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2,416,914

ELECTRON DISCHARGE DEVICE

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Fig. 1.

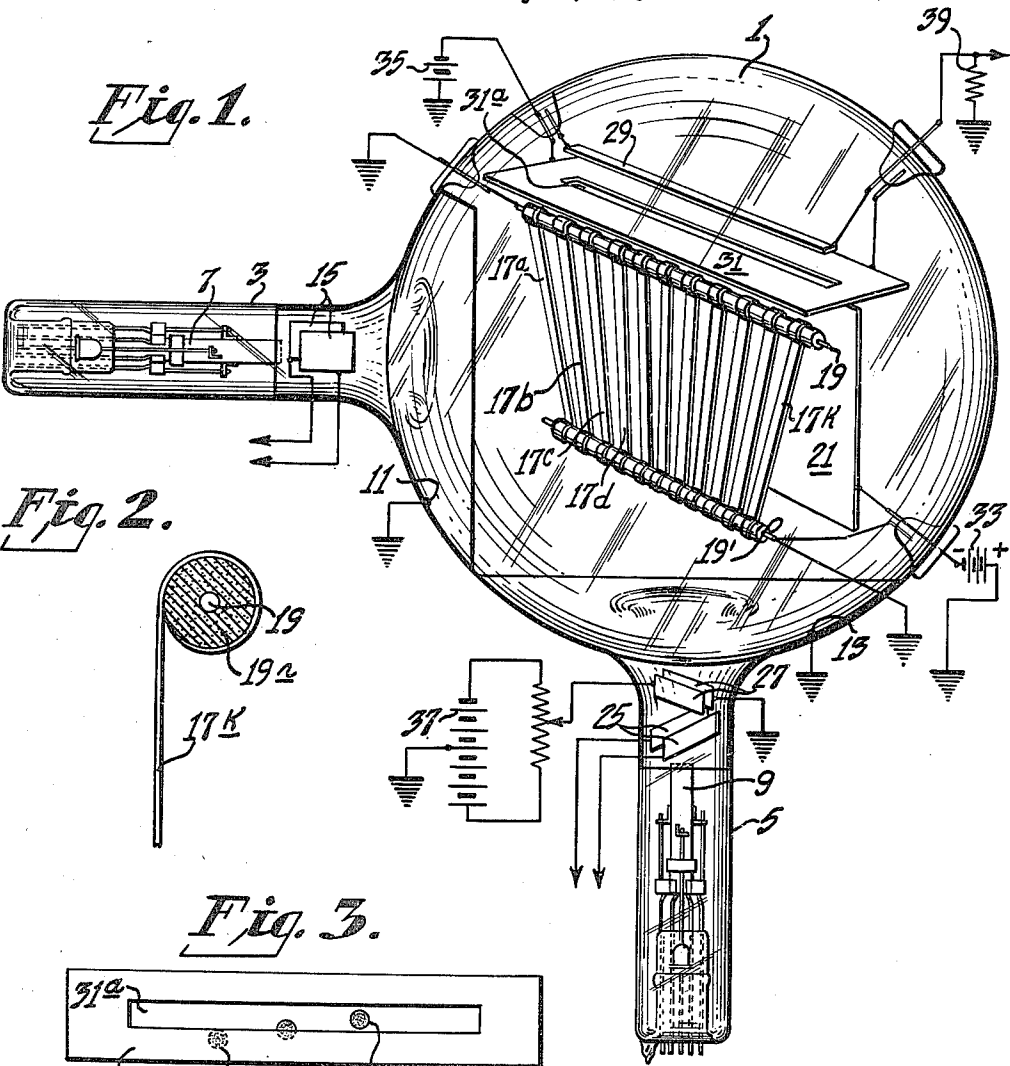


Fig. 2.

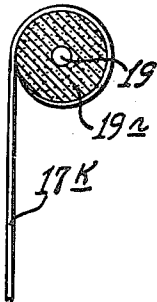


Fig. 3.

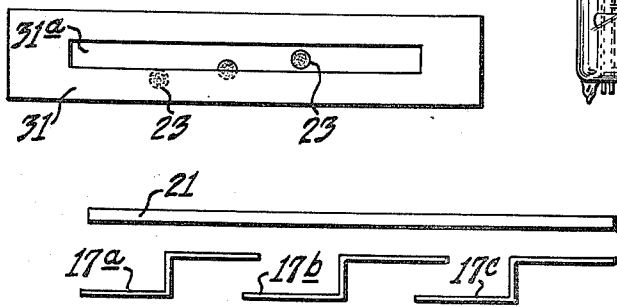


Fig. 4.

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ELECTRON DISCHARGE DEVICE

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13 Claims. (Cl. 250-150)

1 This invention relates to electron discharge de-
vices and particularly to so called plural-beam
cathode ray tubes.

Cathode ray tubes are known wherein a signal
is put on a storage screen by one electron beam
and taken off the screen by a second electron
beam. Such tubes find useful application, by way
of example, in radar and other systems for the
communication of intelligence where they may
be employed to improve the signal-to-noise ratio
by "averaging-out" undesired components from
the signal-bearing pulses or waves.

The storage screens used in such tubes have
heretofore comprised either a two-sided mosaic,
in which case the "put-on" and "take-off" beams
are directed upon opposite sides of the screen
(see British Patent 501,179), or a single-sided
caesiated screen of a special (commutator-type)
laminated construction. In this latter case both
beams usually impinge the same side of the
screen, preferably at different velocities (as to
this, see pending application Serial No. 492,658,
filed June 26, 1943).

Irrespective of the advantages claimed for the
plural beam tubes of the prior art, it may be said,
generally, that the insulation and other problems
incident to the construction and use of their
"mosaic type" or "commutator type" signal-storage
electrodes renders such tubes more expensive
and difficult to manufacture and service than is
necessary or desirable.

Accordingly, an important object of the present
invention is to provide an improved cathode
ray tube incorporating a signal-storage electrode
of a novel construction which (a) presents sub-
stantially no insulation problems either in its
manufacture or use, and (b) dispenses entirely
with caesium and other "activating" agents.

Another and related object of the present in-
vention is to provide a simple, inexpensive and
trouble-free plural-beam cathode ray tube and
one capable of "averaging-out" undesired com-
ponents from the signal waves or pulses in radio,
radar and analogous systems for the communica-
tion of intelligence.

Other objects and advantages will be apparent
and the invention itself will be best understood
by reference to the following specification and to
the accompanying drawing, wherein

Fig. 1 is a perspective view of a plural beam
tube constructed in accordance with the principle
of the invention and showing certain electrical
connections thereto,

Fig. 2 is an enlarged end view of one of the

2 resistive supports for the slat-like armature or
electrodes of Fig. 1,

Fig. 3 is a plan view of the slatted masking
electrode of Fig. 1 and showing how the beam
from the "vertical" electron-gun is deflected, and

Fig. 4 is a plan view showing an alternative
target electrode assembly.

In Fig. 1 of the drawing, 1 designates the bulb-
ous portion of a highly evacuated tube or enve-
lope having two hollow neck portions 2 and 5
each of which contains an electron gun, 7 and 9,
respectively, which are directed inwardly to the
center of the bulb along axes spaced substan-
tially 90° apart. As in standard practice, ground-
ed metallic coatings 11 and 13 on the inner sur-
face of the tube serve as the second anodes for
these "guns" 7 and 9. The gun 7 is provided
with a single pair of deflecting plates 15 which
are arranged to move the electron beam, which
passes therebetween, to and fro across a number
of spaced metal strips 17a, 17k, which are sup-
ported in a common plane normal to the axis of
the gun 7 on two rod-like members comprising
separate wires 19, 19', coated with a resistive
material, 19r (Fig. 2), such for example as carbon
or graphite. A metal plate 21 is supported be-
hind the spaced metal strips 17 in a plane parallel
to the plane of said strips and spaced therefrom.
This metal plate 21 is in useful capacitive rela-
tion with the several spaced metal strips 17a,
17k and thus may be said to comprise a common
armature for a number of discrete capacitors
which are connected (in parallel relation) to
ground through the carbon resistors 19r. The
use of the common armature 21 for all these
capacitors obviously is to be preferred to the use
of a number of separately paired armatures.

The electron beam 23 (see Fig. 3) from the
other gun 9 is directed into and scans the vac-
uous space between the back plate 21 and the
strip-like structure 17. To this end, the gun 9
is provided with a pair of deflecting plates 25 and
a second pair of plates 27 which may be employed
in centering said beam. This beam 23 is directed
toward a collector electrode 29 which is mounted
behind a longitudinal slot 31a in a masking plate
31 which is mounted in a plane normal to the
axis of the gun 9 on the remote side of the said
inter-armature space. It will be observed that
the metal strips or armatures 17a, 17k are ar-
ranged like the sticks of a fan whose "pivot" or
center lies adjacent to the deflector plates 25
of the electron gun 9. Thus the electron beam 23
from the gun 9 in sweeping the vacuous space
between the armatures 17-21 will not be in reg-

ister with more than one of the metal strips 17a, 17b, etc. at any given moment. It is therefore apparent that if this beam 23 is deflected at any given point within the said space the deflection will be a function of the charge upon the particular armature (17a or 17b, etc.) with which the beam is in register at the moment it is deflected.

As indicated in Fig. 1 the relative potential distribution among the electrodes is preferably (but not necessarily) as follows: The several armature strips 17a, 17b, etc. are connected through the resistive material 19r, and wires 19, 19' to ground. The common armature or back plate 21 and the masking electrode 31 are maintained slightly negative with respect to ground, as by the batteries 33 and 35, respectively. A third battery 37 connected to the centering electrodes 27 serves to position the beam 23 from the electron gun 9 with respect to the slot 31a in the masking electrode 31. The deflecting electrodes 25 for the gun 9 are connected to a suitable deflecting circuit (not shown) but which will be understood to have a time cycle sufficiently rapid to ensure persistence of vision when the target electrode 29 is connected (as through a resistor 39) to an image tube, not shown.

The signal-bearing noise-affected pulses or waves are applied to the grid of the first gun 7, and the beam from the said gun, thus modulated, is moved rapidly to and fro across the capacitor strips 17a, 17k, in synchronism with the received pulses by the deflecting circuit which is connected to the horizontal deflecting plates 15. It is apparent that since the strips 17a, 17k are connected to ground through the resistors 19r each strip will accumulate an electron-charge (from the beam) which is of "average intensity." That is to say, the charge on each strip is not the result of a single excursion of the beam but is the result of many excursions. Now, since the "noise peaks" tend, over a period of time, to be of a uniform average intensity, it is apparent that the charge on each strip in any given period (of sufficient length) will tend to be the same intensity and will tend to deflect the beam 23 (from the other gun 9) a definite lateral distance with respect to the edge of the slot 31a in the masking electrode 31. Thus, referring now to Fig. 3, if the beam 23 (from the gun 9) is so oriented (by adjusting the potential supplied to its centering electrodes 27 by the battery 37) that in the absence of signal it will impinge the masking electrode 31 (instead of passing through the slot 31a), the "noise" will not be transmitted to the output or target electrode 29. On the other hand, when a signal bearing pulse or wave is applied to the grid of the gun 7 the resulting additional charge developed upon the slot-like armatures 17a, 17k and occasioned by the presence of the signal on the said beam will cause the beam 23 from the other gun (9) to be deflected laterally, so that the said beam passes through the slot 31a in the masking plate 31 and impinges the target electrode 29, thereby recreating only the signal pulse or wave in the output circuit of the device. It is, of course, apparent that if desired the beam 23 may be originally so oriented that it is partly or entirely centered within the slot 31a. In the last mentioned case the added signal (or other pulse or wave or voltage) will cause the said beam to be directed upon the masking electrode 31 rather than upon the target electrode 29.

The fan-shape pattern of the capacitor armatures 17a, 17k permits of a more compact elec-

trode assembly than would be the case if these slot-like electrodes were all arranged in parallel vertical array, since in the latter case the gun 9 would have to be disposed farther away from the interarmature space if the electron beam is to be prevented from being in register with more than one slot at any given moment.

The invention is susceptible of other modifications. Thus, in some cases it is desirable to prevent the signal-bearing beam from the gun 7 from passing between the slats 17a, etc. and impinging the "back plate" 21. In this event the slats may be arranged in overlapping relation, for example in the manner indicated in Fig. 4.

Numerous other modifications and applications of the invention will suggest themselves to those skilled in the arts to which the invention appertains. Accordingly, the foregoing description of a preferred embodiment of the invention is to be interpreted as illustrative and not in a limiting sense except as required by the prior art and by the spirit of the appended claims.

What is claimed is:

1. An electron discharge device comprising an evacuated envelope, a plurality of pairs of capacitor armatures mounted within said envelope with one armature of each pair arranged substantially in a common plane and presented in useful capacitive relation across an intervening space to the armature with which it is paired, an electron-gun mounted to project a stream of electrons upon said first mentioned armatures, a second electron-gun mounted to project a beam of electrons through said intervening space along an axis substantially parallel to said common plane, and an output electrode assembly mounted on the side of said intervening space which is remote from said second electron-gun and upon which the electrons from said second gun impinge.
2. The invention as set forth in claim 1 and wherein said first mentioned electron-gun is provided with means for directing the stream of electrons therefrom to and fro across the armatures which are mounted in said common plane.
3. The invention as set forth in claim 1 and wherein said second mentioned electron-gun is provided with means for centering the beam therefrom with respect to a selected point upon said output electrode assembly.
4. The invention as set forth in claim 1 and wherein said second mentioned electron-gun is provided with means for directing the beam of electrons therefrom to and fro within said intervening space in a direction substantially parallel to said common plane.
5. The invention as set forth in claim 1 and wherein the armatures mounted in said common plane comprise a multiplicity of metal slats arranged like the sticks of a fan whose "pivot" lies adjacent to the leading end of said second mentioned electron-gun.
6. The invention as set forth in claim 1 and wherein one armature of each pair comprises a common armature.
7. The invention as set forth in claim 1 and wherein said plurality of pairs of capacitor armatures are connected in parallel.
8. The invention as set forth in claim 1 and wherein resistive means are provided for coupling the armatures in said common plane to ground.
9. The invention as set forth in claim 1 and wherein said output electrode assembly comprises a mask having a slit therein and a target

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electrode mounted in register with said slit on the remote side of said mask.

10. The invention as set forth in claim 1 and wherein the armatures in said common plane are mounted in overlapping relation.

11. An electron discharge device comprising an evacuated envelope containing a plurality of pairs of capacitor armatures mounted in substantially parallel planes with one armature of each pair presented in useful capacitive relation across an intervening space to the armature with which it is paired, means for generating and projecting a beam of electrons through said intervening space in a direction substantially parallel to the planes of said armatures, an output electrode assembly mounted in the path of said beam adjacent to that boundary of said space which is remote from the source of said beam, said output electrode assembly comprising a masking electrode having an aperture therein and a target electrode mounted in register with said aperture, and means for creating discrete differences in potential among said capacitor armatures whereby to deflect said electron beam laterally with respect to said masking and target electrodes and to thereby proportionately vary the beam current impinging the said electrodes.

12. The invention as set forth in claim 11 and wherein the means for creating discrete differences in potential among said capacitor armatures comprises means for generating and projecting a signal modulated beam of electrons upon one armature of each of said pairs.

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13. Method of averaging-out noise from noise-affected signal bearing waves in a signaling circuit including a plurality of capacitors of the type having spaced apart armatures, said method comprising generating a stream of electrons, directing said stream of electrons longitudinally through said interarmature space toward a target, generating a second stream of electrons, impressing the noise affected waves upon said second beam and rapidly scanning one armature of each capacitor with said second beam to establish an electrostatic field among said armatures proportional to the average of the noise during several excursions of said second beam, adjusting the position of said first mentioned beam so that it is deflected away from its target by the said average electrostatic field and is directed upon said target when said signal bearing waves are applied to said noise affected second electron beam.

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The following references are of record in the file of this patent:

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