

July 29, 1941.

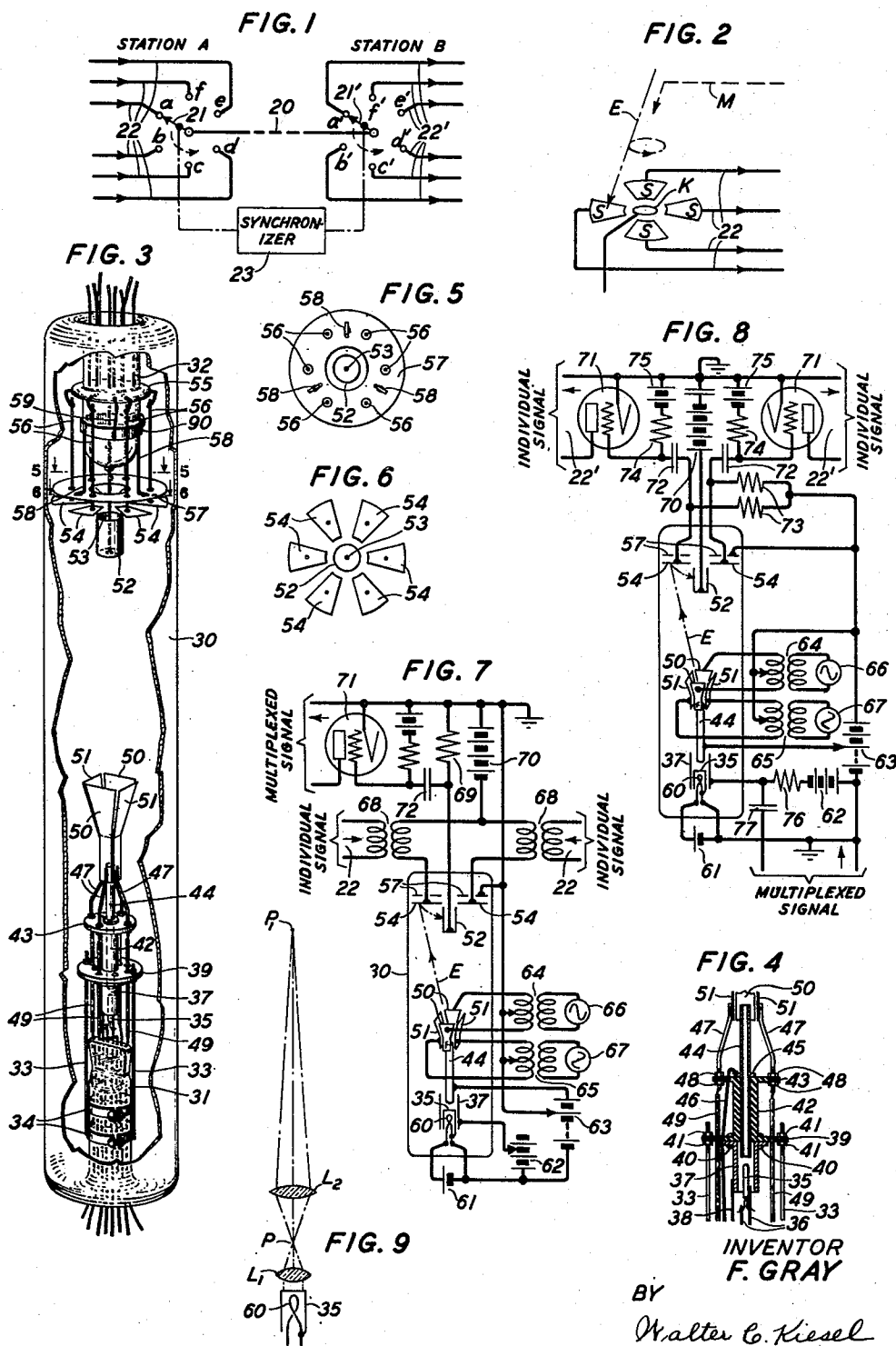
F. GRAY

2,250,527

SIGNAL TRANSLATING APPARATUS

Filed Feb. 11, 1939

3 Sheets-Sheet 1



BY

Walter C. Kiesel
ATTORNEY

July 29, 1941.

F. GRAY

2,250,527

SIGNAL TRANSLATING APPARATUS

Filed Feb. 11, 1939

3 Sheets-Sheet 2

FIG. 10

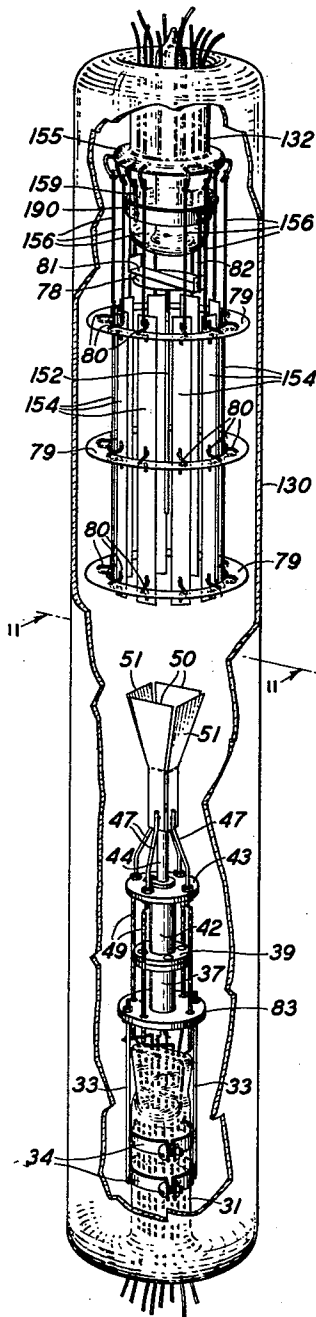


FIG. 11

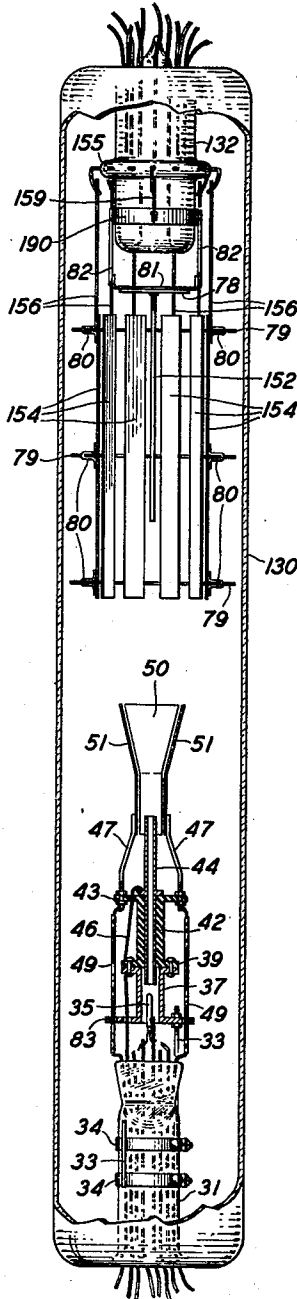
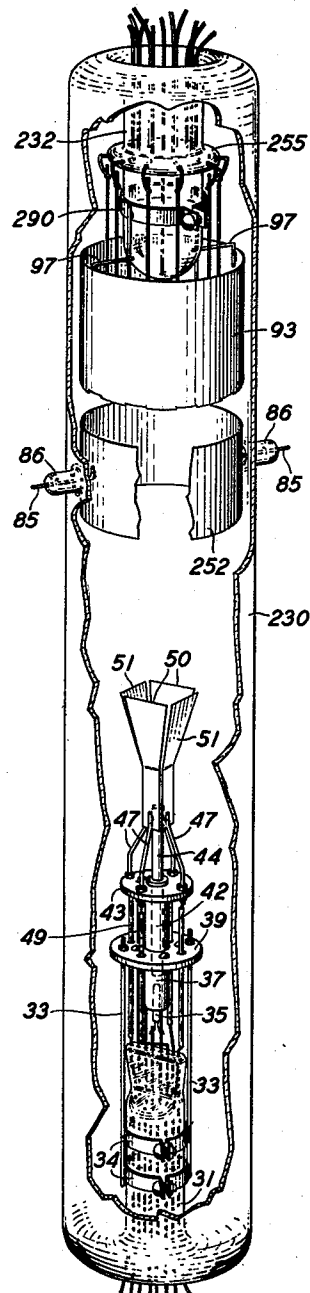


FIG. 12



INVENTOR
F. GRAY
BY

Walter C. Kiesel
ATTORNEY

July 29, 1941.

F. GRAY

2,250,527

SIGNAL TRANSLATING APPARATUS

Filed Feb. 11, 1939

3 Sheets-Sheet 3

FIG. 13

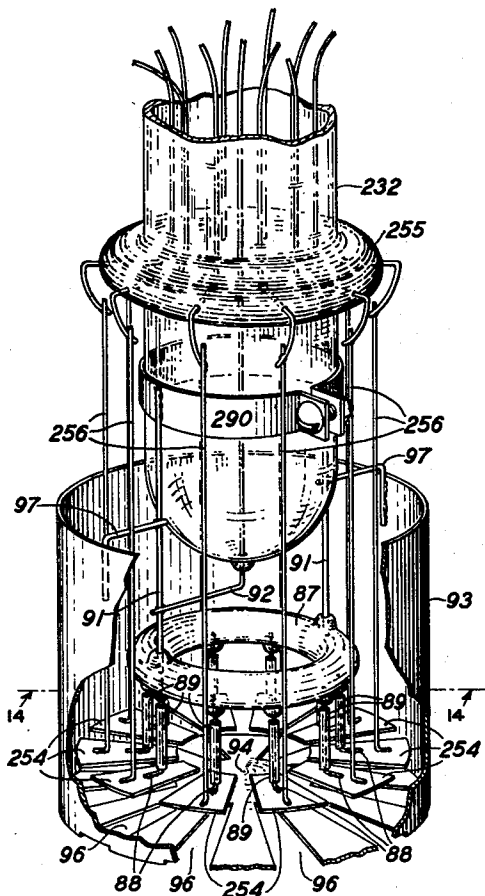


FIG. 14

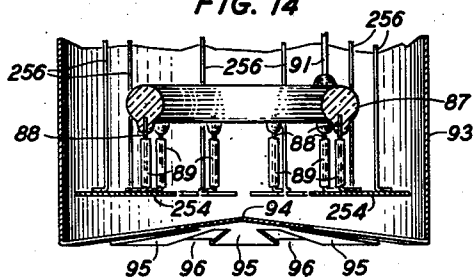


FIG. 17

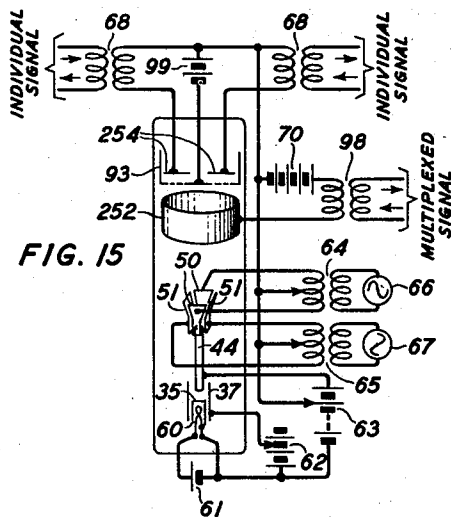
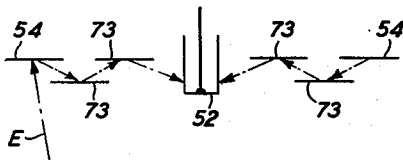
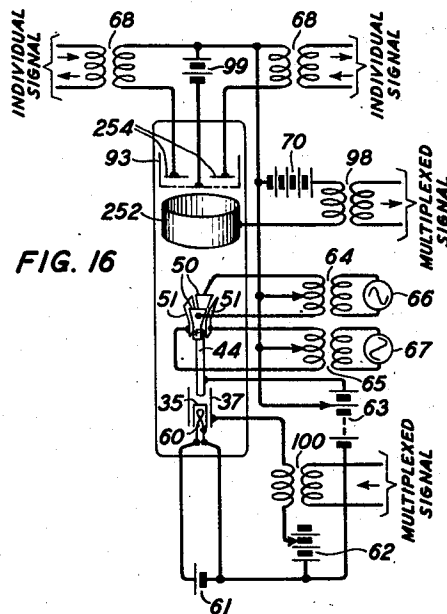


FIG. 16



INVENTOR
F. GRAY

BY

Walter C. Kiesel
ATTORNEY

UNITED STATES PATENT OFFICE

2,250,527

SIGNAL TRANSLATING APPARATUS

Frank Gray, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application February 11, 1939, Serial No. 255,897

13 Claims. (Cl. 250—152)

This invention relates to signal translating apparatus and more particularly to multiplex telephone systems and electronic distributors or commutators therefor.

In general, in multiplex telephone systems, a plurality of complex signals or electrical waves, corresponding, for example, to speech or music, are produced at individual sending stations, commutated at a common transmitter and transmitted together with a carrier to a receiver. At the receiver, the signals corresponding to the original complex signals or waves are separated and distributed to individual stations.

In such systems, faithful and satisfactory translation of the original signals or waves necessitates the reproduction at each of the individual receiving stations a complex wave corresponding in time, frequency and magnitude to the waves or signals produced at the corresponding sending station. It necessitates also substantially complete segregation at the receiver of the several complex signals or waves so that there will be no distortion of the sound or music distributed to the individual receiving stations and the signal received at each of the latter will correspond accurately to the original signal produced at the corresponding sending station, without noise or cross-talk effects.

One object of this invention is to faithfully commutate and then distribute a plurality of complex signals or waves.

Another object of this invention is to prevent distortion, as by cross-talk, of the complex distributed signals or waves.

A further object of this invention is to simplify multiplex telephone systems and the commutators and distributors utilized therein.

Still another object of this invention is to eliminate cross-talk in multiplex telephone systems in a facile and economic manner.

In one illustrative embodiment of this invention, a multiplex telephone system comprises a transmitter and a receiver connected by a common transmission channel, the transmitter and receiver having connected thereto a plurality of individual translating or signal channels. The common transmission channel is connected to the individual channels in succession and repeatedly at high frequency, at both the receiver and transmitter, by a commutator or distributor, the commutators or distributors at the receiver and transmitter being in synchronism whereby only corresponding individual channels at opposite ends of the common transmission channel are connected at any particular instant.

The operation of the system comprises, broadly speaking, the repeated sampling of the complex signals produced at the individual channels connected to the transmitter, transmission of the samples, and then the distribution of the complex signals to the corresponding individual channels at the receiver. The sampling is repeated so frequently that the original signals are reproduced substantially in their original form.

In accordance with a broad feature of this invention, the commutators or distributors are electron discharge devices of particular construction. In one illustrative form, such an electron discharge device comprises a plurality of targets or plates, which may be connected to the individual channels at either the transmitter or receiver end of the system, means, such as an electron gun, for producing a concentrated electron beam, and means for deflecting the electron beam to impinge upon the targets or plates in sequence and repeatedly at high frequency.

In accordance with one feature of this invention, the targets or plates have the surfaces thereof upon which the electron beam impinges constructed or treated so that they are capable of efficient and copious secondary electron emission. These targets or plates are cooperatively associated with a common collector electrode or anode which may be connected to the common transmission channel.

In accordance with another feature of this invention, the electron gun and the beam deflecting electrodes are associated to constitute an electron lens system having a point focus within the electron gun and capable of projecting upon the targets or plates a sharply defined image of the focus point.

In accordance with a further feature of this invention, a shielding member is provided adjacent the targets or plates to prevent dispersion of electrons which do not impinge upon the targets or plates, and to prevent also impingement of such electrons upon other portions of the structure. The electron receiving surface of the shielding member may be coated with a fluorescent material to facilitate adjustment of the trajectory of the electron beam.

In accordance with another feature of this invention, an auxiliary electrode is provided in cooperative relation with the plates or targets, which electrode functions to reduce the capacitances between the plates or targets and the collector electrode or anode and may be utilized also to control or modulate the secondary electron currents to the collector electrode.

In accordance with still another feature of this invention, each of the targets or plates may constitute a primary cathode of an electron multiplier having the common collector electrode or anode as the output electrode.

The invention and the foregoing and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings wherein:

Fig. 1 is a schematic diagram of a multiplex signaling system showing generally the components of a system illustrative of one embodiment of this invention;

Fig. 2 is another schematic diagram showing generally elements of an electronic distributor device forming a component of the system illustrated in Fig. 1;

Fig. 3 is a view in perspective of an electron beam distributor constructed in accordance with this invention, a portion of the enclosing vessel being broken away to show the internal structures more clearly;

Fig. 4 is a detail view in section of the electron gun and electron lens system incorporated in the distributor shown in Fig. 3.

Figs. 5 and 6 are partial cross-sectional views along planes 5-5 and 6-6, respectively, of Fig. 3 illustrating the form of the backing plate and targets, respectively, in the distributor shown in Fig. 3 and showing also the space relation of the targets with respect to one another and the collector electrode;

Fig. 7 is a circuit diagram illustrating the use of the distributor shown in Fig. 3 as a sending or transmitting device;

Fig. 8 is another circuit diagram illustrating the use of the distributor shown in Fig. 3 as a receiving device;

Fig. 9 is a schematic view illustrating the lens equivalent of the structure shown in Fig. 4;

Fig. 10 is a perspective view of an electron beam distributor illustrative of another embodiment of this invention, a portion of the enclosing vessel being broken away to show the internal structures more clearly;

Fig. 11 is a side view of the distributor shown in Fig. 10, partly broken away and partly in section along plane 11-11 of Fig. 10;

Fig. 12 is a perspective view of an electron beam distributor illustrative of still another embodiment of this invention, a portion of the enclosing vessel and of one of the electrodes being broken away to show details more clearly;

Fig. 13 is an enlarged detail perspective view of the target end of the distributor illustrated in Fig. 12, a portion of the shield being broken away to show the targets and the supports therefor more clearly;

Fig. 14 is a side view in section along plane 14-14 of Fig. 13;

Figs. 15 and 16 are circuit diagrams illustrating the use of distributors of the construction shown in Figs. 12, 13 and 14 in two-way conversation systems; and

Fig. 17 is a schematic detail view illustrating a modification of an electron beam distributor constructed in accordance with this invention.

Referring now to the drawings, the multiplex transmission system illustrated schematically in Fig. 1 comprises a common transmission channel 20 connected to the two stations A and B. For purposes of discussion station A will be treated as a transmitting station and station B will be treated as a receiving station, although,

as will be apparent from the description appearing hereinafter, each station may be utilized for both transmission and reception. Station A comprises a commutator or distributor having a plurality of segments *a* to *f*, inclusive, and a rotatable means or arm 21 for connecting each of the segments to the common channel 20. Suitable channels 22, for example telephone lines, are connected individually to the segments. The receiving station B likewise comprises a commutator or distributor having a rotatable means or arm 21' and a plurality of segments *a'* to *f'*, inclusive, which are connected individually to channels 22', for example telephone lines. The rotatable connecting means 21 and 21' are connected through a synchronous system 23 so that when the arm 21 connects the common channel 20 to one of the segments at station A, the arm 21' connects the corresponding segment at station B to the common channel 20.

Signals, such as complex electrical waves corresponding to speech or music, impressed upon the channels 22 are sampled and commutated at station A and transmitted substantially simultaneously over the common transmission channel 20. At station B, the multiplex signal from the common channel is analyzed and the individual signals distributed to the proper segment *a'* to *f'* and the associated individual channels 22'.

The frequency of sampling and distributing will be dependent, of course, upon the requirements of each particular system. For commercial transmission of speech, it has been found that transmission of frequencies up to about 3,000 cycles is satisfactory. For such transmission, a frequency of about 6,000 cycles for sampling and distributing is indicated to be adequate. With such a distributor frequency, speech components above 3,000 cycles will beat with the distributor frequency to produce frequencies of less than 3,000 cycles. In order to eliminate the spurious frequencies thus produced and thereby to obtain faithful transmission and reproduction of the original signals, each of the individual channels may be designed in accordance with known methods to have a cut-off frequency of about 3,000 cycles.

The multiplexed signal transmitted over the common channel 20 will comprise a series of square-topped waves. For economic and practical reasons, the frequency range of the common channel is terminated at a cut-off frequency, which may be designated as f_c . This may result in the spreading out of an impulse at one of the segments *a* to *f* and an overlapping thereof upon an impulse from the next adjacent segment with a consequent cross-talk between the individual channels.

Such cross-talk may be substantially eliminated, or at least held to amplitude levels not objectionable for commercial speech transmission if the cut-off frequency f_c is approximately or greater than $1/T$, where T is the time interval between the centers of the impulses. If there are n individual speech channels each having a cut-off of 3,000 cycles, the upper frequency limit required for the common channel is determinable by the relation $f_c = n \times 6000$.

Each of the distributors, as shown schematically in Fig. 2, comprises means, to be described fully hereinafter, for producing a rotating concentrated electron beam E, which impinges in succession upon the segments *s*, four of which only are shown in Fig. 2, and a collector elec-

trode or anode K. Each of the segments may be a generally sectoral plate or target having the surface thereof upon which the electron beam impinges constructed or treated to render it capable of copious and efficient secondary electron emission.

At the sending station A, the various segments have applied thereto variable potentials corresponding to the signal, for example, speech or music, to be transmitted. The electron beam in impinging upon a segment will cause the emission of secondary electrons and the flow of a current from the segment to the collector electrode K, the magnitude of the current being determined by the potential upon the segment. As the beam rotates, the secondary electron currents from the segments in succession flow to the collector electrode and together produce a multiplex signal which is transmitted over the common channel 20.

At the receiving station B, the electron beam E is modulated in accordance with the incoming multiplex signal, designated by the line M in Fig. 2, in a manner to be described hereinafter. As the beam rotates it impinges upon the segments in sequence and causes the emission of secondary electrons therefrom, which flow to the collector K. Corresponding speech or music signals, then, may be distributed to individual receiving or listening stations each connected between the collector K and one of the segments by means including the channels 22. Inasmuch as the beams are rotated in synchronism, each segment at the receiving station will be connected effectively only to the corresponding segment at the sending or transmitting station.

One illustrative electron beam distributor or commutator constructed in accordance with this invention comprises, as shown in Fig. 3, an elongated enclosing vessel 30 having aligned inwardly extending stems 31 and 32 at opposite ends thereof. Mounted upon the stem 31, as by supports including a plurality of uprights or standards 33 affixed to and extending from bands or collars 34 clamped about the stem 31, is an electron beam producing and beam rotating structure. This structure, as shown more clearly in Fig. 4 comprises a thermionic cathode 35 supported from the stem 31 by leading-in conductors 36 embedded in the stem. In the form illustrated in Figs. 3 and 4 the cathode is of the indirectly heated equipotential type, although it will be understood that cathodes of other types, for example, filamentary, may be used. The cathode 35 is encompassed by a cylindrical electrode 37 which is provided with a leading-in conductor 38 and is affixed to an insulating spacer having a flange or disc 39, as by eyelets 40. Preferably, the cathode 35 and cylindrical electrode 37 are coaxial.

The insulating spacer is secured to the uprights or standards 33, as by nuts 41 threaded upon the uprights, and has an integral cylindrical hub portion 42 terminating at the other end in a flange or disc 43. Extending through the hub 42 and fitted in the bore therein is an elongated cylindrical electrode 44 having a flange 45 seated upon the flange or disc 43 and provided with a leading-in conductor 46. Preferably, the electrode 44 is coaxial with the cathode 35 and the bore therein is circular, although the bore may be of other section, for example rectangular or elliptical.

The flange or disc 43 has secured thereto a plurality of metallic supports 47, such as rods

having nuts 48 threaded thereon, each of which has connected thereto a leading-in conductor encased in an insulating sleeve 49, such as a glass tube, fitted in an aperture in the disc or flange 39. The rods or supports 47 carry pairs of similar deflector or sweep plates 50 and 51 which are equally spaced about an axis coincident with the longitudinal axis of the electrode 44. As shown clearly in Fig. 3, each of the deflector or sweep plates has a rectangular portion affixed to one of the supports 47 and an outwardly bent trapezoidal portion. The rectangular portions form an enclosure into which the electrode 44 extends.

The electrode 37 acts as an electron lens L₁, as illustrated in Fig. 9, to produce a point focus P just inside the lower end of the electrode 44, which acts as a first anode. This anode together with the sweep or deflector plates 50 and 51, which act as a second anode, define a second electron lens L₂ producing a second focus whereby an image of the point P is produced at the point P₁.

A cup-shaped or cylindrical collector electrode or anode 52, coaxial with the anode 44, is supported from the stem 32 by a rigid leading-in conductor 53 sealed in this stem. Equally spaced about the collector electrode 52 and arranged coplanar and in circular formation, as shown clearly in Fig. 6, are a plurality of plates or targets 54, which may be substantially sectoral as shown. Preferable, the plates or targets 54 are constructed of a material which will result in the emission of a plurality of secondary electrons for each impinging primary electron whereby an amplification of the impinging electron beam is obtained. For example, the plates or targets may be of nickel or beryllium or they may be of silver and have the electron receiving surface thereof treated to form a matrix or coating including silver oxide, caesium oxide and some free caesium.

The stem 32 has intermediate its ends an annular flange or seal 55 in which there are sealed leading-in conductors 56, which are connected individually to and support the targets or plates 54. Disposed behind the targets or plates 54 is an annular plate or electrode 57 which is supported by rods or wires 58 extending from a collar or band 59 clamped about the stem 32 and having a leading-in conductor 59 connected thereto. This plate or electrode 57 receives electrons which do not impinge upon the targets or plates 54 and shields the various leading-in conductors extending from the stem 32 from such electrons. Preferably, the surface of the plate or electrode 57 is coated with a fluorescent material to facilitate adjustment of the electron beam.

The device shown in Fig. 3 may be operated either as a sending distributor, as illustrated in Fig. 7, or as a receiving distributor as illustrated in Fig. 8. As shown in Fig. 7, the cathode heater, which may be a filament 60, is supplied from a suitable source such as a battery 61 and the electrode 37 is maintained at a positive or negative potential with respect to the cathode 35 as by a battery 62. The first anode 44 is maintained strongly positive, for example of the order of 600 volts, with respect to the cathode as by a battery 63, the sweep or deflector plates 50 and 51 being connected to an intermediate positive point of this battery through the secondary windings of transformers 64 and 65. The positive potential applied to these plates may be of the order of 300 volts.

The sweep or deflector plates 50 and 51 are

energized at high frequency, for example 6,000 cycles, by oscillators 66 and 67, respectively, through the transformers 64 and 65, the two oscillators being 90 degrees out of phase so that a rotating field is produced between the deflector or sweep plates. Although two oscillators are shown, it will be understood, of course, that a single oscillator having a split output may be used. Also although an electrostatic rotating field is utilized, it will be understood that a rotating magnetic field may be employed. In the latter case, the beam motion may be adjusted by rotating the external sweep coils about the axis of the device.

Each of the plates or targets 54 is connected to a corresponding one of the individual signal channels 22 through a transformer 68 and the collector electrode or anode 52 is connected to a point common to the secondary windings of all the transformers 68, through a suitable resistance 69 and a source, such as a battery 70, which maintains the collector electrode or anode at a positive potential with respect to each of the targets or plates. When the device is utilized as a sending distributor, this potential preferably is such that it alone would draw about one-half of the secondary electrons, for no signal, away from each target or plate so that the collector electrode operates about substantially the midpoint of the secondary current-potential between targets and collector characteristic.

The resistance 69 is connected across the input circuit of an amplifier 71, a suitable blocking condenser 72 being provided as shown. The output circuit of the amplifier is coupled to the common transmission channel 20.

The electrons emanating from the cathode 35 are concentrated into a beam focussed, as described heretofore, to a point P_i, which, when the beam is rotated by the fields produced by the deflector or sweep plates, lies in the electron receiving surfaces of the targets or plates 54. As the beam revolves it impinges upon the targets or plates repeatedly and in succession to cause the emission of secondary electrons therefrom which constitute currents flowing to the common collector electrode or anode 52. The magnitude of the current from each of the targets or plates will be dependent, of course, upon the potentials produced upon each plate by the corresponding individual channel coupled thereto. The secondary electron currents from the plates or targets flow in succession through the resistance 69 to cause corresponding variations in the output of the amplifier 71, which constitutes a multiplexed signal current.

As illustrated in Fig. 17, each secondary electron current may be effectively amplified by operating the targets or plates 54 as primary cathodes of individual electron multipliers. Each multiplier comprises a plurality of auxiliary secondary electron emitting cathodes 73 having the collector electrode or anode 52 as the output electrode thereof. The trajectories of the secondary electrons are indicated generally in Fig. 17 by the arrows.

In the receiving distributor circuit illustrated in Fig. 8, the sweep or deflector plates are maintained at a higher positive potential, for example, twice the potential, of the first anode 44. Each target or plate 54 is connected to the cathode 35 through an individual resistance 73 and to the collector electrode 52 through an individual series circuit including a condenser 72, resistance 74 and biasing battery 75. In this case the bias

upon the collector electrode preferably is such that the collector electrode draws substantially all the secondary electrons to it. Each combination including a resistance 74 and the battery 75 is connected between the cathode and control electrode of a corresponding amplifier 71. The output circuit of each amplifier is coupled to a corresponding output or receiving channel 22'.

An input or control circuit coupled to the common transmission channel is coupled to the cathode 35 and electrode 37 across the battery 62 in series with a resistance 76. A blocking condenser 77 is provided as shown. The multiplexed signal applied between the cathode 35 and electrode 37 modulates the rotating electron beam E which impinges in succession and repeatedly upon the plates or targets 54. The secondary electron current from each target flows through the corresponding resistance 74 and produces variations in the input of the associated amplifier 71 and corresponding variations in the output thereof.

Inasmuch as at any particular instant there is secondary electron emission from only the target or plate 54 upon which the electron beam is impinging, electron cross-talk is substantially prevented.

It will be noted that because of the form and disposition of the targets or plates the capacitances therebetween and between each target and the collector electrode are at substantially a minimum.

In the electronic distributor illustrated in Figs. 10 and 11, the electron gun and deflecting or sweep plate structure is the same as in the distributor shown in Fig. 3 and described hereinabove except that the electrode 37 is provided with an integral flange 83 to which the supports 33 are affixed. The targets or plates, however, are elongated parallel plates or strips 154, mounted in a substantially cylindrical boundary coaxial with the collector electrode or anode 152, which may be an elongated rod or wire having affixed thereto or integral therewith a metallic plate or disc 78. The targets or plates 154 are secured to annular insulating spacers 79, for example, of mica, as by wires 80, and are supported from the stem 132 by leading-in conductors 156 sealed in the annular flange 155. The targets or plates 154 may be constructed of the same materials as the targets 54 in the distributor illustrated in Fig. 3 so that when the electron beam impinges upon the inner surface thereof, each target will release secondary electrons, which flow to the collector electrode 152.

The plate or disc 78 of the collector electrode structure is affixed, as by welding, to a cross-piece or support 81 which is carried by rods or wires 82 extending from a band or collar 190 clamped about the stem 132 and having a leading-in conductor 159 connected thereto.

The electron discharge device disclosed in Figs. 10 and 11 is particularly suitable for use as a receiving distributor and may be associated with external circuits in the manner illustrated in Fig. 8, and operated in the same way as described heretofore with respect to the distributor illustrated in Fig. 3. It may be operated also as a sending distributor and connected and operated as illustrated in Fig. 7 and described heretofore.

Electron multiplier sections, similar to those illustrated in Fig. 17, may be provided in the distributor shown in Figs. 10 and 11, each multiplier having one of the targets or plates 154 as

the primary cathode and the collector electrode or anode 152 as the output electrode thereof.

In the electron distributor shown in Figs. 12, 13 and 14, the electron gun and sweep or deflector plate structure is the same as in the distributor illustrated in Fig. 3 and described heretofore. The collector electrode 252, however, is a cylinder of metal or other conductive material, such for example, as graphite, and is supported by a pair of diametrically opposite wires or rods 85 sealed in the side wall of the enclosing vessel 230, as shown at 86, and extending therefrom.

As shown in Figs. 13 and 14, the targets or plates 254, which are generally sectoral and which may be of any of the materials mentioned heretofore for the targets 54 in the distributor shown in Fig. 3, are supported from an annular insulating member 87 by individual rods or wires 88, which may be encased in insulating sleeves 89, such as glass tubes. The insulating member 87 is supported by a pair of rigid rods or wires 91 having one end embedded therein and the other end affixed to a band or collar 290 clamped about the stem 232. The insulator-target structure may be braced by a wire or rod 92 affixed to one of the supports 91 and sealed in the stem 232. Electrical connection to the targets or plates 254 may be established through leading-in conductors 256 sealed in the flange 255. The targets 254 are substantially coplanar, equally spaced and in circular formation about an axis coincident with that of the collector electrode 252.

The targets or plates 254 are surrounded by conductive grid or shield including a cylindrical wall 93 coaxial with the collector electrode or anode 252 and an apertured conical base having an imperforate central portion 94 and equally spaced, radially extending tapering arms 95. The arms 95 form a plurality of radially extending slots 96, each of which is in alignment with a corresponding one of the targets or plates 254. The grid or shield may be supported by a pair of rigid wires or rods 97 secured to the supports 91. Suitable electrical connection to the grid or shield may be established through the conductor 92.

The electron discharge device illustrated in Figs. 12, 13 and 14 may be utilized for two-way communication as both a sending and a receiving distributor, two ways of operation thereof being shown in Figs. 15 and 16. In these figures circuit elements corresponding to those of Figs. 7 and 8 are identified by the same numerals. The collector electrode or anode 252 is connected to the targets or plates 254 through the secondary winding of a transformer 98 and has a positive potential, for example of the order of 100 volts, applied thereto by a source, such as the battery 70. The shield or grid electrode 93 also is connected to the plates or targets 254 as shown and is maintained at a negative potential, for example of ten volts or less, with respect thereto by a source of such as a battery 99. The potentials applied to the various electrodes may be of magnitudes given heretofore in the description of Figs. 7 and 8. In Fig. 16, the electrode 37 is connected to the primary winding of a transformer 100.

As will be apparent from the description previously given, in Figs. 15 and 16 a rotating electron beam is produced which impinges upon the targets or plates 254 in sequence and repeatedly at high frequency. The impinging electrons cause the emission, from the targets or plates, of secondary electrons which flow to the collector elec-

trode or anode 252, through the slots or apertures 96.

In Figs. 15 and 16, when the device is operated as a sending distributor, the various secondary electron currents are modulated in accordance with the variable potentials impressed between the grid or shield 93, 95 and the targets or plates through the transformers 68. The multiplexed signal is transmitted to the common transmission channel 20 by the transformer 98.

In Fig. 15, when the apparatus is operating as a receiving distributor, the potentials corresponding to the multiplexed signal are impressed between the collector electrode or anode 252 and the targets or plates 254, and the components thereof distributed to the proper individual signal channels.

In Fig. 16, when the apparatus is operating as a receiving distributor, the complex variable potentials corresponding to the multiplexed signals are impressed upon the electrode 37, through the transformer 100, and the intensity of the electron beam is varied accordingly. The components of the multiplex signal are distributed to the proper individual channels.

The shield or grid electrode 93, 95, it may be noted, serves to decrease the capacitances between the targets or plates 254 and the collector electrode or anode 252. Also, when the distributor is operating as a sender, this electrode serves as a modulating electrode. Furthermore, the slots or apertures 96 may be of somewhat less width than the targets or plates 254 so that but restricted portions of the latter are energized by the electron beam.

Although several specific embodiments of this invention have been shown and described, it will be understood, of course, that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. Signal translating apparatus comprising a collector electrode means, a plurality of spaced targets each having an electron emissive surface facing said electrode means, individual leading-in conductors for said targets, means for producing a beam impinging upon the emissive surface of said targets in sequence, and a fluorescent plate facing the opposite surface of said targets.

2. In an electron discharge device, a cathode and an electron lens system in cooperative relation with said cathode comprising a cylindrical electrode encompassing said cathode, deflector means spaced from said electrode and mounted in a boundary coaxial therewith, and a second cylindrical electrode coaxial with said first electrode, and having one end portion extending between said deflector means and the opposite end portion extending into said first cylindrical electrode.

3. In an electron discharge device, a cathode, a cylindrical electrode encompassing said cathode, an elongated cylindrical anode coaxial with said electrode and having an end portion within said electrode, and a plurality of deflector plates mounted in a boundary coaxial with said anode, each of said plates having an end portion and an outwardly inclined trapezoidal portion, said anode extending into the space bounded by said end portions.

4. In an electron discharge device, a cathode, an insulating member having a cylindrical portion coaxial with said cathode and having flanges

at opposite ends of said cylindrical portion, a cylindrical electrode affixed to one of said flanges and encompassing said cathode, deflector means supported from the other of said flanges and defining an opening coaxial with said cathode, and a cylindrical anode extending through said cylindrical portion.

5. In an electron discharge device, the combination defined in claim 4 wherein said anode extends into said cylindrical electrode and said opening and said deflector means comprises plates inclined outwardly with respect to the axis of coaxiality.

6. A signal translating device comprising a collector electrode, a plurality of elongated, parallel strip electrodes mounted in a cylindrical boundary encompassing said collector electrode, individual leading-in conductors for said strip electrodes, each of said strip electrodes having the surface thereof toward said collector electrode secondary electron emissive, an electron gun for producing an electron beam, and sweep plates for rotating said beam to impinge upon said strip electrodes in sequence.

7. A signal translating device comprising an enclosing vessel having a stem at one end, an elongated collector electrode supported from said stem, a plurality of elongated targets parallel to said collector electrode and mounted in a cylindrical boundary coaxial therewith, individual leading-in conductors for said targets sealed in said stem, a plurality of spaced insulating members spacing said targets, electron beam producing means at the other end of said vessel, and means for directing the electron beam to impinge upon said targets.

8. A signal translating device comprising a collector electrode, a plurality of targets in cooperative relation with said collector electrode, means for energizing said targets to produce a flow of electrons therefrom to said collector electrode, and a shield having an apertured portion between said targets and said collector electrode.

9. A signal translating device comprising a plurality of radially extending targets arranged in a circle, a collector electrode in cooperative relation with said targets, means for producing an electron beam to energize said targets, and a shield electrode having an apertured portion between said targets and said collector electrode

and having a cylindrical portion encompassing said targets.

10. A signal translating device in accordance with claim 9 wherein said apertured portion of said shield electrode comprises radially extending portions bounding radially extending apertures, one for each of said targets and in alignment therewith.

11. A signal translating device comprising an enclosing vessel having a stem at one end, electron beam producing means at the other end of said vessel, a plurality of substantially sectoral targets adjacent said stem and arranged in a circle, an insulating member spacing and supporting said targets, means supporting said member from said stem, leading-in conductors for said targets, a collector electrode mounted intermediate said beam producing means and said targets, and a shield electrode having an apertured portion between said targets and said collector electrode and a cylindrical portion encompassing said targets.

12. Means for translating signals in multiplex comprising a plurality of target electrodes each of which has a secondary electron emissive surface, said target electrodes being electrically individual and separately maintainable at desired potentials, a collector electrode in electron receiving relation with all of said emissive surfaces, and means for producing individually controllable secondary electron currents between said target and collector electrodes including means for producing an energizing beam and means for directing said beam to impinge upon said target electrodes in sequence.

13. Means for translating signals in multiplex as defined in claim 12, wherein said target electrodes are electrically separate members arranged in a circle coaxial with said collector electrode and have individual leading-in conductors associated therewith in such manner that the potential of each of said target electrodes is variable independently of the potential of all the other target electrodes, and wherein the secondary electron producing means comprises an electron gun for producing an electron beam and means for rotating said beam to impinge upon said target electrodes in sequence.

FRANK GRAY.