

THE PENNSYLVANIA RAILROAD

SPECIAL INSTRUCTIONS GOVERNING CONSTRUCTION AND MAINTENANCE OF SIGNALS AND INTERLOCKINGS

C. E. 223-B

NOTE. Immediately upon receipt of these Special Instructions, acknowledgment must be made by filling in and sending this blank to your Supervisor Communications and Signals.

Date-----

To:-----
Supervisor Communications & Signals.

Received copy of current Special Instructions Governing Construction and Maintenance of Signals and Interlockings
—C.E. 223-(b)

Name

Title

Location

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GENERAL INSTRUCTIONS

A. Employees, engaged in the construction or maintenance of signals and interlocking apparatus, must familiarize themselves with the current issue of Timetable, Book of Rules, C.E. 223, C.E. 227, S-7-C, and in electrified territory the C.T. 290, including all supplements of the foregoing.

T. & S. Employees, except Helpers, will be examined and record maintained on form M.W. 4 as follows:

C.E. 223 at least once in 2 years.

C.E. 227 at least once in 2 years.

S-7-C at least once in 3 years.

C.T. 290 at least once in 3 years.

Helpers must familiarize themselves with and be examined on the S-7-C and C.T. 290 including supplements.

T. & S. Employees will be examined on the Book of Rules and Timetable Special Instructions at least once in 3 years and record maintained on Form C.T. 1516.

B. Employees are responsible for the inspection, adjustment and proper maintenance of all signal and interlocking apparatus assigned to their care. They must promptly report to their superior any condition requiring his attention.

C. Employees must instruct their subordinates as to the necessity for safety, efficiency and economy, and that all work must be done in accordance with authorized practices.

D. In these instructions, "Supervisor Telegraph and Signals" includes "Assistant Supervisor Telegraph and Signals"; "Inspector Telegraph and Signals" includes "Foreman Telegraph and Signals."

E. Supervisors Telegraph and Signals or Inspectors or Foremen Telegraph and Signals must read over the C.E. 223 with their men to insure that the various provisions are properly understood by all concerned.

F. "Signalman" in these instructions refers to the employe who operates the block or interlocking station, commonly termed "Operator".

G. The Supervisor Telegraph and Signals must keep the supervisory officer of the Signalmen advised of any operating changes at interlocking and block stations.

H. Changes in C.E. 223 or its supplements must not be made to meet special conditions without approval of the Superintendent Telegraph and Signals.

J. Alterations must not be made to any of the apparatus or circuits unless properly authorized.

K. Installation of experimental devices, or trial of unapproved material, must not be made unless specifically authorized.

GENERAL—ALL SYSTEMS

136.1 Plans, where kept. Track layout plan, circuit plan, and where mechanical locking is used, locking sheet and dog chart, shall be kept at each interlocking and circuit plan shall be kept at each controlled point in traffic control systems; circuit plan for each automatic signal shall be available at the headquarters of the employee directly responsible for the maintenance of such signal; copies of all of the foregoing plans, and profile plan, drawn to scale, showing locations of signals, grades and alignment, for the sections of railroad under the jurisdiction of a divisional signal supervisory officer shall be kept at his headquarters; copies of plans pertaining to signal and interlocking facilities under the jurisdiction of general, regional or system signal officers shall be kept at their offices. All plans shall be correct and legible and available for use.

136.2 Grounds. Each circuit, the functioning of which affects safety of train operation, shall be kept free of any ground or combination of grounds which will permit a flow of current equal to or in excess of 75% of the release value of any relay or other electro-magnetic device in the circuit, except circuit which includes any track rail.

136.3 Locking of instrument cases and interlocking machine cabinets. Outdoor signal and instrument cases shall be locked, except signal mechanism housings at interlockings where maintenance forces are continuously on duty. Power interlocking machine cabinets, time releases, and electric locks exposed on interlocking machines shall be locked or sealed.

136.4 Interference with normal functioning of device. The normal functioning of any device shall not be interfered with in testing or otherwise without first taking measures for insuring safety of train operation which depends on normal functioning of such device.

136.6 Hand operated switch equipped with switch circuit controller. Hand-operated switch equipped with switch circuit controller connected to the point, or with facing-point lock and circuit controller, shall be so maintained that when point is open one-fourth inch or more on facing-point switch and three-eighth inch or more on trailing-point switch, track or control circuits will be opened or shunted or both, and, if equipped with facing-point lock with circuit controller, switch cannot be locked. Switch circuit controllers, facing-point locks and switch-and-lock movements and their connections shall be securely fastened in place, and contacts maintained with an opening of not less than one-sixteenth inch when open.

136.7 Circuit controller operated by switch-and-lock movement. Circuit controller operated by switch-and-lock movement shall be maintained so that normally open contacts will remain closed and normally closed contacts will remain open until the switch is locked.

136.8 Operating characteristics of electro-magnetic apparatus. Operating characteristics of electro-magnetic apparatus shall be maintained in accordance with the limits within which such apparatus is designed to operate.

136.11 Adjustment, repair or replacement of apparatus. Any piece of apparatus or any part thereof which fails to perform its intended function shall be promptly adjusted, repaired or replaced.

12 When necessary to remove or disconnect any essential apparatus for replacement, repairs, inspection, testing or cleaning, train or engine movement must not be permitted over the route involved, unless levers and operating units affected are properly secured, or until the apparatus has been restored and the devices are known to be in proper working order.

13 In case of changes in, failure of or damage to signal or interlocking apparatus or highway crossing apparatus, the employe in charge must give the Signalman or Crossing Watchman full information concerning the apparatus affected, and arrange with him for the safe movement of traffic until repairs are completed.

14 Should a failure of switch, signal, or device used in connection therewith be reported, and no cause found, the apparatus must be observed for a sufficient period to insure that it is operating properly. If the condition reported is of such a nature that the safety of operation is affected, precautions must be taken as outlined in Instruction No. 15. Tests and reports must be made under the direction of the Supervisor Telegraph and Signals.

15 In case of train accident, immediate action must be taken as follows:

- (a) Secure all signals, including distant signals, governing movements into that portion of track or tracks, which is or may be occupied or fouled by derailed or damaged equipment, so as to display their most restrictive indications, by disconnecting local controls at each signal, and seal the housings enclosing apparatus which may have been involved in the accident. After tracks have been cleared, signals may be restored to service under the direction of the Supervisor Telegraph and Signals or his representative.

- (b) If signals are found to have given false indication or if switches or other apparatus have not functioned properly, through failure of mechanism or controlling device, defective mechanism or device must be replaced under the direction of the Supervisor Telegraph and Signals, and reserved under seal, without change or repairs, until inspected or otherwise directed by the Superintendent Telegraph and Signals, or his representative. If the trouble is due to defective wiring or defective wires, they must not be removed, but may be disconnected from the terminals, and, after new wires are installed, housing must be sealed and evidence of failure preserved until the Superintendent Telegraph and Signals, or his representative, has had an opportunity to make the desired inspection or test.
- (c) If the proper sealing iron, and seals are not immediately available to place the apparatus under seal, a competent person must be assigned to see that the apparatus, wiring or wires are not tampered with until seals are applied.
- (d) Record of action taken must be made on Form C.E. 204.

16 Regular inspection of protective features provided at sidings where inflammable liquids are loaded or unloaded must be made to insure that they are properly maintained to function as intended.

17 Whenever electrical storms occur, Maintainer Telegraph and Signals must immediately, if on duty, or as soon as possible after coming on duty, check ground meter readings, and, on extended sections, make a general survey of his territory by telephone, to Signalmen or other employes, to determine general condition of interlockings or section. In case of severe storm, inspection shall be made as soon as practicable. Corrective action must be taken as necessary.

18 If track is found unsafe, due to broken rail, wide gauge, obstruction, or other conditions, signals (wayside and cab) governing over it must be secured to display their most restrictive indication, and immediate action taken to protect trains, notifying proper authorities. After corrective action has been taken, signals may be restored to normal operation.

19 When snow-melting oil or any other heating device for melting snow and ice in switches is in operation, maintainer must be alert and if any

evidence of damage to apparatus, wireways, wires, insulation at switches, etc. appears, immediate action must be taken to prevent any irregular operation of switches and signals that may result.

20 Doors of housings, containing signal and interlocking devices, must be kept tight when closed to prevent water from entering; all unused openings must be filled to prevent the entrance of rodents or insects. Ventilators must be kept in good condition and clean to allow free circulation of air.

21 Extreme care must be used when drilling, filing or chipping metal parts in or near spring combination or other exposed electrical connections, and suitable safeguards provided to prevent particles lodging in apparatus and producing an unsafe condition. Care must also be used to prevent tools or other metal articles coming in contact with adjacent electrical connections. Broom straw or other non-conducting material must be used for the purpose of tracing or locating contacts in spring combination or other electrical apparatus.

22 Interlocking or control machine, switch movements, and other appurtenances, shall be kept in good condition, free from excessive lost motion, rust, grease and dirt. Levers and locking shall be kept clean. All bearing parts shall be kept lubricated but excessive lubrication should be avoided. Bolts and dowel pins shall be kept tight, cotters properly spread, and sufficient tension in latch springs. Contacts shall be kept clean and properly adjusted. Lubricants used shall be in accordance with C.E. 240.

23 When a slide protection fence is actuated, before signals protecting the movements are restored to normal operation, the tracks throughout the entire length of the fence must be patrolled.

24 Placing any object in instrument cases or on interlocking machines, which is not an essential part of signal or interlocking equipment, is prohibited.

25 Pipe casing through which pipes are run must be free from water and kept filled with non-freezing oil, per C.E. 240. Stuffing boxes must be properly adjusted.

26 Cranks, compensators, and other mechanical connections shall work freely, but shall not have excessive lost motion in moving parts. They shall be kept clean, properly centered, lubricated and in alinement.

27 Maintenance of apparatus not specifically covered in these instructions shall be in accordance with instructions issued for such apparatus. When not so covered, the manufacturer's instructions shall be followed.

SIGNALS

136.22 Semaphore signal arm, clearance to other objects. At least one-half inch clearance shall be provided between semaphore signal arm, and any object that may interfere with its operation.

136.26 Buffing device, maintenance. Buffing device shall be maintained so as not to cause the signal to display a less restrictive aspect than intended.

136.27 Phantom signal aspect. Measures shall be taken to prevent recurrence of a phantom signal aspect.

28 Signals must not be operated by hand for the movement of trains. When necessary to operate signals by hand for tests, inspections or repairs, permission must be obtained from the Superintendent.

29 Signal blade, lens, roundels, glass, and lamp shall be cleaned as often as necessary to insure good indications. Cracked or broken roundel or lens shall be replaced.

30 Ladder, hand railing, and platform shall be kept in good condition and securely fastened.

31 Proper lamp bulbs must be used in all electric signal units.

32 Semaphore spectacle casting shall rest against the stop provided for that purpose, allowing slot arms and vertical connections to be free from downward pressure when in the most restrictive position.

33 Bearings shall be lubricated and kept free from grit and dirt.

34 Mechanism shall be kept in proper adjustment. Excessively worn or defective parts shall be replaced.

35 On signal employing a toggle arrangement, the slot toggle adjustment shall not be changed from its original setting. If the adjustment of toggle changes due to wear, toggle or slot arm shall be replaced.

36 Slot armature side play measured at lower end of armature, shall not exceed one-eighth ($\frac{1}{8}$) inch.

37 Tooth disk on motor armature or pawl in retaining mechanism which has become worn or burred shall be replaced.

38 Action shall be taken when necessary to prevent phantom indications from reflected external sources.

39 Deflecting prisms shall be assembled and maintained to spread the light in the proper direction.

40 Frequent inspection should be made to avoid materials, snow, etc., interfering with view of dwarf signals. Tree limbs and foliage obstructing view of high signals should be kept properly trimmed.

TRACK CIRCUITS

136.51 Track circuit requirements. Track relay shall be in deenergized position whenever any of the following conditions exist, and the track circuit of an automatic train-stop, train-control, or cab-signal system shall be deenergized in the rear of the point where any of the following conditions exist:

(a) When a rail is broken or a rail or switch-frog is removed except when a rail is broken or removed in the shunt fouling circuit of a turnout or crossover, provided, however, that shunt fouling circuit may not be used in a turnout through which permissible speed is greater than 45 miles per hour. It shall not be a violation of this requirement if a track circuit is energized when a break occurs within the limits of the joint bars or rail-joint bond, or as a result of leakage current or foreign current in the rear of a point where a break occurs or a rail is removed.

(b) When a train, locomotive, or car occupies any part of a track circuit, including fouling section of turnout, except turnouts of a hand-operated main track crossover. It shall not be a violation of this requirement where the presence of sand, rust, dirt, grease or other foreign matter on the rail prevents effective shunting.

- (c) Where switch shunting circuit is used:
1. Switch points are not closed in normal position.
 2. A switch is not locked where facing point lock with circuit controller is used.
 3. An independently operated fouling point derail equipped with switch circuit controller is not in derailing position.

136.56 Shunting sensitivity. Track circuit shall be so maintained that track relay will be in deenergized position if, when track circuit is dry, a shunt of 0.06 ohm resistance is connected across the track rails of the circuit, including fouling sections of turnouts.

136.57 Shunt wires. Shunt wires and fouling wires, except shunt wires to switch circuit controller through which signal control circuits are controlled and track circuits are shunted, shall consist of at least two conductors and each shall be of sufficient conductivity and maintained in such condition that the track relay will be in deenergized position when the circuit is shunted.

136.59 Insulating rail joints. Insulating rail joints shall be maintained in condition to prevent sufficient track circuit current from flowing between the rails separated by the insulation to cause a failure of any track circuit involved.

60 When the head of the rail in track circuit territory is covered with rust, sand, coal, or any other material which may interfere with the proper shunting of the track circuit, and which cannot be immediately cleared, the Maintainer Telegraph and Signals must notify the Signalman, in writing, that such track circuits cannot be depended upon for the locking of specified switches, and that lever lights on levers involved must not be accepted as indicating that these track sections are clear.

Such levers must be secured by lever blocking devices at all times, except during lever operation, and a "Rusty Rail" sign must be attached. Blocking devices must not be removed nor levers operated until it is known that train or engine movements are clear of the switches.

61 When rails, switch points, or frogs are removed, the Signal forces must secure all signals governing over them, so that they will display their most restrictive indications, and flag protection must be provided. Except for minor replacements (one or two rails, frog or switch point) the regular working order must not be restored until it is known that the track is safe and that rust does not prevent shunting of track circuits. This requirement will be met if the Maintainer Telegraph and Signals, after track is ready for service and after assuring himself that block is clear, connects up the track relay and carefully observes its performance on the passage of trains and when trains are running through the block. The control wire for the relay should be held on the relay binding post so that circuit can be quickly opened on the passage of train should rust prevent the relay from operating properly. The relay must be observed a sufficient number of times to positively insure that it opens properly and remains open while the train is passing through the block.

62 The voltage or current of track relays must not exceed the maximum specified in C.S.E. 32. (When reissued, C.E. 232.) A check must be made when tracks are raised or cleaned.

63 In electric traction territory the paths for the return of the traction current must be opened only as authorized by proper authority. All paths must never be opened at the same time. When making renewals or repairs, a return circuit for traction current must always be maintained.

64 (a) When cars are stored on a track protected by automatic block signals, the Signalman handling the movement must notify the Maintainer Telegraph and Signals, advising him of the limits of track on which traffic will be suspended as a result of the stored cars. The Maintainer Telegraph and Signals must disconnect the track relays and

track feeds within these limits as promptly as possible and also the control circuits of all high and restricted speed signals within the limits specified. In Cab Signal territory he must also disconnect the code transmitter control wire from the code control relay for each track circuit occupied.

(b) When the cars have been removed, the Maintainer Telegraph and Signals must assure himself that the relays shunt properly and that the signals function as desired, before restoring normal operation.

65 (a) When cars are stored within the limits of an interlocking or on a siding where switch leading to siding is remotely controlled, the Signalman must, with the Blocking Devices, secure the levers controlling the track units and signals affected, in their proper position, and also the levers of such other units as may be necessary to insure that a signal cannot be given leading to the track or tracks involved. The Maintainer Telegraph and Signals must be notified as promptly as possible and he must disconnect the track relays, feed wires to the track circuits, if used, and also the control wires to all high and restricted speed signals governing to such tracks. The switches involved should be secured in accordance with Instruction 350 of these Instructions, except where use of switch is required for movements other than to the portion of track stored; in which case, Instruction 67 of these Instructions must be complied with.

(b) When cars are being removed, the Signalman must arrange for sufficient movement over the bonded section to insure proper shunting of the circuits. After the Maintainer Telegraph and Signals has assured himself, by careful inspection, that normal conditions have been restored, he must so notify the Signalman, who may then remove the Blocking Devices and make such reports as are required.

66 When stored cars will affect the circuits of highway crossing protection, approach locking, annunciators, etc., the Maintainer Telegraph and Signals must take all necessary precautions to safeguard the highway crossings affected and to insure safe operation. When cars are removed, the Maintainer Telegraph and Signals must restore normal working conditions as promptly as possible, after assuring himself that all the apparatus affected functions properly.

67 When stored cars are being removed from a storage track and the switch at the exit end of this track is interlocked or located near an interlocking, the levers in the route involved must be secured by Blocking Devices until movement is com-

pleted, to avoid improper operation due to false track circuit indication resulting from rusty wheels.

68 Bonding, including track circuit connections, shall be maintained in condition to insure low resistance.

69 Insulating rail joints and switch insulation, including pipe line insulation, shall be maintained in good condition.

70 Pipe line under rail shall clear base of rail, which forms part of track circuit, at least one inch.

WIRES AND CABLES

136.74 Protection of insulated wire; splice in underground wire. Insulated wire shall be protected from mechanical injury. The insulation shall not be punctured for test purposes. Splice in underground wire shall have insulation resistance at least equal to the wire spliced.

136.76 Interference of wires with operating parts of mechanisms. Wires shall not interfere with operating parts of mechanisms.

136.77 Tagging of wires. Each wire shall be tagged or otherwise marked so it can be identified at each terminal. Nomenclature shall correspond to that of the circuit plan. Tags or other marks of identification in instrument cases and apparatus housings shall be made of insulating material and shall not interfere with moving parts of apparatus.

78 Lightning arrester shall be properly connected and ground maintained with resistance to ground preferably not more than 15 ohms.

79 In order to avoid the possibility of damage to insulation, wires must not be crowded or jammed.

80 Wires and cables, without metal sheath, in trunking and other open conduits, must be examined to detect physical damage, semi-annually in territory where trouble due to rodents has been experienced, and annually at other points.

81 Splices in rubber and thermo-plastic insulated conductors must be made in accordance with C.E. 206.

82 All binding posts and wire terminals in place must have their full complement of nuts and washers, which must be kept jammed. Care must be used to avoid undue strain or damage to threads on binding posts, small machine screws and bolts.

83 Wire conduits must be installed and maintained to prevent mechanical injury to the insulated wires and cables and to exclude rodents. Vacant spaces in wire openings of instrument cases, etc., must be packed tightly with approved sealing material. Wire and cable openings through floors, and other wire ways which would act as a flue to spread any fire which might occur, must be sealed with approved asbestos cement.

84 On pole line carrying signal circuits broken insulators shall be replaced.

CIRCUIT CHANGES AND TESTS INCIDENT THERETO

85 Alterations must not be made to any apparatus or circuits without proper authority. Revised plans must be procured from the Superintendent Telegraph and Signals.

86 All changes must be made under direct supervision of a designated competent employe, who is personally responsible for work under Instructions 88, 90, and 92, and must know that the employes making wire changes and connections are thoroughly qualified for and have full understanding of the work assigned them.

The man in charge must be responsible for the necessary local wiring diagrams, on which must be clearly indicated the apparatus wiring, etc., that is in service and that which is to be added. Points at which new circuits tie in with those in service must be plainly marked.

87 At interlockings when wire changes are made that may interfere with the normal operation of the signal and interlocking system, the distant signals must be arranged so that they will not display an indication more favorable than Approach and the switches spiked and wedged for all train movements until the wire changes are completed and checked, unless otherwise authorized by the Superintendent. In cab signal territory the cab signal indication between the home and distant signal must not be more favorable than Approach.

88 Any necessary relocation of apparatus and wiring in service, either permanent or temporary, must be made under the personal direction of the man in charge, and all circuits interfered with in any way must be thoroughly tested immediately after relocation and before circuits are allowed to function for normal operation.

89 New apparatus must be located and new wiring placed and connected to the new apparatus, without disturbing work in service where possible.

90 New wiring through apparatus in service or tying to wiring in service must be handled under the personal direction of the man in charge. All wiring tied in to existing apparatus and circuits must be tested before tying in, to insure no interference with work in service.

91 The man in charge must make necessary notations on wiring diagram to show any new wiring which is connected to working circuits or apparatus, and must clearly mark on his diagrams connections required for final arrangement which cannot be made prior to cut-over without interfering with work in service. Wires which are to be

connected at cut-over must be marked with yellow tags. Wires which are to be removed at cut-over must be marked with red tags. Wires which, for any particular reason, cannot be hooked up without special arrangement, must be marked with green tags. Wires bearing green tags must be connected only by the man in charge or under his specific instructions which shall definitely state that "green tag wires" are to be connected. On completion of changes, all colored tags must be removed.

92 Before final cut-over, all circuits changed must be thoroughly tested as far as possible, and final arrangement must be tested in entirety by a supervisory employe other than the man in charge.

93 When a revision involves additional levers in a machine, such levers must be secured against improper or unintentional operation.

94 The men engaged in making or testing circuit changes must have full understanding with Signaller as to any interference with working units, must obtain permission for necessary use of switches or signals, and must secure switches in accordance with Instruction 351.

The man in charge of changes must cooperate with Maintainer Telegraph and Signals so that the latter may be posted at all times as to the condition of the plant.

All signal testing and circuit changes must be in accordance with the other provisions of C.E. 223 and C.E. 227 in so far as they apply.

95 To provide a check against misunderstanding, when the man in charge directs another to close or open wire connections to wiring or apparatus in service, he must state specifically what is required, using wire number or other definite description, and, when possible, must indicate on the circuit plan or the wiring diagram the connection that is to be closed or opened. If the open circuit is protected by a green tag, the man in charge must so state. The one who is to carry out the instruction must repeat the order exactly as received, must not attach wires protected by green tag unless specifically directed, and after carrying out the order must advise in detail, using wire numbers, etc.

96 When circuits are to be closed only for test, the one assigned to this work should preferably remain at that point until the test is completed and then again open the circuit, reporting to the man in charge the exact conditions. The man in charge must, at the earliest opportunity, and before leaving the work, verify the conditions as reported.

RELAYS AND CIRCUIT CONTROLLERS

201 The inverting of relays or otherwise tilting them in order to close the contacts, or holding or fastening the contacts of indicators closed, is prohibited.

202 The bridging of contacts on relays, indicators or any circuit controlling device, or energizing relays or indicators direct from any source, which will in any way impair the protection of such circuit controlling device, must be done in accordance with the following instructions:

- (a) The use of jumpers for the bridging of contacts is restricted to cases of absolute necessity, as when a switch and signal wire or apparatus is damaged, resulting from a wreck, dragging equipment, or similar occurrence; when A.C. signal power line trouble occurs; when signal power line is being tested; when necessary in connection with tests specified in C.E. 227, and when renewal of track structure cannot be taken care of otherwise and then only to avoid unnecessary delay to trains. Generally, jumpers must not be used in connection with ordinary maintenance.
- (b) When a condition arises, making it necessary to use jumpers, the Supervisors and Assistant Supervisors Telegraph and Signals and the Inspectors Telegraph and Signals in the territory mentioned below, are permitted to authorize the use of jumpers after receiving authority from the Superintendent.

NEW YORK DIVISION

From "Harold" Interlocking to and including "Union" Interlocking, Rahway, N. J.

"Jacy" Interlocking, Jersey City, to "Hudson" Interlocking, both inclusive.

PHILADELPHIA TERMINAL DIVISION

"A" Interlocking, Broad St. Station to 30th St. Station.

"Broad" Interlocking, Broad St. Suburban Station, to North Philadelphia Interlocking, both inclusive.

30th St. Station to and including "Overbrook" Interlocking.

30th St. Station to and including "Brill" Interlocking.

PITTSBURGH DIVISION

Terminal area, "PH", "US", "UF"
and "BU" Interlockings.

- (c) When a condition arises in territory other than that designated necessitating the use of jumpers, their use must be authorized by the Supervisor or Assistant Supervisor Telegraph and Signals, after receiving authority from the Superintendent.
- (d) Before jumpers are applied to bridge any contacts or to energize a relay or indicator by power direct, from any source, either within or outside of interlocking limits, the Telegraph and Signal employe authorizing the placing of the jumpers must obtain the approval of the Superintendent. Whenever authority is given by the Superintendent for the application of jumpers, the Train Dispatcher or Train Director must make notation on the train sheet and the Signalman on the block sheet, and a blocking device placed on each interlocking switch and signal lever affected. Before jumpers are placed in territory outside of interlocking limits, the Signalman on each side of the location affected by the use of jumpers must, in addition to the Train Dispatcher or Train Director, have full knowledge that jumpers are to be applied and notations on the block sheet of their application must be made. When jumpers are used, either within or outside of interlocking limits, the Signalman must make a message memorandum of the condition, explaining it to the Leverman, and post the memorandum in a conspicuous place. If going off duty while the abnormal condition exists, he must bring it to the attention of the Signalman and Leverman who relieve him, fully explaining the condition to them. The memorandum sheet must not be filed until the Telegraph and Signal employe authorized to use jumpers has reported that normal conditions have been restored.
- (e) When a Telegraph and Signal employe is instructed to place jumpers, he must remove jumpers immediately after the emergency ceases, and then he must report to the party giving the authority for the application of the jumpers that they have been removed, advising that normal conditions have been restored.

The employe securing authority from the Superintendent for the application of jumpers must advise the Train Dispatcher or Train Director, and any other interested employe, that the jumpers have been removed and the switch and signal circuits restored to normal condition. Notation must be made by the Train Dispatcher or Train Director on the train sheet, and by the Signaller on the block sheet, of the removal of the jumpers.

- (f) The Telegraph and Signal employe securing authority for the use of jumpers must make sure that they are not used for a longer period than necessary. The Telegraph and Signal employe authorized to apply the jumpers will be held personally responsible for their proper application and removal and must know that the switch and signal circuits have been restored to normal condition.

203 When applying jumpers for testing power line in A.C. automatic signal territory two or more qualified employes must cooperate in their application and all must know that they have been removed.

204 Jumpers must not be less than eight (8) feet in length, of flexible wire not smaller than No. 16 A.W.G. and must not be coiled when applied. When not in use, they must be kept in a designated place and a check made to insure their having been returned each time they have been used, either by actual observation of the jumpers or by observing jumper indication lights where provided.

205 The greatest possible care must be used in applying a jumper to keep to a minimum the amount of protection cut out by its use.

NOTE: The intention of these instructions is twofold; first, to guard against improper use of jumpers; second, to insure their removal, even though precautions have been taken to render conditions entirely safe during their use. These instructions, therefore, apply regardless of whatever else may be done; such as disconnecting circuits, setting signals at "Stop", securing switches and levers, or other precautionary measures.

206 The insertion of insulating material between the contacts of circuit controllers to prevent shunting of track circuit, or the insertion of similar material in other contacts, which would in any way impair any protective feature of any circuit, is prohibited.

207 The seals on relays and other similar

apparatus must in no case be broken except by an authorized person. Relays or similar apparatus removed from service, due to defect, must have a tag (C.E. 246) attached, stating defect, if known, and marked "not fit for service". They must not be used again until a tag (C.E. 245) is attached by Testman, stating "O.K. for service."

208 Where contacts are visible contact openings must be observed frequently and, if found more or less than normal, or otherwise defective, apparatus must be replaced.

209 Switch repeating ("SS" or "WPR") relays must be regularly observed when switches and other apparatus are being operated to see that relay assumes full open position and note operation of neutral and polar contacts when relay is in both normal and reverse position.

210 The following relays must operate as indicated for the normal position—where signals are controlled, the normal position must control the "clear" position of the signal.

(a) Model 15 Vane Relay—Vane must be up
(b) Style TV-30 Relays—Vane must rotate counterclockwise.

(c) D.C. Polar Relay:

1. With polar armature operating in a horizontal plane—contacts must rotate counterclockwise, viewed from above.
2. With polar armature operating in a vertical plane—contacts must rotate clockwise, viewed from the front.

211 All circuit controllers must be kept clean and properly adjusted, and the original sets or bends of contact springs must, as far as possible, be maintained, and any excessive setting or bending which may produce an unsafe condition is prohibited.

212 When work is being done on polarized circuits, only one wire must be off the binding posts at a time, or wires and posts must be clearly marked to avoid any possibility of reversing the circuit.

After wires are restored, circuit must be checked immediately to see that all apparatus involved is working properly.

MOVABLE BRIDGES

226 Rail locks must be adjusted so that they cannot be locked with the rails raised one-fourth inch or more from their proper position.

227 Wedge locks must be kept adjusted so that they cannot be locked unless the wedges are within one inch of their proper position.

228 Circuit controllers, operated by surfacing wedges, must be kept so adjusted that the circuit will not be completed unless the wedges are within one inch of their proper position.

229 Bridge repeating ("SS" or "WPR") relays, or equivalent, must be regularly observed with bridge locked and unlocked.

230 Apparatus and circuits must be maintained in accordance with these instructions and any special regulations applicable at the bridge in question. Adjustments must be maintained in accordance with C.E. 227, Test No. 15.

INTERLOCKING, TRAFFIC CONTROL SYSTEMS, AND SWITCHES

136.303 Control circuits for signals, selection through circuit controller operated by switch points or by switch locking mechanism. The control circuit for power-operated or slotted mechanical signal governing movements at higher than restricted speed in the facing direction over switches, movable-point frogs and derails shall be selected through circuit controller operated directly by switch points or by switch locking mechanism, or through relay controlled by such circuit controller, for each facing-point switch, movable-point frog and derail in the routes governed by such signal. Circuits shall be arranged so that such signal can display an aspect to proceed only when each such switch, movable-point frog and derail in the route is in proper position. Such power-operated signals hereafter installed shall be controlled in this manner through circuit controllers or switch repeating relays for all switches, movable-point frogs and derails in the routes governed by such signals.

136.326 Mechanical locking removed or disarranged, requirement for permitting train movements through interlocking. When mechanical locking of interlocking machine is being changed or is removed from the machine, or locking becomes disarranged or broken, unless protection equivalent to mechanical locking is provided by electric locking or electric circuits, train movements through the interlocking shall not be permitted until each switch, movable-point frog or derail in the route is spiked, clamped or blocked in proper position so that it cannot be moved by its controlling lever, and then train movements shall not exceed restricted speed until the interlocking is restored to normal operation. It will not be necessary to comply with this requirement at interlockings where protection is in service in accordance with Instruction 136.303, provided that the signal controls are arranged so that the signals cannot display an aspect the indication of which is less restrictive than "proceed at restricted speed".

136.329 Bolt Lock. Bolt lock shall be so maintained that signal governing movements over switch or derail and displaying an aspect indicating stop cannot be operated to display a less restrictive aspect while derail is in derailing position, or when switch point is open one-half inch or more.

136.330 Locking dog of switch and lock movement. Locking dog of switch-and-lock movement shall extend through lock rod one-half inch or more in either normal or reverse position.

136.331 Repairs to switch and signal valves and cylinders. Repairs to switch and signal valves and cylinders shall not be made while they are in service.

136.332 Air distribution system, draining condensation. Provision shall be made for draining condensation out of air distribution system at low points. Condensers, tanks, reservoirs, and air distribution lines shall be drained frequently enough to avoid overflow of condensation into branch lines and apparatus.

136.333 Pole changer on electric switch operating mechanism. Pole changer on electric switch operating mechanism shall be maintained so that movement of switch mechanism follows movement of controlling lever.

136.334 Point detector. Point detector shall be maintained so that when switch mechanism is locked in normal or reverse position, contacts cannot be opened by manually applying force at the closed switch point. Point detector circuit controller shall be maintained so that the contacts will not assume the position corresponding to switch point closure if the switch point is prevented by an obstruction, from closing to within one-fourth inch where latch-out device is not used, and to within three-eighths inch where latch-out device is used.

136.342 Switch circuit controller. Switch circuit controller connected at the point to switch, derail, or movable-point frog, shall be maintained so that its contacts will not be in position corresponding to switch point closure when switch point is open one-fourth inch or more.

343 Switch, movable-point frog or split-point derail shall be maintained so that it cannot be locked if the switch point is prevented by an obstruction from closing to within one-quarter inch.

344 Switches shall be adjusted and maintained in accordance with Form C.E. 40. When parts of switch layouts, which may affect the adjustment and locking of the switch, are repaired or replaced, or when adjustments are made in connection therewith, obstruction test in accordance with Form C.E. 40 must be made before switch is restored to normal service.

345 Plungers and locking dogs must be full size at locking end. Corners at the ends of plungers and locking dogs, and the edges of openings in lock rods, must be kept sufficiently square to meet the requirements of Form C.E. 40, Report of Switch Inspection and Tests. The small openings in lock rods must not exceed the width of the rectangular locking dog or plunger by more than three-eighths inch.

346 Plungers must have at least 8-inches stroke, and must clear the lock rod when withdrawn not less than one inch nor more than one and one-half inches.

347 Where it is required that switches or derails be mechanically locked in one position only, the lock rod must be arranged with one locking opening.

348 Holes in lock rod shall have square edges and be not more than one-eighth inch larger than round plunger.

349 If units become in any way inoperative or are disconnected, the Signalman must secure the controlling lever or levers by approved Blocking Devices and notify the Maintainer Telegraph and Signals. When necessary to apply Blocking Devices on levers of electro-mechanical machines, they must be applied to both large and small levers.

350 When necessary to disconnect a switch, movable-point frog or derail (hereinafter called switch) from its operating mechanism, or to disconnect No. 1 switch rod, the following, in addition to providing complete protection for trains, must be done:

- (a) The closed point must be held securely against the stock or knuckle rail, by a spike driven in each of the first two ties back of the point, and on 45 ft. switches at the midpoint, and where possible the spikes must pass through the tie plates.
- (b) A standard wooden wedge, plan S-521, must be driven between the open point and the stock or knuckle rail and be secured by, (1) a lag screw or heavy nail through one of the clip bolt holes, or (2) a piece of wood spiked to the first and second ties ahead of the point, or (3) a light flat headed bolt through a hole in the wedge adjacent to the side of the first tie under the point and between this tie and No. 1 or head rod. The bolt must be secured in place by a cotter pin or split key below the bottom of wedge.
- (c) If necessary to disconnect both No. 1 and No. 2 switch rods, train movements must not be made over the switch until one or both rods are properly connected to the switch points and the switch has been secured in accordance with 350 (a) and (b). If the open point is removed, trailing movement may be made after the closed point has been secured in accordance with 350 (a). For facing movements end of lead rail must be moved away from the running rail to provide

at least five inches clearance and be provided with a riser wedge fastened to the tie and movements made at restricted speed.

- (d) If necessary to disconnect the switch rods of a switch in an interlocking, or if switch is in automatic territory, or is connected with a distant switch signal or switch indicator, the work must be done in charge of the Track Foreman in cooperation with the Maintainer Telegraph and Signals.
- (e) If switch is in an interlocking, the following also must be done:
 - 1. The locking dog or plunger must be inserted through lock rod if possible.
 - 2. The controlling lever of an interlocking machine, or the lever in a Traffic Control System Machine, must be placed in the position corresponding to that of the switch. Interlocking levers must be secured by lever blocking devices which must not be removed nor levers operated until instructions to do so are received from the man in charge.
 - 3. The power for power-operated switches must be cut off.
 - 4. At a pneumatic switch a blow-off cock or union must be opened to prevent possible accumulation of pressure through leaky valves.
 - 5. At an electric switch the motor brushes must be removed and the brush holders so secured that they cannot come in contact with the commutator, or, in lieu thereof, the fuse must be removed from the circuit supplying power to the master controller.
 - 6. Power-operated switches must be kept spiked and wedged until the power is again turned on so that an accidental change in the position of the valves or controlling apparatus or connections cannot cause the switch to go to the wrong position.
- (f) When necessary to disconnect switch, derail, or other unit, it should be done at the crank nearest the unit.

351 When necessary to disconnect locks, circuits, or other safeguards in an interlocking, except mechanical locking (See Instruction 136.326), all switches affected must be safely secured before any train or engine is permitted to pass over them, as follows:

- (a) The closed point must be held against the stock or knuckle rail by a spike in the head tie, and on 45 ft. switches, at the mid-point; where possible, the spike must pass through the tie plate.
- (b) A standard wooden wedge, plan S-521, must be driven between the open point and the stock or knuckle rail.
- (c) Special Instructions 350 (e) must be followed.
- (d) No movements are to be made over switches affected without the consent of the man in charge, and he must, upon completion of repairs, test levers by manipulation before surrendering jurisdiction over the machine.
- (e) The Inspector Telegraph and Signals, Maintainer Telegraph and Signals, or other Telegraph and Signal Department employe in charge will be held solely responsible for carrying out the above instructions.

352 Should any of the apparatus referred to in Instructions 350 and 351 fail to function properly, Signalman shall restore any power operated switch lever, which, after several trials, has failed to go to the desired position, as far as possible toward the original position where it shall remain until instructions are received from the Maintainer Telegraph and Signals. If no Maintainer is available, Signalman shall notify the Superintendent and be governed by local Divisional instructions. If, on electric switches the ammeter indicates excessively heavy current the lever shall be placed and left in the center position, except at electric interlockings where master controllers are used.

Unless the failure is very clearly of such a nature that repairs can be made by the Maintainer in less time than necessary to secure the switches in accordance with Instructions 351 (a), (b), and (c), the units involved must be secured in accordance with these instructions, except that where, due to excessive distance from the switch to the control point, it is impracticable to get the lever to correspond with the position of the switch, the lever must be put as far as possible toward the desired position and lever blocking devices applied.

After securing the switch, or switches, the routes affected must be patrolled through the group of switches adjacent thereto to ascertain that the route is properly set, each switch is secured and in safe condition for train movement and that there are no conflicting routes.

353 When, due to failure, switches have been secured, movements over routes must be made at Restricted Speed (until Maintainer or higher authority has investigated conditions and authorized

normal speed) as follows:

- (a) Where mechanically operated signals are in service—by clearance card (Form C).
- (b) Where power operated signals are in service—by a signal not more favorable than Restricting (Rule 290) which will necessitate opening the control of the track indicating relay where high or restricted speed routes are involved.

354 Electric locks on conventional type interlocking machine, lock (KM) relays on relay interlockings, including Traffic Control Systems, must not be released by hand, except in cases of emergency, or when necessary on account of repairs, and then only upon authority from the Superintendent or Supervisor Telegraph and Signals. Whenever an electric lock or lock (KM) relay is released by hand, notation must be made by the Train Dispatcher on the Train Sheet and by the Signaller on the Block Sheet. The Maintainer Telegraph and Signals must make a detailed report on Form C.E. 204. After authority has been received to release an electric lock or lock (KM) relay by hand, the following precautions must be taken:

Signal Indication Locks or Relays

- (a) If a signal lever cannot be restored to its normal position on account of the signal indication lock or relay holding, the lock or relay must not be released until the Maintainer Telegraph and Signals or Signaller knows that all signals directly controlled by the lever are in "Stop" position and all signals governing the approach to these signals are in their normal or a more restrictive position, except where the following precautions are taken:
 1. If the Maintainer Telegraph and Signals or Signaller knows that the home signals controlling the affected lock or relay are in the "Stop" position, an arrangement may be made by the Superintendent to notify all trains governed by the distant signal controlling the lock or relay affected that the signals are out of order, and to proceed as though the most restrictive indications were displayed, until examination has been made. Lock or relay may then be released.
 2. Examination must be made as soon as possible to determine whether the lock or relay failed to release on account of signal failing at more favorable than its normal position or because of a defect in the indication circuit.

Switch Indication Locks or Relays

- (b) Switch indication locks or relays may be released by hand after the switches have been properly secured and checked as prescribed by Instructions 350, 351 and 352.

Switch Lever Locks

(Detector Locks or Switch Locking Relays)

- (c) Electric switch lever locks (detector locks or switch locking relays on relay interlockings, including Traffic Control Systems) may be released by hand after being certain that there is no train or engine on or approaching the switches controlled by the levers affected. Signal more favorable than Restricting (Rule 290) must not be displayed after the locks or relays have been released until the track has been inspected, unless the switch lever light indicators show that the track is clear.

Traffic Lever Locks or Traffic Relays

- (d) Traffic lever locks or traffic relays may be released by hand after arrangements have been made with the Superintendent to safeguard the movement of trains in the territory affected.

Electric Locks on Hand Operated Switches

- (e) Electric locks on hand operated switches may be released by hand after permission is procured from the Superintendent.

355 Machine parts, connections and devices affecting the operation of mechanical locking must be renewed as frequently as necessary to insure reliable operation.

356 Quick switches must not be operated by hand for the purpose of permitting lever to be restored to previous position in the event of failure.

357 Quick switches must be regularly inspected for proper clearance and so maintained as to insure that the toggle springs are intact and have proper tension, and that there is no binding to prevent free operation.

358 Quick switches must operate after the lever is moved beyond the indicating point and before it reaches a point $\frac{3}{16}$ " from full normal or reverse position, measured by inserting a $\frac{3}{16}$ " gauge between lever and quadrant stop.

359 The spring combination on electro-pneumatic and similar machines and the adjustment of contact springs and bands with relation to indica-

tion and electric locking must be carefully maintained as follows:

- (a) Only contact springs with a sharp (V-shape) bend instead of a gradual curve at contact point must be used, and the main stem of the spring must be straight so that any accidental bending during cleaning, or otherwise, will draw back rather than push forward the point of contact. All springs must be secured to the insulating bed plates by bolts that pass through the bed plate, and not more than two wires are to be connected to the same spring combination terminal post.
- (b) Contact bands and springs must be cleaned periodically by wiping thoroughly with a clean dry cloth free from lint. Approved commercial cleaning cloths or chamois, moistened with oil, must be used as necessary to maintain clean contacts. Oil must be used very sparingly at relatively long intervals on the roller shaft bearings and must never be used on the bevel gears.
- (c) Contact and roller surfaces which inadvertently become covered with an oil film must be cleaned by wiping with a clean cloth free from lint, to which a small amount of cleaning fluid, such as carbontetrachloride or benzol, has been added. These surfaces must then be rubbed carefully with a clean dry cloth, free from lint, to remove all traces of the cleaner and any remaining residue.
- (d) Contact part of springs must meet the contact bands evenly and squarely in order to provide maximum contact. They must have sufficient pressure to provide good contact, but not enough to interfere with proper operation, especially of the quick switch. Checks must be made at least annually to insure that all springs are closed or opened at the proper point in the lever movement.
- (e) On levers with 60 degree roller travel, the normal and reverse switch control bands and NX and RY bands, for the control of switch repeating relays, must be on enlarged roller sections.
- (f) Check the adjustment of each segment with the lever position, as determined by the quadrant, and adjust the segment, if necessary, so that with the lever at the indication, or locking point, on the quadrant, the locking tooth on the segment will clear the latch from .008 inch to .010 inch.

- (g) To insure proper relation between segments and switch control bands, hold up reverse indication magnet and have the lever thrown so that the reverse safety tooth binds against and holds up the latch. With any lost motion, which may exist, taken out by turning the roller by hand, as far ahead toward the full reverse position as possible, the reverse control band must be open to a minimum of $\frac{1}{32}$ inch (normal control band will be open slightly more). With the normal safety tooth binding the latch of the normal indication magnet and lost motion taken out of the roller toward the full normal position, the normal control band must be open a minimum of $\frac{1}{32}$ inch (reverse control band will be open slightly more). Be certain that the reverse control band is observed in connection with the reverse safety tooth, the normal control band in connection with the normal safety tooth, and that lost motion in the roller is forced in the proper direction.
- (h) The "BD" band for the control of the lock magnet of Model 14 switch movement type valves must remain open when the lever is moved from either normal or reverse position against detector lock tooth. The "NX" and "RY" bands controlling switch repeating relays, where a back contact of this relay is used for energizing the lock magnet of Style "C" and "CP" valves, must remain closed with the lever against its detector lock tooth.

360 Where a lever is equipped with a mechanical stick push button circuit controller, this controller must be so adjusted as not to move toward the normal position enough to open the reverse contact until the lever has passed the indicating point going normal.

361 Where electric locking is provided on a mechanical machine with Model 12 or similar electric locks, to lock the lever latch down, as in detector or similar locking, the segments of these locks must be cut and maintained so that, with one-fourth inch obstruction under the bottom of the latch rod, the locking dog of the electric lock will be free to drop to the locked position, and when in the locked position the lever latch cannot be raised more than a total of one-half inch.

362 Where electric locking is provided on a mechanical machine with Model 12 or similar electric locks, to lock the lever latch up, as in signal

indication or similar locking, the segments of these locks must be so cut and adjusted that, with the lever latch held up by the electric lock, it must be up not less than five-eighths inch from its normal position, and with the lever latch raised and the lever normal the locking dog of the electric lock must not bind on the locking segment.

363 The use of oil on latches, segments or trunnions of electric locks is prohibited.

364 Employes must not unlock switches that will in any way affect trains closely approaching or passing. Non-interlocked switches in main tracks, or leading to main tracks, when not in use, must be locked in normal position.

365 If necessary to disconnect a locking switch stand, switch circuit controller, combined plunger lock and circuit controller, or similar apparatus, from a non-interlocked switch, unless the switch is wedged and spiked in its normal position in accordance with Instruction 350 (a) and (b), or when such switches are open for inspection, adjustment or repair of such apparatus or of pipe-connected derails, the following precautions must be taken:

- (a) Control circuits or connections for signals involved must be so arranged that signals will display their most restrictive indications.
- (b) Where telephone is available. arrange with Signaller to protect against train movements in both directions; where telephone is not available provide flag protection in both directions.

366 Electric locks on Type "G" and hand-operated switch mechanisms must be regularly inspected to insure that all parts are intact and that working parts move freely.

367 Electric switch locks having indication circuits must be carefully inspected for missing or worn parts, which might render the lock-out feature inoperative; and the indication circuits must be tested in accordance with instructions for testing signal lock circuits in so far as these instructions apply.

368 Air distribution system shall be so maintained that leakage in any section of the plant will not exceed one pound in one minute from normal pressure with all apparatus connected and at rest.

369 Air strainer used between air distribution system and air apparatus shall be cleaned frequently enough to avoid air pressure reduction.

370 Where circuits are not arranged as provided on plan S-862, the following action is prescribed:

At electro-pneumatic interlockings with unit compressors, where low air pressure alarms are provided, the alarm shall be set 5 pounds below the cutting-in pressure of the compressors to provide as much time as possible between the alarm and the action as herein provided.

In the event of air alarm, switches shall be placed normal or in position most likely to be needed and no further operations made until pressure is normal or Maintainer is on the ground.

At interlockings where all of the switch mechanisms are Style A-5 or A-1, equipped with friction locks, operated by cut-off type valves with restoring circuits, the operation of switch levers shall be discontinued when the air pressure is below 45 lbs., unless there is a Maintainer on duty to assist in moving the switches. At such places, when the air pressure is below 20 lbs., trains shall be stopped at home signals. Proceed signals may then be displayed. If switches are secured in accordance with Instruction 351, proceed signals may be displayed without stopping trains.

At interlockings where there are any No. 14 or motion plate type switch mechanisms in service, the operation of all switch levers shall be discontinued when the air pressure is below 80 lbs., unless there is a Maintainer on duty to assist in moving the switches. At such places, when the air pressure is below 35 lbs., no train movements shall be made over any of the switches until they have been secured in accordance with Instruction 351. After switches are secured, proceed signals may be displayed without stopping trains.

AUTOMATIC TRAIN STOP, TRAIN CONTROL, AND CAB SIGNAL SYSTEMS

136.526 Roadway element not functioning properly. When a roadway element except track circuit of automatic train stop, train control or cab signal system is not functioning as intended, the signal associated with such roadway element shall be caused manually to display its most restrictive aspect until such element has been restored to normal operative condition.

136.528 Restrictive condition resulting from open hand-operated switch—requirement. When a facing point hand-operated switch is open one-fourth inch or more, or a trailing point hand-operated switch three-eighths inch or more, or hand-operated switch is not locked where facing point lock with circuit controller is used, the resultant restrictive condition of an automatic train stop or train control device of the continuous type or the resultant restrictive cab signal indication of an automatic cab signal device on an approaching locomotive shall be maintained to within 300 feet of the points of the switch.

136.531 Trip arm—height and distance from rail. Trip arm of automatic train stop device when in the stop position shall be maintained at a height above the plane of the tops of the rails, and at a horizontal distance from its center line to gage side of the running rail, in accordance with specifications.

532 Roadway element shall be securely fastened to ties. Bolts should be kept tight; missing bolts, cracked or broken housings, should be replaced.

533 Test circuit or test loop shall be maintained in good condition and current in same properly adjusted.

HIGHWAY GRADE CROSSING PROTECTION

1091 A Maintainer Telegraph and Signals being assigned to a new section or additional territory, or temporarily relieving another Maintainer Telegraph and Signals, must make immediate study of highway crossing signal conditions.

1092 Whenever severe electrical storms occur, an inspection of the highway crossing signals must be made by Maintainer or other Telegraph and Signal employe, under the direction of the Supervisor Telegraph and Signals or Inspector Telegraph and Signals as promptly as consistent, to check all apparatus and power supply, and correct any defects found.

1093 During snow or sleet storms, when conditions warrant, a check must be made of all electric crossing gates, and snow or ice sufficient to interfere with proper operation of the gates must be removed.

1094 (a) Gate arm torque adjustment must be checked each time that any change is made in gate arm, location of gate arm lamp, or any other alteration affecting the total weight of the assembly.

(b) Gate arm position must be properly adjusted to avoid a drooping gate arm when down and to avoid the possibility of travel beyond the desired raised position.

(c) Gate arms must be checked when in the raised position to avoid any possibility of arm fouling on wires, cables, trees, etc.

(d) Lubricants per C.E. 240 or in accordance with manufacturer's recommendation must be used.

1095 When automatic highway crossing protection fails to properly indicate approach of trains, manual crossing protection must be provided promptly and maintained until necessary repairs are made.

1096 When there is an accident at a crossing protected by automatic highway crossing protection, manual protection must be provided as soon as possible. The Maintainer Telegraph and Signals must make necessary observations and tests, without opening the instrument case, to determine if the protection is working properly, and report conditions to the Supervisor Telegraph and Signals, and be governed by his instructions. The Maintainer Telegraph and Signals, should, if possible, obtain the name and address of the person or persons injured, also the license number of the vehicle involved, and of as many witnesses as possible.

BATTERIES IN FLOATING OR TRICKLE CHARGE SERVICE

NOTE: Floating charge—A continuous input of current to a storage battery.

Trickle charge—A continuous input of current to a storage battery to compensate for internal losses only.

Batteries connected directly across rectifiers and load are under floating charge.

Batteries connected across rectifiers but to the load only when alternating current power supply is off are under trickle charge.

1126 Jars or containers must be kept clean, level, and as dry as practicable.

1127 Trays and supports must be kept clean, dry, and in such condition as to prevent surface leakage of current.

1128 All connections must be kept clean and tight. Exposed brass or copper battery connections must be kept covered with a thin coating of vaseline, No-ox-id or equivalent.

1129 Battery housings or compartments must be kept clean and when batteries are located in a building ventilation must be provided. Where the inside is of wood or metal, it must be painted with acid-resisting paint.

1130 Ventilating filling plugs must be maintained, properly secured in each cell.

1131 Hydrometers and syringes must be properly protected against breakage and against injurious effects on the apparatus from acid. Separate syringe must be used for lead-acid type and for Nickel-Iron-Alkaline type of battery.

1132 Distilled water, or water approved for use in batteries, must be kept in covered glass or porcelain containers.

1133 After tests and readings have been completed, water must be added, if necessary to maintain proper solution level. When water is added in cold weather, solution must be agitated by use of the syringe to prevent freezing.

1134 Electrolyte must be maintained at a level three-quarters inch above top of plates, or at electrolyte level mark.

Lead Acid Type

1135 Careful visual inspection must be made to detect broken, cracked or buckled plates, misplaced separators, or undue accumulation of sediment and for proper height of electrolyte.

1136 Additional acid must not be added to replace losses due to evaporation. Electrolyte of the same specific gravity as that of balance of cells must be used in replacing loss.

1137 In order that batteries may be kept properly charged, a minimum voltage of 2.16 per cell must be maintained with the charging current on. The specific gravity of the electrolyte should be in accordance with the manufacturer's instructions.

Nickel-Iron Alkaline Type

1138 The charging rate should be not less than 150 milliamperes more than the predetermined average discharge in order to maintain maximum capacity. A minimum voltage across each cell of 1.5 when charging current is on must be maintained.

1139 The manufacturer's booklet, entitled "General Instructions for the Installation and Maintenance of Edison Storage Cells," contains recommended practice for installation and maintenance and instructions for cycle charging. If the battery is kept fully charged, cycle charging is not required.

1140 Specific gravity at 70 deg. F. should be not less than 1.157 nor more than 1.227. Consult the manufacturer's booklet for effects of temperature changes.

Primary Battery Type

1141 Instructions issued by the manufacturer, covering installations and maintenance of primary batteries, should be closely followed.

In the A.C. Primary Battery System, where from 10 to 22 cells connected in series are used, batteries should be kept in a healthy condition and ready for action at all times by shunting a resistance of one-half ohm across the batteries for fifteen minutes when first set up, and thereafter for five minutes twice a month or ten minutes every month.

Where automatic time clock shunting device is used, one-half ohm shunt shall be connected across batteries for thirty seconds each day, as a means of maintaining the battery in an active condition.

NOTE: A.C. Primary Battery System—Alternating current is used for normal operation of the connected apparatus with the primary batteries idle, and connected to the load only when A.C. power supply is off.

Batteries—General

1142 Batteries shall be of sufficient capacity for the service required, and shall be kept sufficiently charged or renewed as often as necessary to insure safe and reliable operation. Connections shall be kept clean and tight and cracked or broken jars shall be replaced.

TESTS

1251 When making electrical tests of switch and signal circuits, the proper meters must be used, and it must be known that no unsafe conditions are set up by the application of such testing apparatus.

When using switch or signal circuits for temporary telephone, it must be known that the use of telephones will not, in any way, affect the circuits.

1252 Periodical tests of signaling and interlocking devices must be made regularly. The frequency of tests specified in C.E. 227 represents the maximum interval between tests. Local conditions may make more frequent tests advisable, in which case supplementary instructions will be issued by the Superintendent Telegraph and Signals.

1253 Other tests that may be designated from time to time must be made in accordance with instructions that will be issued in connection therewith.

ISSUED

July 6, 1951.

C. J. Henry
Chief Engineer

