Sept. 10, 1929. M. E. MACKSOUD 1,727,373

TRANSLATING DEVICE

Filed July 3, 1926 2 Sheets-Sheet 1

Fig. 1.

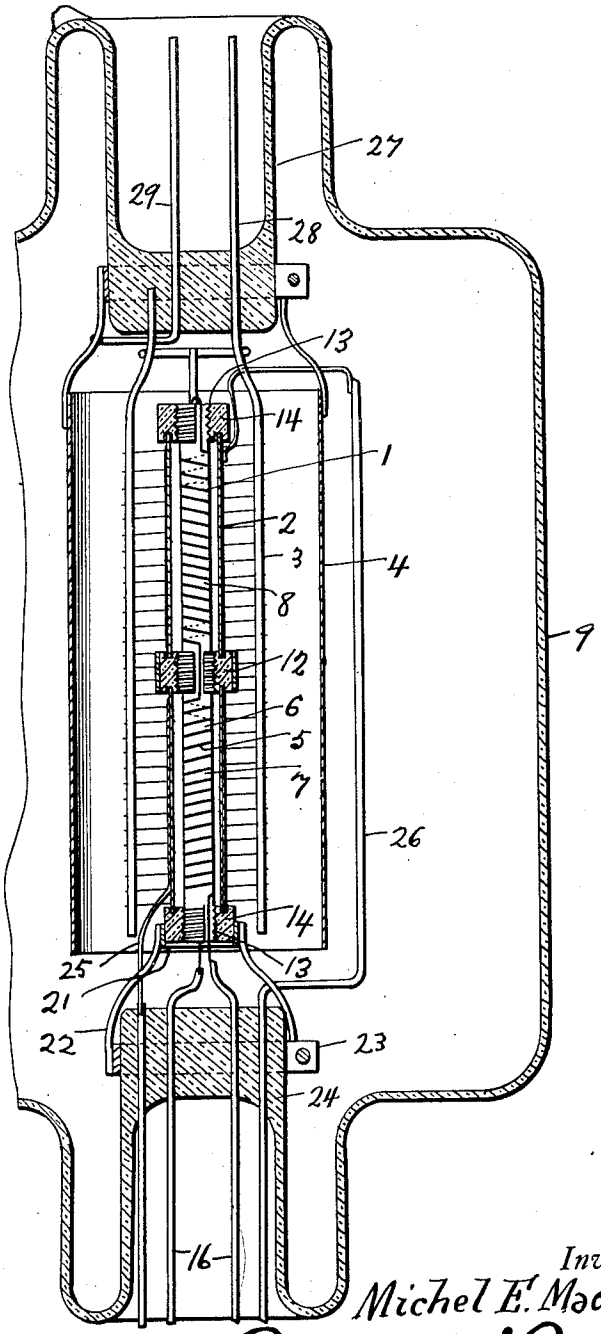
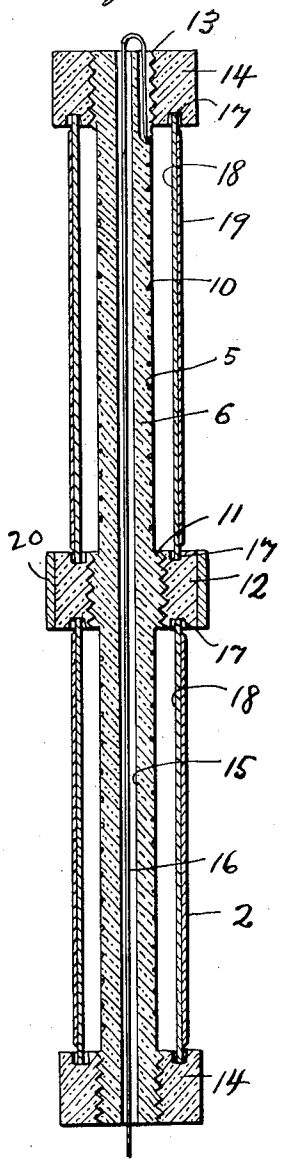


Fig. 2.



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Fig. 3.

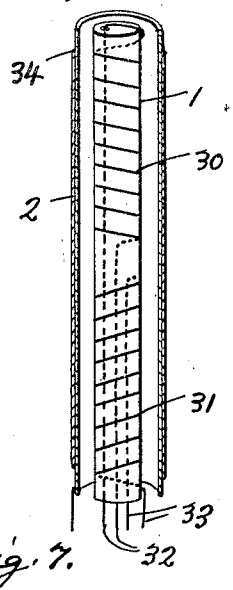


Fig. 4.

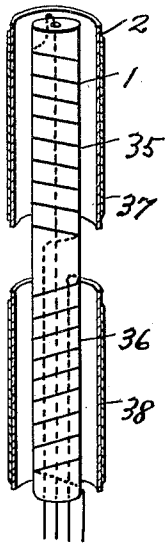


Fig. 5.

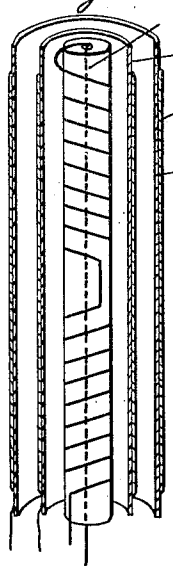


Fig. 6.

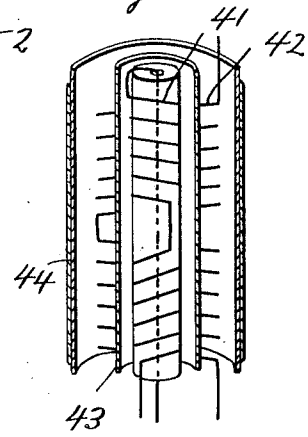


Fig. 7.

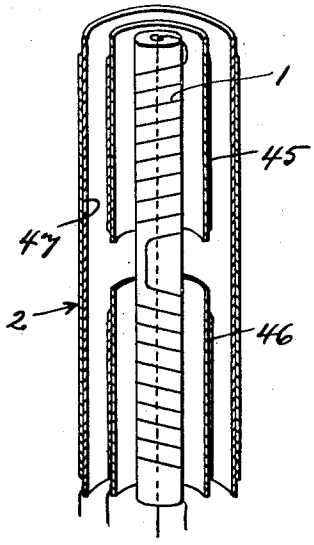


Fig. 9.

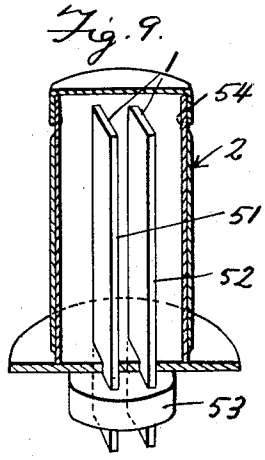
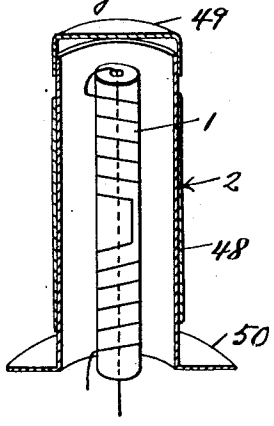


Fig. 8.



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Patented Sept. 10, 1929. 1,727,373

UNITED STATES PATENT OFFICE.

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TRANSLATING DEVICE.

Application filed July 3, 1926. Serial No. 120,375.

This invention relates to variable current translating devices and particularly to a new design of electron discharge tubes containing four electrodes.

The prior art as is well known, provides electron discharge devices having three elements including a cathode, grid and anode, and in which the cathode is usually in the form of an electrically energized filament which upon energization becomes incandescent and through suitable treatment such as thoriation is caused to emit an electron flow traveling toward the plate of the device, and thru this operation tubes of this three element type are in general use for transmitting and receiving radiant energy as well as for other purposes now well known.

This invention comprehends the improvements of devices of this character by providing a tube construction having four elements instead of three and in which two of the elements form the principal features of this invention and replace the incandescent thoriated cathode now generally used.

In providing this new construction, this invention improves the operation of these electron discharge devices without losing any of the advantageous results produced thereby but on the other hand increasing the efficiency of operation and providing new functions and applications for the tubes so as to provide a double simultaneous operation in the tube in which each is independent of the other, and in which the results produced by the double function may be ultimately utilized in combination as set forth in my copending application, filed simultaneously herewith and bearing the next successive serial number hereto Serial No. 120,376, filed July 3, 1926.

This invention further comprehends the provision of a four element electron discharge device which is suitably adapted for operation from the usual power circuit used for city lighting purposes whether direct or alternating current, and in which the effects of the alternating current through the special construction and cooperation of the electrodes of the tube are prevented from having undesirable or disadvantageous effects in the operation of the radiant energy receiving or transmitting apparatus, but on the other hand, cooperates to produce a greater efficiency of operation of this apparatus. A further feature of the invention resides in the provision of a four element tube specially adapted for use with radiant energy receiving and transmitting systems in which a source of variable power may be used to insure the operation of the device in which two of the elements cooperate to rectify a portion of the power consumed in the operation of the device to produce potentials suitable for application in the plate circuit of the system for the purpose of eliminating the necessity for more than one source of power supply, and in which any available source of power supply is adapted for use in operation of the system.

The invention further comprehends numerous structural advantages to provide a translating device of the character mentioned and with the above and numerous other objects in view a more complete and full understanding of the invention will be obtained from the following detailed description, and claims directed to the preferred construction of the device, it being understood, however, that various changes in the relation and construction of the parts and the method of operation may be made which are clearly within the scope of the invention as herein set forth.

In the drawings forming part of this application:—

Figure 1 is an enlarged longitudinal section through a structure embodying the elements of this invention.

Fig. 2 is an enlarged detail section through the cathode and heating electrode structure of the tube, showing the manner of mounting the elements in their associated relation.

Figs. 3 to 9 inclusive are detail diagrammatic illustrations showing a series of variations in the structural relation between the cathode and the heating electrode therefor for producing a cooperation between the electrode in which both halves of the cycle

of alternating current may be simultaneously or independently rectified together with the provision of suitable means for absorbing or limiting as well as preventing the formation of any possible magnetic field around the heating electrode that may be present.

1, 2, 3 and 4 respectively, indicate the four electrodes or essential elements of the improved translating device forming the subject matter of this invention and which are hereafter referred to as a filament or heating means, a cathode or electron emitting electrode, grid and plate or anode, respectively.

The heating means or electrode 1 is formed as illustrated in Figs. 1 and 2 of a suitable wire 5 wound in helical form on a suitable cylinder 6 in a pair of sections 7 and 8 having one section provided with the helical winding in reversely wound relation to the other section, so as to neutralize inductive effects for the purpose of producing a non-inductive heating electrode within the envelope or tube 9. The cylinder 6 is formed with reversely extending helical grooves 10 to receive the reversely wound sections 7 and 8 of the heating electrode 5. These sections 7 and 8 are spaced in the central portion from each other and in which the cylinder 6 is formed with a portion of enlarged diameter having a threaded periphery 11 for threadedly receiving the supporting collar 12 of suitable insulating material.

The free ends of the cylinders 6 are threaded as indicated at 13 to receive the supporting collars 14 at opposite ends, while the central portion of the cylinder is provided with an axial bore 15 to provide a conduit for one of the circuit wires 16 connecting the opposite terminals of the filament with a suitable source of power supply or power supply circuit.

The collars 12 and 14 are formed in their opposed faces with annual recesses 17 in concentric relation to the cylinder 6 and which receive the metallic sleeves 18 coated on the exterior surface with suitable electron emitting material indicated at 19. These sleeves 18 form the cathode 2 or electron emitting surfaces as above set forth.

The coating on the tubes 18 which are preferably formed of nickel or some other similar material, is provided with a composition of one of the alkaline earth oxides which are known to be highly emittive of electrons under low degrees of heat, while any other electron emitting substance may be used where found desirable. The tube 6 may be made of alundum, crystolon or a silicate in the form of a solid cylinder with a central bore or of suitable tubing, several forms of which are already on the market and in common use for various purposes and where desired are provided with threaded or grooved surfaces. The collars 14 are of similar material to the cylinder 6 so as to provide an insulating mounting for the heating electrode 1 and the cathode 2. The central collar 12 is provided with a metallic cap of annual form as indicated at 20 to form a shield for the central portion of the heating element 1 for magnetic field of the heating element, as well as a terminal for a discharge circuit which may be utilized for discharging static or other undesirable currents or oscillations.

This assembly of parts including the cylinder 6 and the heating and cathode elements 1 and 2 respectively when assembled as shown in Fig. 2, are suitably supported in the envelope or tube 9 through the mounting of the lower cap collar 14 in the supporting ring 21 carried by the arms 22 secured to the supporting clamps 23 suitably mounted on the stem 24 formed integral with the envelope 9 in the finished structure of this translating device. A pair of circuit connections 25 and 26 extend from the cylinders or tubes 18 forming the cathode elements through the stem 24 so that each sleeve may be independently connected in suitable electrical circuits for purposes which will be described.

The construction of the stem 24 and the method and manner of extending the circuit connections to the elements of the tubes through the stem are made in accordance with the well known practice in the art in the construction of this tube and further description thereof is therefore not believed to be necessary.

An important feature of this tube construction is that a pair of stems are used including the second stem 27 which is alined in the form shown in Fig. 1 of the drawings with the stem 24, and at the opposite end of the envelope 9. This stem serves to support the grid and plate or anode element 3 and 4 respectively of the device in the proper associated relation with the cathodes 2, and these grid and anode elements may be constructed in any manner found desirable as at present known to the art to secure the desired functioning of the tube in translating systems already well known in the art. This second stem structure 27 permits the extension of the leads or circuit wires 28 and 29 from the grid and anode respectively outwardly through the envelope 9 for connection with exterior circuits in any desired manner and in order to eliminate the necessity of shielding these conductors from the conductors for the elements 1 of the tube to prevent mutual inductance between the leads or wires passing through the tube when alternating current is used for operating the heating element 1, so that the induction of interfering currents and reproduction of the sounds generated thereby is

lessened or prevented in radiant energy amplifying systems.

The heating element 1 may or may not be electron emitting, but for the full functioning of the tube is preferably electron emitting and in which it will be understood that the electron flow from the heating element 1 is toward the cathode 2 while the electron flow from the cathode is outwardly therefrom to the anode 4 from which it will be readily apparent that the electron flow from both the heating electrode and the cathode are in the same direction.

In this connection, it will be readily appreciated that the electron flow from the heating electrode 1 has its field limited by the metallic sleeves 18 which receive and absorb the electrons and in this connection function as an anode in conjunction with the electrode 1 so that the electron flow from electrode 1 may be utilized to rectify the current in the circuit including this heating element. This is obtained through associating the terminals of this circuit with suitable connections having electrical connection with the sleeves 18. Any suitable circuit may be used in cooperation with this heating electrode and the cathode 2 such as is well known in the art for rectifying oscillating or varying electric current in which this cathode will function as an anode in cooperation with the heating element 1.

In the operation of this tube to function in this manner and in all manners, the heat of the element 1 is transmitted to the sleeves or cylinders 18 by radiation and the electron flow or the travel of ions between the element 1 and the element 2 so that the sleeves 18 are heated to a suitable temperature with the coating 19 and at this temperature, this coating will produce the electron flow from the cathode 2 as a result of the action of this coating.

This cathode 2 functions as the cathode element within the envelope 9 for electrical cooperation with the grid and plate 3 and 4 respectively. As a result, suitable translating systems or amplifying systems may be associated with the cathode 2, the grid 3, and anode 4 and the well known function of these elements obtained in said system.

At this point it is desired to clearly point out that in the operation of the tube the cathode 2 will simultaneously function in conjunction with the grid 3 and the anode 4 independently of its function as an anode in conjunction with the electronic emission from and with the heating element 1 to rectify the oscillating currents in the circuit to said heating elements, and said cathode. In addition to this function, the construction of the element 2 or both may be varied within desired limits in order to provide a half wave rectifier or a full wave rectifier. In this connection, the construction shown in Fig. 1, functions as a full wave rectifier when the two sleeves 18 are connected in independent circuits in any well known manner to obtain the proper association with the circuit 16 to the element 1 for full wave rectification purposes.

For a further understanding of this feature, reference is made to Fig. 3 of the drawing, showing what may be said to be the reverse of the structure shown in Fig. 1 in which the element 1 is constructed in two independent but reversely wound coils 30 and 31 having independent circuit connections 32 and 33 respectively, while the cathode element 2 is formed of a single sleeve 34 coextensive with the extent of the sections 30 and 31 of the electrode 1 forming a half wave rectifier instead of the full wave rectifier as in Fig. 1. In this construction the cathode 2 is heated to electron emitting condition by the two filament sections 30 and 31 which when energized, are heated to incandescence so that the cathode functions in the usual manner in the assembled tube structure as set forth above.

In Fig. 4, the filament or element 1 is constructed in independent windings 35 and 36 with independent leads as shown and set forth in Fig. 3, and above described, and the cathode element 2 is formed in two sections 37 and 38 which are axially alined and concentric to the element 1 in order that a full wave rectifier may be provided with a separate reversely wound element 1. This construction may be desirable for suitable operation of the tube where each rectified half wave is used independently of the other and the cathode element 2 is still used as a single electron emitting terminal in conjunction with a grid and plate as above set forth.

As has been heretofore described in connection with Fig. 1 of the drawing, the cathode element 2 forms a shield for the heating element 1 to prevent the magnetic field or oscillation as a result of using alternating current to energize the element 1 to prevent any magnetic field or lines of force or the flow of electrons from the element 1 beyond the zone of the cathode, in order to prevent transmission of undesired energy to the remaining elements of the tube structure and in order to increase the protection or shielding of the element 1 in this manner, the structure shown in Fig. 5 is provided. This structure includes a heating element 1 constructed as shown in Fig. 1, and a pair of concentric electron emitting electrodes 39 and 40 respectively in which the element 40 forms the cathode 2 of a structure embodying the grid and anode elements in cooperation therewith. The thermionic action in a structure as in Fig. 5 provides the heating of the sleeves 39 and 40 from the heating element 1 in order that each of these elements will be heated sufficiently to produce an

electron emission from the coatings on the outer surfaces of each. This double shielding of the element 1 provides an efficient protection against interference or undesired current from the heating element 1, while the sleeves 39 and 40 may be connected with independent circuits associated with the circuit to the element 1 for suitable cooperation to rectify alternating or oscillating current through the electron flow between element 1 and sleeve 39 and the electron flow from the element 39 to element 40 which is in the same direction in each case.

Fig. 6 illustrates a construction wherein a pair of heating coil sections 41 and 42 are mounted in concentric relation and have their convolutions wound in reverse directions so that the magnetic field of one section will neutralize that of the other, while a suitable tubular element 43 encloses the section 41 and is positioned within the section 42. The cathode is indicated at 44 and as heretofore stated, is provided with the electron emitting coating. This cathode is concentrically disposed over the section 42 of the heating element and may be used for current rectifying purposes if desired, in conjunction with either or both of the sections of the heating element indicated at 41 and 42 in any desired manner.

Fig. 7 illustrates a structure wherein the heating element 1 is constructed similar to that shown in Fig. 1 with a pair of concentric axially alined sleeves 45 and 46 respectively disposed over this heating element and in spaced relation thereto which may be utilized in cooperation with the heating element to form the current rectifier, in a manner as heretofore clearly set forth. The cathode 2 is formed of a concentric sleeve indicated by the numeral 47 which is coextensive with the sleeves 45 and 46 and the element 1 so as to prevent the flow of current past the zone of this cathode which is heated in a manner which should now be well understood from the above description to provide for electronic emission where desired for purposes for current amplification and rectification in translating systems independent of the operation of the element 1 and the cathode as a rectifier for the current or a portion of the current in the power supply circuit.

Fig. 8 illustrates a construction in which the heating element 1 is constructed as shown in Fig. 1, while the cathode element 2 includes a sleeve 48 coextensive with the element 1 and formed to receive a cap 49 on one end while the opposite end, and preferably that attached to the stem is formed with an outwardly annular extending flange 50. This cap and flange 50 is provided for further neutralizing any tendency of formation or flow of magnetic lines of force or electrons beyond the zone of the cathode 2 in order to guard against transmission of energy between the element 1 and electrodes 3 and 4, where the structure is used for a double function as a current rectifier of the power current and in conjunction with a translating system.

It is to be understood in the application of this invention that the envelope or tube 9 may be either evacuated to a high degree in a manner well known in the art or it may be gas filled with any of the various gaseous formations known to the art for obtaining the operating advantages of the tube under either type of construction, and where the gas is a conductor such as mercury vapor, neon, argon, krypton, or any other suitable conductive gas has been found more desirable to utilize a construction of the heating means 1 and the cathode 2 as illustrated for example in Fig. 9, in which a pair of flat plate elements 51 and 52 are mounted in spaced parallel relation in a suitable insulating supporting member 53 and covered by the sleeve 54 forming the element 2 or cathode of the structure which is suitably coated so that it will be electron emitting when heated to the proper temperature.

In this construction, the application of alternating current to the plates 51 and 52 with the opposite terminal of the circuit connected to each plate, it will be understood that the action of the plates as a capacity will maintain a charge thereon sufficient to produce a heating effect in conjunction with the flow of current provided for by the conductivity of the ions of the gas between the plates. This heat will be transmitted to the cathode 2 so that it will be heated to electron emitting temperature, and in which this cathode will still form the shield for preventing undesirable effects in the circuits associated therewith operating independently of the heating element while this cathode still functions in conjunction with the heating element as a current rectifier for the power from the circuit connected with the plates 51 and 52 which may be utilized in any desired manner such as is set forth in the co-pending application above mentioned.

From the foregoing description, it will therefore be clearly understood that this invention provides a new development in the art in which four elements are used in the tube construction, two of said elements being electron emitting and having the electron emission flowing in the same direction. One electron emitting element forms a terminus for the electrons emitted from the other, while one of these electron emitting elements cooperates with the other to form a current rectifier in which operation it functions as an anode while the same electrode also functions as a cathode for cooperation in a well known manner with the two remaining electrodes in the tube structure. It

is therefore clear that a translating device has been provided by this invention which, while designed for use on the usual house lighting or power circuit provided in cities and similar locations, for general use, will efficiently function in a well known manner in radient energy systems and in addition provide rectified current for impressing the various potentials required in the circuits of these systems, may also be applied to various other uses where alternating currents are desired to be rectified or where direct or pulsating currents are adapted for use and must be provided from an alternating supply.

Having thus described my invention, what I claim as new is:—

1. A translating device, comprising an evacuated envelope, a cylinder, a plurality of collars mounted on said cylinder, a heating element mounted on said cylinder, means supporting the cylinder in the envelope, and a cathode element formed of a plurality of sleeves mounted on said collars in spaced relation to said cylinder.

2. A translating device, comprising an evacuated envelope, a heating element, a straight supporting member mounted in said envelope supporting said heating element, collars mounted on said supporting member at each end and at the center, and cathode sleeves mounted on said collars and enclosing said heating element.

3. In a translating device, an evacuated envelope, a cylinder mounted within said envelope, a heating element non-inductively wound on said cylinder, spaced collars mounted upon said cylinder, concentric cylinders mounted between said collars and means for supporting said first mentioned cylinder.

4. In a translating device, an evacuated envelope, a cylinder mounted within said envelope, an emittive non-inductive heating means on said cylinder, collars secured upon the ends and at the center of said cylinder, coated cylinders supported concentrically upon the first cylinder, and between the end and center collars and a metallic shield disposed upon the center collar.

5. A translating device comprising an evacuated envelope, a cylinder, a length of wire non-inductively wound on said cylinder, said wire being emittive and acting as a cathode of a rectifier, spaced supports on said cylinder, multiple concentric electrodes forming the anode of a rectifier mounted upon said supports, said multiple concentric electrodes forming the common cathode of the translating device, and a grid and a plate concentric to said cathode.

In testimony whereof I affix my signature.

MICHEL E. MACKSOUD.