

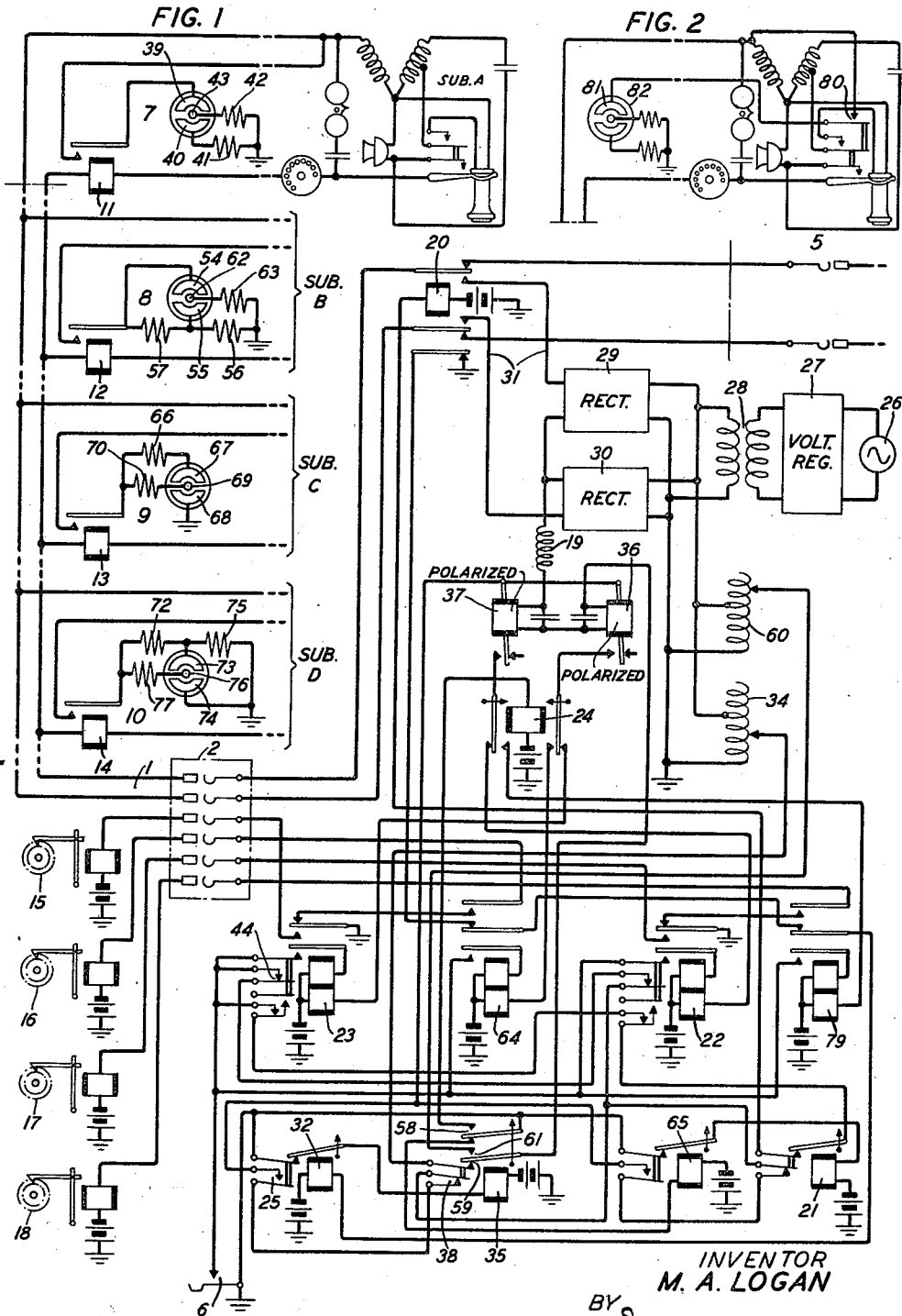
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to arrangements in systems for identifying subscribers of party lines.

An object is to obtain increased efficiency in the use of identification tests for determining the calling subscribers on party lines.

Heretofore arrangements of this kind have been used in which tests were performed by having three-element space discharge devices at the subscribers' stations on a party line for identifying calling parties. In such cases when a subscriber calls, a current of a particular polarity is applied to operate a space discharge device, and cause it to unbalance relay devices at the central office to identify the calling party.

Another arrangement has been proposed in my copending application, Serial No. 316,902, filed February 2, 1940, which makes use of a three-element tube and a network at each station for identifying substations on a party line. This arrangement is such that a control electrode in the tube at such station is connected to a specially tuned network to both conductors of the line. Another electrode is connected to ground while a third electrode is connected directly to one of the conductors of the line. At the central office an arrangement is provided whereby a series of different testing frequencies may be applied in succession across the line conductors and simultaneously current from a special source is applied to the conductor connected directly to the third electrode. In response to a particular frequency applied the network at the calling station causes the associated tube to ionize over the control gap between the first and third electrodes. This permits current to flow from the special source over the associated conductor and the main gap between the second and third electrodes to ground. This current causes the operation of a relay at the central office to identify the calling line as determined by the particular testing frequency applied at the time.

It is a feature of the present invention to employ cold cathode three-element tubes arranged with suitable networks and ground connections at the substations of party lines for identification. If a four-party line is considered, two of the stations are provided with networks so connected and adjusted in relation to the elements of the tubes and the ground that said tubes will ionize in response to low voltage as applied by an alternating current source and one of the tubes will cause rectified current to flow from said source through it and the line in one direction and the other tube will cause rectified current to

flow from said source through it and the line in the opposite direction, while the networks, tubes and ground connections at the other stations are so adjusted and connected that said tubes will only ionize in response to high voltage as applied by an alternating current source and one of these last-mentioned tubes will cause rectified current of one polarity to flow from said source through the tube and the line while the other of this last-mentioned pair of tubes will cause rectified current of the opposite polarity to flow from said source through it in the line.

Another feature is an arrangement at the central office whereby when a test is to be made for a calling subscriber, the low and high voltages are applied from alternating current sources at the central office to the line in sequence so that one or the other of said voltages will ionize the tube at the calling station and cause the rectified current to flow through the tube and the line in one direction or the other, and equipment whereby the called line is identified by the application of alternating current voltage of low or high potential and by the flow of the rectified current in one direction or the other. Two polarized relays are arranged in circuits to operate depending on the direction of the rectified current flowing through the line and other relays are provided in the circuits in certain connections to operate to apply the alternating current voltages of the low or high potentials in sequence. Identifying signals or registers may be operated by these relay equipments to identify the calling party.

Another feature relates to means whereby when a test is to be made as a party is calling, the associated network and tube of the calling station are held connected to the line by the application of current from a direct current source at the central office over the line and the tests may then be performed as described.

This invention has been illustrated in the accompanying drawing in which,

Fig. 1 shows a four-party line and automatic telephone system to which the applicant's invention has been applied; and

Fig. 2 shows a subscriber's telephone circuit with a modified equipment in accordance with the applicant's invention attached thereto.

Referring now to the drawing the party line has been shown terminating in four subscribers' telephone circuits at A, B, C and D. In the showing for subscriber A, a complete telephone circuit has been shown equipped with a particular circuit arrangement forming part of the

equipment for identifying the subscriber in accordance with the present invention. The equipments for subscribers' stations B, C and D have only been shown partially to indicate the special equipments required for identifying the subscribers in accordance with the present invention. The line 1 may terminate in a line finder 2 which is merely shown in a diagrammatic form by means of brushes and terminals of a line finder of any type well known in the art. Brushes and terminals for line 1 have also been shown for extending connections to metering devices for the four subscribers on line 1. At the central office this line finder extends to an equipment especially provided for identifying calling subscribers and to brushes of an associated selector 5 extending to terminals for connections beyond. Any selector circuit well known in the art may be employed. In this central office equipment a key 6 has been shown which may be operated to connect certain leads to ground to make the identification equipment effective. The equipments at the subscribers' stations on line 1 for identifying a calling line may, for example, at subscriber station A consist of a three-element space discharge device 7 having its electrodes connected in a certain manner through resistances to ground to identify the station. Similar devices 8, 9 and 10 at stations B, C and D, respectively, are provided with their electrodes connected in different manners through resistances to ground to identify these stations when calling. To connect these identification equipments at the subscribers' stations, relays are provided which operate to establish such connections for station A and these relays are marked 11, 12, 13 and 14 for stations A to D, respectively.

Referring now to the operation of this system, it may be assumed that the subscriber at station A calls by removing his receiver from the switch-hook. This closes a circuit across the tip and ring conductors and the line finder 2 will operate to connect the line 1 to the circuit for identifying the calling station at the central office and to the selector 5 in any well-known manner. When this connection is made circuits are completed for the subscriber identifying circuit to operate one of the registers of the group 15 to 18 to record that a calling subscriber has been identified. In this case the register 15 will operate to identify the subscriber at station A when calling. The first operation that takes place is the energization of a relay 20 over a circuit from battery through the winding of this relay, contacts of relays 21, 22, and 23 to ground at 6. Relay 20 in operating connects the subscriber identifying equipment for testing to determine which subscriber had called. It should be noted that the alternating current source 26 is connected through voltage regulator 27 and the repeating coil 28 to rectifiers 29 and 30 for the application of direct current over leads 31 through contacts of relay 20, brushes of line finder 2 over the tip and ring conductors of line 1 through the subscriber's loop at station A and through the winding of relay 11. Relay 11 operates and connects the cathode of tube 7 through its contacts to the tip conductor of line 1. A circuit is now completed from ground through a portion of the inductance or autotransformer 34, contacts of relay 35, windings of relays 36 and 37 in series, inductance 19 through the rectifier over one of the conductors 31, contacts of relay 20, line finder 2, tip conductor of line 1 and contacts of relay 11 to the cathode 39

of tube 7. It should be noted that the inductance 34 is connected across the repeating coil 28 so that alternating current from the source 26 is now transmitted through the inductance 34 and a portion of the alternating current voltage from the source 26 is therefore now applied to the cathode 39 over the above-mentioned circuit. This voltage is sufficient to cause the tube 7 to ionize between the cathode 39 and the control anode 40 through resistance 41 to ground. The resistance 41 is merely a current limiting device adjusted to cause ionization to take place at this lower voltage but not to permit appreciable current to flow. As tube 7 ionizes a rectified current will now flow through this tube from ground through resistance 42, main anode 43, cathode 39 and over the above-mentioned circuit through the inductance 34 to ground during the negative half wave of the alternating current as applied through this inductance 34. As the relays 36 and 37 are polarized, the current in the direction from ground at tube 7 will be such as to cause the relay 36 to operate, while relay 37 will not operate, being responsive only to current in this circuit in the opposite direction. Relay 36 in operating closes a circuit for the operation of relay 23 from battery through the lower winding of this relay, contacts of relay 24, contacts of relay 36, contacts 25 of relay 32, which is slow in releasing but releases on the operation of relay 20, contacts 38 of relay 35, contacts of relay 22, contacts 44 of relay 23, to ground at 6. Relay 23 in operating closes a holding circuit for itself from battery through its upper winding and upper inner armature and front contact to ground at 6 and opens the original circuit for this relay at the contacts 44. Relay 23 in operating closes a circuit for the operation of register 15 from battery through the winding of this register, a terminal and brush of the line finder 2, contacts of relay 23 to ground, thus recording the fact that the subscriber at station A has called. Relay 23 in operating also opens the energizing circuit for relay 20 so that relay 20 will now release and cause the reoperation of relay 32. This release of relay 20 disconnects the line from the subscriber identifying equipment and connects it to the selector 5 so that the calling subscriber at station A may now dial in the usual manner to operate the selector 5 to establish the connection beyond when dialed tone is received as is well known in the art. Relay 36 is, of course, released on the release of relay 20. The removal of the alternating current source restores tube 7 to normal. The key 6 may now be opened to release relay 23 in any suitable manner, for example, by instrumentalities operative in the selector 5.

If the subscriber of station B had called, relay 12 would have operated to connect tube 8 to the line 1 for ionization but the low voltage applied at the inductance 34 would not cause this tube to ionize over the cathode 54 and anode 55, as, in addition to a resistance 56 to ground for the anode 55, a resistance 57 is inserted across these elements. The tube 8 would, therefore, require a higher voltage in order to ionize. This is accomplished as follows: It should be noted that relay 32 in releasing opens the circuit for 35 which would release after an interval due to its slow-to-release characteristics. The release of relay 35 would then close a circuit for the operation of relay 24 from battery through the winding of this relay, contacts 58 of relay 35 to ground at 6 and also open the circuit for the

connection to the inductance 34 to the line at contacts 59. Relay 35 would also close a circuit from ground through the inductance 60, contacts 61 of relay 35, windings of relays 36 and 37, inductance 19, rectifier 29, one of the conductors 31, contacts of relay 20, line finder 2, the tip conductor of line 1, contacts of relay 12 to the cathode 54 of tube 8. It should be noted that the inductance 60 is connected in circuit with the alternating current source 26 in the same manner as inductance 34 except that in this case a higher voltage would be applied through the inductance 60 than was applied at inductance 34. This higher voltage will now be sufficient to ionize the tube 8 across the cathode 54, control anode 55, resistance 56 to ground. As the main anode 62 is connected through a resistance 63 in the same manner as anode 43, for the subscriber at station A, rectified alternating current will now flow through tube 8 in the same direction as for tube 7 and cause relay 36 to operate. When relay 36 now operates, a circuit for relay 64 is closed as soon as the slow-to-release relay 65 releases due to the release of relay 35, from battery through the lower winding of relay 64, contact of relays 24, 36, 65, 21, 22, 23 to ground at 6. Relay 64 in operating closes a locking circuit for itself from battery through its upper winding, upper inner armature and front contact to ground at 6. This relay now also closes a circuit for the register 16 from battery through the winding of this register, a terminal and brush of line finder 2, contact of relays 64 and 23 to ground to identify the subscriber at station B as calling. Shortly thereafter the slow-to-release relay 21 will release due to the release of relay 65 and cause the release of relay 20 so that the line will be released from the testing equipment and connected to the selector 5.

If the subscriber at station C had called, this station would have been tested by a low voltage applied at the inductance 34 and this low voltage would have been applied through a resistance 66 over the cathode 67 and anode 68 to ground to ionize tube 9 in the same manner as tube 7 was ionized. In this case, however, the rectified current through tube 9 will flow in the opposite direction from ground over the anode 68 and main anode 69 through resistance 70, contacts of relay 13, over the line 1, line finder 2, contacts of relay 20, one of the conductors 31, rectifier 29, inductance 19, windings of relays 37 and 36, contacts 59 of relay 35, inductance 34 to ground. As the rectified current is now in the opposite direction, relay 37 will operate instead of relay 36 as in the case of testing for stations A and B and close the circuit for the operation of relay 22 from battery through the lower winding of this relay, contacts of relays 24, 37, 65, 21, 22 and 23 to ground at 6. Relay 22 in operating closes a locking circuit for itself from battery through its upper winding and its inner upper armature and front contact to ground at 6 and also closes a circuit for the register 17 from battery through the winding of this register, a terminal and brush of line finder 2, contacts of relay 22 to ground. Relay 22 in operating causes the release of relay 20 to disconnect the testing equipment from the line and relay 20 reoperates relay 42.

In case the subscriber at station D had called, the tube 10 will not ionize on the low voltage through the inductance 34 as in addition to the resistance 72 for a cathode 73, the control anode 74 is shunted by a resistance 75, thus requiring a higher voltage to be applied on the cathode 73

before the tube 10 ionizes. Therefore relays 32 and 35 are released in succession and the higher voltage is applied from ground through the inductance 60, through contacts 61 of relay 35 through the windings of relays 36 and 37, inductance 19, rectifier 29, one of the conductors 31, contacts of relay 20 through the line finder 2 and line 1, contacts of relay 14, resistance 72, cathode 73, anode 74, to ground, to ionize this tube 10. As relay 35 is released relay 24 will operate. When this takes place a rectified current is applied in the same direction as rectified current was applied through tube 9, due to the connection of the main anode 76 and resistance 77 to ground through the anode 74 and relay 37 is then operated from the direct current through tube 10 in the proper direction. A circuit is now completed for relay 79 from battery, lower winding of this relay, contacts of relays 24, 37, 65, 21, 22, 23 to ground at 6. Relay 79 in operating closes a locking circuit for itself from battery through its upper winding and upper inner armature and front contact to ground at 6, and also closes the circuit from register 18 from battery through the winding of this register, a terminal and brush of line finder 2, contacts of relays 79 and 22 to ground to record that the subscriber at station D has called. When relay 21 releases, relay 20 is released and the test equipment is disconnected from the line.

Thus it will be seen that in case of a subscriber at station A calling, low voltage will ionize tube 7 and if the subscriber at station B is calling, a high voltage will ionize tube 8 and in these cases the direction of the rectified current through these tubes will be in the same direction to operate the polarized relay 36, while relay 24 will only operate in case of station B calling to select the proper register. In case of the station C calling, a low voltage will ionize tube 9 and if the station D is calling a high voltage will ionize tube 10, and the direction of the rectified current through these tubes will be in the same direction to cause the operation of relay 37 while relay 24 will only operate in case station D is calling to select the proper register. Therefore, the testing involves low and high alternating current voltages applied to rectifying tubes and the polarity of the direct current caused by them.

In regard to Fig. 2 the subscriber's station shown therein has been modified so that in place of a relay for connecting the tube circuit to one conductor of the party line to identify a calling party, the tube circuit is connected through a pair of contacts 80 controlled by the switchhook. Thus, when the subscriber removes his receiver from the switchhook the cathode 81 of the tube 82 may be connected to the tip conductor of the line. In this case a direct current supply need not be provided in the identification equipment at the central office and hence the rectifiers 29 and 30 would not be required.

What is claimed is:

1. In a telephone system, a central office, a telephone line extending therefrom, two stations on said line, a source of relatively low alternating voltage and a source of relatively high alternating voltage at the central office, means for applying said sources to the line, means at one station effective when the low voltage source is applied for causing rectified current to flow in a given direction from said source over the line, means at the other station effective when the high voltage is applied for causing rectified current to flow in a given direction from said source over the

line, and means responsive to the rectified current flowing from said sources for identifying said stations.

2. In a telephone system, a central office, a telephone line extending therefrom, four stations on said line, a source of low alternating voltage and a source of high alternating voltage at said central office, means for applying said sources to said lines, means at a set of two of said stations effective when the low voltage source is applied for causing rectified current to flow in one direction from said source over the line for one of said stations and in the opposite direction for the other of said stations, means at the other set of two stations effective when the high voltage source is applied for causing rectified current to flow in one direction from said source over said line for one of said last-mentioned stations and in the opposite direction for the other of said last-mentioned stations, and means responsive to the rectified current flowing from said sources for identifying said stations.

3. In a telephone system, a line having four subscribers' stations associated therewith, a source of low alternating voltage, a source of high alternating voltage, means for applying said sources to said lines, a cold cathode tube at each station, a network and a ground connection associated with each of said tubes, said network and ground connection at two of said stations being connected to the corresponding tubes and so adjusted as to cause the associated tubes to ionize on the application of low alternating voltage to said line while one of the tubes causes rectified current from said source to flow through the tube and over the line in one direction and the other tube causes the rectified current from said source to flow through said other tube and over said line in the opposite direction when said tubes ionize, while the network and ground connections at the other two stations are so connected with the corresponding tubes and so adjusted as to cause the associated tubes to ionize on the application of high alternating voltage through said line and with one of said latter tubes causing rectified current from said last-mentioned source to flow through said tube over the line in one direction and the other of said last-mentioned tubes causing rectified current to flow from said last-mentioned source through said tube and over the line in the opposite direction when said tubes ionize, and means for identifying the calling station operative as determined by the corresponding effective alternating voltage applied and the direction of the rectified current flowing through the line.

4. In a telephone system, a central office, a telephone line, two stations on said line, a source of direct current at the central office, two sources of alternating current of low and high voltage respectively at the central office, voltage and current responsive means at each station, means at the central office operative when a station is calling for applying current from said direct current source and voltage from said low and high alternating voltage sources over said line in succession, means at one of said stations when calling operative in response to current from said direct current source when applied to the line for connecting the associated voltage and current responsive means to said line, said voltage and current responsive means at said station being then responsive to low alternating voltage applied at the central office for causing rectified current to flow from said low alternating voltage

source over said line in one direction, means at the other of said stations when calling operative in response to current from said direct current source when applied to the line for connecting the associated voltage and current responsive means to said line, said voltage and current responsive means at said other station being then responsive to high alternating voltage applied at the central office for causing rectified current to flow from said high alternating voltage source in the opposite direction, and means at the central office responsive to said rectified currents received over said line to identify a calling station.

5. In a telephone system, a central office, a telephone line, two stations on said line, a source of direct current at the central office, two sources of alternating current of low and high voltage respectively at the central office, voltage and current responsive means at each station, means at the central office operative when a station is calling for applying current from said direct current source and voltage from said low and high alternating voltage sources through said line in succession, means at one of said stations when calling operative in response to current from said direct current source when applied to the line for connecting the associated voltage and current responsive means to said line, said voltage and current responsive means at said station being then responsive to low alternating voltage applied at the central office for causing rectified current to flow from said low alternating voltage source over said line in one direction, means at the other of said stations when calling operative in response to current from said direct current source when applied to the line for connecting the associated voltage and current responsive means to said line, said voltage and current responsive means at said other station being then responsive to high alternating voltage applied at the central office for causing rectified current to flow from said high alternating voltage source in the opposite direction, two oppositely polarized relays at the central office, means for operating one of said polarized relays in response to the rectified current applied to the line if said first-mentioned station is calling and for operating the other of said polarized relays in response to the rectified current applied to the line if said second-mentioned station is calling, means responsive to the operation of said first-mentioned relay for identifying said first-mentioned calling station, and means responsive to the operation of said second-mentioned relay for identifying said last-mentioned calling station.

6. In a telephone system, a central office, a telephone line extending therefrom, four stations on said line, a source of relatively low alternating voltage and a source of relatively high alternating voltage at said central office, means for applying said sources to said line operative when a station is calling, means at two of said stations effective when the low voltage source is applied for causing rectified current of one direction or the other to flow over said line to said central office from said low voltage source depending on whether one or the other of said stations is calling, means at said two other stations effective when the high voltage source is applied for causing rectified current of one direction or the other to flow over said line to said central office from said high voltage source depending on whether one or the other of said

last-mentioned stations is calling, and means at said central office responsive to a rectified current flowing from said low voltage source over said line for identifying one or the other of said first-mentioned stations if calling and depending on the direction of the rectified current flowing, and responsive to rectified current flowing from said high voltage source over said line for identifying one or the other of said last-mentioned stations if calling and depending on the direction of said rectified current.

7. In a telephone system, a central office, a telephone line extending therefrom, four stations on said line, a source of relatively low alternating voltage and a source of high alternating voltage at said central office, means at one of two stations operative when calling for applying the low voltage source to said line and responsive to the application of said low voltage source for causing rectified current to flow in one direction from said source over said line, means at the other of said two stations when calling for applying the low voltage source to said line

and responsive to the application of said low voltage source for causing rectified current to flow in the opposite direction from said source over said line, means at said central office and at one of the other two stations operative when calling for applying said high voltage source to said line and responsive to the application of said high voltage source for causing rectified current to flow in one direction from said source over said line, means at the central office and at the other of said last-mentioned two stations operative when calling for applying said high voltage source to said line and responsive to the application of said high voltage source for causing rectified current to flow in the opposite direction from said source over said line, and means at the central office responsive to a rectified current flowing over said line in one direction or the other and depending on whether the low voltage or the high voltage source was applied to the line for identifying a corresponding calling station.

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