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IMPULSE COUNTING AND SELECTING DEVICE

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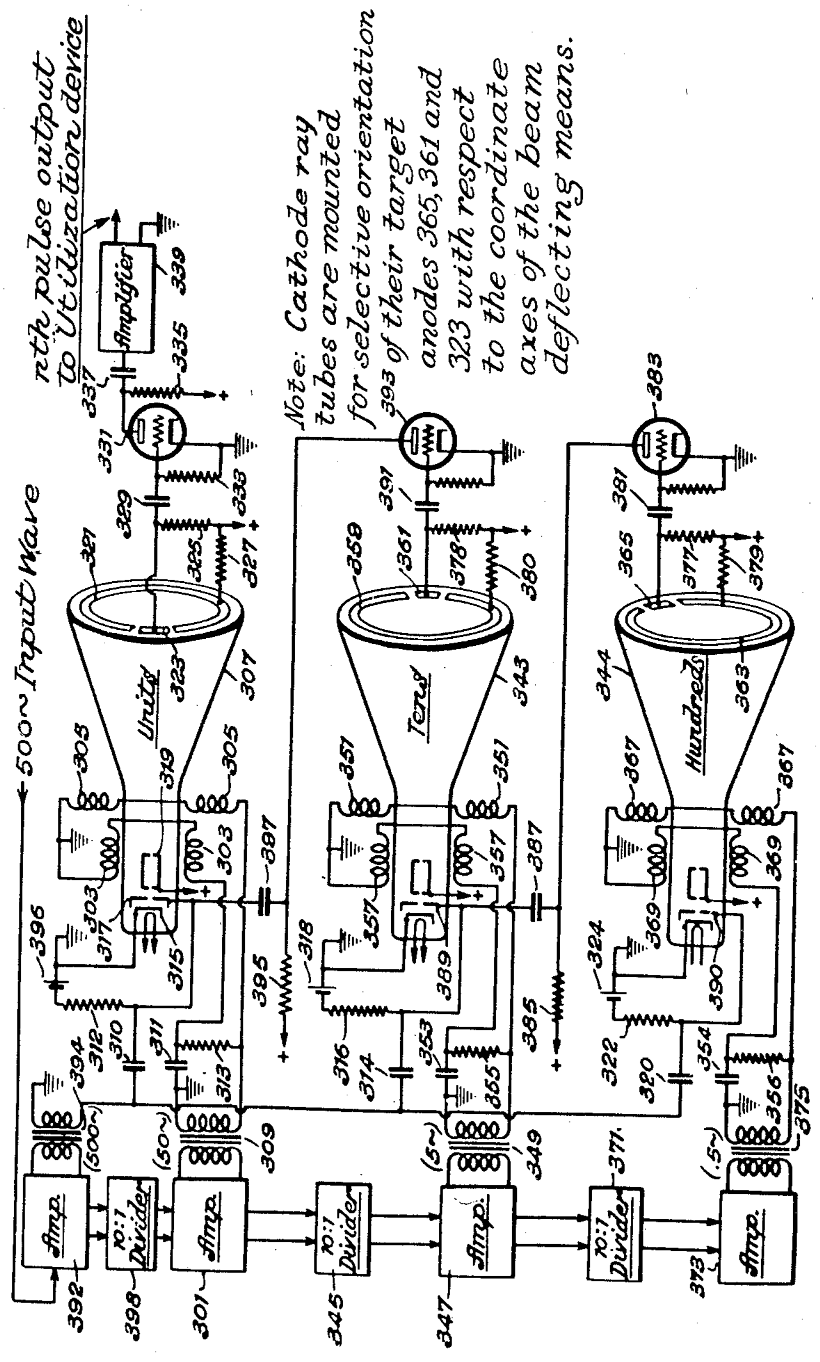

INVENTOR
Alfred N. Goldsmith
BY H. S. Grover
ATTORNEY

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IMPULSE COUNTING AND SELECTING DEVICE

Alfred N. Goldsmith, New York, N. Y.

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7 Claims. (Cl. 177—353)

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This invention relates to impulse counting and selecting systems and more particularly to a device in which cathode ray tubes are utilized for selecting a particular impulse in a given train whereby the operation of a utilization device may be suitably timed. This application is a division of my copending application Serial No. 421,898, which was filed December 6, 1941.

In the parent application, I have described a "radio centercasting system" suitable for gathering information, such as public opinions, from groups of respondents who may be selected members of the public. Each of these respondents is provided with radio receiving and transmitting equipment so arranged as to communicate with a central station where opinions may be automatically collected, classified, and analyzed.

In a voting system such as I disclosed in the parent application, I showed a preference for collecting votes from various outlying respondent stations in a predetermined sequence. The method of gathering votes sequentially has two main advantages, namely, precision of counting the votes and compilation of the voting statistics so that the source of each individual vote is identified.

Accordingly, it is an object of the invention herein claimed as divisional subject matter to provide impulse counting and selecting apparatus suitable for initiating the operation of any desired utilization device at a precise moment determined by the arrival of a control impulse which is a particular one in a train of impulses.

It is another object of my invention to provide impulse counting and selecting apparatus operable from a periodic train of impulses, such apparatus including cathode ray tube means whereby a single impulse in the train is selected for controlling a utilization device and for timing the operation of the latter.

It is still another object of my invention to provide a system of the class described in which a control signal may be sent out from a central station for the purpose of starting and stopping the operation of various respondent transmitters, such starting and stopping being obtained by a time sequence method, whereby the responses produced in the central station may be capable of accumulation in a predetermined order.

The foregoing and other objects and advantages of my invention may be achieved with the aid of apparatus presently to be described, and by the adoption of novel methods which are either explicitly set forth, or otherwise implied, in the text of this specification.

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My invention will now be described in more detail, reference being made to the accompanying drawing, the sole figure of which shows a preferred circuit arrangement for selecting a single impulse in a given train as the initiating impulse for control of a utilization device.

Referring to the drawing, I show a preferred form of apparatus suitable for counting the impulses in a given train and for producing a response when the *n*th impulse in the train is reached. The apparatus comprises a plurality of cathode ray tubes arranged to count incoming cyclic impulses and to deliver a single output impulse when a specified number of incoming impulses has arrived at a given respondent station. A 500-cycle wave derived from a suitable control source is fed to an amplifier **392** having two output circuits, one of which is utilized in partially controlling the release of electrons by the electron guns in the several cathode ray tubes **307**, **343**, and **346**.

Output energy from amplifier **392** is also fed to a frequency divider **398** and thence to an amplifier **301**. This amplifier has two output circuits, one for producing two-phase deflecting circuit potentials to be applied to the deflecting coils **303** and **305** of the cathode ray tube **307**. The frequency divider **398** preferably has a 10 to 1 ratio between its input and output frequencies. Thus a 50-cycle wave is fed across transformer **309** which has a secondary in circuit with the vertical deflecting coils **305**. At two points in this circuit ground connections are indicated. In order to produce a phase displacement of 90° in the currents which traverse the horizontal coils **303**, a phase displacing network consisting of capacitor **311** and impedance **313** is employed. As is well-known, such a phase displacing network may be suitably designed to produce quadrature phase displacement between the currents traversing the coils **303** and **305** respectively, and thus to provide rotary scanning of the electron beam.

The cathode ray tube **307** comprises a cathode **315**, a control electrode **317**, a focusing anode **319**, a target anode **321**, and a second target anode **323**. Anode **321** is here shown as a broken ring subtending an arc of $\frac{9}{10}$ of a circle, or 324°. Anode **323** subtends substantially an arc of 36° or $\frac{1}{10}$ of a circle. The two anodes **321** and **323** are connected by means of impedances **325** and **327** respectively to the positive terminal of a suitable direct current source. The negative terminal of this source is preferably grounded, and so is the cathode **315** of the tube.

Rotary scanning of the electron beam in the cathode ray tube 307 is thus provided by the two-phase currents derived from the transformer 309 and the phase displacing network 311, 313. As the beam rotates, it will, for $\frac{9}{10}$ of one revolution, traverse the anode 321, and for $\frac{1}{10}$ of a revolution, it will traverse the anode 323. The arrival time of the beam at the center of the anode 323 is determined by the orientation of this anode with respect to the axes of the deflecting coils 303 and 305, and is adjusted in accordance with the units digit of the call number for a given station. When anode 323 is impacted by electrons, a negative impulse is impressed across capacitor 329, which blocks the current otherwise normally flowing in discharge tube 331. This discharge tube possesses the usual electrodes, of which the control grid and cathode are interconnected by a grid leak resistor 333, while the anode is fed with positive potential from any suitable source across an impedance 335. When the discharge tube 331 is blocked, the rise of potential on its anode produces an impulse across capacitor 337 for actuating an amplifier 339, thereby to emit a control signal which is fed to an electronic keyer of the type disclosed in the parent application Serial No. 421,898, or to any other utilization device the operation of which is to be initiated at the instant of receiving a particular pulse in the counting train. The keyer of the parent application conditions a power amplifier momentarily so as to cause a voting station to transmit a voting signal.

During the persistence of the 500-cycle wave train applied to amplifier 392, the frequency divider 398 continues to function. The 50-cycle output from amplifier 301 also persists and delivers suitable potentials to the deflecting coils 303 and 305. In order to render the hundreds and tens digits of a station's calling number effective, the emission in tube 307 is restricted to a brief period which comprehends only 10 cycles of the 500-cycle wave. Furthermore, the electron stream flows only during ten positive half-cycles of this wave. During this time the electron beam will be directed toward nine different portions of the anode 321 and some portion of the anode 323. During 990 of the cycles of the 500-cycle wave the electron beam will be blocked by a blocking bias derived from source 396. This is true because the blocking bias is so set that it will be overcome only when control impulses are applied to the control electrode 317 across capacitors 310 and 397 simultaneously. I will now explain the manner of overcoming this blocking bias in order to produce the one effective impulse for selection of the respondent station, which impulse is initiated by a negative charge on the anode 323, for producing a surge impulse across capacitor 329, thereby to block the discharge in tube 331. The blocking of tube 331 causes a positive impulse to be fed across capacitor 337 to amplifier 339.

A frequency divider 345 is controlled by output current from the amplifier 301. This divider preferably has a 10 to 1 ratio between input and output frequencies. The output frequency of 5 cycles is amplified by the unit 347 which also has two output circuits. One such output circuit includes the primary of a transformer 349 occupying the same position with relation to cathode ray tube 343 and its deflecting circuits as is obtained by the transformer 309 and the deflecting circuits of cathode ray tube 307. In other words, transformer 349 feeds current of one phase to the vertical deflecting coils 351 and thence to ground. The phase displacing network consisting of capacitor 353 and impedance 355 causes current of quadrature phase to be fed to the horizontal deflecting coils 357 and thence to ground.

Each of the cathode ray tubes 343 and 344 is similar in construction to that of cathode ray tube 307. The electron gun elements need not, therefore, be described in detail. Furthermore, the same construction of anode electrodes exists in the different cathode ray tubes, and these need no further description. In cathode ray tube 343, however, the 324°-anode is labelled 359, while the 36°-anode segment is labelled 361. Correspondingly, in cathode ray tube 344, I have labelled the larger anode 363 and the smaller one 365. Vertical deflecting coils for tube 344 are labelled 367 and the horizontal deflecting coils 369.

One of the two output circuits from amplifier 347 feeds a 5-cycle current to a frequency divider 371 which also has a ratio of 10 to 1 between its input and output frequencies, thus delivering a frequency of .5 cycle per second to amplifier 373. This amplifier has an output transformer 375 across which the .5-cycle current is fed to a phase-splitting network 354, 356, and thence to the vertical and horizontal deflecting coils 367 and 369.

From the foregoing description of the amplifiers 392, 301, 347 and 373 and their interconnections through frequency dividers 398, 345 and 371 it will be seen that the beams in the three cathode ray tubes are rotated at different velocities corresponding to gears having 10 to 1 ratios therebetween. The maximum scanning velocity of 50 revolutions per second is obtained in tube 307; in tube 343 the velocity is 5 revolutions per second; and in tube 344 the velocity is ½ revolution per second.

Tube 343 has an output circuit from its anode 361 and through impedance 378 to the positive side of an anode potential source. The anode 359 is connected to the same source through impedance 380. The scanning velocity in tube 343 is such that ten marking impulses of the 500-cycle wave are caused to traverse capacitor 314 and to discharge electrons from the gun while the beam is aimed once at the anode 361. During each scanning revolution 90 marking impulses are suppressed or rendered ineffectual by aiming the beam at the anode 359. When the beam is effective a negative surge across capacitor 391 blocks tube 393, thus delivering ten impulses through resistor 395 and across capacitor 397 for aiding in the release of electrons by control electrode 317 in tube 307.

Only one out of ten scanning revolutions of the beam in tube 343 is rendered effective in accordance with the preceding paragraph. The other scannings are suppressed by the biasing source 318 during the absence of control impulses to be derived from the action of tubes 344 and 383.

Tube 344 has an output circuit from its anode 365 through impedance 377 to the positive side of an anode potential source. The anode 363 is connected to the same source through impedance 379. Impulses derived from the impact of 100 electronic puffs or clouds against anode 365 traverse the capacitor 381 for controlling a discharge tube 383 thereby to repeatedly block the same. The anode potential rises in this tube when it is blocked, due to the presence of a load resistor 385 in its connection to an anode potential source. Positive impulses, 100 in succession at the 500-cycle rate, are impressed across capacitor 387 for controlling the electrode 389 in cathode ray tube 343. At these instants simultaneous impulses across capacitor 314 cause the electron stream in tube 343 to be released while it is deflected rotatively just once. During the remainder of the time of transmission of the 500-cycle wave train preceding and/or following the reception of these 100 marking impulses the beam in cathode ray tube 344 is directed ineffectually against the anode 363, so that the emission in tube 343 becomes blocked.

The fundamentals of my counting system as set forth in the paragraphs immediately preceding may be extended, if desired, to a system wherein additional cathode ray tubes would be employed to permit counting up to a number having four or more digits. Alternatively, the arc subtended by the selecting anode segments 323, 361 and 365 might be reduced in degrees, and at the same time the ratio between input and output frequencies of the frequency dividers 398, 345, and 371 would be of a higher order so that the scanning velocities in the several cathode ray tubes would bear higher ratios one to another. Thus a higher order of selectivity would be obtainable without the use of additional apparatus components.

I previously mentioned that in order to select each respondent station for operation in a predetermined sequence, it is arranged for the cathode ray tubes 344, 343, and 307 to be rotatively adjusted on their respective axes thereby to place their effective anode segments 365, 361 and 323 in suitable angular relation to the vertical and horizontal axes of the deflecting coils which are associated with these tubes. The mere act of rotating the cathode ray tubes in this manner enables me to adjust each electronic counter at a given respondent station so that it will be caused to deliver a single control signal across the capacitor 337 and thence through amplifier 339 to the electronic keyer at an instant corresponding to its orderly position in the entire series of respondent stations. When the 500-cycle frequency is initiated by the central station a sufficient number of marking impulses in the train is caused to be transmitted so that each of the respondent stations will pick up its particular individual controlling impulse in the entire train, and the different respondent stations will send out their voting signals successively and in a predetermined order.

The equivalent of counting gears may be readily understood as provided by the association of the three cathode ray tubes 344, 343 and 307, in accordance with the foregoing description. In order to illustrate more specifically how an individual respondent station is to be selected at a particular instant when its count of half-cycles is reached in the train of 500-cycle waves, the operation of the circuit arrangement shown will now be recapitulated.

The 500-cycle input wave is limited to 999 marking impulses which are applied to amplifier 392 and utilized across transformer 394 for opposing the cut-off biases of sources 396, 318 and 324 so that control electrodes 317, 389 and 390 will stand only slightly below the cut-off threshold in the presence of these marking impulses. Scanning of the electron beams in tubes 307, 343 and 344 take place to the number of 100 revolutions, 10 revolutions and one revolution respectively. Selection of the time when, or the single impulse by which, the electronic keyer is actuated depends upon the coincidence of a marking impulse and the blocking of the two tubes 383 and 393. This moment is, therefore, determined by the respective orientations of the anodes 365, 361 and 323.

To those skilled in the art, various modifications of my invention will suggest themselves, in view of the foregoing description of the embodiment which I prefer.

I claim:

1. Apparatus settable to produce a response only upon reception of a predetermined one of a plurality of periodically transmitted marking signals, said apparatus comprising a series of cathode ray tubes each having an electron gun the emission from which is controlled at least in part by said marking signals, and each having rotary beam deflecting means, and a plurality of target anodes, active and passive, means for applying quadrature-phased potentials to the deflecting means of each tube means for maintaining fixed multiple ratios between the scanning velocities in the several tubes, circuit means intercoupling an active target anode in one said tube and a control electrode in another said tube for at times aiding said marking signals in their control of the emission, means for setting each of said active target anodes in a predetermined angular relation to axes on which said quadrature phased potentials are applied, and a utilization device coupled to an active target anode in the tube whose beam rotates at the highest velocity, said utilization device being arranged to manifest said response only when the active target anodes in all said tubes are simultaneously impacted by the several electron beams.

2. An electronic counter comprising a plurality of cathode ray tubes, an electron gun, target anodes and rotative beam deflecting means in each tube, means including sources of polyphase potentials for actuating the beam deflecting means, at scanning velocities individual to each tube, an input circuit for each tube, said input circuit carrying a wave train the nth cycle of which is to be detected, the frequency of said wave train being harmonically related to each of said polyphase potentials, separate means responsive to the impact of electrons upon a particular target anode in each tube for designating a predetermined phase of each beam scanning cycle, and means responsive to the simultaneous occurrence of phase designations in all of the tubes for manifesting said nth cycle of the wave train.

3. An electronic counter according to claim 2 in which said polyphase potentials are decimally related to each other and to the frequency of said wave train.

4. An electronic counter according to claim 2 and including frequency dividers for deriving said polyphase potentials from said wave train, and phase shifters for maintaining a quadrature phase relation between two components of said potentials as applied in the deflecting means individual to each tube.

5. Apparatus for selecting a single cycle in a given wave train for control of a responsive device, said apparatus comprising a plurality of cathode ray tubes each having electrodes for producing an electron beam and target anodes toward which the beam is aimed, deflecting means associated with each tube for causing the beam therein to scan rotatively the target anodes of that tube, means including a wave energy source and frequency dividers acting upon the deflecting means of each tube to produce cyclic deflection

of the beam at different rates, each rate being one to which the frequency of the given wave train is harmonically related, means for orienting one of the target anodes in each tube with respect to the coordinate axes of the deflecting means, thereby to detect the instant when the beam passes through a predetermined phase of its scanning cycle, and means for combining the effects of the detections when they occur simultaneously in all of the tubes, thereby to pass a control pulse to said responsive device at the instant of reception of said single cycle of the wave train.

6. In combination, a source of periodic impulses, a set of cathode ray tubes each having a controlled electron gun together with means for rotatively deflecting its electron beam, a selecting and a non-selecting segmental target anode in each tube, circuit means including frequency dividers controlled by said impulses and energy

components derived therefrom for so controlling the rotative scanning velocities in the several tubes that a ten-to-one revolution ratio is maintained from tube to tube, circuits each intercoupling the selecting target of one tube and a control electrode in the gun of another tube in which the scanning velocity is greater, each said circuit constituting means for releasing electrons in the controlled gun only when the selecting target of the controlling tube is impacted by the electron beam therein, and a utilization device coupled to the selecting target in the tube wherein the scanning velocity is greatest.

7. The combination according to claim 6 and including means for adjustably orienting the selecting target in each tube with respect to a phase axis of reference pertaining to the beam deflecting means.

ALFRED N. GOLDSMITH.