American Telephone and Telegraph Company
Printed in U.S.A.

BELL SYSTEM PRACTICES
Teletypewriter Stations

SECTION P65.902.3
Issue A, 11-1-56
Long Lines Department
Dist. Class. 400AC-600AC

SIGNALLING SYSTEMS

64C SELECTOR SYSTEM

PUSH BUTTON CALLING CIRCUIT

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1. GENERAL

1.01 This Section supplements existing information pertaining to the 64C Selector System.

1.02 This Section describes the Push Button Calling Circuit per Drawing WA11447-SD, Issue 7.

1.03 This circuit is an optional replacement for the dial, dial key, and pulse divider calling equipment of the 64C Selector System. It can be arranged to reproduce all standard five or six digit codes, with the exception of those codes which use the Numeral 2 as the second digit; i.e. those codes starting with 1-2.

1.04 The Push Button Calling Circuit is so named because the generating and transmitting of a selected code is controlled by momentarily depressing a non-locking key associated with the particular code.

1.05 This Calling Circuit may be used on any facility or service where the 64C Selector System is applicable, limitations in usage being due to the receiving equipment and not the Calling Circuit.

1.06 The Calling Equipment consists of:

(a) One or more Key and Lamp Cabinets; and

(b) A Pulse Generator and Code Relay Unit.

1.07 Two types of Key and Lamp Cabinets have been made available to care for different types or sizes of installations. The following non-locking keys are common to both types:

(a) One MD Key and one MC Key are provided in each cabinet for operating similarly designated code relays, which are usually assigned to master disconnect and connect codes respectively.

(b) One CD Key is provided for each code relay designated C. These keys are normally furnished in groups of ten, and are associated with individual station or group selection codes.

(c) One CN Key is provided in each cabinet to permit immediate release of the line and interruption of any code in the process of being transmitted.

(d) One CD Lamp is provided in each cabinet. This lamp is lighted only when a code is being transmitted by the Calling Circuit.

1.08 The smaller of the two types of Key and Lamp Cabinets is suitable for use only in single channel applications. It is manufactured in accordance with Drawing WA11710 (WA11447-ED, List 3 or 3A). It can be equipped with either 10 or 20 CD Keys. In addition to the keys and lamp listed in Paragraph 1.06,it contains the following:

(a) One LN Key is provided per cabinet. This key controls an optional precautionary feature which maintains the MD, MC and CD Keys in a disabled condition until such time as the LN Key is momentarily depressed. This feature is often considered desirable in that it affords considerable protection against transmission of codes from random punching of keys. Optional strapping in the Pulse Generator circuit eliminates this function of the LN Key, and makes the MD, MC and CD Keys effective except during periods when a code is being transmitted.

(b) One LN Lamp is provided per cabinet. This lamp lights when the LN Key is operated to indicate that the MD, MC and CD Keys have been enabled. When the precautionary feature is not desired, the LN Lamp is removed from its socket.

1.09 The larger of the two types of Key and Lamp Cabinets is suitable for use in either single channel applications (WA11447-ED, List 3B) or in manual tape relay system applications (WA11447-ED, List 2, 2A or 2B). In the single channel arrangement the cabinet can be equipped with a maximum of 30 CD Keys, all other features being identical to those described in Paragraphs 1.06 and 1.07. In manual tape relay system applications the cabinet contains the keys and lamp listed in Paragraph 1.06, and also the following:

(a) One LN Key is provided for each line requiring push button calling, and those non-locking keys each displace one of a maximum of 30 CD Keys; i.e., the total of LN plus CD Keys in a single cabinet cannot exceed 30, and an auxiliary cabinet will be required if this number is inadequate. Momentarily depressing an LN Key will seize the selected line if both the line and the calling circuit are idle. Successful seizure of the line enables the MD, MC and CD Keys.

(b) One LN Lamp is provided per cabinet. This lamp lights when any line is seized, and remains lighted so long as the line and calling circuit are connected.

(c) One HLD Key is provided per cabinet. Holding this key depressed prevents the manual tape relay system from locking out the calling circuit at the end of a code transmission. Consecutive codes may be transmitted so long as the HLD Key is held operated.

1.10 The Pulse Generator and twelve code relays designated MD (master disconnect), MC (master connect), and C1 to C10 comprise a basic unit capable of generating twelve different code signals. The Pulse Generator is energized and connected to the line as a result of actions originated by the operation of a code relay under control of a CD Key of the Key and Lamp Cabinet. The characteristics of the code signal are determined by optional strapping and lead connections to the operated code relay.

1.11 If more than twelve different codes are required, additional code relays are furnished in groups of ten.

1.12 Circuit design prevents operation of more than one code relay at a time. In the case of manual tape relay system applications it is impossible to seize more than one line at a time.

1.13 In manual tape relay system applications, arrangements prevent the relay system from locking out the calling circuit following transmission of a master disconnect code thereby

permitting reseizure of the line with the associated LN Key. This same feature prevents the blocking of the transmitter following a master disconnect transmission, permitting loss of messages if there are deviations from normal operating procedures. Completion of the design of an applique which would prevent locking out the calling circuit but would block the transmitter following transmission of a disconnect code has been deferred pending tariff rulings and receipt of an order indicating the need for this added feature.

2. EQUIPMENT

2.01 The Pulse Generator and twelve Code Relays are mounted on a panel which occupies the space of five 1-3/4" x 19" mounting plates.

2.02 Additional groups of ten Code Relays occupy two 1-3/4" x 19" mounting plates per group.

2.03 Pulse Generator and Code Relay equipments may be mounted on bay framework or in cabinets such as the ED91194-01, Group 10 cabinet, with use of adapters, where necessary,to accommodate 19" plates.

2.04 The small Key and Lamp Cabinet per Drawing WA11710 measures 7-1/4" high, 4-5/8" wide, and 5" deep. It is equipped with a bracket for mounting at the side of a table or desk.

2.05 The larger Key and Lamp Cabinet per Drawing WA11447-ED measures 4-1/4" high, 10-3/8" wide, and 5-1/16" deep. It is usually attached to the top of the transmitting or control console of manual tape relay systems. A bracket is available for mounting this cabinet at the side of a table,desk or console when desired.

2.06 Interconnection of the Pulse Generator and Key Cabinet is by means of a cable terminated in Jones Plug and Socket.

3. POWER REQUIREMENTS.

3.01 The Push Button Calling Circuit requires either negative 120 volts DC ± 10 per cent or negative 130 volts DC ± 10 per cent power supply and draws a current of about 0.5 ampere when generating a code signal.

3.02 If the voltage connected to the calling circuit goes below 105 volts, the Pulse Generator may fail to operate. Calibration of the Pulse Generator requires a nominal voltage between 112 and 137 volts and unsatisfactory operation may be expected if the voltage varies more then ± 10 per cent from the nominal value, goes below 105 volts, or above 150 volts.

4. CODE SIGNAL DESCRIPTION

4.01 As described in Section P65.902, Paragraph 4.16, a spacing signal of about one second duration is required to connect receiving 64C equipments to the circuit. This is referred to in this Section as a "cut-on pulse".

4.02 Section P65.902, Paragraph 4.18, covers the manner in which the receiving selector is stepped by charging and discharging the (A) condenser through the 60-type selector winding. The charge or discharge rate of the condenser, plus the operate, hold, and release characteristics of the 60-type selector establish a requirement that there be an interval between stepping impulses of about 70 to 150 milliseconds. On 60 speed teletypewriter services, a further limitation is imposed, in that a spacing signal appreciably less than 80 milliseconds in length may cause the receiving selectors to be disconnected from the circuit as described in Section P65.902, Paragraphs 4.19 to 4.25, and 10.10. A nominal 100 millisecond interval between stepping impulses is considered normal, and is referred to in this Section as a "digit pulse" to identify it as being similar to one of the pulses in the series generated when the dial is released in a dial and pulse divider arrangement.

4.03 When it is desired to step all receiving selectors on a circuit to a fixed pin or contact position simultaneously, the proper master code may be transmitted as a continuous series of equally spaced pulses, preceded by the cut on pulse. However, when it is desired to step only one selector, or a group comprising less than the total receiving equipments on a line, to a fixed pin, it is necessary to break the series of pulses into two, three or four groups with a sufficient pause between each group to permit the code wheels of unwanted selectors to return to their starting positions. These pauses between groups of digit pulses are referred to in this Section as "interdigit pulses", and correspond to the time between selecting digit dialing operations in a dial and pulse divider arrangement. The length of this pulse should be at least 420 milliseconds to assure proper restoral of code wheels. The code wheel of the selector or selectors required to respond to the code signal will have a code pin engaged with the holding spring during these interdigit pulses and will therefore be prevented from returning to the starting position.

4.04 When the code wheel of a receiving selector has advanced to a fixed pin it is held, with contacts closed, until the last impulse of the code is received. During this interval the function relay of the receiving equipment and relays of associated applique circuits must operate or release as required to initiate the desired function at the selected station. To provide adequate time for the relay action, the length of this "last interdigit pulse" is increased to nearly double the time allowed for the other interdigit pulses.

5. CIRCUIT DESCRIPTION

(A) Description of Push Button Calling Circuit in Single Channel Applications

5.01 This circuit is shown on Drawing WA11447 9D, Sheet 3, Fig. 2B or Sheet 5, Fig. 2C; Sheet 5, Fig. 52C: and Sheet 6, Figs. 1A and 3A. It is made up of a key and lamp cabinet, an interconnecting

cable terminated in Jones Plug and Socket, and a pulse generator and code relay unit. The stepping of the 209B selector of Fig. 1A results in generating a series of alternate ground and open pulses as the selector brush arm passes over the terminals of Row 3 of the associated bank. These pulses are translated and repeated to the line as neutral, or close and open pulses by the L relay. The selector magnet is driven by the P relay, through normal contacts of the F or ID relay. The P relay operates when the P electron tube becomes conducting and releases when the tube is extinguished. Each operation of the selector magnet opens the selector interrupter spring contacts, extinguishing the tube to release the P relay and de-energize the magnet. Each release of the selector magnet advances the selector one step. In effect, four distinct RC timing arrangements are available for connection to the starter anode of the tube to establish its firing period, and therefore the time interval between each successive advance of the selector brush arm. Optional strapping arrangements of an operated code relay, together with the advance of brush arms associated with Rows 2, 5 and 6 of the selectro bank, determine which timing arrangement is connected to the tube starter anode, either directly or through operation of the ID or F relays. By connecting the tube starter anode to the proper timing arrangement, the length of pulse at the start and between each advance of the selector is controlled to terminate the cut on pulse, introduce digit or interdigit pulses and initiate the last interdigit pulse in the proper sequence to generate the selected code. The cut on pulse is initiated and the last interdigit pulse is terminated by operation and release, respectively, of the ST relay which removes a short from the L relay contacts to start the code transmission and replaces the short to end the code transmission. Operation and normal release of the ST relay is dependent on similar action by one of the code relays. The selected code relay is operated by momentarily depressing the associated MD, MC, or CD Key of the Key and Lamp Cabinet per Fig. 2B or 2C. Except in those cases where the "W" option shorting strap is placed

across the 3-4T contacts of the SZ relay of Fig. 1A, it is necessary to operate this relay by momentarily depressing the LN Key of Fig. 2B or 2C in order to enable a code key to operate a code relay. During the periods when the SZ or ST and a code relay are required to be operated, they are locked up to a ground supplied through normal contacts of the CN Key of Fig. 2B or 2C. Momentarily depressing the CN Key opens this ground supply to release these relays. The release of the ST relay places a short across the L relay contacts to blind the line to any additional pulses generated. Ground on the selector brush arm associated with Row 1 of the bank maintains a potential across the P tube and a connected timing circuit to assure that the selector will continue to advance until it reaches its (stop and) start position on Step 22. The ST relay is operated at all times during a code transmission, and in this condition it places a short across Terminals 29 and 30 of the pulse generator A terminal strip. By cross-connection or cabling, this short may be extended to blind a unit of station equipment from receiving the code signals.

5.02 In the idle condition, all relays are released; the selector is on Step 22; the timing circuit condensers are discharged; and all elements of the P electron tube are at the same potential with respect to ground.

5.03 Ground from Terminal 32 of the A terminal strip of Fig. 1A is fed through the interconnecting cable, Fig. 52C, to Terminal 25 of the C Jones Plug of the Key and Lamp Cabinet, Fig. 2B or 2C. From Terminal 25, this ground is supplied to the CN and LN Keys and to the CD Lamp. Momentary operation of the non-locking LN Key connects ground back through the interconnecting cable on the SZ lead to operate the SZ relay, the operate path being completed through normal Contacts 2-1T of the ST relay and "X" wiring to battery. The SZ Relay locks up through its Contacts 1-2B, "X" wiring, the interconnecting cable, and normal contacts of the CN Key to ground.

5.04 Battery from Terminal 1 of the A terminal strip of Fig. 1A is fed through "G" wiring in the interconnecting cable to the LN Lamp. The operation of the SZ relay completes a ground path from the selector brush arm, through Terminal 22 of Row 1 of the bank, Contacts 5-6T of the F relay, Contacts 3-4T of the ST relay; Contacts 4-3T of the SZ relay, and the interconnecting cable to the LN Lamp to light it; and to the MD, MC, and CD Keys to enable them to operate an associated code relay. The lighting of the LN Lamp indicates that the MD, MC and CD Keys are no longer disabled. With "W" option wiring these code keys are not dependent on prior operation of the SZ relay, and since the LN Lamp loses its significance, it is removed from its socket to prevent it from being permanently lighted except when codes are being transmitted. It will be noted that the code keys are not supplied with ground during a code transmission because of the ST Relay being operated; nor until the selector has returned to its start position following a code transmission or CN Key operation. The operation of a code key breaks the ground path to all higher numbered keys, and while still momentarily depressed the ground to all code keys is opened by operation of the ST relay, making it impossible to operate more than one code relay at a time.

5.05 The interconnecting cable per Fig. 52C (also 52D in larger installations) provides an operating path from each code key to its associated code relay (Fig. 1A or 3A). Battery is supplied to the code relays through normal contacts of the ID key by the P relay, if released: the ID relay, if released and the F relay, if the ID relay is operated and the F relay released. When the selected code relay operates, its 4-5T contacts close, extending the ground from the code key to the winding of the ST relay. At the same time, Contacts 7-6T of the operated code relay connect battery to the other end of the ST relay winding, operating the relay.

5.06 When the ST relay operates, it locks up to ground through its 3-4B contacts and normal contacts of the CN Key in the Key and Lamp Cabinet. It also returns this lock up ground to the ground side of the code relay winding through ST relay Contacts 4-3B and code relay Contacts 5-4T, to lock up the code relay. The ST and code relays can be released by operating the CN Key or by opening the battery source. The operation of the ST relay starts the code transmission and performs miscellaneous functions as follows:

(a) Opens the line to initiate the cut on pulse by removing the short from the contacts of the released L relay.

(b) Connects ground to the selector magnet and interrupter contacts, and through these contacts to the anode of the P electron tube and the ST resistor. Grounding the main anode of the three element cold cathode electron tube creates a potential difference between the cathode and anode which will cause the tube to conduct once it is fired by a breakdown voltage on the starter anode. The ground applied through the ST resistor, P resistor and P potentiometer, To the P capacitor charges the latter at a rate such that it will reach the tubes starter anode breakdown voltage in about one second. The capacitor is connected to the starter anode through the 5-4T contacts of the ID relay;

(c) Furnishes a ground to which the F relay can lock up when it has been operated;

(d) Opens the ground path to the code keys;

(e) Opens the operating path of the SZ relay, which releases, extinguishing the LN Lamp if provided;

(f) Connects battery through the interconnecting cord to the CD Lamp, which lights to indicate that a code transmission is in progress; and,

(g) Places a short across Terminals 29 and 30 of the A terminal strip which can be used to blind associated equipment from receiving the code signals.

5.07 When the P capacitor and the starter anode of the tube reach a potential about 75 volts positive with respect to the negative voltage supplied to the tube cathode through the P relay winding, the tube fires. Its cathode current flowing through the relay winding causes the P relay to operate. This current also creates a voltage drop across the relay winding and the R1 resistor, raising the cathode potential and extinguishing the starter anode. Conduction continues between the main anode and the cathode.

5.08 Operation of the P relay removes battery supply from the released ID relay and from the operated code relay. The code relay still receives battery through normal contacts of the ID relay and is not affected by the P relay operation. When the armature and Contact 2 of the P relay close, a shunt is placed across the P capacitor to discharge it prior to the next timing interval. The closing of the armature and Contact 1 of the P relay completes an operating path for the selector magnet through Contacts 4-5B of the ID relay, and 3-4B of the F relay in parallel, and the magnet winding to ground applied in Paragraph 5.06 (b), above.

5.09 As the selector armature advances toward the magnet core, it breaks the interrupter contacts to open the ground path to the main anode of the tube, established in Paragraph 5.06 (b). With this ground removed, the tube main anode returns to the same potential as the cathode, extinguishing the tube to release the P relay. The release of this relay opens the operating path of the selector magnet and removes the shunt from the discharged P capacitor. As the selector armature starts to return to its back stop, the interrupter contacts again close to re-establish ground to the main anode of the tube, and through

the ST and P resistors and the P potentiometer to start charging the P capacitor for the next timing period. Immediately after closing the interrupter contacts, the releasing magnet armature advances the selector to Step 1 from its starting position on Step 22.

5.10 The following changes take place when the selector is advanced to Step 1:

(a) Ground is transferred from Terminal 22 to Terminals 1 to 21 inclusive of Row 1 of the bank. The removal of this ground from Terminal 22 disconnects, at its source, the only ground supply to the CD keys of the key and lamp cabinet, assuring that these keys will remain in a disabled condition until the selector returns to its start position on Step 22 or 44. In addition to the selector being on Step 22, it is necessary for the F and ST relays to be released, and the SZ relay either operated or furnished with "W" option wiring to enable the CD Keys. The connection of ground to strapped Terminals 1 to 21 supplements the ground to the interrupter contacts which was originally supplied by operation of the ST relay as described in Paragraph 5.06 (b). This supplementary ground assures that even though the ST relay releases, due to completion of the code transmission or operation of the CN Key, a potential will be furnished through the interrupter contacts to charge the P capacitor, fire the tube and step the selector to its start position on Step 22.

(b) Terminals 1 to 21 of Row 2 of the bank are strapped together. So long as the associated brush arm is not on Step 22, a short is maintained across the ST resistor. The shorting of the ST resistor increases the charging rate of the P capacitor so that it reaches a potential sufficient to fire the tube in about 60 or 65 milliseconds. This interval, plus relay and magnet operate times and a portion of the magnet release time, results in pulses about 100 milliseconds in

length. So long as the P capacitor and tube starter anode are connected through Contacts 4-5T of the released ID relay, and the selector is not in its start position on Step 22, pulses of this length will be generated.

(c) All odd numbered terminals of Row 3 of the bank are strapped together, and as the associated brush arm advances to one of these terminals, it supplies ground to complete the operating path of the L relay, which closes the line circuit. The operation of the L relay, when the selector advances to Step 1, terminates the cut on pulse and initiates the first digit pulse. Subsequent steps alternately open and close the line.

5.11 In order to introduce interdigit pulses in the generated code, arrangements are made to transfer the tube starter anode from control of the P capacitor to the ID capacitor by operating the ID relay as the selector reaches predetermined points in the code transmission. When the ID relay operates, it transfers the tube starter anode which appears on strapped Springs 2 and 4T of the relay from contact with Spring 5T associated with the P capacitor to contact with Spring 1T associated with the ID capacitor. It also removes a 1000 ohm shunt from the ID capacitor, permitting it to start charging through Contacts 6-5B of the released F relay and the ID resistor to ground. In about a half second the ID capacitor develops a sufficient voltage to fire the tube, operating the P relay to open the operating path of the ID relay and advance the selector a step. Each individual station code requires a distinct pattern of pulses and this is accomplished by planned variations in the location of interdigit pulses through strapping or leads between code relay contacts and bank terminals, each code relay being strapped differently. These straps or leads are identified as D1, D2, D3 and D4 straps (see Paragraph 5.19) to indicate that an operating path for the ID relay is established when

the selector has advanced the number of steps corresponding to the 1st selecting digit of the code, the sum of the first two selecting digits, the sum of three selecting digits, or the sum of four selecting digits respectively. As the selector advances to Step 3, the grounded brush arm associated with Row 6 of the bank starts a scanning operation, seeking an operating path for the ID relay through a D strap, the contacts of an operated code relay, and the ID relay winding to battery furnished by the P relay when released. The path for Terminal 3 of Row 6 includes normal Contacts 1-2B of the F relay to prevent a path through Terminal 3 from being mistaken for 25 if the selector must make a second half revolution to complete transmission of a 26 impulse code. The F relay will be unoperated at Step 3 but operated at Step 25 to open the path through Terminal 3. The brush arm of Row 6 scans Terminal 3 to 18, and operates the F relay on Step 19. The brush arm of Row 5 scans terminals corresponding to 20, 24 and 26 steps, having been supplied with ground when the F relay operated. The brush arm of Row 1 scans Step 22 through Contacts 5-4B of the operated F relay. Each time the scanning operation reveals an operating path for the ID relay, the latter transfers the tube starter anode to the ID capacitor, thereby holding the selector on the step which established the operating path until the tube fires. Subsequent operation of the P relay opens the main battery supply to the ID Relay, and (if the F relay is released) the ID relay has time to fully release before advance of the selector magnet opens the interrupter contacts to extinguish the tube and release the P relay, thereby re-establishing battery to the ID relay winding. The ID relay does not have time to reoperate in the interval between release of the P relay and the advance of the selector which opens the ground path to the ID relay. There is considerable margin for safe operation in each of these race conditions, and even if the ID relay reoperated momentarily it would have no adverse effect on pulse generator operation. Should the ID relay fail to release in its alloted time, the first pulse following the interdigit pulse would be

only 30 to 40 milliseconds in length, and the equipment should be investigated for a condition which would greatly lessen the operate time of the selector magnet or greatly increase the release time of the ID relay. It will be noted that no D strap is provided for Step 26, the fact that code transmission is continuing when the selector reaches this step being sufficient evidence that a 26 impulse code is being transmitted since no standard codes require a greater number of impulses.

5.12 When the grounded brush arm associated with Row 6 of the bank reached Step 19, it operated the F relay. The operation of this relay prepares the circuit for subsequent generation of the last interdigit pulse, for scanning Steps 20 to 26 for an ID relay operating path, and for returning the generator to the starting position, as follows:

(a) F relay Contacts 9-10T connect ground to the brush arm of Row 5 so that it may scan Steps 20, 24 and 26;

(b) Contacts 7-8T lock up the F relay to ground provided by the ST relay as described in Paragraph 5.06 (c);

(c) Contacts 4-5T connect Terminal 22 of Row 1 of the bank to code Point 22 of the A terminal strip so that this point may be scanned for an operating path for the ID relay;

(d) The transfer of battery on 2T from Spring 3T to Spring 1T removes the battery supply which previously held the code relay operated during those periods when both the ID and P relays had removed their supplies, and it furnished a secondary supply to the ID relay;

(e) When Contacts 1-2B open, a possible path for false operation of the ID relay at Step 25 of the selector is eliminated;

(f) The opening of 3-4B eliminates one of two parallel operate paths for the selector magnet;

(g) The opening of 5-6B inserts the S-ID resistor in series with the ID resistor and capacitor.

(h) Contacts 7-8B place an auxiliary short across the ST resistor to keep this resistor out of the charging path of the P capacitor if the code transmission is still in progress when the brush arm associated with Row 2 of the bank leaves Step 21.

5.13 The selector continues to step at the digit pulse rate until the scanning operation of the brush arms associated with Rows 5 and 1 of the bank results in operation of the ID relay. This ID relay operation transfers the tube starter anode from the P to the ID capacitor. Also, it opens one of the two remaining battery sources for the operated code relay, and opens the only remaining operating path for the selector magnet. With the S-ID resistor added in its charging path per Paragraph 5.12 (g) it takes about one second to charge the ID capacitor to a sufficient voltage to fire the tube. As the tube becomes conducting, it operates the P relay to remove the last battery source to the code relay, permitting it to release. The operation of the P relay does not cause release of the ID relay because the latter now receives battery from the operated F relay as covered in Paragraph 5.12 (d). The selector magnet operating path is open at contacts of the ID and F relays.

5.14 Release of the code relay opens the battery supply to the ST relay, and, unless the selector is on Step 26, it also opens the ground supply to the ID relay. The release of the ST relay results in the following:

(a) Contacts 1-2B place a short across the L relay contacts to close the loop, thereby terminating the last interdigit pulse and blinding the line to any further action of the L relay.

(b) Contacts 9-10T remove a ground source from the selector magnet and the main anode of the tube. If the selector is on Step 22, the removal of this ground extinguishes the tube and prevents further stepping by the selector. If the selector is not on Step 22, an auxiliary ground source from the brush arm of Row 1 of the bank maintains the tube conducting and furnishes ground to step the selector when its battery path is restored by release of the F or ID relays.

(c) Contacts 11-12T remove the short from Terminals 29 and 30 of the A terminal strip, and the blind from connecting apparatus.

(d) Contacts 7-8T remove the lock up ground from the F relay, permitting it to release.

(e) Contacts 5-6B remove the battery source to the CD Lamp of the Key and Lamp Cabinet to extinguish it, indicating the completion of code transmission.

5.15 The ID relay is somewhat slower in releasing than the ST relay. Unless the selector was on Step 26 when the code transmission was completed, the release of the ID relay precedes the release of the F relay. In releasing, the ID relay transfers the tube starter anode back to the P capacitor, and closes the path between Contact 1 of the P relay and the selector magnet. If the code transmission ended on Step 22, neither of these actions has any effect, as covered in Paragraph 5.14 (b). If the selector is on Step 20, 24 or 26, it will step at the digit pulse rate until it reaches its start position on Step 22, or Step 44 if a second half revolution is required, at which point the ground furnished by Row 1 of the bank is removed from the selector magnet and the tube.

5.16 If the selector was on Step 26 at the end of code transmission, release of the F relay will precede that of the ID relay due to the latter receiving its ground supply directly from Row 5 of

the bank. In this case the release of the F relay opens its Contacts 1-2T, removing the battery supply to the ID relay. If the F relay releases before the ID, it closes the battery path to the selector magnet to advance the selector to Step 27. Subsequent action is as described in Paragraph 5.15. With all relays released, the calling circuit is restored to its idle condition if the selector is on Step 22 or when it advances to Step 22 or 44.

5.17 In units manufactured prior to Issue 7 of Drawing WA11447-SD, both anodes of the tube, and the tube side of the P capacitor were not terminated when the circuit was idle. Leakage to ground would gradually build up a charge across the P capacitor to a point where the tube would often be on the verge of firing, and would fire as soon as the operation of the ST relay applied ground to the main anode. As a result, the length of the cut on pulse would be reduced, and would depend largely on the length of time the circuit had been idle and on the relative humidity. To overcome this condition, a lead was provided from SZ relay Contacts 4-5B, through the 1000 ohm R2 resistor to the tube side of the P capacitor. This arrangement shunted down the P capacitor, removing any leakage charge, each time the SZ relay was operated prior to a code transmission. Thus, except when "W" wiring is specified, the timing charge of the P capacitor actually starts when the SZ relay releases to remove the shunt, rather than when operation of the ST relay applies ground to the ST resistor as described in Paragraph 5.06 (b). The 10 megohm PS resistor has been bridged across the P capacitor to terminate the capacitor and both tube anodes during idle periods on units manufactured in accordance with Issue 7 of Drawing WA11447-SD, and on earlier units which have been modified in accordance with Detailed Change Sheet WA11447-DCS which has been reproduced as Sheet 5 of Drawing WA11447-T. While the shunting action of the SZ relay should no longer be required, the type of wire insulation on many units of early manufacture was left to the discretion of the shop, and some of these units might perform better during extreme humidity conditions as a result of shunting the P capacitor immediately prior to code transmission

5.18 The C1 capacitor and R10 resistor form a network which is bridged across the cathode and starter anode terminals of the electron tube. In some tube applications such networks are used to suppress starter voltage oscillations which might occur if the starter current were held to an extremely low value. As applied in the Push Button Calling Circuit, the network serves no useful purpose.

5.19 The D4 strap referred to in Paragraph 5.11 is not shown in Fig. 1A of Drawing WA11447-SD, although its application is described in Note 107 of the drawing. The D4 strap is only used in 6 digit codes, and because of the number of inquiries for optional features which would require use of those code relay contacts which the D4 strap employs, wiring for the contacts is not shown.

(B) Description of Push Button Calling Circuit in Manual Tape Relay System Applications

5.20 This circuit is shown on Drawing WA11447-SD, Sheet 5, Figs. 2D, 52C, 52D and 53; and Sheet 6, Figs. 1A and 3A. With the exception of the following features, the operation is identical to that described in Paragraphs 5.01 to 5.19.

5.21 In Fig. 1A, "Y" wiring is used and "X" and "W" wiring are omitted. Ground from the brush arm associated with Row 1 of the bank is supplied to Terminal 22 of the row, through Contacts 5-6T of the F relay, to Contacts 3-4T and 1-2T of the ST relay. The ground on Contacts 1-2T of the ST relay is applied to Terminal 6T of the SZ relay winding. The ground on Contacts 3-4T of the ST relay is extended through Contacts 4-5T of the SZ relay, the interconnecting cable with "H" wiring (Fig. 52C), Springs 2-3 of the HLD key (Fig. 2D), to the LN Key associated with the first line, and through series strapping to all other LN keys. When the LN Key associated with the selected line is momentarily depressed, it disconnects the enabling ground from all higher numbered LN Keys and applied the ground

through the interconnecting cable (Fig. 52D, "N" wiring) to the manual tape relay system equipment assigned to the selected line. See Drawings WA11449 and WA11450 for the external circuit. If the selected line is busy, the path of the ground is open and nothing happens. If the selected line is idle, a path is established to operate a relay which returns battery supply to the LP1 lead, lighting the LN Lamp of the Key and Lamp Cabinet to indicate that the line has been seized. This lamp remains lighted while the line is seized. The same external relay returns the original enabling ground through its lock up contacts to the LC lead of the Key and Lamp Cabinet, through Contacts 2-3 of the CN Key and the interconnecting cable (Fig. 52C) to Terminal 6B of the SZ relay. At this time the SZ relay has ground on each side of its winding, and the external relay has two ground sources; First, the original enabling ground furnished through the momentarily operated LN Key; and second, a path through its lock up contacts, the LC lead, the CN Key, the SZ relay winding, Contacts 1-2T of the ST relay, Contacts 5-6T of the F relay, and Terminal 22 of Row 1 of the bank to the grounded brush arm. When the enabling ground is removed by releasing the LN Key, the external relay locks up over the path through the SZ relay winding, operating the SZ relay.

5.21 When the SZ relay operates, the ground on its 4T spring is transferred from 5T to 3T, disabling the LN Keys and enabling the CD Keys to operate a code relay.

5.22 The operation of the ST relay at the start of code transmission furnishes an auxiliary lock up ground through its 5-6T contacts and the R9 resistor to hold the external relay operated, and opens the operating path of the SZ relay.

5.23 When the ST relay releases at the end of code transmission, it opens the lock up path of the external relay. The F varistor across the winding of the F relay makes this relay sufficiently slow in releasing that it will not close its normal Contacts 5-6T until the external relay has opened its lock up

contacts. It will be noted that if the selector were on Step 22, early release of the F relay could re-establish a lock up path for the external relay through the ST relay Contacts 1-2T and the SZ relay winding.

5.24 Momentarily depressing the CN Key breaks the lock up path for the external relay as well as the operate path of the SZ relay and the lock up path of the ST and code relays, permitting all to release.

5.25 Holding the non-locking HLD Key operated furnishes an auxiliary lock up ground to hold the external relay operated. Also, it establishes a ground path through Terminal 22 of Row 1 of the bank, and normal contacts of the F, ST and SZ relays to enable the code keys with the SZ relay released. This arrangement permits holding a seized line while two or more codes are transmitted, preventing the manual tape relay system equipment from locking out the calling circuit when the ST relay releases its lock up of the external relay at the end of each code transmission.

5.26 Ground through Contacts 1-2T of the MD (master disconnect) code relay, and an auxiliary path from the brush arm associated with Row 1 of the bank, Terminal 22 of the row, Contacts 4-5T of the F relay, and Contacts 6-7T of the ID relay are connected to Terminal 2 of the A terminal strip. Cross-connections extend this lead to lock down the relay in the manual tape relay system which performs the function of locking out the calling circuit at the end of a code transmission. In this manner lock out is prevented following transmission of a master disconnect code, and the line can be reseized to send other codes without having to resort to key manipulation at the control position.

6. OPERATION

6.01 Description of Operation of Push Button Calling Circuit in Single Channel Application When "W" Wiring is Furnished

(a) When a receiving station is to be called, momentarily depress the CD Key associated with the code assigned to the selected station. The lighting of the CD Lamp indicates that the code transmission is in progress. When the light goes out, it indicates that the code transmission has been completed. If the transmitted code was a 24 or 26 impulse code, there may be a delay of nearly two seconds before the selector of the calling circuit returns to its idle condition to restore the enabling ground to the code keys.

(b) When it is desired to call two or more stations, one immediately after the other, follow the same procedure as in (a) except that there must be a pause of about one-half second between each call, and the CD Key must be held operated until the CD Lamp lights.

6.02 Description of Operation of Push Button Calling Circuit in Single Channel Applications when "W" Wiring is Omitted

(a) When a receiving station is to be called, momentarily depress the LN Key, and when the LN Lamp lights, momentarily depress the CD Key associated with the code assigned to the selected station. The CD Lamp lights and the LN Lamp is extinguished to indicate that the code transmission is in progress. When the CD Lamp goes out, it indicates that the code transmission has been completed.

(b) When it is desired to call two or more stations, one immediately after the other, follow the same procedure as in (a) except that the CD Key must be held depressed until the CD Lamp lights and the LN Lamp is extinguished.

6.03 Description of Operation of Push Button Calling Circuit in Manual Tape Relay System Applications

(a) When a line is to be seized and a receiving station called, momentarily depress the LN Key assigned to the selected line. If the LN Lamp fails to light, it indicates that the Push Button Calling

Circuit has been locked out by the manual tape relay system because of the line being busy or for other reasons. Follow normal manual tape relay system operating procedures in determining if the line is busy or if the lock out should be released. Following release of the lock out, again depress the LN Key.

(b) When the LN Lamp lights after the LN Key has been momentarily depressed, it indicates seizure of the associated line. Momentarily depress the CD Key associated with the code assigned to the called station. The CD Lamp lights at the start of the code transmission, and both the CD and LN Lamps are extinguished when the code transmission is completed to indicate that the code signal has ended and that the line has been released.

(c) When it is desired to call two or more stations, one immediately after the other, follow the same procedure as in (a) and (b), except that the HLD Key must be held depressed from the time that the first CD Key has been operated until the CD Lamp lights after operation of the last CD Key. A pause of at least one-half second is required between the extinguishing of the CD Lamp and the operation of the next CD Key. For the second and subsequent stations called, the CD Key must be held depressed until the CD Lamp lights.

6.04 Use of the CN Key in Releasing a Seized Line or Preventing Completion of a Code Transmission

(a) By momentarily depressing the CN Key it is possible to release a line of a manual tape relay system which has been seized in error.

(b) On single channel installations not equipped with "W" wiring depressing the CN Key will disable the code keys and extinguish the LN Lamp in those cases where the LN Key has been depressed in error.

(c) If an error has been made in selecting a code key and is promptly recognized, momentarily depressing the CN Key will prevent completion of the code transmission and avoid performance of the action associated with the code. It is essential that a master disconnect code be sent on the line immediately following use of the CN Key in halting a code transmission, and if stations had been connected to the line before the CN Key was operated, two consecutive master disconnect codes should be transmitted. This is because of unwanted side effects associated with use of the key, as follows: When the CN Key is depressed, it removes the lock up ground from the ST relay of Fig. 1A, and the release of the ST relay closes the line circuit by placing a short across contacts of the L relay. Assume, for example, that the selector of the calling circuit and the code wheels of all receiving selectors have just completed advancing four steps when the CN Key is depressed. The holding spring will engage a movable code pin in Position 16 (Fig. 2, Section P65.901) and prevent receiving code wheels from restoring to their starting positions at stations having the Numeral 4 for their first selecting digit. The 12th, 14th and 20th codes of B.S.P. Section P65.902, Table A, are 14061, 14971 and 14881 and would be affected. The closing of the line circuit may shorten the fourth digit pulse sufficiently to make the A tube of receiving selectors (Section P90.982.1) conducting and prevent further response of the selector to line signals. The next code transmitted on the line will step the code wheel from pin Position 16 and it would therefore be impossible to select any of these three stations by sending the proper code, but if the Code 18841 were transmitted, it would advance the selector having Code 14881 to a fixed pin and result in a false operation. By sending a master disconnect code on the line after using the CN Key, all receiving selectors can be restored to their starting positions. If one or more stations were connected to the line prior to sending the master disconnect code their status remains

uncertain until a second master disconnect code is transmitted, for the first such transmission may have advanced them from a movable pin rather than from the starting position of the code wheel, in which case they would step beyond the fixed pin associated with the master disconnect function. A 22 impulse master disconnect code received by a station with the code wheel held on pin Position 16 will advance the code wheel to the D fixed pin (Fig. 2 of B.S.P. Section P65.901), but this is of no significance as fourth functions are not assigned to codes having the Numeral 4 as the fist selecting digit. Codes having the Numeral 2 as the first selecting digit are not used with the Push Button Calling Circuit, and do not enter into the problem.

(d) Optional wiring of manual tape relay systems is usually such that the calling circuit will be locked out of single circuits if the CN Key is depressed after code transmission has started. This lock out may be prevented by holding the HLD Key depressed from before the time that the CN Key is depressed until the first master disconnect transmission is started as indicated by lighting ff the CD Lamp. If lock out occurs, re-entry is covered by standard manual tape relay system operating practices.

7. CODE COMBINATIONS

7.01 While dial and pulse divider equipment is limited to a maximum of ten consecutive impulses in a series, the Push Button Calling Circuit can generate as many as 26 consecutive impulses. This series of impulses may be shortened and/or divided into two, three or four groups separated by interdigit pulses.

(a) A series of 20, 22, 24 or 26 consecutive impulses will normally be used in transmitting a master code.

(b) Two groups of impulses separated by an interdigit pulse may be used for group selection, such group selection being distinct from the group selection described in BSP Section P65.902, Paragraph 6.06.

(c) Three or four groups of impulses are used in duplicating the individual station codes listed in Tables A and B of B.S.P. Section P65.902, or in generating additional codes.

7.02 The ability of the Push Button Calling Circuit to generate more than ten consecutive impulses results in a new type of group selection and a considerable increase in the quantity of different code signals. The extent to which these features may be applied is limited by availability of suitable testing arrangements and by the frequent retention on a line of one or more stations dependent on dial and pulse divider equipment for calling.

(a) If all stations on a line are equipped with Push Button Calling Circuits, and if similar equipment is provided at key testrooms for generating test code signals, the code combinations listed on Table G and the groups listed on Table H may be assigned.

(b) If one or more stations on a line are equipped with dial and pulse dividers, and if such stations are only required to transmit individual station codes, but not group or master codes, then those five digit codes listed on Table E and groups listed on Table F may be assigned. Six digit codes may also be used, but the development of six digit code information similar to that shown on Tables D, E, F, G and H for five digit and equivalent codes is beyond the scope of this Addendum. In using Tables E and F, it is assumed that the dial type portable test set will be used in testing response to individual station codes and that the test for response to master and group codes will be omitted as superfluous.

(c) If one or more stations on a line are equipped with dial and pulse dividers, and if these stations are required to transmit master as well as individual station codes, only those code combinations listed on Tables A and B of B.S.P. Section P65.902 may be used, and such of these codes as have the Number 2 for the first selecting digit must be omitted. Table D lists the group selections applying to the codes of Table A of Section P65.902, but such groups may be selected only by stations equipped with Push Button Calling Circuits.

7.03 As referred to in this addendum and associated Tables C, D, F, and H, group selection consists of sending a series of consecutive impulses which will step all receiving selectors to a specified movable pin position. Stations having a pin in this position comprise the selected group. Following an interdigit pulse which permits the code wheels of stations not in the group to return to their starting position, a second series of consecutive impulses steps the selectors of the group from the movable pin position to a fixed pin position associated with the desired function. The two series of pulses are preceded by a cut on pulse and followed by a last interdigit pulse as in other code transmissions. One of the equipped pin positions required for receipt of the individual station code is used for the group selection. On lines employing five digit or equivalent station codes, each receiving selector has two movable pin positions equipped and will therefore respond to two different group selection codes. No two stations will respond to the same pair of group selection codes. In some applications, a sub control office may be required to receive all signals or messages directed to each of two groups, in which case it is assigned the individual station code which is common to both groups. By not assigning certain group or station codes, it is possible to have each station on a line respond to only one of the several group codes which may be assigned to different sections of the line or to different types of stations. It

is also possible to have group selection for some stations and omit it for other stations. Regardless of grouping arrangements, all stations will respond to master codes. If station codes per Table G may be used, and if a small number of groups are required, as many as four functions may be performed on a group basis in many cases. In general, the greater the number of groups required, the fewer stations are permitted per group as indicated below with respect to Table H:

Number of Groups	Stations Per Group				
	Group A	Group B	Group C	Group D	Group E
2	14	13			
3	13	13	12		
4	12	12	12	11	
5	11	11	11	11	10
10	6	6	6	6	6

7.04 Tables A and B of B.S.P. Section P65.902, and Tables E and G of this Addendum list the individual station codes in the order of available functions, four function codes being placed at the top of the list. The tendency to assign these codes to individual stations in the order listed is usually not compatible with the assignments required for group selection. For this reason, the identifying number representing a particular code signal is referred to as the "code designation" on Tables D to H, rather than "station" as on Tables A and B of B.S.P. Section P65.902. In assigning individual station codes and group selection per Tables G and H, it is probable that the main control office on a line would be known as Station 1, but if it were not required to respond to group selection, it would be assigned the code designated 105. This is because the code designated 105 responds to group Codes P and R, and its assignment does not reduce the number of stations which may be placed in Groups A to N. Normally, Groups P, Q, and R will not be assigned, as all code designations except 105 in these groups also respond to one of the Group A to N selection codes.

TABLE C

Group Selection Code Signals

For Use With Push Button Calling Circuits

Group	1st Function	2nd Function	3rd Function	4th Function	Receiving Station Equipped Pin Position
A	(18)2	(18)4	(18)6	(18)8	2
B	(17)3	(17)5	(17)7	(17)9	3
C	(16)4	(16)6	(16)8	(16)(10)	4
D	(15)5	(15)7	(15)9	(15)(11)	5
E	(14)6	(14)8	(14)(10)	(14)(12)	6
F	(13)7	(13)9	(13)(11)	(13)(13)	7
G	(12)8	(12)(10)	(12)(12)	(12)(14)	8
H	(11)9	(11)(11)	(11)(13)	(11)(15)	9
J	(10)(10)	(10)(12)	(10)(14)	(10)(16)	10
K	9(11)	9(13)	9(15)	9(17)	11
L	8(12)	8(14)	8(16)	8(18)	12
M	7(13)	7(15)	7(17)	7(19)	13
N	6(14)	6(16)	6(18)		14
P	5(15)	5(17)	5(19)		15
Q	4(16)	4(18)			16
R	3(17)	3(19)			17
Master	(20)	(22)	(24)	(26)	

Notes: 1. Only selecting groups of impulses are shown, the first and last digits "one" of a dial code being produced automatically by the Push Button Calling Circuit.

2. The numbers ten to nineteen are shown in parenthesis to indicate that the number refers to a single group of impulses.

3. Each station will respond to either or both of two group codes, but no two stations will respond to the same pair of group codes. If it is desired that a station respond to only one group code, then the alternate group must not be assigned.

TABLE D

Group Selection of Code Designations (Stations) Listed on Table A of B.S.P. Section P65.902, When All Group Selection is Performed With a Push Button Calling Circuit, But Stations Also are Required To Respond To Individual and Master Codes Transmitted With Dial and Pulse Divider Equipment

Groups (Note 3)	C	D	E	F	G	L	M	N	P	Q	R
C						2	1	3			
D						7	6	5	4		
E						11	10	9	8	12	
F						18	17	16	15	14	13
G						24	23	22	21	20	19
L	2	7	11	18	24						
M	1	6	10	17	23						
N	3	5	9	16	[illegible]						
P		4	8	15	21						
Q			12	14	20						
R				13	19						

Notes: 1. When it is required that a sub control, or equivalent station, respond to both of two group selection codes, assign it a code designation appearing at the intersection of one group column and the other group line. Thus, if the station is required to respond to Group F and Group N codes, it should be assigned code designation 16.

2. When it is required that no station respond to more than one group code, assign code designations as listed by groups in Column C, D, E, F and G, and omit Groups L, M, N, P, Q, and R, or vice versa.

3. Refer to Table C for group selection code signals.

TABLE E

Five-Digit Individual Station Codes With A Continuous Series of Impulses for Master Codes. (See Notes 1 to 3)

Code Designation	Individual Station Code				Movable Pin Positions	Groups
	1st Function	2nd Function	3rd Function	4th Function		
1	10821	10841	10861	10881	2,10	A,J
2	19921	19941	19961	19981	2,11	A,K
3	18021	18041	18061	18081	2,12	A,L
4	10731	10751	10771	10791	3,10	B,J
5	19831	19851	19871	19891	3,11	B,K
6	18931	18951	18971	18991	3,12	B,L
7	17031	17051	17071	17091	3,13	B,M
8	10641	10661	10681	10601	4,10	C,J
9	19741	19761	19781	19701	4,11	C,K
10	18841	18861	18881	18801	4,12	C,L
11	17941	17961	17981	17901	4,13	C,M
12	10551	10571	10591		5,10	D,J
13	19651	19671	19691		5,11	D,K
14	18751	18771	18791		5,12	D,L
15	17851	17871	17891		5,13	D,M
16	16951	16971	16991		5,14	D,N
17	15051	15071	15091		5,15	D,P
18	10461	10481	10401		6,10	E,J
19	19561	19581	19501		6,11	E,K

TABLE E (CONT'D)

Code Designation	Individual Station Code 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Positions	Groups
20	18661	18681	18601		6,12	E,L
21	17761	17781	17701		6,13	E,M
22	16861	16881	16801		6,14	E,N
23	15961	15981	15901		6,15	E,P
24	14061	14081			6,16	E,Q
25	10371	10391			7,10	F,J
26	19471	19491			7,11	F,K
27	18571	18591			7,12	F,L
28	17671	17691			7,13	F,M
29	16671	16791			7,14	F,N
30	15871	15891			7,15	F,P
31	14971	14991			7,16	F,Q
32	13071	13091			7,17	F,R
33	10281	10201			8,10	G,J
34	19381	19301			8,11	G,K
35	18481	18401			8,12	G,L
36	17581	17501			8,13	G,M
37	16681	16601			8,14	G,N
38	15781	15701			8,15	G,P
39	14881	14801			8,16	G,Q
40	13981	13901			8,17	G,R

TABLE E (CONT'D)

Code Designation	Individual Station Code 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Positions	Groups
41	19291				9,11	H,K
42	18391				9,12	H,L
43	17491				9,13	H,M
44	16591				9,14	H,N
45	15691				9,15	H,P
46	14791				9,16	H,Q
47	13891				9,17	H,R
48	18201				10,12	J,L
49	17301				10,13	J,M
50	16401				10,14	J,N
51	15501				10,15	J,P
52	14601				10,16	J,Q
53	13701				10,17	J,R
Master	(20)	(22)	(24)	(26)		

Notes: 1. As master codes can be transmitted only from stations equipped with Push Button Calling Circuits, only the selecting impulses are shown for these codes, the first and last digits "one" being generated automatically by the calling circuit

2. Individual station codes may be sent with either Push Button Calling Circuit or Dial and Pulse Divider equipment.

3. Receiving equipments can be tested for response to individual station codes, but not for response to master codes, using the Dial Type Portable Test Set.

TABLE F

Group Selection of Code Designations Listed on Table E, When All Group and Master Code Selection is Performed With a Push Button Calling Circuit, but Receiving Stations May Be Required to Respond to Individual Station Codes Transmitted With Dial and Pulse Divider Equipment, and are Tested With the Dial Type Portable Test Set

Groups (Note 3)	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
A									1	2	3					
B									4	5	6	7				
C									8	9	10	11				
D									12	13	14	15	16	17		
E									18	19	20	21	22	23	24	
F									25	26	27	28	29	30	31	32
G									33	34	35	36	37	38	39	40
H										41	42	43	44	45	46	47
J	1	4	8	12	18	25	33				48	49	50	51	52	53
K	2	5	9	13	19	26	34	41								
L	3	6	10	14	20	27	35	42	48							
M		7	11	15	21	28	36	43	49							
N				16	22	29	37	44	50							
P				17	23	30	38	45	51							
Q					24	31	39	46	52							
R						32	40	47	53							

Notes:

1. When it is required that a sub control or equivalent station, respond to both of two group selection codes, assign it a code designation appearing at the intersection of one group column and the other group line. Thus, if the station is required to respond to Group F and Group N codes, it should be assigned code designation 29.

2. When it is required that no station respond to more than one group code, assign code designations as listed by groups in Columns A to H, including Codes 48 to 53 of Group J. Omit Groups K to R, and Codes 1, 4, 8, 12, 18, 25 and 33 of Group J.

3. Refer to Table C for group selection code signals.

TABLE G

Five-Digit and Equivalent Individual Station Codes for Use When All Calling Stations Are Equipped With Push Button Calling Circuits, And a Suitable Source of Test Signals Is Available (Note 2)

Code Designation	Individual Station Codes 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Position	Groups
1	(16)22	(16)24	(16)26	(16)28	2,4	A,C
2	(15)32	(15)34	(15)36	(15)38	2,5	A,D
3	(14)42	(14)44	(14)46	(14)48	2,6	A,E
4	(13)52	(13)54	(13)56	(13)58	2,7	A,F
5	(12)62	(12)64	(12)66	(12)68	2,8	A,G
6	(11)72	(11)74	(11)76	(11)78	2,9	A,H
7	(10)82	(10)84	(10)86	(10)88	2,10	A,J
8	992	994	996	998	2,11	A,K
9	8(10)2	8(10)4	8(10)6	8(10)8	2,12	A,L
10	7(11)2	7(11)4	7(11)6	7(11)8	2,13	A,M
11	(15)23	(15)25	(15)27	(15)29	3,5	B,D
12	(14)33	(14)35	(14)37	(14)39	3,6	B,E
13	(13)43	(13)45	(13)47	(13)49	3,7	B,F
14	(12)53	(12)55	(12)57	(12)59	3,8	B,G
15	(11)63	(11)65	(11)67	(11)69	3,9	B,H
16	(10)73	(10)75	(10)77	(10)79	3,10	B,J
17	983	985	987	989	3,11	B,K
18	893	895	897	899	3,12	B,L

TABLE G(CONT'D)

Code Designation	Individual Station Codes 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Position	Groups
19	7(10)3	7(10)5	7(10)7	7(10)9	3,13	B,M
20	(14)24	(14)26	(14)28	(14)2(10)	4,6	C,E
21	(13)34	(13)36	(13)38	(13)3(10)	4,7	C,F
22	(12)44	(12)46	(12)48	(12)4(10)	4,8	C,G
23	(11)54	(11)56	(11)58	(11)5(10)	4,9	C,H
24	(10)64	(10)66	(10)68	(10)6(10)	4,10	C,J
25	974	976	978	97(10)	4,11	C,K
26	884	886	888	88(10)	4,12	C,L
27	794	796	798	79(10)	4,13	C,M
28	(13)25	(13)27	(13)29	(13)2(11)	5,7	D,F
29	(12)35	(12)37	(12)39	(12)3(11)	5,8	D,G
30	(11)45	(11)47	(11)49	(11)4(11)	5,9	D,H
31	(10)55	(10)57	(10)59	(10)5(11)	5,10	D,J
32	965	967	969	96(11)	5,11	D,K
33	875	877	879	87(11)	5,12	D,L
34	785	787	789	78(11)	5,13	D,M
35	(12)26	(12)28	(12)2(10)	(12)2(12)	6,8	E,G
36	(11)36	(11)38	(11)3(10)	(11)3(12)	6,9	E,H
37	(10)46	(10)48	(10)4(10)	(10)4(12)	6,10	E,J
38	956	958	95(10)	95(12)	6,11	E,K
39	866	868	86(10)	86(12)	6,12	E,L

TABLE G (CONT'D)

Code Designation	Individual Station Codes 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Position	Groups
40	776	778	77(10)	77(12)	6,13	E,M
41	(11)27	(11)29	(11)2(11)	(11)2(13)	7,9	F,H
42	(10)37	(10)39	(10)3(11)	(10)3(13)	7,10	F,J
43	947	949	94(11)	94(13)	7,11	F,K
44	857	859	85(11)	85(13)	7,12	F,L
45	767	769	76(11)	76(13)	7,13	F,M
46	(10)28	(10)2(10)	(10)2(12)	(10)2(14)	8,10	G,J
47	938	93(10)	93(12)	93(14)	8,11	G,K
48	848	84(10)	84(12)	84(14)	8,12	G,L
49	758	75(10)	75(12)	75(14)	8,13	G,M
50	929	92(11)	92(13)	92(15)	9,11	H,K
51	839	83(11)	83(13)	83(15)	9,12	H,L
52	749	74(11)	74(13)	74(15)	9,13	H,M
53	82(10)	82(12)	82(14)	82(16)	10,12	J,L
54	73(10)	73(12)	73(14)	73(16)	10,13	J,M
55	72(11)	72(13)	72(15)	72(17)	11,13	K,M
56	6(12)2	6(12)4	6(12)6		2,14	A,N
57	5(13)2	5(13)4	5(13)6		2,15	A,P
58	6(11)3	6(11)5	6(11)7		3,14	B,N
59	5(12)3	5(12)5	5(12)7		3,15	B,P
60	6(10)4	6(10)6	6(10)8		4,14	C,N
61	5(11)4	5(11)6	5(11)8		4,15	C,P

TABLE G (CONT'D)

Code Designation	Individual Station Codes 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Position	Groups
62	695	697	699		5,14	D,N
63	5(10)5	5(10)7	5(10)9		5,15	D,P
64	686	688	68(10)		6,14	E,N
65	596	598	59(10)		6,15	E,P
66	677	679	67(11)		7,14	F,N
67	587	589	58(11)		7,15	F,P
68	668	66(10)	66(12)		8,14	G,N
69	578	57(10)	57(12)		8,15	G,P
70	659	65(11)	65(13)		9,14	H,N
71	569	56(11)	56(13)		9,15	H,P
72	64(10)	64(12)	64(14)		10,14	J,N
73	55(10)	55(12)	55(14)		10,15	J,P
74	63(11)	63(13)	63(15)		11,14	K,N
75	54(11)	54(13)	54(15)		11,15	K,P
76	62(12)	62(14)	62(16)		12,14	L,N
77	53(12)	53(14)	53(16)		12,15	L,P
78	52(13)	52(15)	52(17)		13,15	M,P
79	4(14)2	4(14)4			2,16	A,Q
80	3(15)2	3(15)4			2,17	A,R
81	4(13)3	4(13)5			3,16	B,Q
82	3(14)3	3(14)5			3,17	B,R

TABLE G (CONT'D)

Code Designation	Individual Station Codes 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Position	Groups
83	4(12)4	4(12)6			4,16	C,Q
84	3(13)4	3(13)6			4,17	C,R
85	4(11)5	4(11)7			5,16	D,Q
86	3(12)5	3(12)7			5,17	D,R
87	4(10)6	4(10)8			6,16	E,Q
88	3(11)6	3(11)8			6,17	E,R
89	497	499			7,16	F,Q
90	3(10)7	3(10)9			7,17	F,R
91	488	48(10)			8,16	G,Q
92	398	39(10)			8,17	G,R
93	479	47(11)			9,16	H,Q
94	389	38(11)			9,17	H,R
95	46(10)	46(12)			10,16	J,Q
96	37(10)	37(12)			10,17	J,R
97	45(11)	45(13)			11,16	K,Q
98	36(11)	36(13)			11,17	K,R
99	44(12)	44(14)			12,16	L,Q
100	35(12)	35(14)			12,17	L,R
101	43(13)	43(15)			13,16	M,Q
102	34(13)	34(15)			13,17	M,R
103	42(14)	42(16)			14,16	N,Q
104	33(14)	33(16)			14,17	N,R

TABLE G (CONT'D)

Code Designation	Individual Station Codes 1st Function	2nd Function	3rd Function	4th Function	Movable Pin Position	Groups
105	32(15)	32(17)			15,17	P,R
Master	(20)	(22)	(24)	(26)		

Notes: 1. Only selecting groups of impulses are shown, the first and last digits "one of a dial code being produced automatically by the Push Button Calling Circuit.

2. The dial test set is inadequate for testing many of these code signals. A source of code signals, such as the Push Button Calling Circuit, must be available in a nearby testroom if these codes are assigned.

3. The numbers ten to seventeen are shown in parenthesis to indicate that the number refers to a single group of consecutive impulses. Digits not in parenthesis each represent a group of impulses. The Code 32(15) should be read: three, two, fifteen.

TABLE H

Group Selection of Code Designations Listed on Table G, When All Calling Stations are Equipped With Push Button Calling Circuits, And Suitable Test Signals Can Be Provided

Groups	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
Omit Code Designations On Line When Adding Group Per Note 2																
C	1															
D	2	11														
E	3	12	20													
F	4	13	21	28												
G	5	14	22	29	35											
H	6	15	23	30	36	41										
J	7	16	24	31	37	42	46									
K	8	17	25	32	38	43	47	50								
L	9	18	26	33	39	44	48	51	53							
M	10	19	27	34	40	45	49	52	54	55						
N	56	58	60	62	64	66	68	70	72	74	76					
P	57	59	61	63	65	67	69	71	73	75	77	78				
Q	79	81	83	85	87	89	91	93	95	97	99	101	103			
R	80	82	84	86	88	90	92	94	96	98	100	102	104	105		

TABLE H (CONT'D)

Code Designations Rejected per Note 2 Because of Previous Assignment of Group	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
	The Following Code designations Form Part of the Groups Above, But are Rejected When Groups Are Added Per Note 2															
A			1	2	3	4	5	6	7	8	9	10	56	57	79	80
B				11	12	13	14	15	16	17	18	19	58	59	81	82
C					20	21	22	23	24	25	26	27	60	61	83	84
D						28	29	30	31	32	33	34	62	63	85	86
E							35	36	37	38	39	40	64	65	87	88
F								41	42	43	44	45	66	67	89	90
G									46	47	48	49	68	69	91	92
H										50	51	52	70	71	93	94
J											53	54	72	73	95	96
K												55	74	75	97	98
L													76	77	99	100
M														78	101	102
N															103	104
P																105

Notes: 1. If a sub control or equivalent station is required to respond to both of two group selection codes, it should be assigned the code designation, from the lower half of Table H, which appears on the line corresponding to one of the groups and in the column corresponding to the other group. Thus, if a station is required to respond to both Group F and Group N codes, follow Line F to Column N, and find the code designation 66 which responds to both group selection codes. See Note 4.

TABLE H (CONT'D)

Notes: 2. If each station is required to respond to only one of two or more assigned group selection codes, the groups should be assigned in order starting with Group and Column A in the upper half of Table H. If only two groups are required, as many of the fourteen code designations of Column A as are required may be assigned to the stations of Group A, while thirteen code designations are available for Group B stations. If Group C is also required, the code designation 1, appearing on Line C, must not be assigned to either Group A or Group C stations. If a fourth Group, D, is required, code designations 2 and 11 are also not assigned. Thus, as each additional group is assigned, the number of code designations available for assignment in all but the immediately preceding group is reduced by one. See Note 5.

3. Refer to Table C for group selection code signals.

4. Example showing two sub control stations per Note 1.

Station	Control	1st	2nd	3rd	4th	5th	6th	7th Sub Control	8th	9th	10th	11th	12th	13th Sub Control	14th
Code Desig.	28	29	30	31	4	5	6	1	21	22	23	13	14	12	35
Station Code	(13)25	(12)35	(11)45	(10)55	(13)52	(12)62	(11)72	(16)22	(13)34	(12)44	(11)54	(13)43	(12)53	(14)33	(17)26
Group	D	D	D	D	A	A	A	A and C	C	C	C	B	B	B and E	E
Group Code	(15)5	(15)5	(15)5	(15)5	(18)2	(18)2	(18)2	(18)2 or (16)4	(16)4	(16)4	(16)4	(17)3	(17)3	(17)3 or (14)6	(14)6

TABLE H (CONT'D)

Notes: 5. Example showing five group selection assignments per Note 2.

Station	Control	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
Code Desig.	4	13	14	21	15	5	28	16	35	22	6	29	23	36	17 17
Station Code	(13)52	(13)43	(12)53	(13)34	(11)63	(12)62	(13)25	(10)73	(12)26	(12)44	(11)72	(12)35	(11)54	(11)36	983
Group	A	B	B	C	B	A	D	B	E	C	A	D	C	E	B
Group Code	(18)2	(17)3	(17)3	(16)4	(17)3	(18)2	(15)5	(17)3	(14)6	(16)4	(18)2	(15)5	(16)4	(14)6	(17)3

6. If the main control stations or other station's receiving equipments are not included in a group, they should be given code designations 105, 104, 103, 102 101, 78, etc., in order to minimize interference with group assignments

8 TESTING FEATURES OF THE PULSE GENERATOR UNIT

8.01 The pulse generator and code relay unit of the Push Button Calling Circuit per Fig. 1A of Drawing WA11447-SD, has certain built-in testing features. These include non-locking LV and TST Keys, and locking PLS and ID Keys.

(a) The LV Key furnishes battery and ground supplies, and a current limiting LV resistor used in making low voltage tests on the 209B selector.

(b) The TST Key furnishes ground to operate the ST relay when prior operation of a code relay is not desired in making tests.

(c) The ID Key transfers the battery sources, normally used in operating a code relay, to the winding of the ST relay so that the ST relay may be operated and released when code relay operation is not desired in making tests.

(d) The PLS Key is operated when digit pulse length is to be adjusted by observing the characters selected by a teletypewriter. Contacts 2 and 3 prevent blinding of the station teletypewriter during the test code transmission. Contacts 5 and 6 complete an operating path from Terminal 22 of Row 1 of the bank to the L relay winding to hold the L relay operated during the period that the selector is in its starting position on Step 22. This prevents the spacing out on pulse from being transmitted to the line and teletypewriter. Contacts 7 and 8 prepare an operating path for the ID relay which is completed when the selector reaches Step 21. As the L relay is operated on all odd numbered steps, including 21, the equivalent of a last interdigit pulse is a continuation of a closed condition on the line. The test signal is a series of 20 impulses, including 10 spacing digit pulses, with no cut on or last interdigit pulse.

8.02 Availability of a pen type recorder employing a calibrated paper tape is highly desirable in adjusting digit pulse length and in observing the generated signal for irregularities resulting from trouble in the unit. If the recorder is remotely located with respect to the calling circuit, suitable facilities for signal transmission and voice communication are needed. A station teletypewriter may be substituted for the recorder in adjusting the digit pulse length.

9. INSTALLATION

9.01 General

(a) The installation requirements of B.S.P. Section P65.902, Paragraph 8.01, (a), (c), and (e) apply to the Push Button Calling Circuit.

(b) See Part 2, EQUIPMENT, for mounting arrangements.

(c) Before connecting power to the pulse generator and code relay unit, verify, add, or remove X or Y strapping, and W strapping if specified in the order. Also, verify by a continuity test that the correct option, G or H wiring, has been furnished in the Interconnecting Cable (Sheet 5 of Drawing WA11447-SD, Fig. 52C) as use of the wrong option may place a direct short between battery and ground. Optional strapping of the Key and Lamp Cabinet should be provided or verified. All connecting wiring should be completed and verified before power is connected to the unit.

9.02 CAUTION: Fig. E of Drawing WA11447-SD, Sheet 4; and "ZX" wiring of Fig. 1A, WA11447-SD, Sheet 6, may be used only if the power source is fused at 20 amperes or less, as in the case of manual tape relay system applications. While permitted by the National Electrical Code, its use with the Push Button Calling Circuit is considered undesirable. It has been included in the drawing as a temporary means of fusing the relay load of the calling circuit

in manual tape relay system applications where spare distributing fuses have not been furnished at the fuse panel, and where necessary distributing fuses cannot be provided in time to avoid delay or interruption of service. In all such cases, either on new or existing installations, arrangements should be made to fuse the power lead per Fig. D of WA11447-SD, Sheet 4, remove "ZX" wiring, and add "ZW" wiring, at the earliest possible date.

10. EQUIPMENT TROUBLE AND ROUTINE MAINTENANCE PROCEDURE

10.01 Follow instructions of Section P65.902, Paragraphs 9.01 to 9.05.

11. ADJUSTMENTS, TESTS AND INSPECTIONS

11.01 General. Before making any adjustments on the pulse generator, verify that the power supply voltage is not fluctuating excessively and adjust the voltage, if necessary, to secure a value within plus or minus two volts of the nominal value.

11.02 Low Voltage Test of 209B Selector. Low voltage tests of the 209B selector as specified in B.S.P. Section B468.002 are performed by momentarily depressing the LV Key of the pulse generator. Before making such tests, the P electron tube must be removed from its socket to prevent it from taking control of the selector when the brush arms advance to Step 1. The operated LV Key furnishes ground and battery through the LV and HV resistors to the selector magnet winding to energize it. The current limiting effect of the LV resistor results in a voltage about five volts less than normal being applied across the magnet winding. The selector should step satisfactorily with this lower voltage. Replace the P electron tube in its socket when the low voltage test is completed.

11.03 Test for Smoothness and Regularity of Selector Stepping. Operation of the ID Key, followed by momentarily depressing the TST Key causes the pulse generator to originate a 26 impulse master code. The Push Button Calling Circuit should be

disconnected from its associated line during this test. Operation of the ID Key transfers to the ST relay winding those battery sources normally applied to the code relay winding as described in Paragraphs 5.05 and 5.13. Momentarily depressing the TST Key applies operating ground to the ST relay, which locks up and performs all functions described in Paragraph 5.06. As no code relay is operated to introduce interdigit pulses, the selector advances to Step 26 at which point a brush arm applies ground to Terminal 26 of Row 5 of the bank to operate the ID Relay and introduce the last interdigit pulse. Subsequent operation of the P relay removes the last battery source from the ST relay, as described for the code relay in Paragraph 5.13. When the F and ID relays release, the selector advances to its stop position on Step 44 (22). The long series of pulses should reveal any irregularily in the stepping of the selector, particularly as it advances from Step 22 to Step 23.

11.04 Digit Pulse Length. The transmission of two consecutive digit pulses of the nominal 100 millisecond length through a 60 speed regenerative repeater will add bias to the pulses so that one pulse will be 88 to 90 milliseconds and the other 110 to 112 milliseconds in length. This is because the regenerative repeater converts the spacing pulse to the equivalent of a teletypewriter Character "O" or "T" signal. This does not adversely affect operation of 64C receiving selectors, and is primarily of interest only in connection with analyzing selector code signals registered by a tape recorder. An 88 millisecond pulse would be adequate on 60 speed services and would also suffer minimum distortion in passing through a 75 speed regenerative repeater, being approximately equal to a teletypewriter Character "T" signal. The reason for retaining the 100 millisecond pulse length in the code generated by the calling circuit is because of the effect of voltage variations on its pulses. A 10 per cent increase from the nominal value of

All spacing pulses should be of the same length. Unless a regenerative repeater is present between the pulse generator and the recorder, all marking pulses should be of the same length. If there is a regenerative repeater between the pulse generator and the recorder, the first marking pulse may be slightly shortened or lengthened, and its length should not be included in the averaging of marking and spacing pulses.

(b) Adjusting Digit Pulse Length Using a Teletypewriter and the PLS, ID and TST Keys of the Pulse Generator. Before making this test the associated line should be disconnected and a dummy or spare line not equipped with 64C receiving selectors should be substituted. This is essential because the generated signal consists of twenty impulses. Any 64C receiving selectors on the line and in a condition to respond to line signals would advance 20 steps on the first test, and would attempt to advance to the equivalent of Step 40 on the second test. This would not only result in false master connect signals on each odd numbered test, but might damage the 60 type selectors on even numbered tests by causing overlapping of coils in the spiral spring. The ID Key is operated prior to the test to furnish battery to the ST relay as described in Paragraph 11.03. Operation of the PLS Key prepares the pulse generator for generating twenty impulses, including ten spacing digit pulses, and removes the blind from the station teletypewriter so that it will respond to the code signals. The open or spacing pulses generated when the selector is on even numbered Steps 2 to 20 are interpreted by the teletypewriter as a start element and a series of teletypewriter code elements. With the teletypewriter on its optimum range setting, momentarily depress the TST Key. The P potentiometer of the pulse generator should be adjusted until the teletypewriter selects a series of ten characters; predominantly the Character "T" but with an occasional "O" with a 60 speed teletypewriter; and predominantly "Blanks" but with an occasional "T" with a 75 speed

teletypewriter. Repeat the test as required until the desired adjustment is secured. It should be noted that the procedure described in Paragraphs 10.04 and 10.05 of Section P65.902 may be readily adapted to use in adjusting the pulse length of the Push Button Calling Circuit, but any added accuracy secured thereby is of no consequence in circuit operation, and the procedure is quite involved. When the correct adjustment has been secured, restore the ID and PLS Keys to their normal position.

(c) Adjusting Digit Pulse Length Using an Ohmmeter. This adjustment should be used only if it is not practicable to connect the pulse generator to a recorder or a teletypewriter as covered in (a) and (b) above. Before making this test, disconnect the power supply from the pulse generator circuit by removing the distributing fuse at the fuse panel, disconnecting or turning off the rectifier, or by other suitable means.

CAUTION: Removing the .25 ampere SloBlo Fuse from the pulse generator panel is not sufficient as this fuse supplies only the selector. With standard adjustments, the relay and selector magnet operate and release times which contribute to the digit pulse length may be assumed to be about 35 to 40 milliseconds. The balance of 60 to 65 milliseconds is due to the length of time required for the P capacitor to charge to the starter breakdown voltage of the P electron tube. With a nominal 120 volt battery or rectifier supply, and an electron tube having average characteristics each 1000 ohms in the charging path of the P capacitor contributes about one millisecond to the time required to fire the tube. A 100 millisecond digit pulse may generally be obtained by adjusting the P potentiometer until the resistance of the P resistor and potentiometer totals 60,000 ohms. If a nominal 130 volt supply is used, the resistance should total about 66,000 ohms. The accuracy of the pulse length is dependent on average characteristics in the circuit

components, but since no great degree of accuracy is required in the pulse length, and any deviations from average in component characteristics would usually increase the pulse length, the method is satisfactory for use in those cases where the adjustment described in (a) or (b) is not feasible. After the potentiometer adjustment has been made, and the ohmmeter disconnected, reconnect the power supply to the unit.

11.06 Refer to B.S.P. Section B468.002 for maintenance, lubrication, and adjustment of the 209B selector.

11.07 When pen type recorders equipped with a gate circuit, or other device which delays the start of recording, are used in observing signals generated by the calling circuit, appropriate corrections must be applied to the observed length of the cut on pulse.

11.08 After a 276F relay has been placed in its socket, following installation, test, or replacement, the calling circuit should be operated to send two or three codes before being restored to service. This spreads the mercury on the contacts to a normal condition, correcting for any displacement which may have been caused by handling or shipping.