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BINARY CODING AND DECODING TUBE OF THE CATHODE RAY TYPE

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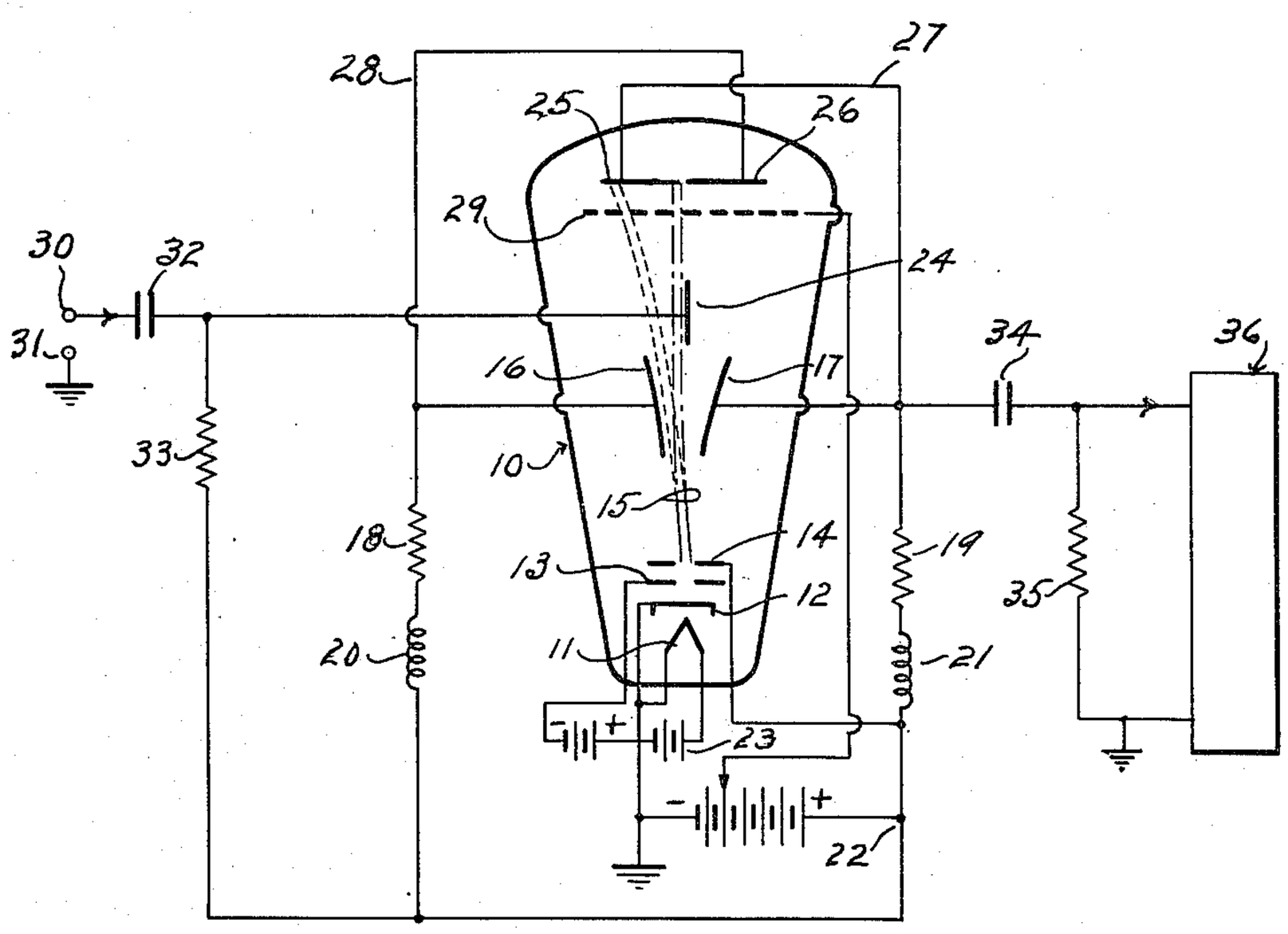

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BINARY CODING AND DECODING TUBE OF THE CATHODE RAY TYPE

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This invention relates to cathode-ray tubes and more especially it relates to such tubes particularly suitable for use in switching systems, such for example as so-called binary coding and decoding systems.

One of the well-known types of electronically controlled computers employs the so-called binary system of coding, wherein a cathode-ray beam is switched from one to the other of two targets. The two positions of the beam are used to control a so-called binary counter. Heretofore, in order to switch the beam, it has been necessary to employ relatively complex electronic switching apparatus for applying successively received pulses to the proper beam deflecting elements. Furthermore, it is highly desirable in many cases to be able to operate the counting apparatus or similar device in response only to coded pulses of the same polarity or phase.

Accordingly, one of the principal objects of this invention is to provide a simplified and reliable cathode-ray tube of the deflectable or flip-flop beam kind.

Another object is to provide an improved binary coding tube employing a shiftable cathode-ray beam.

A feature of the invention relates to a cathode-ray tube wherein the cathode-ray beam can be subjected to flip-flop action only in response to received pulses of the same sign or phase.

Another feature of the invention relates to a cathode-ray tube of the deflectable beam type wherein the beam has two different stable trajectories or positions and an intervening unstable trajectory or position so that the beam will always remain in either one of its two stable positions for input pulses of the same sign.

A further feature relates to the novel organization, arrangement and relative location and interconnection of parts which cooperate to provide an improved flip-flop switching system of the cathode-ray beam type.

Other features and advantages not particularly enumerated, will be apparent after a consideration of the following detailed descriptions and the appended claims.

In the drawing which shows, by way of example, one preferred embodiment of the invention, the numeral **10** represents any well-known evacuated enclosing bulb or envelope of glass or other suitable material. Suitably mounted within the tube at one end is an electron gun, comprising for example the heater element **11**, the electron-emitting cathode **12**, and successive beam-forming and electron-accelerating electrodes **13** and **14**. It will be understood, of course, that the invention is not limited to any particular kind of electron gun construction and therefore any electrode arrangement that is well-known in the cathode-ray tube art for producing a focussed beam **15** of cathode rays or electrons, can be used. The beam **15** passes between a pair of oppositely disposed metal plates **16**, **17**, each of which is connected through a respective resistor **18**, **19**, and respective series inductance, **20**, **21**, to the positive terminal **22** of the direct current power supply, such as is conventionally used with cathode-ray tubes. Likewise, the heater **11** is connected to a suitable heating source **23**, and the electrode **13** which for example may be the usual cathode-ray control-grid, can be negatively biassed with respect to the cathode, as indicated. When neither of the deflector plates **16**, **17** is energized, the beam **15** proceeds along a trajectory which extends equidistant from the said plates **16** and **17**.

Suitably mounted so as to be located in the path of this normal trajectory is another metal plate **24** which is mounted so as to be "edge-on" with respect to the beam. A pair of metal plates or targets **25**, **26**, are mounted at the opposite end of the tube and laterally displaced equally from the center line of the tube. The target **25** is connected directly by conductor **27** to the deflector plate **17**. Similarly the target **26** is connected by conductor **28** to the deflector plate **16**. Preferably, although not necessarily, a fine-wire open-mesh secondary electron suppressor grid **29** can be mounted in front of the targets **25**, **26**, to return to the target any secondary electrons that may be emitted therefrom. The targets are spaced apart by a relatively narrow gap which is narrower than the cross-sectional width of the beam **15**, so that as its intercept with one target is decreasing its intercept with the other target is increasing.

A suitable pulse input circuit of any well-known type for supplying positive pulses is connected to the input terminals **30**, **31**, and thence through the coupling condenser **32** to the electrode **24**. The said electrode **24** is also connected to the positive potential point **22** through a suitable resistor **33**. The target **25** may be coupled through a suitable condenser **34** and coupling resistor **35** to a suitable load circuit **36** which may be another tube similar to tube **10**.

In order to understand the operation of the tube **10**, let it be assumed that the beam **15** is in the dotted line deflected position where it impinges upon the target **25**. If a positive pulse is now applied through condenser **32** to electrode **24**, that electrode will attract the beam and cause it to swing toward the target **26**. When the beam assumes the dot-dash line trajectory as shown, it begins to leave the target **25** and as a result the potential of that target will rise because less electron current will flow through resistor **19**. At the same time, the potential of deflector plate **17** will also increase in the positive direction and this will aid in the swinging of the beam from target **25** to target **26**. When the beam begins to strike the left-hand edge of target **26**, electron current starts flowing from that target through resistor **18**. Consequently, the voltage on deflector **16** will start decreasing or start going negative from its average value. This will further tend to move the beam towards the right so that it completely impinges upon the target **26**. The net result of this action is that the positive pulse applied to electrode **24** will very rapidly swing the beam from target **25** to target **26**, where the beam remains in its second stable position.

The beam remains in this position until the receipt of the next positive pulse through condenser **32**. This positive pulse will now cause the beam to move towards the left until it begins to impinge upon the target **25**. In this case the potential on deflector **17** goes negative and tends to increase the deflection of the beam towards target **25**. Thus, a series of positive pulses received at the terminals **30**, **31**, will flip the beam **15** back and forth between the two targets **25** and **26** in synchronism with these pulses. In the absence of any such positive pulses, the beam will remain stably positioned on the last target upon which it had impinged. The purpose of the inductances **20**, **21**, in series with the resistors **18** and **19**, is to supply a fly-wheel action to make sure that the input pulse applied to electrode **24** will swing the beam past the dead center position. However, this extra fly-wheel action is not necessary in most cases since the dead center position of the beam is one of unstable equi-

librium and it has been found that the inductance of the circuit wires themselves will provide enough inductive or fly-wheel action. Preferably, the "edge-on" electrode **24** is thinner than the cross section of the beam so that it does not intercept too much of the electron beam as it is being flipped from one target to the other.

From the foregoing, it will be seen that the input pulses are not applied to the deflector plates but are applied to a separate trigger electrode **24** which is independent of the said deflector plates and the said electrode **24** is located in the position of unstable equilibrium of the beam. The arrangement disclosed therefore is to be distinguished from the so-called continuously oscillating cathode-ray beam type of tube where the beam continuously oscillates back and forth between the pair of output electrodes. In the system as disclosed, the beam stays put on the particular target electrode to which it has been deflected in response to the last received pulse, and it responds only to positive pulses applied to the electrode **24**.

While one particular embodiment has been disclosed herein, various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A cathode-ray tube of the type described comprising in combination, means to develop a cathode-ray beam, a pair of target electrodes upon which the beam is to impinge alternately, a pair of beam deflector electrodes, a beam triggering deflection electrode, said triggering electrode being located between said deflecting electrodes and said target electrodes and symmetrically located with respect thereto, and means to apply positive impulses to said triggering electrode to switch the beam alternately in opposite directions from one target to the other in step with said impulses.

2. A cathode-ray tube of the type described comprising in combination, means to develop a cathode-ray beam, a pair of target electrodes upon which the beam is alternately to impinge, a pair of beam deflector electrodes, said beam in the absence of potentials on said deflector electrodes following a substantially straight line trajectory located symmetrically between said deflector electrodes, a beam triggering deflection electrode located in the path of said trajectory and symmetrically between said deflectors and targets, means to apply positive impulses to said triggering electrode to switch the beam alternately in opposite directions from one target to the other in step with said impulses.

3. A cathode-ray tube according to claim 2, in which one of said targets and one of said deflector electrodes is located to one side of said trajectory, and the other of said targets and the other of said deflector electrodes is located to the other side of said trajectory, said one of said targets being directly connected to said other deflector, and said other target being directly connected to said one of said deflector electrodes.

4. Cathode-ray tube apparatus of the type described, comprising in combination, an electron gun to develop a focussed beam of electrons tending to follow a straight line trajectory, a first deflector electrode, a first target electrode, a second deflector electrode, a second target electrode, said first deflector electrode and said first target electrode being located to one side of said trajectory, said second deflector electrode and said target being located to the other side of said trajectory, a beam triggering deflection electrode mounted in the path of said trajectory, a source of positive impulses for said triggering electrode and circuit connections between all said electrodes and gun to cause the beam to stay put alternately on said targets in response to successive received positive impulses on said triggering electrode.

5. Cathode-ray tube apparatus according to claim 4, in which both of said deflector electrodes are statically biassed to substantially the same positive direct current potential and each of said deflector electrodes is connected to the cathode of the electron gun through a respective load resistor, each load resistor being connected to a corresponding one of said targets.

6. Cathode-ray tube apparatus according to claim 5, in which each of said deflector electrodes is connected to the positive terminal of a direct current power supply through a respective load resistor, said load resistors being connected to respective ones of said targets, and said triggering electrode is also connected to said positive potential.

7. Apparatus according to claim 6 in which each of said resistors is connected in series with an inductance.

8. Cathode-ray tube apparatus according to claim 4, in which said triggering electrode is in the form of a flat metal plate which is mounted "edge-on" with respect to said trajectory.

9. A cathode-ray beam tube for binary computing systems and the like comprising in combination, an evacuated enclosing envelope containing an electron gun for developing an electron beam, a pair of output targets upon which the gun is arranged to impinge alternately, a set of three beam deflector plates, two of said plates being biassed to substantially the same positive potential, a source of positive impulses, means connecting the third deflector plate to said source of positive impulses, and circuit connections between said targets and said first two plates to cause successive positive impulses on said third deflector plate to flip the beam in opposite directions from one target to the other in step with said impulses.

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