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Aug. 3, 1954 F. E. TIDBALL 2,685,681

SIGNAL DISTRIBUTING AND SYNCHRONIZING SYSTEM

Filed June 3, 1952 2 Sheets-Sheet 1

Employs a mechanical distributor having a single set of contacts and a single brush. Distributor connects different channels through the contacts. Sync. pulses are developed during the short period when brush bridges two contacts

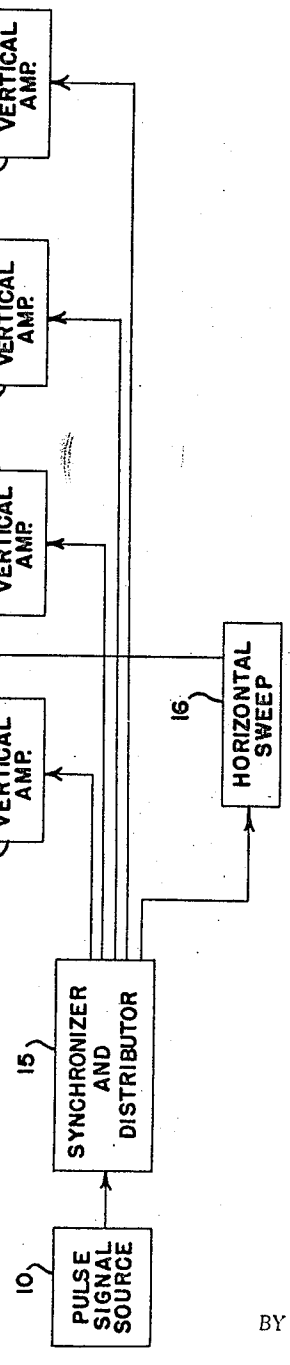


FIG. 1.

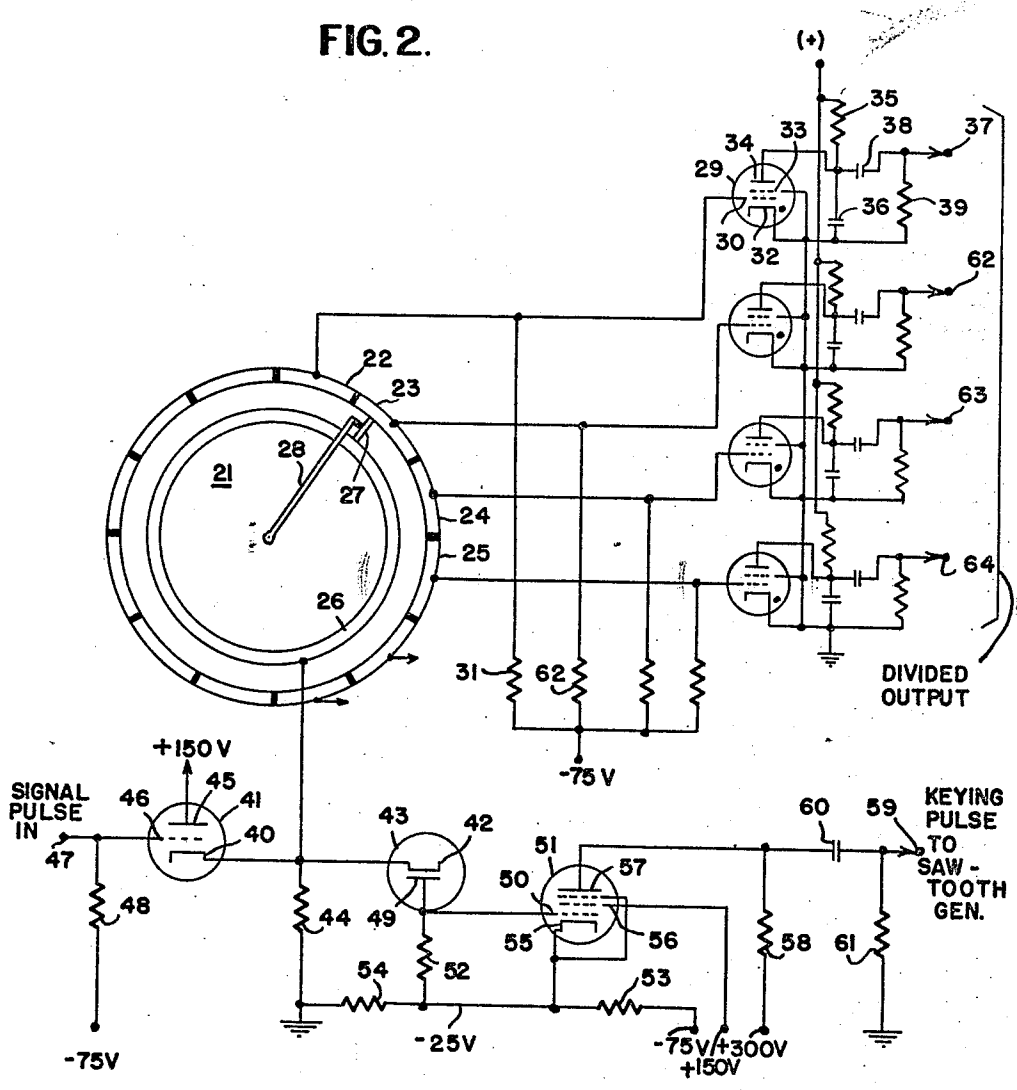
INVENTOR
FRANK E. TIDBALL
BY George Sipkin
B. L. Zanquill
ATTORNEY

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SIGNAL DISTRIBUTING AND SYNCHRONIZING SYSTEM

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FIG. 2.



INVENTOR
FRANK E. TIDBALL
BY George Lipkin
B. L. Zanquill
ATTORNEY

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SIGNAL DISTRIBUTING AND SYNCHRONIZING SYSTEM

Frank E. Tidball, Minneapolis, Minn., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

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4 Claims. (Cl. 340—147)

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This invention relates in general to multiplex electrical signalling devices and in particular to mechanical synchronizing devices for directing time displaced signals into a plurality of analyzing channels in dependency on the time occurrence thereof in successive time periods and for providing keying signals indicative of the start of each time period.

Wholly electronic devices suitable for performing the above operations and employing trigger circuits and gating tubes can be designed with little difficulty. Such electronic devices can be made quite reliable and trouble-free and are in reality the only practical type of apparatus suitable for high speed switching operations. In spite of this situation there are numerous instances where low speed switching rates permit the use of mechanical sequencing devices or commutators, particularly where it is desired to keep circuit complexity to an absolute minimum or to operate under conditions of severe mechanical vibration likely to have adverse effect upon the useful life of delicate electron tubes.

One of the chief drawbacks in the use of a mechanical commutator device for multi-purpose operation is in the accuracy required in the manufacture and assembly of the component parts so that synchronism is maintained in the switching provided by the several commutators. Such accuracy requirements mean higher manufacturing costs resulting in a higher initial cost. Additionally maintenance costs are also higher because in many instances complex equipment and highly skilled personnel are required for adjustments after even comparatively simple servicing operations such as replacing brushes which have been removed for cleaning or renewing.

Accordingly it is an object of the present invention to provide a simple and sturdy mechanical sequencing device for channeling multiplex signals into a plurality of analysing channels.

Other and further objects and features of the present invention will become apparent upon a careful consideration of the following description and the accompanying drawings wherein:

Fig. 1 shows a block diagram of a type of system wherein the apparatus of the present invention may be utilized; and

Fig. 2 is a schematic diagram of a combined synchronizing and channeling apparatus embodying the invention.

With particular reference now to Fig. 1 of the drawing, a specific combination of apparatus employing the principles of the present invention is shown. In this apparatus, it is desired to distribute incoming pulse signals, as obtained from the pulse signal source 10, to a plurality of indicator devices, as represented by the oscilloscopes 11, 12, 13, and 14, which may be referred to merely as "scopes," during successive time intervals in a repetitive sequence. These scopes 11–14

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include cathode ray tubes of a conventional type having two perpendicularly disposed beam deflection means together with intensity control means. The scopes 11–14 receive the distributed signals from the pulse signal source 10 through the synchronizer and distributor 15 which device is shown in detail in Fig. 2 and later described herein. The distributed signals are applied as vertical deflection signals through the amplifiers 17, 18, 19 and 20 to the scopes 11–14 respectively. Alternately, the signals could be applied to the scopes 11–14 as intensity modulation signals.

Horizontal deflection or "sweep" time base signals for the scopes are obtained from the horizontal sweep circuit 16 which is connected to the synchronizer and distributor 15. As shown in Fig. 1 all scopes receive the same horizontal deflection signals, however only one scope gives indication at any one instant and that is the one which is receiving the distributed output from the synchronizer and distributor 15. The horizontal sweep circuit may be of a triggered or "slave" type operative in response to a pulse type signal produced by the synchronizer portion of the device of block 15. Thus, in the apparatus of Fig. 1, the horizontal sweep block 16 will include an output amplifier of a type suitable for the type of deflection employed whether it be electro-static or electromagnetic.

The specific circuit shown in Fig. 2 illustrates in schematic form a preferred embodiment of the features of the present invention. This device of Fig. 2 is an apparatus which would be suitable to provide the combined operations of synchronizing and distributing as required for the equipment located in block 15 of Fig. 1.

The apparatus of Fig. 2 is built around a mechanical device 21, shown schematically as a single multi-segment commutator having segments 22, 23, 24, 25, etc., a slip ring 26, brush assembly 27, and a brush mounting and motive means 28 such as a mounting arm suitably journalled and rotated by a motor not shown. The brush contacting the segments 22, 23, 24, 25, etc. is of sufficient width to bridge the insulating gap between adjacent segments so that in motion thereof, it momentarily contacts two segments as it travels from one segment to another. In the showing of Fig. 2, a twelve segment commutator has been represented with typical output circuits connected to four of the segments. It is to be understood that in actual apparatus there would ordinarily be as many electronic output circuits as there are commutator segments.

Each electronic output circuit, for example that connected to segment 22, includes a soft tetrode electron tube 29 having its grid 30 connected to commutator segment 22 and to a source of negative potential, typically of minus 75 volts, through a resistance 31. The cathode 32 and grid 33 are connected to ground while the anode

34 is connected to a source of B-plus potential through resistance 35. Obviously triodes or other multielectrode tubes can be used in place of tube 29. Additionally the anode 34 is by-passed to ground by capacitance 36 and coupled to an output terminal 37 by means of a short time constant circuit comprising capacitance 38 and resistance 39. Normally, therefore, the potential at the grid 30 is such that tube 29 is held non-conductive by virtue of the hevay bias voltage applied to its grid. Thus in the non-conductive condition, capacitance 36 becomes charged to the B-plus potential through resistance 35.

The slip ring 26 of the mechanical device is connected to the cathode 40 of a triode electron tube 41, to the cathode 42 of a diode electron tube 43 and to ground through a resistance 44. The tube 41 has its anode 45 connected to a source of B-plus potential typically of 150 volts and its grid 46 connected to a source of input signals to be separated on the basis of time occurrence as obtained at the input terminal 47. Additionally grid 46 is connected to a source of biasing potential typically of minus 75 volts through a grid return resistance 48.

Tube 43, the cathode 42 of which has previously been mentioned as being connected to slip ring 26, has its anode 49 connected to the grid 50 of a pentode type electron tube 51. Additionally anode 49 is connected through signal developing resistance 52 to a tap point of a voltage divider comprising resistances 53 and 54 connected between a source of biasing potential typically of minus 75 volts and ground. Typically the potential of the tap point between resistances 53 and 54 is minus 25 volts. Additionally the cathode 55 of tube 51 is also connected to this tap point on the voltage divider. By virtue of this connection, tube 51 is thus provided with zero bias when tube 43 is non-conductive, the grid 50 and cathode 55 being at the same potential. The screen grid 56 of tube 51 is connected with a suitable source of potential typically of 150 volts positive with respect to ground, whereas the anode 57 is connected to a source of B-plus potential typically of 300 volts positive with respect to ground through the signal developing anode resistor 58. Additionally the anode 57 is connected to a keying pulse output terminal 59 by means of coupling circuit including capacitance 60 and resistance 61.

In the operation of the apparatus of Fig. 2, sequential input signals of pulse type and of positive polarity are supplied to terminal 47. These signals may be of many forms, but the general problem is that of dividing them into separate output lines on a basis of time occurrence so that they appear as pulses at the individual output terminals 37, 62, 63, 64, etc., separated on the basis of their time occurrence. The mechanical apparatus 21 is operated typically by means of a suitable motor drive producing rotation of the brush assembly 27 in a clockwise direction at a desired speed. The brush assembly 27 being, for example, a pair of brushes providing contact between individual segments of the commutator and the slip ring 26 and being insulated from ground so as to produce the sequential connection of the individual segments of the commutator to the slip ring 26. With this arrangement the brushes make connections which form a series voltage divider path from ground through resistance 44, slip ring 26 and one of the segments, 22 for example, and its corresponding resistance, 31 for example, to the minus 75 volt potential. This voltage divider action may typically place a potential at the cathodes 40 and 42 of minus 20 volts when the brush assembly 27 contacts the associated single segment such as 22. In this situation, with the cathode of tube 43 at minus 20 volts and the anode 49 thereof at a potential of minus 25 volts, tube 43 is non-conductive so that no potential is developed across resistance 52 and tube 51 is provided with substantially zero bias so that it is heavily conductive with the anode 57 thereof at a low potential. The brush assembly 27 which contacts the segments of the commutator, as has been previously mentioned, is of sufficient width to bridge the insulating gap between adjacent segments. Thus with this situation, whenever the brush assembly bridges the gap between two adjacent commutator segments, such as segments 22 and 23 for example, the slip ring 26 and cathodes 40 and 42 are actually connected to the minus 75 volt potential through two resistances of equal magnitude, resistances 31 and 62. Voltage divider action between the parallel connected resistances 31 and 62 in series with the single resistance 44 will then lower the potential of the cathodes 40 and 42 to a typical potential of approximately 32 volts. In this condition then tube 43 will become conductive to produce a potential drop across resistance 52 of approximately 7 volts. This grid bias change effects a substantial reduction in the conductivity of tube 51 to produce in increase in potential at the anode 57. This potential increase, however, will persist for only a very short period of time during which the brush assembly 27 bridges the gap across two adjacent commutator segments. It is to be noted, of course, that the diode 43 prevents the application of signal pulses as applied to terminal 47 to the grid 50 of tube 51. The only possibility of any interference is when an input signal pulse is applied to terminal 47 at a precise moment at which the brush assembly 27 bridges the gap between adjacent commutators. The low impedance cathode follower action of tube 41 will almost completely mask any conductivity changes at the cathodes 40 and 42 due to bridging action of commutator segments. Due to this situation, which may prevail occasionally, it is therefore desirable that any so attached generator fed from the terminal 59 be of the fly-wheel type, such as is employed in current television receivers and which is merely synchronized by the pulse obtained from terminal 59 rather than being directly triggered thereby.

The circuit thus far described provides output synchronizing impulses at the terminal 59 in coincidence with each instant of time at which the brush assembly 27 contacts one of the segments 22, 23, etc., to start the time instant allotted to signal representation from each.

The input signals of positive polarity delivered to terminal 47 are divided on a time occurrence basis to produce ionization of appropriate gas tubes 29, etc., to provide output signals in corresponding output lines 37, 62, 63, 64, etc. Output signals occur in coincidence with initiating input signals.

Mechanical complexity is reduced because only a single multi-segment commutator is required to provide the divided output signals in the separate output chambers and the synchronizing signals in a separate line for indicating the start of a time period for one of the output channels.

Typical values for various circuit elements in the drawings are as follows:

Resistance 31, 62, etc	56K ohms
Resistance 35	1 megohm
Capacitance 36	0.1 microfarad
Capacitance 38	0.1 microfarad
Resistance 39	100K ohms
Resistance 44	27K ohms
Resistance 48	68K ohms
Resistance 52	100K ohms
Resistance 53	5K ohms
Resistance 54	2.5K ohms
Resistance 58	330K ohms
Capacitance 60	0.1 microfarad
Resistance 61	470K ohms

From the foregoing it is obvious that many modifications in the features of the present invention may be made without exceeding the scope thereof as defined in the appended claims.

What is claimed is:

1. A signal distributing system for directing applied signals into a plurality of output channels on a basis of their time occurrence and also providing synchronizing signals in coincidence with the transition from one output channel to another comprising, a multi-segment commutator having at least as many insulated segments as output channels in the system, each segment being connected to an output channel, brush means suitably mounted and driven for sequentially contacting the segments of said multi-segment commutator, said brush means having sufficient contacting length measured in its path of travel to span the insulating space between adjacent segments, a source of control potential, a plurality of control resistors individually connected between each commutator segment and the source of control potential, signal input means connected to said brush means for delivering input signals to said brush means, and control means connected to said brush means for providing an output synchronizing signal upon contact of the brush means with adjacent segments.

2. A signal distributing system for directing applied signals into a plurality of output channels on a basis of their time occurrence and also providing synchronizing signals in coincidence with the transition from one output channel to another comprising, a multi-segment commutator having at least as many insulated segments as output channels in the system, brush means suitably mounted and driven for sequentially contacting the segments of said multi-segment commutator, said brush means having sufficient contacting length measured in its path of travel to span the insulating space between adjacent segments, a plurality of electron tubes having anode, cathode, and control grid electrodes, means independently connecting a grid of each of said electron tubes to an individual commutator segment, a source of biasing potential exceeding the cut-off voltage of the electron tubes, a grid resistor for each electron tube connected between the tube grid and the source of biasing potential, signal input means connected to said brush means for delivering input signals to said brush means, and control means connected to said brush means for providing an output synchronizing signal upon contact of the brush means with adjacent commutator segments.

3. A signal distributing system for directing applied signals into a plurality of output channels on a basis of their time occurrence and also providing synchronizing signals in coincidence with the transition from one output channel to another comprising, a multi-segment commutator having at least as many insulated segments as output channels in the system, brush means suitably mounted and driven for sequentially contacting the segments of said multi-segment commutator, said brush means having sufficient contacting length measured in its path of travel to span the insulating space between adjacent segments, a plurality of gas-filled electron tubes having anode, cathode, and control grid electrodes, means independently connecting a grid of each of said electron tubes to an individual commutator segment, a source of biasing potential exceeding the cut-off voltage of the electron tube, a grid resistor for each electron tube connected between the tube grid and the source of biasing potential, anode current control means for said electron tubes for interrupting anode current flow therein, signal input means connected to said brush means for delivering input signals to said brush means, and control means connected to said brush means for providing an output synchronizing signal upon contact of the brush means with adjacent commutator segments.

4. A signal distributing system for directing applied signals into a plurality of output channels on a basis of their time occurrence and also providing synchronizing signals in coincidence with the transition from one output channel to another comprising, a multi-segment commutator having at least as many insulated segments as output channels in the system, brush means suitably mounted and driven for sequentially contacting the segments of said multi-segment commutator, said brush means having sufficient contacting length measured in its path of travel to span the insulating space between adjacent segments, a plurality of gas-filled electron tubes having anode, cathode and control grid electrodes, means independently connecting a grid of each of said electron tubes to an individual commutator segment, a source of biasing potential exceeding the cut-off voltage of the electron tubes, a grid resistor for each electron tube connected between the tube grid and the source of biasing potential, anode current control means for said electron tubes for interrupting anode current flow therein, signal input means connected to said brush means for delivering input signals to said brush means, control means connected to said brush means for providing an output synchronizing signal upon contact of the brush means with adjacent commutator segments, a unilateral signal path connected to said brush means including a unilateral conductive element and a biasing source therefor, said signal path operative to conduct only when the brush potential falls to a low value upon contact with adjacent commutator segments, and amplifier means connected to said unilateral signal path and responsive to conduction therein to deliver an output synchronizing signal.

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