

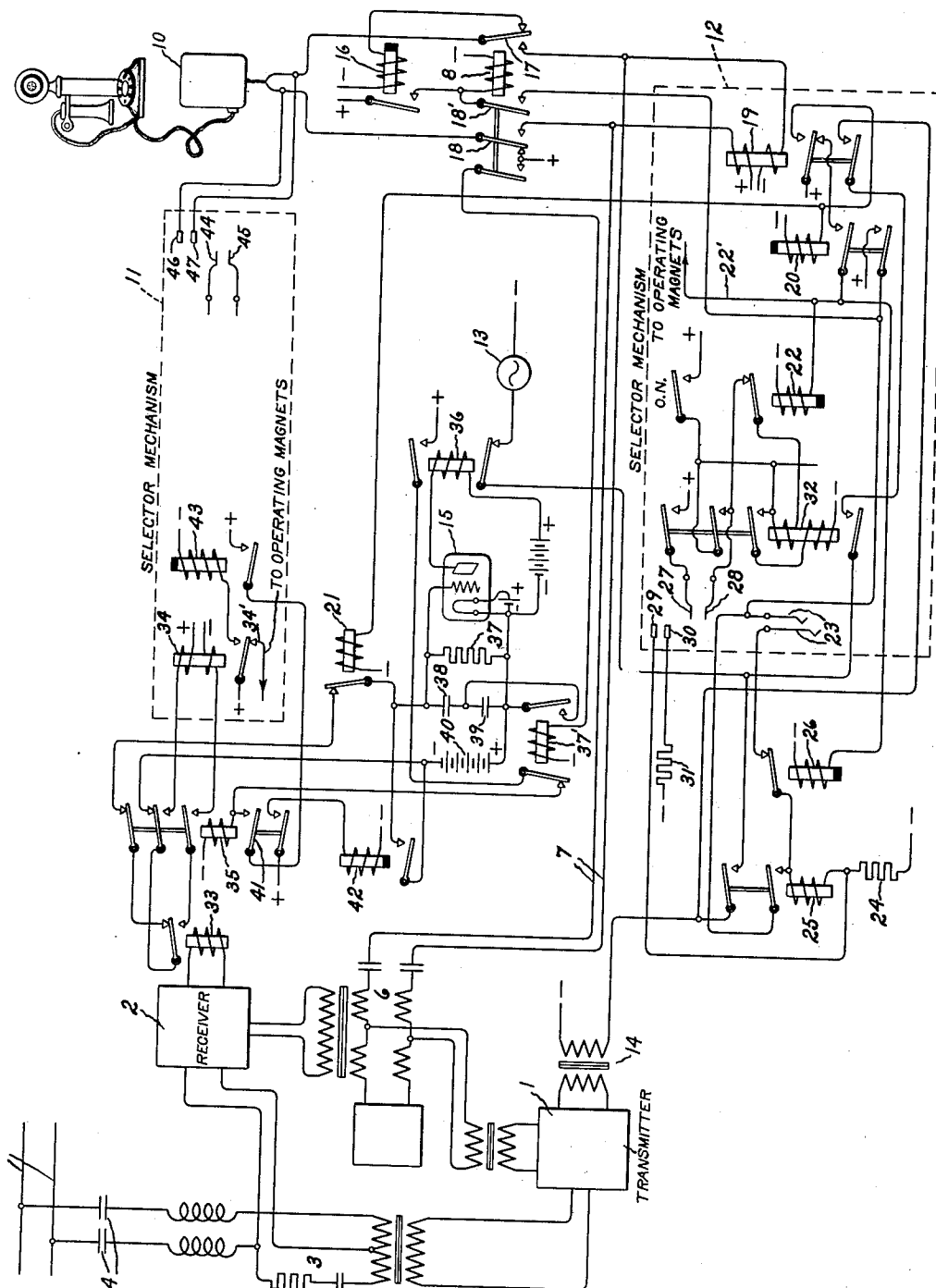
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F. W. FRINK

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SIGNAL SYSTEM

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Inventor:
Frederick W. Frink,
by *Charles C. Tuller*
His Attorney.

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SIGNAL SYSTEM

Frederick W. Frink, Schenectady, N. Y., assignor
to General Electric Company, a Corporation
of New York

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My invention relates to signal systems and more particularly to systems of the type employing carrier current transmitted either by wire, as over the lines of a power distribution system, or by radio, whereby telephone communication is effected.

More particularly my invention relates to the calling means employed in such systems and it has for one of its objects to provide means whereby unnecessary sparking of certain of the relays in the receiving equipment and also excessive wear on the selector mechanism of the receiving equipment is prevented.

In the operation of systems of the type indicated usually a certain form of modulation of the carrier wave is employed for calling. This modulation may comprise code interruptions in the carrier wave itself, or in current of a predetermined frequency, which is employed to modulate the carrier wave for calling purposes or interruptions in both the carrier wave and modulating frequency. For purposes of the present disclosure I will describe a system in which the carrier wave is modulated with current of a predetermined frequency which is interrupted in accordance with code for purposes of calling, it being understood that the invention is applicable in other systems as well.

The frequency, or tone, employed for calling may be in the voice range. In the receiving calling system relays are employed which respond primarily to this calling tone to effect calling operations but which also respond to currents set up in the system due to voice communication. Accordingly, these relays are subject to a certain degree of chattering and sparking at the contacts during conversation between remote parties of the system with which a particular station is associated and through their connections cause operation of the selector mechanism and unnecessary wear on mechanical parts thereof, and particularly on the ratchet mechanism employed.

A more particular object of my invention is to provide means whereby the selector mechanism is disconnected from the receiving system during voice communication and is not connected thereto until an uninterrupted calling current is received for a predetermined interval after which the selector mechanism is placed in readiness to respond to code interruptions in the calling current.

Another object of the invention is to provide in the transmitting system efficient means whereby an uninterrupted calling current is transmitted

for a predetermined interval prior to each transmission of code for calling purposes.

A further object is to provide efficient time delay, or slow acting relay mechanism, for use both in the transmitter and receiver whereby the different intervals employed may be determined.

Still a further object of the invention is to provide a novel method of conditioning the transmitting and receiving equipment respectively to transmit and receive the code signals.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims.

My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing, in which the single figure represents an embodiment of my invention.

I have indicated in the drawing the equipment employed at one of the stations of a carrier current communication system. Similar equipment is, of course, employed at each of the other stations. In the drawing, 1 indicates a carrier current transmitter and 2 a carrier current receiver. The output of the transmitter and the input to the receiver are coupled together through a suitable balanced arrangement 3 and through coupling condensers 4 to a power transmission line 5. The output of the receiver and the input to the transmitter are likewise coupled through a second balanced arrangement or hybrid coil 6 through which they are connected through conductors 7 and contacts on relay 8 to a telephone line extending to an operator's station 10. The call receiving equipment, including the receiving selector mechanism, is indicated at the upper portion of the drawing, the selector mechanism being indicated by the dotted rectangle 11. The call transmitting equipment is indicated at the lower portion of the drawing. This mechanism also includes a selector mechanism indicated by the dotted rectangle 12.

These selector mechanisms 11 and 12 may be of any suitable construction and preferably include two coordinate switches of the Strowger type. The selector mechanism of the transmitting equipment is normally employed for purposes independent of the present invention but is utilized for purposes of the present invention in a manner presently to be indicated. These mechanisms are shown only in so much detail as is necessary to an understanding of the present invention.

Calling is effected through the system by modulating the transmitted carrier with a tone produced by a generator 13, this tone being supplied through circuits later to be described to the tone input transformer 14 of the transmitter. If desired the transmission of the carrier may be controlled by the tone as shown, for example, in Patent No. 1,696,566 to Emmett F. Carter. The circuits of this generator are controlled both by the calling transmitting equipment and by the receiving equipment through a suitable electron discharge time delay relay indicated at 15.

Having now generally indicated the character of the equipment to be described, a more detailed understanding of the invention may be had with reference to its operation.

The operator desiring to call a party at a remote station will first remove his receiver from the hook. Through contacts, not shown, arranged in his telephone instrument, a circuit is completed which extends from the positive side of the source of potential, through armature 13 of relay 8 telephone line and instrument, armature 17 of relay 8 and winding of relay 16 to the negative side of the source of potential. Relay 16 operates and energizes the winding of relay 8. Relay 8 is then actuated and by means of its armatures 17 and 13 connects the telephone line through conductors 7 to the hybrid coil 6 and also to the two windings of line relay 19. Relay 19 is now energized and completes the circuit for slow releasing relay 20 and quick acting relay 21 in the receiving equipment. The purpose of relay 21 will later appear. Relay 20 establishes a holding circuit for relay 8 through its lower armature and armature 18' of relay 8.

The calling party now dials the first digit of the number of the party to be called. Upon each interruption in the telephone circuit produced by the dialing device of his telephone instrument, line relay 19 is deenergized and by means of its upper armature in its lower position completes an obvious circuit, through the upper contacts on relay 20, for slow releasing relay 22 and an additional circuit through conductor 22' to the operating magnets, not shown, of the connector switch of the transmitting system.

After dialing the first digit the connector switch will be operated to a position such that the springs 23 of the selector will engage each other, thereby completing a circuit extending from the negative side of the source of potential through resistance 24, relay 25, contacts of relay 26, springs 23 and lower contacts of relay 20 to the positive side of the battery. Relay 26 prevents this circuit from being closed due to momentary closing of contacts 23 in case the selector is rapidly stepped past the position in which these contacts are closed. Relay 25 then becomes energized and immediately closes its contacts, thereby through its upper contacts connecting the source 13 directly in circuit with the primary winding of the input tone transformer 14. Thus the calling tone produced by the generator 13 is now transmitted to the remote station. Relay 25 also by means of its lower contacts completes a holding circuit for itself through the lower contacts of relay 20. Relay 20 is sufficiently slow to release to prevent this holding circuit from being broken in response to operation of relay 19 during the dialing operation.

It will thus be apparent that during the dialing of the first digit no impulses were transmitted to the remote station but instead the transmitting

equipment was conditioned to transmit the calling current.

The operator will now dial the second digit. Relay 19, following the interruptions produced by the telephone dial, by means of its upper armature and circuit 22', causes the connector switch to be operated to a point such that springs 27 and 28 engage stationary contacts 29 and 30 respectively. When this occurs a circuit is completed which extends from the negative side of the source of potential through an impedance 31, which may be that of equipment employed for other purposes in connection with the system, contacts 30 and 28, upper contacts of relay 22 which are now closed due to deenergization of relay 22 following the second digit of the code, upper winding of relay 32 and off-normal springs O.N. of the connector switch to the positive side of the source of potential. Relay 22 prevents this circuit from being closed in case the selector is stepped rapidly past the position in which contacts 30 and 28 are in engagement. The armatures of relay 32 are sufficiently attracted by the upper winding to cause the circuit of the lower winding to be completed, this circuit extending from the negative side of the source of potential through the lower winding of relay 32, lower armature and contact thereof and off-normal springs O.N. of the connector switch. The armatures of relay 32 are then fully attracted, the middle armature short-circuiting the upper winding of relay 32 and the upper armature short-circuiting the winding of relay 25. That is, since both terminals of the winding 25 are now connected to the positive side of the source of potential, this relay is deenergized.

Upon dropping out, the relay 25, by means of its lower contacts, interrupts its own holding circuit and by means of its upper contacts interrupts the original circuit for the tone generator 13. The generator 13, however, is still connected to the input tone transformer 14 through a circuit in parallel with the upper contacts of relay 25, this circuit extending through the lower contacts of relay 32, lower contacts of relay 19, which is now energized, and the winding of transformer 14.

It will be seen that the circuit of the tone generator now includes the contacts on the line relay which follows the code interruptions produced by the dialing device.

Thus it will be seen that during the dialing of the second digit a long impulse of uninterrupted tone is sent to the remote station, and when the second digit is completed the equipment is conditioned to transmit groups of interruptions in the tone in accordance with additional digits that are dialed.

Referring now to the receiving equipment, it will be seen that the receiver includes a relay 33. This relay is connected in one of the detector circuits of the receiver and is energized whenever the received carrier is modulated with audio signals, as by voice waves, or by the tone transmitted by the generator 13 since this tone is in the audio range. This relay is the calling relay of the system and is utilized to control the selector mechanism 11 to effect desired operations. The selector mechanism includes a primary actuating relay 34, which it will be seen is normally disconnected at the contacts of relay 35 from relay 33. This relay, through conductor 34', controls the operating magnets of the selector.

The receiving equipment also includes an electron discharge time delay relay 15 which com-

prises an electron discharge device having a relay 36 connected between the anode and cathode thereof and a parallel combination of resistance 37 and capacity connected between the grid and cathode. This capacity comprises the condensers 38 and 39 connected in series. Normally a source of potential 40 is connected in parallel with the condensers 38 and 39, this connection extending from the negative side of the source of potential 40 through the middle armature on relay 35, upper contact of relay 33, upper arm of armature 35, and contacts on relay 21 to the grid of the discharge device. Thus the negative potential of the battery 40 is impressed directly between the grid and cathode of the discharge device in parallel with the resistor 37 and condensers 38 and 39 in series and hence relay 36 is deenergized.

When the long tone impulse which is transmitted during the dialing of the second digit, is received at the remote station, relay 33 at that station is energized and interrupts the connection from the negative side of the source 40 to the grid. The relay 36 does not become energized at once, however, because of the energy stored in the condensers 38 and 39. After a predetermined time interval, however, determined by the value of resistance 37 and the capacity of condensers 38 and 39, relay 36 becomes energized and through its upper contacts completes a circuit through the left hand contacts of relay 37' and winding of relay 35. Relay 35 now becomes energized thereby connecting the primary actuating relay 34 directly to the armature and lower contact of relay 33. Relay 34 is then actuated and energizes slow acting relay 43 of the selector mechanism. Relay 35 also by means of its contacts 41 completes a holding circuit for itself and by means of its lower contact energizes slow to pick up relay 42. This relay then restores the bias to the grid of discharge device 15 which was previously removed by the upper contact of relay 35.

Thus relay 36 is again deenergized but relay 35 is maintained energized through the contacts of relay 43. Due to the slow action of relay 42, however, the bias is not restored until the holding circuit for relay 35 is established by relay 43.

It will now be seen that the selector mechanism is prepared to respond to the code interruptions produced in the tone during the dialing of the third, fourth and, if desired, subsequent digits of the code. In response to these impulses the springs 44 and 45 of the connector switch engage their corresponding contacts 46 and 47 respectively, and complete a circuit through the telephone line to the bell of the operator's instrument thereby notifying him of a received call.

Considering again the equipment at the calling station, relays 37' and 21 are both energized at this station, relay 37' through the left hand contacts of relay 8 and relay 21 through the upper contacts of relay 19. Relay 42 is, of course, deenergized at this time. Relay 21 interrupts the connection between the negative side of source of potential 40 and condenser 38 thereby permitting that condenser to discharge through resistance 37. Relay 37' interrupts the circuit of relay 35 and at its right hand contacts short circuits the condenser 39 thereby increasing the length of time required to cause operation of relay 36. Relay 36 is operated after a predetermined interval and by means of its lower contacts interrupts the transmission of the tone. The left hand contacts of relay 37', being included in circuit

with the upper contacts of relay 36, prevent the latter relay from energizing relay 35 and, through relay 42, again applying the bias to the grid of device 15.

It will thus be seen that during the dialing operation the period determined by device 15 starts anew at each impulse transmitted, i. e. upon each energization of relay 19, relay 21 is energized and the source 40 is removed from condenser 38. Thus if the operator waits between digits for a period longer than that required to operate 36 the tone will be interrupted by the lower contacts of that relay and it will be necessary for him to lower his receiver hook thereby restoring the equipment to normal and dial over again.

The discharge device 15 thus serves two purposes. During the call transmitting operation it determines the period that the tone remains on after dialing the different digits. This period may, for the convenience of the operator, be in the neighborhood of three to five seconds. Secondly, during the receiving operation it determines the duration of the preliminary uninterrupted impulse necessary to cause the receiving selector mechanism to be connected to the relay 33. This period may be sufficiently long, as in the neighborhood of one second, or longer than any of the sounds in normal conversation, to prevent operation of relays 33, 35, 34, 43 and selector mechanism 11 during conversation between remote parties on the line. It will of course be understood that occasional operation of the above mentioned relays due to abnormally long sounds is not objectionable since these relays and selector 11 are immediately restored to normal after relay 43 is released following interruption of the sound. Any slight interruption between sounds causes the condensers 38 and 39 to be charged and the period determined thereby to start over again.

The called party, in responding to the call, may remove the receiver from the hook either before or after the tone is interrupted. If he removes it before the tone is interrupted, relay 16, through means not shown, is prevented from operating, and thus his line is not connected to hybrid coil 6. When the tone is interrupted relay 33 is deenergized and deenergizes relays 34 and 43. Relay 43 then interrupts the holding circuit for relay 35, causing that relay to release, and also through means not shown restores the selector mechanism 11 to the normal condition. Relays 16 and 8 then pick up, extending the telephone line through conductors 7 to the hybrid coil 6. The conversation may now take place.

When the calling party replaces his receiver to the hook, relay 19 is deenergized and deenergizes relay 20. This relay then restores the selector 12 to the normal condition.

While I have shown and described a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since many modifications both in the circuit arrangement and in the instrumentalities employed may be made and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination, in a signal system of a transmitter and receiver, of a code sending device, means in said transmitter responsive to operation of said code sending device for causing uninterrupted calling current to be transmitted

- for a predetermined interval and thereafter to cause said calling current to be interrupted in code combination determined by the code sending device, selector mechanism in the receiver responsive to code interruptions in received calling current and means for preventing operation of said selector mechanism except when said code interruptions are preceded by uninterrupted calling current for a predetermined interval.
2. The combination, in a signal system, of a transmitter, a receiver, a code sending device, means in said transmitter responsive to the code sending device to cause uninterrupted calling current to be transmitted for a predetermined interval and thereafter to cause said calling current to be interrupted in code combination determined by the code sending device, selector mechanism in the receiver responsive to code interruptions in received calling current, means including a time delay relay for preventing operation of said selector mechanism except when said code interruptions are preceded by uninterrupted calling current for said predetermined interval, and means including said time delay relay for interrupting calling current transmitted by the transmitter after said code interruptions have been produced.
3. The combination, in a signal system, of a transmitter, a receiver, a code sending device, means in the transmitter to cause uninterrupted calling current to be transmitted for a predetermined interval of time and thereafter to cause said calling current to be interrupted in code combination determined by the code sending device, selector mechanism in the receiver, means including a slow acting relay responsive to received calling current for maintaining said selector mechanism inoperative for a predetermined interval and for rendering said selector operative when code interruptions in the calling current are received and means including said slow acting relay for interrupting calling current transmitted by the transmitter a predetermined interval different from said last mentioned interval after said code interruptions are transmitted.
4. The combination, in a signal system, of a transmitter, a receiver, a code sending device, means in the transmitter to cause uninterrupted calling current to be transmitted for a predetermined interval of time and thereafter to cause said calling current to be interrupted in code combination determined by the code sending device, normally inoperative selector mechanism in said receiver, and means including an electron discharge time delay relay responsive to uninterrupted calling current received for a predetermined interval to render said selector mechanism operative, said electron discharge relay being also arranged to interrupt the transmitted calling current a predetermined interval after the last interruption therein.
5. In a code signaling system employing equipment for transmitting a code having a number of digits, and code receiving equipment, the method which includes utilizing the first digit of the code to condition the transmitting equipment to transmit uninterrupted signal current, utilizing the second digit of the code to condition the transmitting equipment to interrupt said signal current in accordance with successive digits of the code, and utilizing said successive digits to effect desired operations in the code receiving equipment.
6. In a code signaling system employing equipment for transmitting a code having a number of digits, and code receiving equipment, the method which includes utilizing the first digit of the code to condition the transmitting equipment to transmit uninterrupted signal current, utilizing the second digit of the code to condition the transmitting equipment to interrupt said signal current in accordance with successive digits of the code, utilizing the uninterrupted calling current transmitted during the second digit to condition the receiving equipment to respond to interruptions in the signal current and utilizing said successive digits to effect desired operations in the code receiving equipment.
7. In a signal system, a power line having a plurality of signal stations connected thereto, calling selectors at said stations, calling means at said stations for transmitting a prolonged impulse followed by shorter impulses of carrier current modulated with current within the voice frequency range to a called station, and means for operating the selector at the called station responsive to said transmitted calling signal and unresponsive to the currents received during communication between stations.
8. In a signal system, a power line having a plurality of signal stations connected thereto, selectors at said stations, means comprising a selector key for transmitting a code signal comprising impulses of carrier current modulated with current within the voice frequency range and preceded by an impulse of like character having a prolonged length, and means at the called station responsive to the prolonged impulse and the code signal for operating a selector.
9. In a signal system, a plurality of signal stations connected to a transmission line, means for communicating between stations by carrier current modulated with voice frequency currents, calling selectors at said stations, means for transmitting a selective call signal from a calling station comprising carrier current modulated with impulses of current within the voice frequency range, and means at a called station operatively connected to the line during calling and during communication between stations, responsive to said transmitted signal for operating the associated selector and unresponsive to the currents received during communication between stations.
10. In a signal system, a line having a plurality of signal stations connected thereto, means for communicating between stations by carrier current modulated with voice frequency currents, the transmitted and received modulated currents being within the same frequency range, calling selectors at said stations, means for transmitting a selective call signal from a calling station comprising carrier current modulated with impulses of current within the voice frequency range, the modulated calling current being in the same frequency range as the currents employed for communicating between stations, and means at a called station operatively connected to the line during calling and during communication between stations, responsive to said selective signal for operating the associated selector and unresponsive to the currents received during communication between stations.
11. In a signal system, a plurality of signal stations connected to a line, calling selectors at said stations, calling means at said stations for transmitting a prolonged impulse followed by shorter impulses of carrier current modulated with current within the voice frequency range to a called station, call selectors at said stations, and means for operating the selector at a called

station responsive to said transmitted calling signal and unresponsive to the currents received during communication between stations.

12. In a signal system, a plurality of signal stations connected to a transmission line, means for communicating between stations by carrier current modulated with voice frequency currents, calling selectors at said stations, means at said stations for transmitting a prolonged impulse followed by shorter impulses of carrier current modulated with current within the voice frequency range to a called station, and means comprising a slow acting relay at a called station controlled by the transmitted call signal for operating the associated selector, said last mentioned means being unresponsive to the currents received during communication between stations.

13. In a signal system, a line having a plurality of signal stations connected thereto, calling selectors at said stations, calling means at said stations for transmitting a prolonged impulse followed by a code signal of carrier current modulated with voice frequency current, and

means comprising a slow-acting relay for operating the selector at the called station, said last mentioned means being responsive to the prolonged impulse followed by a code signal of impulses and unresponsive to the currents received during communication between stations.

14. In a carrier current communication system, a line, a plurality of signal stations connected to the line, each of said stations having means for modulating carrier current with voice frequency currents when transmitting and demodulating the received modulated waves to obtain voice frequency current, selectors at said stations, means at a calling station for transmitting a code signal comprising impulses of modulated voice frequency current preceded by a prolonged impulse of the same character, means at the called station responsive to the calling signal for operating the associated selector and unresponsive to the currents received during communication between stations.

FREDERICK W. FRINK.

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