

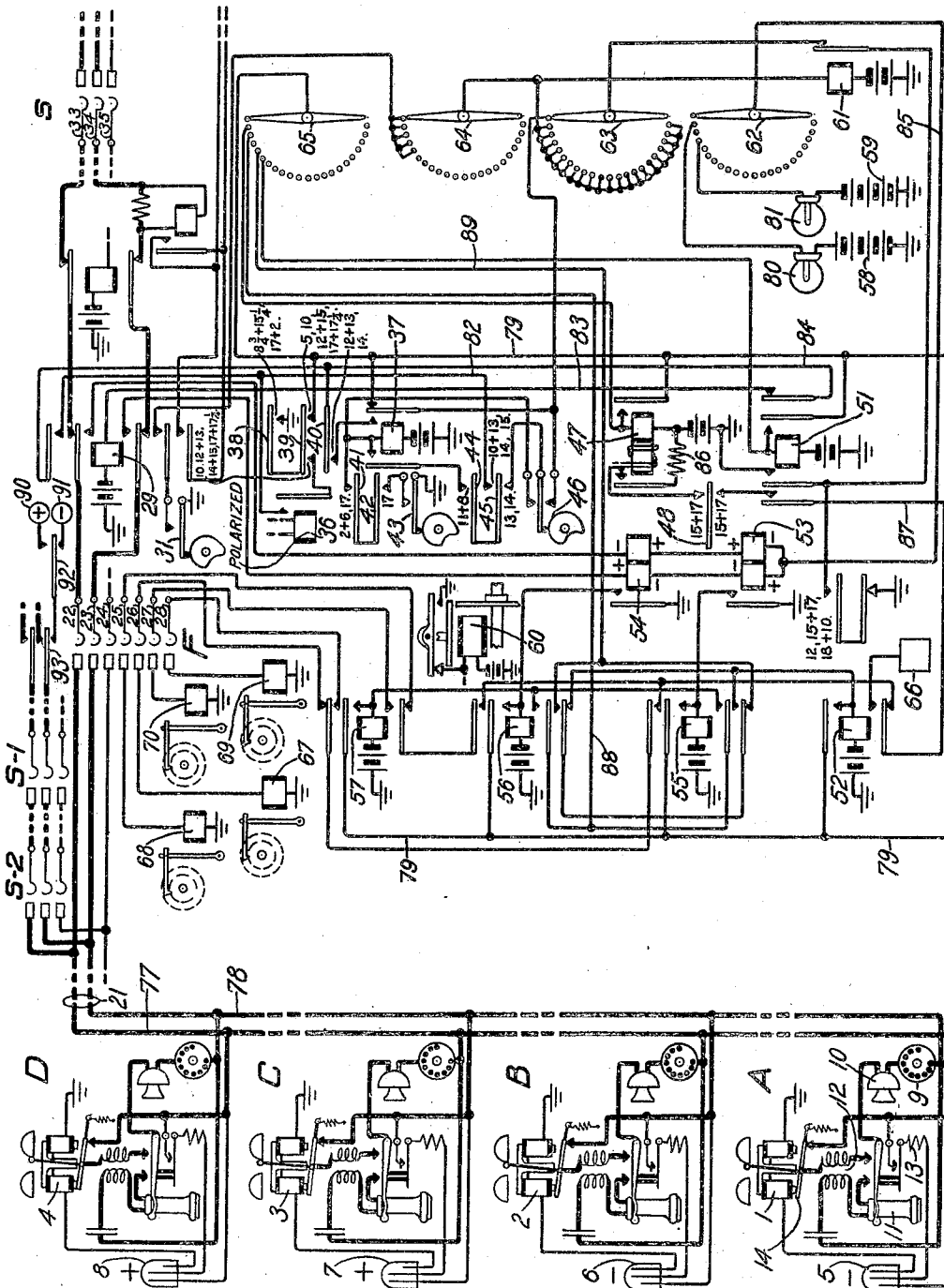
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to the identification of stations on party lines.

The objects are to enable the performance of a positive and reliable test of a party line to identify one of the stations thereon, to simplify the equipment used for this purpose, and to otherwise improve systems of this character.

According to this invention, each of the stations on a four-party line is provided with a directional current-discharge device connected in series with the signal bell. Two of the stations have their bells connected from the tip side of the line to ground, and the other two have their bells similarly connected on the ring side. One of the discharge devices connected on the tip side of the line will permit only current of one polarity to flow, whereas the other device on the same side of the line will permit only the flow of current of opposite polarity. The same is true of the discharge devices connected in circuit on the ring side of the line. By this arrangement, selective ringing of the bells is secured by applying either positive or negative ringing current to either the tip or ring side of the line, and a selective identification may be performed by applying either positive or negative test current to the line. To enable the positive identification of each of the four stations, the signal bells are equipped each with an armature which operates in response to the flow of test current through the bell winding. Two of these armatures in operating open one side of the line, and the other two similarly open the opposite side. These openings control testing mechanism at the central office to make the identification.

A feature of the invention is an arrangement in which the current-discharge devices are so controlled by the switchhook contacts that the device at the calling station is made more sensitive than those at non-calling sta-

tions to insure that current will flow only through the device at the calling station.

An advantage of this invention is that the signal bells, which must necessarily be provided at the stations, serve also in the capacity of test relays for identification purposes, thus avoiding the expense of equipping each station with a relay and also simplifying the system.

The invention is illustrated in the accompanying drawing which shows a party line terminating in a line finder switch together with means at the central office for performing the identification tests and for selectively operating the message registers.

The subscriber's line 21 has four substations; A, B, C and D. These stations are equipped respectively with individual call signal bells 1, 2, 3, and 4. Since it is desirable to furnish full-selective ringing for the stations on the party line, the bells are provided with individual directional current-discharge devices 5, 6, 7, and 8. These devices are arranged to permit the flow of current only in one direction when potential of a sufficient value is applied thereto. Two of the signal bells are connected through their respective current-discharge devices directly to the tip conductor of the line and the other two are similarly connected to the ring conductor of the line. For example, the bell 1 at station A is included in a circuit from ground through the current-discharge device 5 to the tip conductor 77. The same is true of the bell 4 of substation D. Bells 2 and 3 of substations B and C respectively are connected to the ring conductor 78. The device 5 is so poled that it permits current to flow through the windings of the bell 1 only when negative ringing potential is applied to the line. The same is true of device 6 at substation B. Devices 7 and 8 are oppositely poled so as to permit flow only when positive potential is applied to the line.

The substation bells and their respective

discharge devices are also used for the purpose of making the identifying tests to determine the calling station. To this end the armatures of the bells are provided with circuit contacts for controlling the test circuits.

5 The equipment at the central office is arranged to apply at some suitable time positive and negative test potentials to the tip and ring conductors of the line in parallel. According
10 to the polarity of test potential, current will or will not flow through the current controlling discharge device at the substation. When the discharge device permits flow of
15 test current through the windings of the substation bell, the armature of the bell is shifted from its normal position to its operated position to disconnect the bell winding from one side of the line. For instance, the armature
20 14 of bell 1 at substation A in operating disconnects the bell winding from the ring side 78 of the line. This affects the testing apparatus at the central office to enable the discrimination of the calling station.

The current-discharge devices may be of
25 any well-known type in which electrodes are enclosed in a glass tube or container filled with any suitable gas and permit current to flow from one electrode to another when subjected to a sufficient potential in the proper
30 direction. The discharge devices shown in this system are provided with third electrodes which serve to render them more sensitive to applied potentials. The purpose of this is to render the device at the calling station more
35 sensitive to the test potentials than are the devices at non-calling stations to insure that current will flow only through the test circuit at the calling station. This is accomplished
40 by connecting the third electrode of the discharge device to a contact which is closed by the switchhook when the calling subscriber removes his receiver. At station A, for instance, the third electrode, which is shown as
45 the middle electrode in the device 5, is connected through the resistance 13 to the switchhook contacts and thence to the tip side of the line. As an illustration of a current-discharge device of the same general type as
50 those employed in this system, reference is made to the patent to F. Gray, No. 1,784,869, issued Dec. 16, 1930. Another is shown in the patent to Schroter No. 1,605,001, granted November 2, 1926.

55 At the central office, the line terminates in the bank of a line finder switch F, which is diagrammatically illustrated by the brushes 22 to 28 inclusive, and also terminates in the contact bank of a final selector switch S—2.
60 The line finder F is directly connected to a selector switch S having the brushes 33, 34, and 35, which is also illustrated diagrammatically.

65 The line 21 may be seized as a called line

over a connection extending through selector switches S—1 and S—2.

The line finder and selector unit may be similar in construction and operation to the one shown and described in detail in the patent to Kopp No. 1,589,402, granted June 22,
70 1926. Control and operating circuits for a selector switch of this character are also shown in the patent to Stearn et al. No. 1,395,977, granted November 1, 1921. The
75 construction of these switches is illustrated and described in the patent to Craft et al. No. 1,123,696, granted January 5, 1915.

Stations A, B, C, and D are provided at the central office with individual message registers 67, 68, 69, and 70, which are selectively
80 operated to assess calls against the corresponding stations on the line. The registers are selected as a result of the identification test performed at some convenient time after
85 the subscriber initiates the call. The test is made by means of the polarized differential relays 53 and 54 together with oppositely poled sources of test current 58 and 59. By
90 means of the stepping switch shown at the right of the drawing, sources 58 and 59 are connected in succession to a circuit which leads through both windings of the relays 53 and 54 and thence to the tip and ring conductors of the line. Being differential, the relays 53 and 54 will not operate so long as current of equal strength flows through both
95 windings. When the strength of current in one winding of either of these relays exceeds that in the other winding, the relay will or will not operate according to the direction of current flow. For instance, if the strength of current in the right winding of relay 53 exceeds that in the left winding and the polarity of the current is negative, the relay will
100 operate. On the other hand if the polarity is positive, the relay will not operate. It will operate, however, when positive current flowing through the left winding of the relay exceeds in strength the flow of positive current through the right winding. The same is true of relay 54 with the exception that the polarity is reversed.

A detailed description will now be given, and it will be assumed for this purpose that
115 the subscriber at station A initiates a call. In response to the initiation of the call, the line finder F operates to seize the calling line 21. Thereupon the subscriber manipulates his impulse transmitter 9 to set up the called
120 designation in a register sender, not shown, at the central office. The register sender proceeds to control the selector switch S and succeeding selector switches to extend the connection to the called subscriber's line as is
125 fully described in the above-mentioned patents to Kopp and Stearn et al.

When the called subscriber answers, the direction of current flow over the trunk, with whose terminals brushes 33, 34, and 35 of the
130

selector switch S are in contact, is reversed, thereby causing the operation of the polarized supervisory relay 36. At this time, the sequence switch 60 has advanced to some position such as position 13 in which it remains during conversation. As soon after the relay 36 operates as the interrupter 46 closes its upper contact, a circuit is completed from battery through the winding of relay 37, upper contacts of interrupter 46, contacts of sequence switch spring 45, conductor 82, contact of relay 36, left contact of sequence switch spring 39, to ground at sequence switch spring 38. Relay 37 operates and locks through its left contacts, sequence switch spring 44, contacts of sequence switch spring 45 to the grounded conductor 82. As soon after relay 37 operates, as the interrupter 46 closes its lower contacts, a circuit is completed from battery, through the winding of relay 29, conductor 83, outer right contact of relay 51, conductor 84, sequence switch spring 40, right front contact of relay 37, lower contacts of interrupter 46, contacts of spring 45 to the grounded conductor 82. Relay 29 operates and locks through its uppermost contact to the grounded conductor 82.

The brushes 62, 63, 64, and 65 of the stepping switch are now advanced by the successive operation and release of the stepping magnet 61 to control the testing of the subscriber's line. With the brushes in any one of positions 1 to 5 inclusive, position 1 being the normal position, a circuit is closed after relay 29 is operated through the winding of the magnet 61 each time the continuously driven interrupter 31 completes its contacts. This circuit may be traced from battery through the winding of the magnet 61, brush 64, middle lower contact of relay 29, contacts of interrupter 31 to ground. The release of the magnet each time the circuit is opened at the contacts of the interrupter advances the switch one step. After the brushes have advanced beyond position 5, magnet 61 is no longer under the control of the interrupter 31.

With the stepping switch in position 2, a circuit is closed from battery through the right winding of relay 47, brush 65, conductor 79, right contact of sequence switch spring 39 to ground at the spring 38. Relay 47 operates and locks through its winding and right contact to the grounded conductor 79. Relay 47 prepares a circuit for operating the calling subscriber's message register after conversation has been completed. With the stepping magnet in position 2, a circuit is closed from the positive source of testing potential 58, resistance lamp 80, brush 62, conductor 85, through the winding of relays 53 and 54, inner, upper and lower contacts of relay 29 to the tip and ring conductors 77 and 78 of the subscriber's line. This test circuit may be further traced over the tip conductor 77 through the controlling device 5 and the

windings of bell 1 to ground. The circuit over the ring side of the line may be traced over conductors 78, through the impulse transmitter 9, talking transmitter 10, switchhook contacts, right winding of induction coil 12, normal contacts of the bell armature 14, through the device 5 and the windings of the bell to ground.

As the receiver 11 is off the hook at station A, the tip conductor 77 may also be traced through the switchhook contacts and resistance 13 to the third electrode of the discharge tube 5. Over this latter circuit, a potential is applied to the third electrode of the tube 5 to render it more sensitive in case the polarity is in the proper direction. Since the receivers at the remaining stations are on the switchhooks, the third electrodes of the respective tubes are not excited, and therefore, the tubes are not sufficiently energized to break down and permit the flow of current. Due to the polarity of the device 5, however, current is not permitted to flow over the test circuits above traced, and accordingly, the windings of the bell 1 do not energize to disturb the armature 14. Therefore, neither of the relays 53 and 54 will operate since they are not unbalanced.

No further operation takes place while the stepping switch is in position 3. But when the switch is advanced to position 4, the negative source of testing potential 59 is connected through the resistance lamp 81 and brush 62, over conductor 85, through the winding of relays 53 and 54, and thence over the subscriber's line to the electrodes of the discharge device 5. The polarity is such that current is now permitted to flow through the device 5 and the bell windings 1 are energized to shift the armature 14. The armature 14 in opening its normal contact disconnects the ring conductor 78 from the windings of the bell. This opens the circuit through the left windings of relays 53 and 54, whereby current in the right windings predominates. Therefore, relay 53 attracts its armature, but relay 54 remains in an unoperated condition. Relay 53 closes an obvious circuit for relay 55, which operates and locks to the grounded conductor 79.

No further operation takes place until the brushes of the stepping switch are advanced to position 6, at which time the circuit is closed from battery through the winding of relay 51, the brush 65, conductor 79 to ground. Relay 51 operates and locks to conductor 79. Relay 51 at its outer right back contact opens the circuit of relay 29, and the latter relay releases. The relay 51 in operating also connects ground potential through its front contact and inner left armature, contact of the stepping magnet 61, brush 63, winding of magnet 61 to battery. Magnet 61 advances its brushes out of position 6 and also continues to advance them into the normal position since

the terminals with which brush 63 cooperates are connected together. The apparatus remains in this condition during conversation.

When conversation is over and the called subscriber replaces his receiver on the switch-hook, relay 36 releases, and the sequence switch 60 is advanced from the talking position to some subsequent position, such as position 17, to operate the message register of the calling party. The release of relay 36 causes the opening of the holding circuit of relay 37, and the latter relay releases. Relays 47, 51, and 55 are now held in a circuit through their windings and locking contacts, over conductor 79 through the back contact and right hand armature of relay 37, brush 63, in position 1, back contact of magnet 61, inner left armature and contact of relay 51 to ground. While the sequence switch 60 is advancing from position 15 to position 17, a metering circuit is closed from battery through the resistance 86, left contact of relay 47, contacts of spring 48, outer left contact of relay 51, conductor 87, lower back contact of relay 52, uppermost front contact of relay 55, uppermost back contact of relay 57, brush 23, winding of message register 67 to ground. The register 67 operates and charges the call against the sub-station A. When sequence switch 60 reaches position 17, and as soon thereafter as interrupter 43 closes its contacts, a circuit is completed from battery through the winding of relay 37, springs 41 and 42, contacts of interrupter 43 to ground. Relay 37 operates and opens the holding circuit of relays 47, 51, and 55. Relay 37 may be held energized in the manner shown in detail in the above-mentioned patent to Kopp to permit the release of relays 47, 51, and 55 as the sequence switch 60 advances to subsequent positions. From this point, the release of the line finder and selector switches takes place in any well-known manner, such as explained in the above-noted patents to Kopp and Stearn et al.

Assume next that the call is initiated at the substation B. In this case the discharge tube 6 is polarized the same as tube 5, and, therefore, no current flows to the windings of bell 2 when the source 58 is connected to the line. Inasmuch as no current flows through the windings of relays 53 and 54, the relays are not unbalanced and do not attract their armatures. The source of potential 59 is next applied to the line, and, due to the polarity of device 6, current flows through the windings of the bell 2 to ground. The bell 2 attracts its armature and disconnects its winding from the tip conductor 77 of the line, thereby unbalancing the relays 53 and 54 in such a manner that relay 54 attracts its armature while relay 53 does not shift its armature. Relay 54 closes an obvious circuit through relay 56, which operates and locks to the conductor 79. When the sequence switch subsequently ad-

vances from position 15 to brush 17, the metering circuit is completed over conductor 87, lower back contact of relay 52, uppermost front contact of relay 56, lower back contact of relay 57, brush 25, through the winding of message register 68 to ground. Register 68 operates and charges the call to substation B.

Assume next that the call is initiated at substation C. The device 7 at substation C is of positive polarity and will permit current to flow when the source 58 is applied to the line. The bell 3 attracts its armature in response to the flow of current and disconnects its winding from the tip conductor 77. This permits current to flow over the left windings of relays 53 and 54, unbalancing them in such a manner that relay 53 operates its armature, whereas 54 does not. Relay 53 operates relay 55, which looks to the conductor 79. When the stepping switch advances to position 3, a circuit is closed from battery to the winding of relay 57, inner lower front contact of relay 55, conductor 88, brush 65 to the grounded conductor 79. Relay 57 operates and locks to conductor 79. When the negative source of potential 59 is connected to the line in position 4 of the stepping switch, no current flows due to the polarity of the discharge tube 7. Accordingly, relays 53 and 54 do not disturb their armatures. Subsequently, when the sequence switch passes through positions 15 to 17, a metering circuit is completed over conductor 87, through the lower back contact of relay 52, upon front contact of relay 55, uppermost front contact of relay 57, brush 28, through the winding of message register 69. The register 69 operates and charges the call to substation C.

Assume next that the call is initiated at substation D. Discharge device 8 being of the same polarity as device 7 permits current to flow to the windings of bell 4 when the positive source of potential 58 is applied to the line in position 2 of the stepping switch. Bell 4 attracts its armature and disconnects its winding from the ring conductor 78. This deprives the left windings of relays 53 and 54 of current and unbalances the relays in such a way that relay 54 attracts its armature, but relay 53 does not. Relay 54 operates relay 56, which locks to conductor 79. In position 3 of the stepping switch, relay 57 is operated in a circuit from battery through its winding, inner lower front contact of relay 56 to ground over conductor 88 as above traced. Relay 57 locks to the conductor 79. The negative source of potential 59 is next applied to the line, but, due to the polarity of device 8, no current flows, and neither relay 53 nor relay 54 attracts its armature. Subsequently, when the sequence switch passes through positions 15 to 17, the metering circuit is closed over conductor 87, lower back contact of relay 52, uppermost contact of relay 56, lower

front contact of relay 57, brush 27, message register 70 to ground. The register 70 operates and charges the call to substation D.

In case subscribers at more than one of the substations attempt to originate a call at the same time, both testing relays 53 and 54 will operate as above described, causing the operation of relays 55 and 56. When the stepping switch reaches position 5, a circuit is closed from battery through the winding of relay 52, lower front contact of relay 55, lower front contact of relay 56, conductor 89, brush 65, to the grounded conductor 79. Relay 52 operates and locks through its front contact and upper armature to conductor 79. Relay 52 connects battery over the metering lead 87 through its lower armature and front contact to the alarm device 66. This arrangement prevents the operation of any of the message registers and also calls the unstandard condition to the attention of a troubleman. Should neither of the relays 53 and 54 operate during the test, both relays 55 and 56 remain unoperated, and relay 52 operates in this case over a circuit through its winding, lower back contacts of relays 56 and 55, to ground over conductor 89, and the alarm is rendered effective as before.

When the subscriber's line 21 is called by a calling subscriber, the connection is extended in any suitable manner over selector switches S—1 and S—2. Ringing current is applied from either of the sources 90 or 91, through contacts 92 and 93, to cause selective ringing in the well-known manner. The potential of sources 90 and 91 is such as to cause the flow of ringing current through the devices 5, 6, 7, and 8, provided the proper polarity is applied. For a detailed disclosure of one manner in which ringing current may be applied to the line, reference is made to the patent to Reeves No. 1,218,804, granted March 13, 1917.

While the invention has been illustrated in connection with a particular type of system, it is to be understood that it is not so limited but may be embodied in various kinds of systems.

What is claimed is:

1. In a telephone system, a line having a substation thereon, a signal bell for said substation, means for applying current to the line to energize said bell, and test means responsive to the energization of said bell.

2. In a telephone system, a line having a substation thereon, a signal bell for said substation having a winding and an armature, means for applying current to the line to energize said winding, and test means controlled by the armature of said bell.

3. In a telephone system, a line having a plurality of stations, signal bells, one for each of said stations, means for applying current to the line to selectively energize said bells, and test means responsive to the energization of said bells.

4. In a telephone system, a line having two

substations, a signal bell at one station having an armature for applying potential to one side of said line, a signal bell at the other station having an armature for applying potential to the other side of said line, and means responsive to the application of potential to said line by said signal bells.

5. The combination in a telephone system of a line having a number of stations, signal devices, one at each of said stations, current-controlling devices, one in circuit with each of said signal devices, means for applying current to said line for selectively energizing said signal devices, and means responsive to the energization of said signal devices for identifying said stations.

6. The combination in a telephone system of a line having a number of stations thereon, signal bells, one for each station, uni-directional current-controlling devices, one in circuit with each of said bells for causing the selective energization of said bells when current is applied to the line, means for applying current to said line, and test means responsive to the energization of said signal bells for identifying said stations.

7. In a telephone system, a line having a number of stations thereon, a signal bell at one of said stations, means for applying to said line signaling currents of different character, means for applying to said line test currents of different character, a current-controlling device in circuit with said bell for permitting the flow of signaling current and test current of a certain character, and means controlled by the energization of said signal bell in response to the flow of test current for identifying the station.

8. In a telephone system, a line having a number of stations thereon, a signal bell at one of said stations, means for applying signaling current to the line, means for applying positive and negative test current to the line, a current-controlling device in circuit with said bell for permitting the flow of current of a given polarity through said bell, and means controlled by the bell in response to the energization thereof for identifying the station.

9. In a telephone system, a line having a number of stations thereon, signal bells, one for each of said stations, means for applying test current to said line, current-discharge devices, one in circuit with each of said bells for permitting the flow of test current to the corresponding bell when subjected to a given value of potential, means for rendering the current-controlling device at a calling station more sensitive than the devices at non-calling stations, and means controlled in response to the energization of a signal bell for identifying the corresponding station.

10. In a telephone system, a line having a number of stations thereon, signal bells, one for each station, means for applying test

current to the line, space-discharge devices,
one at each of said stations, connected in cir-
cuit with the corresponding signal bells, said
discharge devices serving to permit the flow
5 of test current to the corresponding signal
bells when subjected to a given value of po-
tential, means responsive to the energization
of the signal bell at a given station for iden-
tifying said station, and means controlled by
10 the switchhook at a calling station for ren-
dering the space-discharge device thereat
more sensitive than devices at non-calling
stations.

In witness whereof, I hereunto subscribe
15 my name this 8th day of April, 1930.

ALFRED E. HAGUE

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