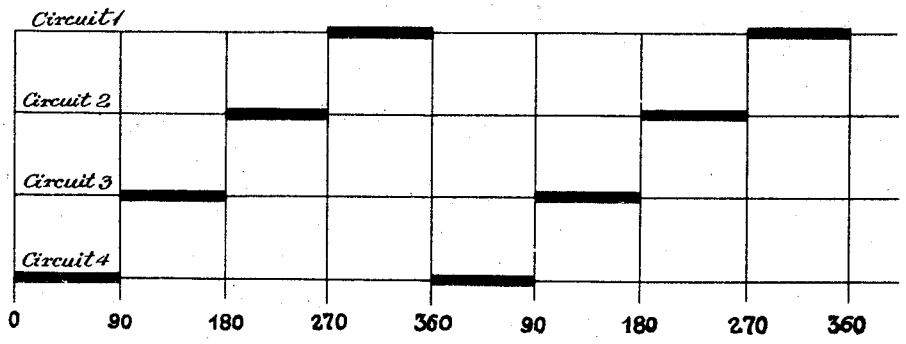
INVENTOR.
Clinton W. Hough,
BY John B. Brady
ATTORNEY.

July 14, 1931. C. W. HOUGH 1,813,929

ELECTRICAL SWITCHING SYSTEM

Filed Aug. 5, 1926 2 Sheets-Sheet 2

FIG. 3



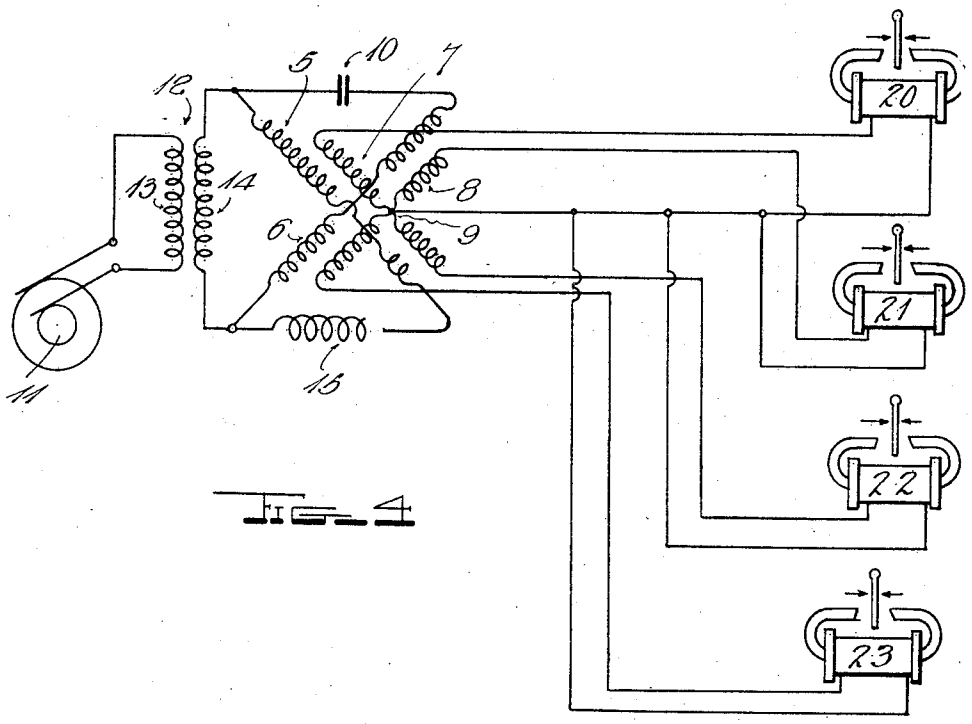


FIG. 4

INVENTOR.
Clinton W. Hough,
BY John B. Brady
ATTORNEY.

Patented July 14, 1931 1,813,929

UNITED STATES PATENT OFFICE

CLINTON W. HOUGH, OF BOONVILLE, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FEDERAL TELEGRAPH COMPANY, A CORPORATION OF CALIFORNIA

ELECTRICAL SWITCHING SYSTEM

Application filed August 5, 1926. Serial No. 127,349.

My invention relates broadly to the control of electrical circuits in successive order and more particularly to the activating of a plurality of circuits in successive order from an initial alternating current source.

One of the objects of my invention is to provide an electrical switching system for rendering a plurality of electrical circuits successively effective in a predetermined order.

Another object of my invention is to provide a circuit arrangement for deriving from an alternating current source currents of a predetermined phase, for exciting or rendering operative a plurality of electrical circuits in successive order.

Other and further objects of my invention will be understood from the specification hereinafter following by reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic view showing one embodiment of my invention; Fig. 2 is a vector diagram of the currents existent in the electrical system of my invention; Fig. 3 is a chart illustrating the sequence of operation of the several circuits in the system; and Fig. 4 illustrates one of the applications of my invention to a system of contact closers which are successively actuated in accordance with the principle of my invention.

In my copending application, Ser. No. 125,234, filed July 27, 1926, I have described a system of multiplex signaling in which selected recurring cycles of a high frequency carrier wave are employed for establishing independent communication channels. The present invention may be employed in systems of the character described in my copending application or in any system where a multiple number of variables are to be controlled by means of one variable at space time intervals. The electrical switching system of the present invention provides means whereby an initial alternating current source may be used to control the successive operation of a plurality of electrical circuits.

Referring to the drawings in more detail, reference character 11 represents a single phase alternating current source which is connected to transformer 12 having primary winding 13 and secondary winding 14 connected to a phase shifting circuit which includes the windings 5 and 6 each of which are divided into two portions and inductively coupled to similar portions of windings 7 and 8 connected at a neutral point 9. A condenser 10 is provided between one side of the windings 5 and 6, while an inductance 15 is provided between the other sides of the windings 5 and 6 for securing a leading or lagging phase characteristic in the circuits A and B which connect to the windings 7 and 8.

The field which is set up with respect to windings 7 and 8 is such that successive circuits may be energized at recurring intervals.

I have represented at Fig. 1 electron tube circuits 1, 2, 3 and 4 wherein the usual grid electrodes are successively energized by the operation of the windings 7 and 8. Each of the output circuits 16, 17, 18 and 19 are successively energized for the controlling of any desired electrical circuit by virtue of the dephasing of the original single phase alternating current source 11.

In Fig. 2 I have represented by vectors and sine waves the successive operation of each of the electron tube circuits 1, 2, 3 and 4. By virtue of the dephasing brought about by the characteristics of condenser 10 and inductance 15 the current across one portion of the winding 7 will rise from zero to a maximum, while the current in the other portion of winding 7 and the portions of winding 8 will be zero. Thereafter the current rises in one portion of winding 8 while falling in one portion of winding 7. Following this the current rises in the opposite portion of winding 7, while it falls in the portions of other windings. Thereafter the current rises in the opposite portion of winding 8 while falling in the other portions of the windings.

The operation of the circuits is repeated in successive recurring spaced intervals, as represented clearly in Fig. 2. The result of this operation is to independently and successively energize the separate circuits 1, 2, 3 and 4.

In Fig. 4 I have illustrated the application of my invention to a system of relay circuits 20, 21, 22 and 23 which are successively operated in recurring order. The relays may

be polarized so that the armatures are attracted once for each alternation of the current or twice during each complete cycle of the alternating current supply 11. When the magnets are polarized the armatures will be attracted once during each cycle, that is, during the positive alternative impulse depending upon the polarity of the magnets. The frequency of natural alternating current supply 11 is selected so that the alternations are sufficiently slow to enable the magnets 20, 21, 22 and 23 to respond to each alternation or cycle of the A. C. supply.

The several circuits may be employed for any desired control system and the successive periods of time through the selected circuits are closed may be used for different purposes.

I have described the broad principles of my invention and it will be understood that the invention may be used in a variety of ways and that no limitations upon the invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A switching system comprising a source of single phase alternating current, a plurality of control circuits and a circuit interposed between said control circuits and said source comprising a plurality of branches and independent transformers having primary and secondary windings with the secondary windings connected in star to said control circuits for deriving a lagging and leading current from said source and successively impressing said lagging and leading current upon said control circuits, and independent electromagnetic relays connected to each of said secondary windings for operation in successive and recurring order.

2. An electrical switching system comprising, in combination, a source of single phase alternating current, a plurality of control circuits, means interposed between said source and said control circuits for deriving a lagging and a leading current from said source, a transformer system having sets of primary and secondary windings corresponding in number to the control circuits, each secondary winding being included in one of said control circuits, and an electro-magnetic relay also included in each control circuit operable in successive recurring order.

3. An electrical switching system comprising a source of single phase alternating current, circuits connected with said source for deriving lagging and leading currents therein, a plurality of control circuits, means coupling said control circuits to said aforementioned circuits comprising independent sets of transformer windings for successively activating said control circuits in accordance with the phase relationship of the currents derived from said source, and a polarized electro-magnetic relay in each of said control circuits operable in recurring order.

4. An electrical switching system comprising a source of alternating current, a plurality of circuits into which said source is arranged to deliver energy, a plurality of work circuits coupled with said first mentioned circuits, means in said first mentioned circuits for deriving lagging and leading currents therein for successively energizing said work circuits and a polarized electro-magnetic relay in each of said work circuits rendered responsive in cyclic order.

In testimony whereof I affix my signature.

CLINTON W. HOUGH.