July 3, 1956 J. H. BRYANT ET AL 2,753,484

SIGNAL INDICATING DEVICE

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Fig. 1

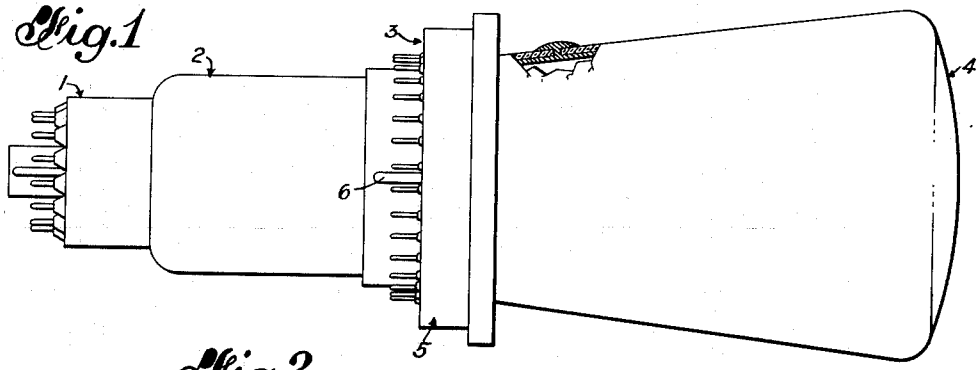


Fig. 2

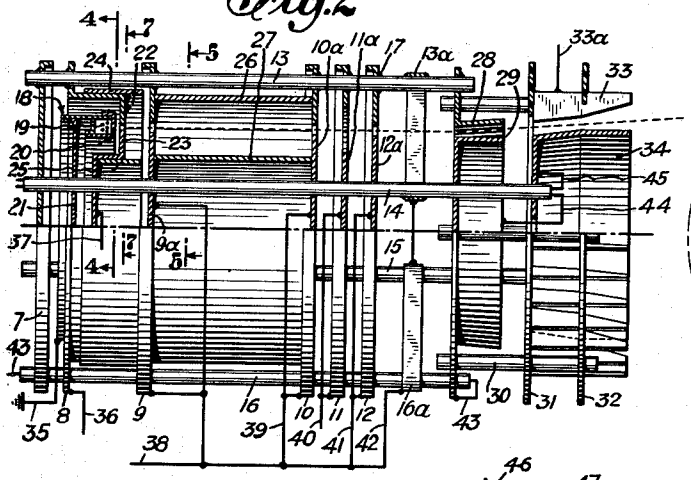


Fig. 3

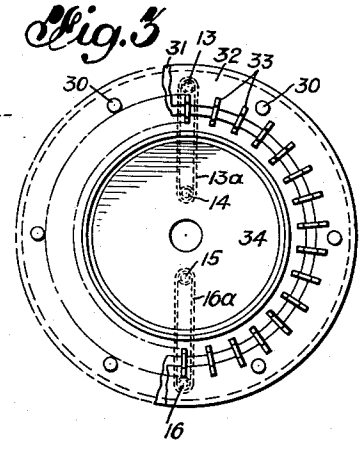




Fig. 1A

Fig. 4

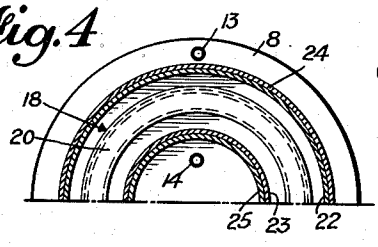
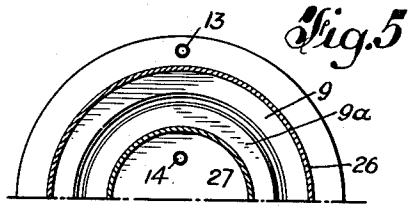


Fig. 5



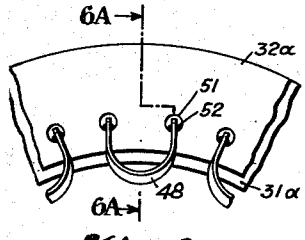


Fig. 6

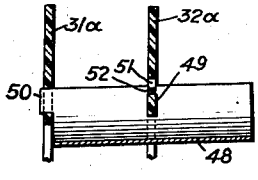
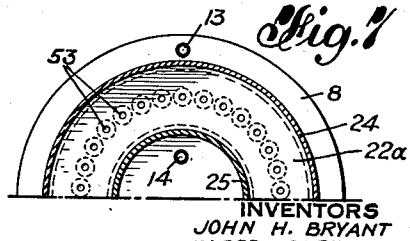


Fig. 6A

Fig. 7



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SIGNAL INDICATING DEVICE

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7 Claims. (Cl. 315—13)

This invention relates to signal indicating devices and more particularly to a cathode ray device for indicating the simultaneous reception of signals from a plurality of signal sources.

It has been proposed heretofore to provide a plurality of electron guns in a single envelope for producing a plurality of electron beams upon which signals from separate sources may cause simultaneous deflection of corresponding beams. This multigun arrangement, however, is expensive and cumbersome to build and, furthermore, is limited to the number of guns that may be provided in a single envelope. In another proposed arrangement a single gun is provided to produce a pencil-like beam together with means for continuously rotating the beam past a plurality of electrodes to which signals may be applied. This arrangement is not capable of producing simultaneous signal indications where the signals are of a duration shorter than the cyclic timing of the beam rotation for the reason that the signal occurrence may not coincide with the beam. To overcome this difficulty, the duration of the signal must be made equal to one or more cycles of beam rotation. Such provision, however, is limited particularly where the cyclic speed of beam rotation is less than the duration of desired signals.

An object of this invention is to provide a cathode ray device for simultaneous indication of signals, regardless of signal duration, from a plurality of different signal sources.

Another object of the invention is to provide a cathode ray device to produce an electron beam of either flat or tubular cross-section, together with means for effecting simultaneous deflection of different portions of the beam in response to a plurality of different signal sources.

One of the features of the invention is the provision of a combination electron gun and signal deflection electrode assembly whereby an electron beam of substantially uniform thickness in cross-section is produced adjacent a plurality of deflecting electrodes to which signal potentials from a plurality of different sources may be applied. The uniform characteristic of the beam may be obtained in different ways, the beam, for example, may be flat and sheet-like in form, or it may be tubular, or it may be subdivided into a plurality of electron streams disposed in close adjacent side-by-side relation. Whether the beam is of continuous sheet-form or a closely arranged series of electron streams, the overall effect is that such a beam or plurality of beams are maintained continuous so that any signal potentials occurring simultaneously on associated electrodes will result in simultaneous deflection of corresponding portions of the electron beam or beams. The electron beam may be directed at a screen whereby deflections of portions thereof may be observed visually or they may be projected on or adjacent a series of targets whereby deflection is detected by movement of the beam portions relative to such targets.

Another feature of the invention is the provision of a deflecting electrode of a form such as to properly focus the deflected electrons of the associated beam to produce a relatively sharp deflection indication. This is particularly important when used in conjunction with targets or a finely calibrated screen.

The above-mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 shows in side elevation a cathode ray device in accordance with the principles of this invention;

Fig. 1A shows a deflection of a portion of the beam as it appears on the screen;

Fig. 2 shows a view partly in longitudinal section and side elevation of the combination gun and signal deflecting electrode assembly of the device;

Fig. 3 shows an end view of the electrode assembly as viewed from the right hand side of Fig. 2 with parts broken away showing the beam diameter control electrodes;

Figs. 4 and 5 are cross-sectional views showing the upper halves of the gun assembly as indicated on lines 4—4 and 5—5, respectively, of Fig. 2;

Fig. 6 is a view in end elevation of a fragmentary portion of the deflecting electrodes showing a modification of the invention;

Fig. 6A is a cross-sectional view taken substantially along line 6A—6A of Fig. 6; and

Fig. 7 is a cross-sectional view corresponding to a view taken along line 7—7 of Fig. 2 illustrating another modification of the invention.

Referring particularly to Figs. 1 to 5, the cathode ray device of this invention is shown to comprise a pin base **1** adapted to be received in a suitable socket, a gun section **2**, a signal input section **3**, and a screen **4**. The signal input section also includes a pin base **5** to which an annular socket may be applied for engagement with the pins, a key pin **6** being provided to align the socket and pin base.

The pin base **1** is of conventional form, the pins thereof having connected thereto leads leading to the several electrodes of the gun. As shown in Fig. 2, the gun structure comprises an end supporting plate **7**, a grid **8**, a series of anode electrodes **9**—**9***a*, **10**—**10***a*, **11**—**11***a*, and **12**—**12***a* through which are disposed a plurality of ceramic tie rods, four of which are shown at **13**, **14**, **15**, and **16**. The plates **7** through **12***a* and the tie rods are assembled together by a suitable cement **17**, such as sauereisen cement No. 7. Tie strips, such as indicated at **13***a* and **16***a*, are looped and secured about pairs of ceramic rods toward the front end of the gun assembly to rigidify the assembly. Adjacent the end plate **7** is mounted a cathode assembly **18** comprising a heater coil **19**, an emissive surface **20**, and a combination stiffening plate and heat shield **21**. The end plate **7** also functions as a heat shield in addition to the plate **21**. The emissive surface **20** is preferably annular as more clearly indicated in Fig. 4. The grid **8** is disposed closely adjacent the cathode assembly and is provided with an annular portion which is divided into an outer portion **22** and an inner portion **23**, with an annular space therebetween. The outer portion **22** is supported by the outer tie rods **13**, **16** while the inner portion **23** is supported by the inner tie rods, such as **14**, **15**. The grid portions **22** and **23** are also provided with skirt portions **24** and **25** which extend within a short distance of anode plates **9**—**9***a*.

Adjacent the grid **8** is an accelerator anode assembly which includes anode electrodes **9**—**9***a* and **10**—**10***a* interconnected by two cylindrical members **26** and **27**, which provide an accelerating passageway for the elec-

tron emission from the cathode. At the extreme end of the ceramic rods 13 and 16 forward of the anode 12—12*a* are two electrodes 28 and 29 disposed for controlling the diameter of the beam as it impinges upon the screen 4. The outer electrode 28 is supported on the outer ceramic rods while the inner electrode 29 is supported by the inner rods 14, 15. These electrodes have surfaces extending in the direction of beam travel to which potentials may be applied so that the desired flaring of the hollow tubular beam can be obtainable.

Carried by the annular electrode 28 are a plurality of ceramic rods, such as indicated at 30, onto which are mounted two annular pieces of insulation 31 and 32, the insulating material being preferably mica, although other equivalent material may be used. Mounted on the annular pieces 31 and 32 is a plurality of signal input electrodes, such as indicated at 33, Figs. 2 and 3, the number of electrodes 33 in the present embodiment being thirty although a greater or lesser number may be provided as may be desired. Spaced inwardly from the series of electrodes 33 is a cylindrical electrode 34 which is carried on the innermost supporting rods 14, 15.

The leads to the various electrodes are provided substantially as illustrated in Fig. 2. The cathode potential is controlled by a lead 35. The leads for the coil 19 are not shown but are led out through the plate 7 for connection to certain of the pins in unit 1. The grid portions 22 and 23 are provided with leads as indicated at 36 and 37, a suitable voltage for these two leads being in the neighborhood of —30 volts. The accelerator anodes 9—9*a* and 10—10*a* are provided with leads 38 and 39. The anode 11—11*a* is provided with a lead 40. Anode 12—12*a* is coupled to lead 38 by connection 41. Typical voltages that may be applied to the leads 38 and 40 are 3000 and 1000 volts, respectively. The three anode groups 10—10*a*, 11—11*a*, and 12—12*a* provide a lens action for concentrating the electron flow. The space between the electrodes 11 and 11*a* is normally greater than the space between the electrodes 10—10*a* and 12—12*a*, as illustrated in Fig. 2. The supporting strips 13*a*, 16*a* are also coupled to the lead 38 as indicated at 42 so as to apply a potential substantially identical to the potential on the anode 12—12*a* to minimize any tendency of the supporting strips to otherwise defocus the electron flow. The material selected for the anode electrodes and the strips 13*a*, 16*a* is preferably a non-magnetic material, such as Monel.

The leads 43 and 44 for the electrodes 28 and 29 may be led back through the ceramic rods which preferably are tubular for this purpose. The potentials applied to the electrodes 28 and 29 average the same potential as applied to the next adjacent anode 12—12*a*, the differences between the two electrodes being balanced relative the potential value applied to anode 12—12*a*. By varying this balanced voltage the diameter of the tubular electron stream impinging on the screen 4 may be adjusted at will.

Signal input connections 33*a* from each of the pins of the base 3 are connected to corresponding ones of the deflecting plates or electrodes 33. The inner electrode 34 is provided with a lead 45 to which a voltage substantially identical to the voltage applied to the anode 12—12*a* is applied.

During operation, the signals either pulse or CW, modulated or unmodulated, are applied to the electrodes 33. The signal voltages thus representing signals received from a plurality of different sources produce deflections of the adjacent portions of the electron beam thereby producing visual indications on the screen 4. These visual indications are in the form of pips 46 and 47, similar to that indicated in Fig. 1A. These pips may vary in amplitude in accordance with the strength of the signal voltage. Where the signal voltage is high, it is found that unless the electrodes 33 are carefully shaped, the pips tend to have a bulging shape.

Figs. 6 and 6A show a form of electrode which provides a desired focusing effect for the deflected electrons so as to insure the provision of a sharply peaked pip regardless of the variation of signal voltage that may be received. These electrodes 48 are generally U-shaped in cross-section, as indicated in the end view shown in Fig. 6. These electrodes 48 extend substantially parallel to the path of electron flow similar to the electrodes 33. Each electrode 48 is provided with a slot 49 to receive the insulating disc 32*a* and tongue-like extensions 50 at one end for reception in openings contained in the insulating disc 31*a*, the tongue being bent for anchorage to the disc. The disc 32*a* is provided with openings 51 in which the lateral edges of the electrodes 48 are anchored by a suitable cement 52. The curvature of the U-shaped electrodes 48, substantially as shown, provides for a gradual increase in deflection of the adjacent electrons from the lateral edges toward the center line of the electrode, thereby insuring a sharply defined deflection pip on the screen for wide variations in signal voltage. Where desired, the screen 4 may be calibrated to indicate the signal sources producing the pips.

In Fig. 7 a cross-sectional view is shown, taken substantially along line 7—7 of Fig. 2, showing a modified form of grid that may be used in conjunction with an annular cathode. The grid 22*a* in this embodiment comprises a series of apertures 53 whereby a series of electron streams are provided in closely spaced relation but in alignment with the signal electrodes 33 or 48, as the case may be. The electron gun in accordance with this embodiment may have anodes as illustrated in connection with the embodiment shown in Figs. 2 to 5, or certain of those electrodes may likewise be provided with apertures, particularly anodes 9, 10 and 12. The visual indications formed on the screen 4 comprise in this embodiment a series of illuminous spots one each corresponding to each of the signal electrodes. Since the electron flow for each illuminous spot is continuous signals regardless of duration and time of reception on the electrodes will produce deflections of the corresponding illuminous spots on the screen.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention, as set forth in the objects thereof and in the accompanying claims.

We claim:

1. A cathode ray device capable of indicating the simultaneous occurrence of a plurality of signals comprising means for producing a tubular electron beam, the tubular wall of which is of substantially uniform thickness in cross-section, at least one electrode disposed adjacent the inner surface of said beam, a plurality of electrodes disposed in spaced relation adjacent the outer surface of said beam and means to apply signal potentials to respective ones of said plurality of electrodes to deflect radially corresponding portions of said beam, said means for producing said tubular beam including a plurality of focusing electrodes certain of which have a series of openings therethrough, said openings being arranged in spaced relation to divide said tubular beam into a plurality of pencil-like streams, each pencil-like stream being disposed adjacent one of said plurality of electrodes.

2. A cathode ray device according to claim 1, wherein said means for producing said tubular beam includes a plurality of electron emissive bodies.

3. A cathode ray device according to claim 1, wherein said means for producing an electron beam includes an annular electron emissive means and said series of openings describe a circle in alignment with said electron emissive means.

4. A cathode ray device according to claim 1, wherein each of said plurality of electrodes comprised a conductor U-shaped in cross-section and of a length at least equal to the width thereof.

5. In a cathode ray device having an electron gun and deflection electrode assembly, a base plate, an annular cathode, a grid electrode, an accelerating electrode, and an anode electrode, said electrodes being disposed in spaced relation with passageways therethrough in substantial alignment with portions of said cathode, a plurality of electron deflection electrodes disposed in annular arrangement adjacent one side of the path of the electron flow determined by said electrode passageways, a plurality of insulating elements extending lengthwise of said electrodes to maintain said end plate, said cathode and said electrodes in spaced relation, certain of said electrodes having two parts with an annular passageway therebetween, the inner electrode parts being mounted on inwardly disposed ones of said insulating elements and the outer electrode parts being mounted on outwardly disposed ones of said insulating elements, and means spaced forward of said end plate to brace said elements radially to form a rigid electrode assembly.

6. In a cathode ray device having an electron gun and deflection electrode assembly, a base plate, an annular cathode, a grid electrode, an accelerating electrode, and an anode electrode, said electrodes being disposed in spaced relation with passageways therethrough in substantial alignment with portions of said cathodes, a plurality of electron deflection electrodes disposed in annular arrangement adjacent one side of the path of the electron flow determined by said electrode passageways and a pair of annular insulating members to support said deflecting electrodes circumferentially of the path of electron flow, each of said deflecting electrodes comprising a tapered conductor extending in the direction of electron flow.

7. In a cathode ray device having an electron gun and deflection electrode assembly, a base plate, an annular cathode, a grid electrode, an accelerating electrode, and an anode electrode, said electrodes being disposed in spaced relation with passageways therethrough in substantial alignment with portions of said cathode, a plurality of electron deflection electrodes disposed in annular arrangement adjacent one side of the path of the electron flow determined by said electrode passageways and a pair of annular insulating members to support said deflecting electrodes circumferentially of the path of electron flow, each of said deflecting electrodes comprising U-shaped members in cross-section with the curved portions thereof extending adjacent but laterally with respect to the direction of electron flow.

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