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A. N. ORMOND
ADJUSTABLE GATING CIRCUIT

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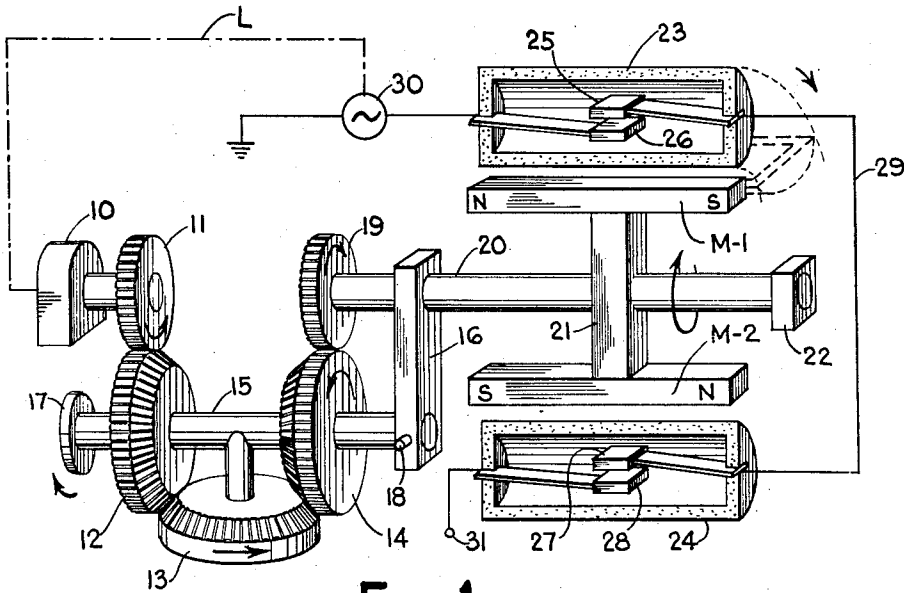


FIG. 1

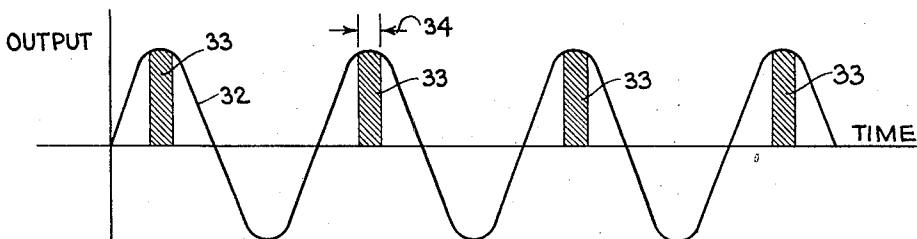


FIG. 2

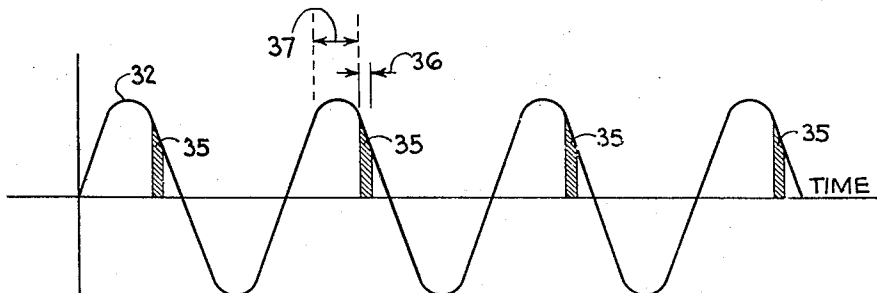


FIG. 3

INVENTOR.
ALFRED N. ORMOND
BY *Elliott & Pastoriza*
ATTORNEYS

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ADJUSTABLE GATING CIRCUIT

Alfred N. Ormond, Inglewood, Calif.

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This invention relates generally to electro-mechanical circuits and more particularly to a novel electro-mechanical gating or chopping circuit useful in connection with the analysis of periodic wave forms.

Present day gating circuits of the mechanical type are limited because of the relatively low frequency response of the switches that are used. As a consequence, the generated gates cannot be made narrow as measured with respect to a time scale. Further, contact resistances in such switches are relatively high.

It is a primary object of the present invention to provide a novel electro-mechanical gating or chopping circuit in which extremely narrow gate widths as measured in time units may be achieved with substantially perfect leading and trailing edges.

More particularly, it is an object to provide a gating circuit of the above type in which both the width of the gate and the position or phasing of the gate with respect to a periodic wave form may be mechanically controlled to a high degree of accuracy whereby the versatility of the circuit is greatly increased.

Another object is to provide an electro-mechanical gating circuit which is relatively simple in construction, very reliable in operation, and extremely economical to manufacture as compared to gating circuits presently available.

These and many other objects and advantages of the present invention are attained by providing a support member carrying a magnet at each end and mounted for rotation about a transverse axis such that the magnets describe a circular locus. A pair of magnetically responsive switches adapted to either open or close under the influence of a magnetic field are disposed adjacent substantially diametrically opposite points on the circular locus such that the passing of the magnetic poles operates the switches. A drive motor including a differential gear is arranged to rotate the support member to cause the magnets to revolve at high speed. The motor itself may be synchronized with a wave form generator providing a periodic wave form to be analyzed. The differential gear enables the phase of the revolving magnets to be varied with respect to the phase of the periodic wave form.

By the above described arrangement, the two switches may be connected in series to the output of the wave form generator. The output signal appearing at the free terminal of the last series switch will include a portion of the wave form "gated" by the two switches. The effective gate width of this output signal may be readily varied by changing the position of one of the switches relative to the other such that it is operated at a different time with respect to the other switch.

A better understanding of the invention will be had by referring to the accompanying drawings in which:

Figure 1 is a schematic perspective view of one embodiment of the electro-mechanical gating system;

Figure 2 illustrates an output wave form useful in explaining the operation of the circuit of Figure 1; and,

Figure 3 is another output wave form similar to Fig-

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ure 2 illustrating changes in the output signal after various adjustments have been made in the circuit of Figure 1.

Referring to Figure 1, the basic components of the electro-mechanical gating circuit include a driving motor 10 connected directly to a driving gear 11. Gear 11 is in turn arranged to drive an input bevel gear 12 of a differential system including a differential bevel gear 13 and an output bevel gear 14. The input and output gears 12 and 14 are mounted for rotation about a stationary shaft 15. One end of the shaft 15 is secured in a stationary end block 16 and the other end of the shaft terminates in an operating wheel or handle 17. The arrangement is such that the shaft 15 may be manually rotated by the wheel 17 and then secured in any set position by a set screw 18 in the block 16. Rotation of the shaft 15 causes the differential bevel gear 13 to assume different circumferential positions with respect to the shaft 15 and thereby will change the phasing between the rotation of the input gear 12 and output gear 14.

Output gear 14 serves to drive a spur gear 19 rigidly secured to a shaft 20 journaled in the bearing block 16 as shown. The shaft 20 serves to mount a support member 21 carrying magnets M-1 and M-2 at its oppositely extending ends. The far end of the shaft is journaled in a supporting end block 22. Rotation of the shaft 20 will thus cause the support member 21 to rotate in a plane substantially perpendicular to the plane of the drawing, as indicated by the curved arrow, whereby the oppositely extending magnets M-1 and M-2 will describe a circular locus.

As illustrated in Figure 1, a pair of magnetic switches 23 and 24 are disposed adjacent diametrically opposite points of the locus described by the magnets. Each of the switches, respectively, include contacts of magnetic material 25, 26, and 27, 28 cantilevered from opposite sides of the switch casings as illustrated. Each of these contacts may be biased to an open position such that the field between the north and south pole of either of the magnets will pass through the contact material to close the contacts. Alternatively, the contacts may be normally biased closed and the influence of the magnetic fields may serve to open the contacts. In the embodiment illustrated in Figure 1, the contacts 25, 26 and 27, 28 are normally open and arranged to close only when the magnet M-1 or M-2 passes adjacent thereto upon rotation of the shaft 20 and support member 21.

As an example of one use of the gating circuit illustrated in Figure 1, contacts 25 and 27 may be connected together by a conductor 29. As shown, contact 26 is connected to the output of a sine wave generator 30 and the contact 23 terminates in a signal output terminal 31. By this arrangement, the two switches are connected in series in the output circuit of the sine wave generator 30. As also schematically illustrated in Figure 1, the sine wave 30 is synchronized with the motor 10 through the synchronizing link L. The synchronization is such that the revolutions per second of the member 21 equal the frequency of the sine wave.

Figure 2 illustrates a plot 32 of the sine wave generated by the generator 30 and the output signal obtained by the gating action of the circuit of the present invention. Each switch will be closed for a finite period of time during the movement of the magnet over an arcuate section of the circular locus immediately closest to the contacts. Therefore, the two switches may be circumferentially positioned slightly less than 180° apart such that one switch will be closed before the other switch is closed, and then opened before the other switch is opened. There will thus be an overlapping portion when both switches are closed and the length of time of this overlapping may be extremely accurately controlled by the circumferential dis-

tance of one of the switches with respect to the other on the circular locus described by the magnets. In fact, it will be evident that the duration of the time when both switches are closed can be made extremely short by proper positioning of these switches.

With the connections illustrated in Figure 1, and with the magnets M-1 and M-2 revolving at the frequency of the sine wave 32, there will be periodic time intervals during which both switches 23 and 24 are closed. These intervals of time or "gates" are illustrated by the shaded areas 33 in Figure 2. The width of the gate is indicated by the arrows 34, and as mentioned above, may be controlled by changing the circumferential position of the switch 23, for example, as indicated by the dotted lines.

In the graph of Figure 2, the phasing of the magnets with respect to the motor 10 and sine wave generator 30 is such that the shaded gate portions 33 will occur at substantially the peaks of the sine wave 32. This relative phasing between the gated portions and the sine wave may be varied by moving the differential 13 of Figure 1 to another position by the handle 17 and locking it in such position by the set-screw 18.

Figure 3 illustrates the effects of the above mentioned gate width and phasing adjustments. In Figure 3 the output signal is shown at 35 and it will be noted that this signal is of a narrow width as indicated at 36. Further, signal 35 has been shifted in phase by movement of the differential gear of Figure 1. The degree of phase shift is indicated by the arrow 37.

If the switch 23 is moved to a position exactly diametrically opposite the switch 24, a gate of maximum width will result. On the other hand, movement of the switch 23 circumferentially towards the switch 24, as indicated by the dotted lines, may narrow the gate to substantially a zero width, if desired, at which point switch 23 would close at the same time switch 24 opened. Further circumferential movement would remove any overlap and the circuit would be continuously open.

If the differential gear 13 of Figure 1 is moved in an opposite direction, the phase shift illustrated in Figure 3 would be to the left rather than to the right. It should be noted that the phase of the gate signal could also be changed by moving both switches 23 and 24 an equal amount to different circumferential positions with respect to the magnets.

From the above description it will be evident that the present invention provides a relatively simple and highly reliable electro-mechanical gating circuit. While the invention has been described with respect to normally open switches, it should be understood that the switches could be biased to a normally closed position and the magnetic field used to open the switches. With such an arrangement portions of a wave form may be removed or chopped. Other modifications and uses within the scope and spirit of the present invention will readily occur to those skilled in the art. The gating circuit is, therefore, not to be thought of as limited to the particular embodiment set forth for illustrative purposes.

What is claimed is:

1. A gating circuit comprising, in combination: a support member including magnets at its opposite ends, said support member being mounted for rotation about a transverse axis passing perpendicularly through the midpoint of a line drawn between said magnets, whereby said magnets described a circular locus upon rotation of said member; first and second magnetic responsive switches adjacent diametrically opposite points on said circular locus in positions slightly less than 180° apart as measured about said circular locus, said first switch being operated in response to the passing of one of said magnets prior to the operation of the second of said switches by the passing of the other one of said magnets; and circuit means connecting said switches in series, said circuit means having an input terminal to receive an electrical wave form and pass said wave form to said

switches and an output terminal leading from said switches yielding gated portions of said wave form.

2. A circuit according to claim 1, in which the position of said first magnetic switch is circumferentially adjustable with respect to said second magnetic switch.

3. An electro-mechanical gating circuit for periodically gating portions of a wave form generated by a wave form generator, comprising, in combination: a support member having magnets secured to its oppositely extending ends mounted for rotation about a transverse shaft passing perpendicularly through the midpoint of a line drawn between said magnets, whereby said magnets described a circular locus upon rotation of said shaft; first and second magnetic responsive switches adjacent diametrically opposite points on said circular locus; conductor means connecting said switches in series and to the output of said wave form generator; a driving motor; a differential gear connected between said driving motor and said shaft; and a synchronizing link connecting said wave form generator to said driving motor for driving said motor at a speed proportional to the frequency of said wave form, whereby said first and second switches are periodically opened and closed to provide a gate signal at the output of said series connected switches constituting a portion of said wave form, the width of said gate signal being adjustable by adjusting the circumferential position of said first switch with respect to said second switch, and the phasing of said gate signal with respect to said wave form being adjustable by adjusting the position of said differential gear.

4. An electro-mechanical gating circuit for periodically gating portions of a wave form generated by a wave form generator, comprising, in combination: a support member having actuating means secured thereto at spaced points; means for periodically moving said support member so that each of said actuating means describes a given locus; first and second switches responsive to said actuating means disposed respectively adjacent each locus; conductor means connecting said switches in series and to the output of said wave form generator; and a synchronizing link connecting said wave form generator to said means for periodically moving said support member so that said support member is moved in a periodic manner proportional to the frequency of said wave form, whereby said first and second switches are periodically opened and closed to provide a gate signal at the output of said series connected switches constituting a portion of said wave form, the width of said gate signal being adjustable by adjusting the spatial position of said first switch with respect to said second switch.

5. A gating circuit comprising, in combination: a support member including at least two magnets secured thereto in spaced relationship; means mounting said support member for rotation whereby said magnets describe a circular locus upon rotation of said member; first and second magnetically responsive switches adjacent said circular locus in circumferentially spaced relationship as measured on said circular locus, the first of said switches being operated in response to the passing of one of said magnets prior to the operation of the second of said switches in response to the passing of the other of said magnets; and circuit means connecting said switches in series, said circuit means having an input terminal to receive an electrical wave form and pass said wave form to said switches and an output terminal leading from said switches yielding gated portions of said wave form.

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