

July 29, 1941.

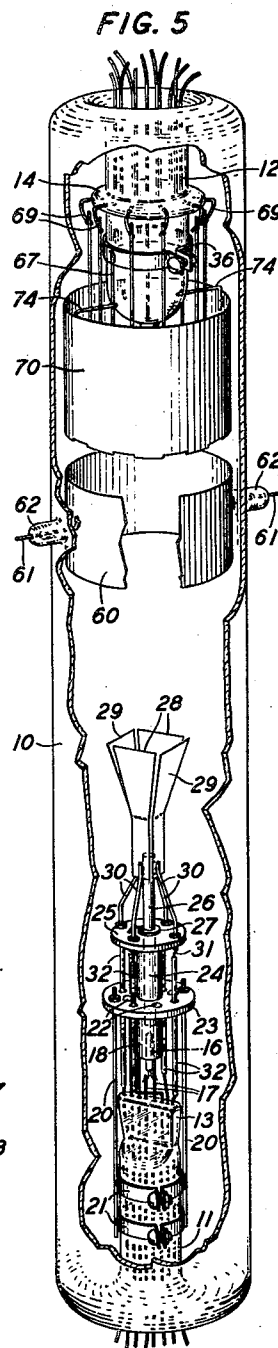
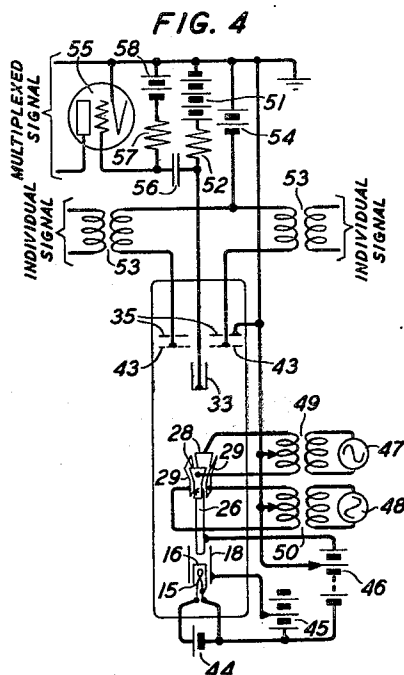
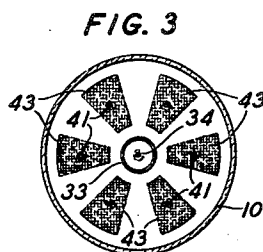
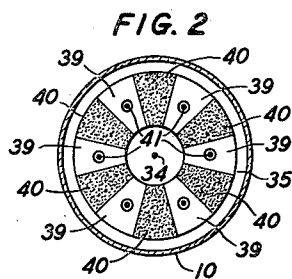
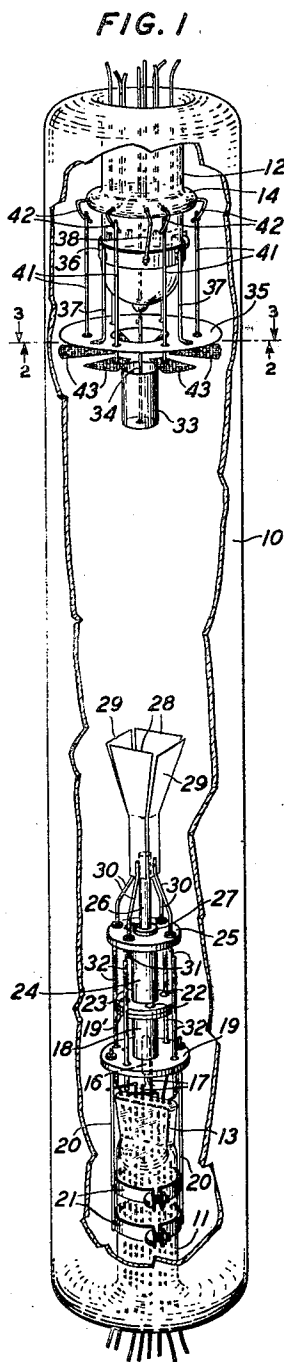
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2,250,528

SIGNAL TRANSLATING SYSTEM AND APPARATUS

Filed Feb. 11, 1939

2 Sheets-Sheet 1



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FIG. 6

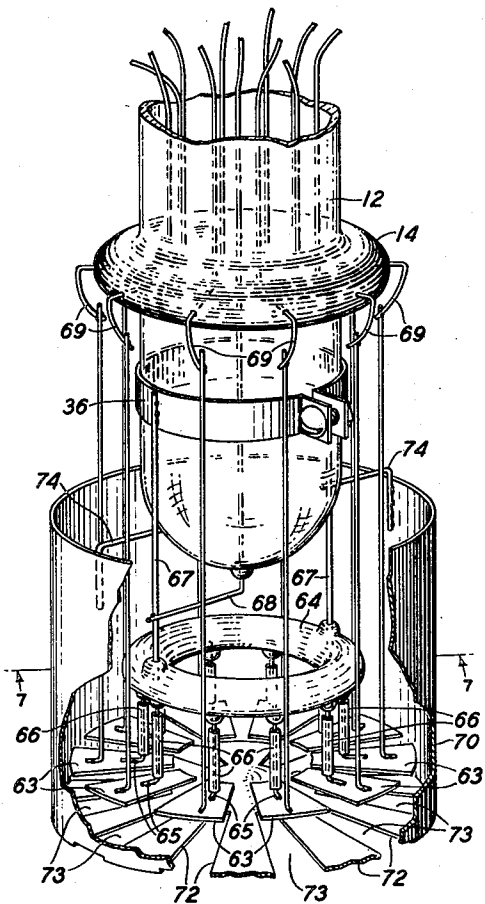


FIG. 7

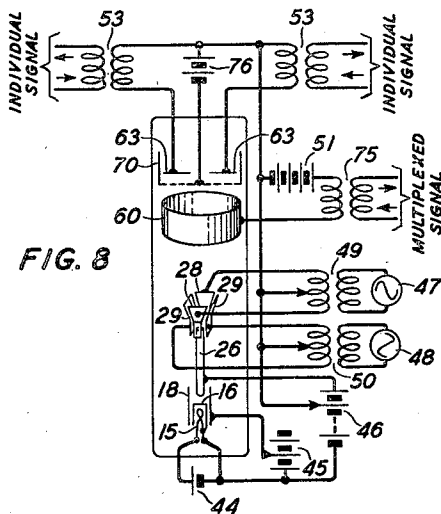
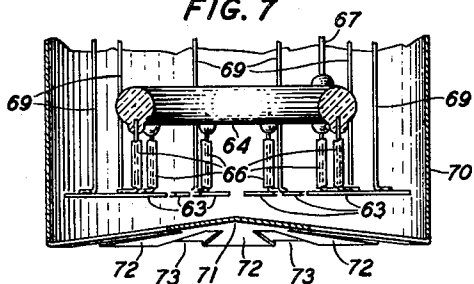


FIG. 8

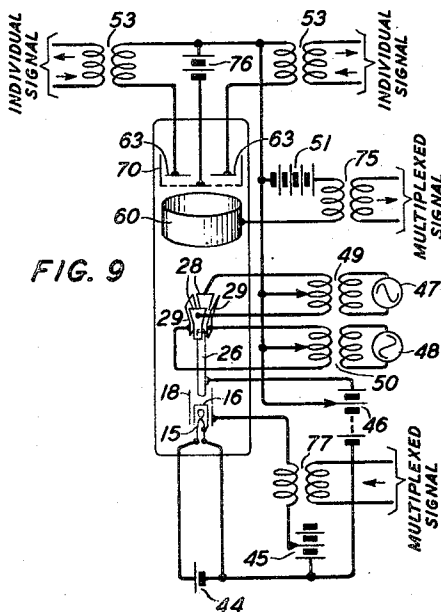


FIG. 9

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SIGNAL TRANSLATING SYSTEM AND APPARATUS

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Application February 11, 1939, Serial No. 255,898

9 Claims. (Cl. 179-15)

This invention relates to signal translating systems and apparatus therefor and more particularly to multiplex telephone systems including electronic commutators or distributors, of the general type disclosed in my application Serial No. 255,897 filed February 11, 1939.

In general, in multiplex telephone systems, a plurality of complex signals or electrical impulses or waves, corresponding, for example, to speech or music, are produced at individual sending stations, commutated at a central or common transmitter and then transmitted as a multiplex signal to a receiver. At the receiver, the signals corresponding to the original complex signals or waves are segregated from one another and distributed to individual receiving stations.

In such systems, faithful transmission of the signals, or more particularly of speech and music, necessitates the generation at the central or common transmitter, of electrical impulses corresponding accurately to the signals to be transmitted, without distortion and without interference between the impulses corresponding to one complex signal and those corresponding to another.

One general object of this invention is to facilitate the faithful transmission of complex signals corresponding, for example, to speech or music.

Another object of this invention is to expedite commutation of a plurality of complex signals without distortion thereof.

A further object of this invention is to prevent electronic cross-talk in multiplex telephone systems.

Still another object of this invention is to simplify the structure and operation of electronic commutators.

In one illustrative embodiment of this invention, an electronic commutator comprises means, such as an electron gun, for producing an electron beam, a plurality of targets upon which the electron beam impinges, an output or collector electrode in cooperative relation with the targets, and means for deflecting the electron beam so that it impinges upon the targets in sequence.

In accordance with one feature of this invention, the surface of the targets upon which the electron beam impinges is made secondary electron emissive and means are provided for modulating the secondary electron current between each target and the collector or output electrode in accordance with complex signals.

In accordance with another feature of this invention, the several targets are fabricated in a

unitary structure. For example, in one specific form the targets may be substantially sectoral secondary electron emissive coatings upon a disc coaxial with the collector or output electrode.

In accordance with a further feature of this invention, the portions of the disc, in the specific target structure described in the preceding paragraph, between the emissive portions are coated with a fluorescent material, whereby adjustment of the path of the electron beam is facilitated.

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 where-
in:

Fig. 1 is a perspective view of an electronic commutator illustrative of one embodiment of this invention, a portion of the enclosing vessel being broken away to show the internal structures more clearly;

Fig. 2 is a detail view along line 2-2 of Fig. 1 showing the construction of the unitary target structure;

Fig. 3 is another detail view, along line 3-3 of Fig. 1, illustrating the form and disposition of the modulating or control electrodes and the disposition thereof with respect to the collector or output electrode;

Fig. 4 is a circuit arrangement for the electronic commutator shown in Fig. 1;

Fig. 5 is a perspective view of an electronic commutator illustrative of another embodiment of this invention, portions of the enclosing vessel and of one of the electrodes being broken away to show the internal structures more clearly;

Fig. 6 is an enlarged detail view in perspective of the target structure of the device shown in Fig. 5, a portion thereof being broken away to show details of construction more clearly;

Fig. 7 is a diametral sectional view of a portion of the structure shown in Fig. 6; and

Figs. 8 and 9 are circuit arrangements for the electronic commutator shown in Fig. 5.

Referring now to the drawings, the electronic commutator illustrative in Figs. 1 to 3 comprises an elongated, evacuated enclosing vessel 10 having coaxial inwardly extending stems 11 and 12 at opposite ends thereof. The stem 11 terminates in a press 13 and the stem 12 is provided with an annular flange or seal 14.

Supported from the stem 11 is a unitary electron beam producing and deflecting structure which may be of the construction shown in my application, Serial No. 255,897 noted hereinabove. This structure comprises a cathode

which, as illustrated in Fig. 4, may be of the equipotential type having a heater filament 15 and a metallic sleeve 16 coated on its outer surface with electron emissive material, the cathode being supported by leading-in conductors 17 embedded in the press 13. It will be understood, of course, that other forms of cathodes, for example filamentary, may be employed.

The cathode is encompassed by a cylindrical concentrating electrode 18, preferably coaxial with the sleeve 16, having an integral flange 19 at one end to which are affixed metallic uprights or rods 20 extending from and carried by a pair of bands or collars 21 clamped about the stem 11. The electrode 18 is provided at the other end with a second integral flange 19' to which there is affixed, as by rivets 22, the flange 23 of an insulating member having a cylindrical body portion 24 and a second flange 25.

Extending through the insulating member and fitted in the bore in the body portion 24 is an elongated tubular anode 26 having an integral flange 27 seated upon the flange 25. Preferably, as indicated in Fig. 4, the anode 26 is coaxial with and extends into the concentrating electrode 18.

A plurality of metallic deflector or sweep plates 28 and 29 are supported from the flange 25 by rods or wires 30, having leading-in conductors 31 extending from the press 13 connected thereto. The conductors 31 may be encased in insulating sleeves, such as glass tubes, 32. As shown clearly in Fig. 1, each of the deflector or sweep plates has a rectangular portion affixed to one of the rods or wires 30 and an outwardly bent trapezoidal portion. The several deflector plates preferably are equally spaced about an axis coaxial with the anode 26. As shown in Figs. 1 and 4, the anode 26 preferably projects into the space bounded by the rectangular portions of the deflector or sweep plates.

The electrode 18, anode 26 and sweep plates 28 and 29 when energized as described hereinafter constitute an electron lens system so that electrons emanating from the cathode are focussed upon a point inside the anode 26 at the end thereof toward the cathode, and an electron image of this point is produced upon the targets to be described hereinafter.

A cylindrical or cup-shaped collector or output electrode 33 is supported coaxially with the anode 26 by a leading-in conductor 34 sealed in the stem 12 and extending through an annular metallic disc 35 also coaxial with the anode 26. The disc 35 is supported from a metallic band or collar 36 clamped about the stem 12, by a plurality of rods or wires 37. A suitable potential may be applied to the disc through a leading-in conductor 38 sealed in the annular flange or seal 14.

As shown clearly in Fig. 2, the surface of the disc 35 toward the collector electrode 33 has thereon a plurality of identical, equally spaced, radially extending, substantially sectoral, secondary electron emissive portions or targets 39. For example, these targets may be of nickel or beryllium or may be a matrix or coating including silver oxide, caesium oxide and some free caesium. The portions 40 of this surface between the emissive targets 39 may be coated with a fluorescent material.

Mounted opposite the coated surface of the disc 35, as by rods or wires 41 extending from leading-in conductors 42 sealed in the flange 14, are a plurality of substantially sectoral grid electrodes 43, each of which is directly opposite,

in alignment with, and of substantially the same size as a corresponding one of the targets 39. As indicated in Figs. 1 and 2, the support rods or wires 41 extend through oversize apertures in the disc 35. As shown clearly in Fig. 3, the several grid electrodes 43 are equally spaced from and in a boundary coaxial with the collector electrode 33.

During operation of the electronic commutator shown in Fig. 1 and described hereinabove, the heater filament 15 is energized as by a battery 44. the concentrating electrode 18 is biased positive or negative with respect to the cathode as by a battery 45, and the anode 26 is maintained at a high positive potential as by a battery 46, as illustrated in Fig. 4. The deflector or sweep plates 28 and 29 are energized from oscillators 47 and 48 through transformers 49 and 50, the oscillators being 90 degrees out of phase so that the deflector or sweep plates produce a continuously rotating field, having a frequency, for example, of the order of 6000 cycles per second. The mid-points of the secondary windings of the transformers 49 and 50 are connected to an intermediate positive terminal on the battery 46 so that the sweep or deflector plates serve as a second anode. The fixed potential applied to the deflector or sweep plates may be, for example, one-half of that applied to the anode 26 or it may be, for example, one-half of that applied to the anode 26 or it may be greater than that applied to the anode 26.

The disc 35, and hence the targets, are maintained at substantially the same positive potential as the deflector or sweep plates and the collector electrode 33 is maintained at a somewhat higher potential as by a battery 51 in series with a resistance 52. Each of the grid electrodes 43 is connected to the collector electrode and the disc 35 through the secondary winding of a corresponding transformer 53 and is biased negatively with respect to the disc 35 as by a battery 54. The primary windings of the transformers may be connected to individual transmitting stations such as telephone substations.

An amplifier 55 has its input terminals connected across the resistance 52 and battery 51, a blocking condenser 56, resistance 57 and grid bias battery 58 being provided as shown. The output circuit of the amplifier 55 may be coupled to a suitable common or multiplex transmission channel.

During operation of the apparatus shown in Fig. 4, the electrons emanating from the cathode are focussed into a concentrated beam by the lens system described heretofore and the beam is rotated by the field produced by the sweep or deflector plates 28 and 29 so that it is focussed and impinges upon the targets 39 repeatedly in sequence. The impinging electrons will result in the emission of secondary electrons from each of the targets so that a plurality of secondary electron streams to the collector electrode 33 will be established. The magnitude of each stream will be dependent of course upon the potential of the corresponding grid electrode 43. Thus, if signal potentials are impressed upon the grid electrodes through the transformers 53, each secondary electron stream will be modulated in accordance with the corresponding signal. The current through the resistance 52, which resistance is common to all of the target-collector electrode circuits, will be a multiplex one composed of currents corresponding to the several individual signals. The bias of the grid or con-

trol electrode of the amplifier 55 and the output of the amplifier will be varied accordingly and the output will be a multiplex signal composed of impulses corresponding to the individual signals impressed upon the grids 43.

It will be noted that, at any particular instant, secondary electrons will be emanating only from that target upon which the beam is impinging so that overlapping and consequent distortion and electronic cross-talk are substantially prevented.

The rotating electron beam will trace a visual path upon the fluorescent portions 40 of the disc 35 and this path will enable facile adjustment of the electron beam for optimum operation.

The multiplex signal may be transmitted over a common channel and the components thereof distributed to corresponding receiving stations as described in my copending application noted heretofore.

In the device illustrated in Figs. 5, 6 and 7, the electron gun and beam deflecting structure is substantially the same as in the device shown in Fig. 1 differing therefrom in that the lower flange 19 of the electrode 18 is omitted and the support rods or uprights 20 are secured to the flange 23 of the insulating member. The collector electrode 60, however, is a cylinder of metal or other electrically conductive material, such for example, as graphite, coaxial with the anode 26, and is supported by a pair of diametrically opposite wires or rods 61 sealed in the side wall of the vessel 10, as shown at 62, and extending therefrom.

The targets 63 are substantially sectoral plates, which may be of nickel or beryllium or other material having good secondary electron emitting properties, or may be of a suitable material having the surface thereof toward the collector electrode treated to form a coating or matrix including silver oxide, caesium oxide and some free caesium. These targets are supported from an annular insulating member 64 by individual rods or wires 65, which may be incased in insulating sleeves 66, such as glass tubes. The insulating member 64 is supported by a pair of rigid rods or wires 67 having one end embedded therein and the other end affixed to a band or collar 36 clamped about the stem 12. The insulator-target structure may be braced by a wire or rod 68 affixed to one of the supports 67 and sealed in the stem 12. Electrical connection to the targets or plates 63 may be established through leading-in conductors 69 sealed in the flange 14. The targets 63 are substantially coplanar, equally spaced and in circular formation about an axis coincident with that of the collector electrode 60.

The targets or plates 63 are surrounded by a conductive grid or shield including a cylindrical wall 70 coaxial with the collector electrode or anode 60, and an apertured conical base having an imperforate central portion 71 and equally spaced, radially extending tapering arms 72. The arms 72 form a plurality of radially extending slots 73 each of which is in alignment with a corresponding one of the targets or plates 63. The grid or shield may be supported by a pair of rigid wires or rods 74 secured to the supports 67. Suitable electrical connection to the grid or shield may be established through the conductor 68 by way of one of the supports 67 and the rigid wire 74 connected thereto.

The electron discharge device illustrated in Figs. 5, 6 and 7 may be utilized as both a sending and a receiving distributor, two ways of operation thereof being shown in Figs. 8 and 9. In

these figures, circuit elements corresponding to those of Fig. 4 are identified by the same numerals. The collector electrode or anode 60 is connected to the targets or plates 63 through the secondary winding of a transformer 75 and has a positive potential applied thereto by a source, such as the battery 51. The shield or grid electrode 70 also is connected to the plates or targets 63 as shown and is maintained at a negative potential with respect thereto by a source, such as a battery 76. In Fig. 9, the electrode 18 is connected to the cathode through the secondary winding of a transformer 77.

As will be apparent from the description previously given, in Figs. 8 and 9 a rotating electron beam is produced which impinges upon the targets or plates 63 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 electrode or anode 60, through the slots or apertures 73.

In Figs. 8 and 9, when the device is utilized as a sending distributor, the various secondary electron currents are modulated in accordance with the variable potentials impressed between the grid or shield 70, 71 and the targets or plates through the transformers 53. The multiplexed signal is transmitted to the common transmission channel by the transformer 75.

In Fig. 8, when the apparatus is operating as a receiving distributor, the potentials corresponding to the multiplexed signal are impressed between the collector electrode or anode 60 and the targets or plates 63, and the components thereof distributed to the proper individual signal channel.

In Fig. 9 when the apparatus is operating as a receiving distributor, the complex variable potentials corresponding to the multiplexed signal are impressed upon the electrode 18, through the transformer 77 and the intensity of the electron beam is varied accordingly. The components of the multiplexed signal are distributed to the proper individual channels.

The shield or grid electrode 70, 71, it may be noted, serves to decrease the capacitances between the targets and plates 63 and the collector electrode or anode 60. Also, when the distributor is operating as a sender, this electrode serves as a modulating electrode. Furthermore, the slots or apertures 73 may be of somewhat less width than the targets or plates 63 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 this invention as defined in the appended claims. For example, although electrostatic sweep or deflecting plates have been shown and described, it will be understood that coils for producing a rotating magnetic field may be employed. Other modifications may occur to those skilled in the art.

What is claimed is:

1. Signal translating apparatus comprising a plurality of spaced secondary electron emissive surfaces, a collector electrode in electron receiving relation with each of said surfaces, means for energizing said surfaces in sequence whereby flow of secondary electron currents therefrom is established, and means for modulating the sec-

ondary electron current from each of said surfaces independently of all the other secondary electron currents.

2. Signal translating apparatus comprising means for producing an electron beam, a plurality of spaced secondary electron emissive targets, a collector electrode in electron receiving relation with and uniformly spaced from each of said emissive targets, means for deflecting the electron beam to scan said targets in sequence, whereby individual secondary electron currents are established between each of said targets and said collector electrode, and means for modulating individually the secondary electron current from each of said targets.

3. Signal translating apparatus comprising a plurality of substantially sectoral secondary electron emissive targets arranged in circular formation, a collector electrode equally spaced from said targets and in cooperative relation therewith, means for energizing said targets in sequence whereby secondary electron currents are established between said targets and said collector electrode, and means including substantially sectoral grids each in juxtaposition to a corresponding one of said targets, for modulating the secondary electron currents.

4. Signal translating apparatus in accordance with claim 3 wherein said targets are radial portions of a disc member.

5. Signal translating apparatus comprising an electron gun for producing a beam of electrons, a collector electrode coaxial with said gun, an annular member adjacent and coaxial with said collector electrode, said annular member having alternate radial secondary electron emissive portions and fluorescent portions, means for rotating

the electron beam to impinge upon said emissive portions in succession, and a plurality of grids each mounted between a corresponding one of said emissive portions and said collector electrode.

6. The method of translating signals in multiplex which comprises producing a plurality of independent secondary electron currents in sequence and repeatedly at high frequency, individually modulating each of said currents in accordance with a corresponding signal, collecting the modulated secondary electron currents in common, and transmitting the resultant common current.

7. Signal translating apparatus comprising a plurality of secondary electron emissive targets, means for energizing said targets in sequence, a collector electrode in cooperative relation with said targets, output circuits between each of said targets and said collector electrode and having a common portion, and means including a plurality of individual signal channels, one for each of said targets, for modulating the secondary electron currents from each of said targets.

8. Signal translating apparatus in accordance with claim 7 wherein said modulating means comprises a plurality of control electrodes, one adjacent each of said targets, and each of said signal channels is connected between a corresponding one of said targets and the control electrode thereadjacent.

9. Signal translating apparatus in accordance with claim 7 wherein said modulating means comprises a control electrode in cooperative relation with said targets and each of said signal channels is connected between said control electrode and a corresponding one of said targets.

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