# Pennsylvania Testing Procedure

THE following paragraphs contain rules and instructions pertaining to particular phases of testing appearing in various instruction circulars issued by the Pennsylvania. Tests 1, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21 and 23, (listed in the schedule of tests which appeared on page 36 of the January issue of Railway Signaling) have been grouped together because they pertain primarily to testing of mechanical and electric locking, and to testing of switches, two subjects of utmost importance to the signaling field. The instructions which appear in C.E.227-A, "Tests of Signal Apparatus," are presented first, followed by supplementary material (such as detailed instructions for the specific tests) appearing in special pamphlet or other form and mentioned in C.E.227-A; the pertinent rules appearing in C.S.E.23-C, but not published in the January issue of Railway Signaling, complete the assembly of material on each test.

# Instructions for Making the Aforementioned Tests of Signal Apparatus

## TEST 1.—Mechanical Locking in Interlocking Machines:

The purpose of this test is to determine that mechanical locking is in accordance with plans and specifications, and in such condition as to insure proper functioning.

Make test in accordance with Form C.E.238.

# C. E. 238

#### Instructions for Inspecting and Testing Mechanical Locking of an Interlocking Machine

#### Inspection

1. The various parts of the locking bed, locking bed supports and connections must be inspected to see that they are properly secured.

2. Driving pieces, dogs, stops and trunnions must be inspected to see that they are properly secured to the locking bars. Where

\*An article discussing organization, general instructions and records for testing on the Pennsylvania was presented beginning on page 35 of the January issue of *Railway Signaling*.

# (Part II)\*

two swing dogs are on one trunnion there must be a cotter pin through top of trunnion or, if trunnion is not provided with cotter hole, it must be slightly riveted by center punching.

3. Locking bars in new locking must have full stroke as follows:

- (b) Mechanical interlocking mechine, Style "A" locking......7/16 in.
- (c) Electro-mechanical interlocking machine, S. & F. locking,

- (f) Power interlocking machine,S. & F. miniature locking...... 1 in.

4. Splices in longitudinal locking bars must be inspected to see that they are straight and bolts, nuts and cotter pins are in place.

5. Where new locking is to be placed in service or a change in locking is made, the locking must be compared with the dog chart to see that they agree.

6. After locking has been inspected and tested, locking bracket caps must be securely fastened in place.

#### Testing

11. Locking must be tested before interlocking machine is placed in service, when a change in locking is made, and at least annually as outlined in Instructions 12, 13, 14 and 16.

12. When lever or latch which should be locked can be moved more than shown below, it shall be considered as having too much lost motion and lost motion must be removed.

- (a) Mechanical machine.
  - 1. Latch operated locking. When lever latch block can be raised to within 3% in. of top of quadrant.
  - Lever operated locking. When lever latch block can be moved more than 3% in. on top of quadrant.

Instructions for testing mechanical and electric locking, switch operation and indication, drawbridge locking, fouling circuits and switch circuit controllers, and the adjustment of contact springs and quick switches on the machines at interlocking plants

- (b) Electro-mechanical machine.
  - 1. Lever moving in horizontal plane. When lever can be moved more than ½ in. when in normal position or ¾ in. when in reversed position.
  - 2. Lever moving in an arc. When lever can be moved more than 3 deg.
- (c) Power machine.
  - 1. Latch operated locking. When lever latch block can be raised to within 7/32 in. of top of quadrant.
  - Lever moving in horizontal plane. When lever can be moved more than ½ in. when in normal position or ¾ in. when in reversed position.
  - 3. Lever moving in an arc. When lever can be moved more than 3 deg.

The above requirements are for interlocking machines in service. For new machines there should be practically no lost motion in locking or connections.

13. On electro-mechanical interlocking machines, the locking between the electric and its mechanical levers must be tested to insure that mechanical levers cannot be operated except when properly released by the electric levers.

14. Latch shoes and rods, rocker links and dies, universal links and quadrants of S. & F. machines must be inspected and tested for lost motion that would permit locking to release if the foot is used on the rocker while lever is in mid-stroke position.

15. Where new locking is to be placed in service or a change in locking is made, a complete test must be made of the locking from the locking sheet by placing all levers normal, when practicable, then testing of levers consecutively commencing with lever with lowest number to see that each lever locks all other levers in the position required by the locking sheet. RAILWAY SIGNALING

16. Complete test of the locking from a signal layout plan must be made as follows:

- (a) Test locking between switch, derail and movable frog levers.
- (b) Test locking between facing point lock and switch, derail and movable frog levers.
- (c) Set up each route and endeavor to release latch or operate each signal lever that should be locked by that route; then raise latch on signal lever, or reverse signal lever, governing movements over route, endeavor to release latch or operate each lever that should be locked by the signal lever; then restore latch or lever to normal position and make similar test with lever or latch for the opposing signal.
- (d) Where route or traffic levers are used, make test as outlined for signal levers in Instruction 16-c.
- (e) Set up each route and endeavor to release or operate the lever for each signal that governs over that route with one trailing switch at a time in the wrong position, and all other switches in the route in proper position and locked.
- (f) Where facing point locks are used, set up each route and endeavor to release or operate the lever for each signal that governs over that route with one switch at a time unlocked, and all other levers in proper positions for the movement.

17. When new locking is to be placed in service or a change in locking is made, to insure that locking of a route does not interfere with parallel routes, the parallel routes must be set up and signal levers operated for movements in both directions on each route.

18. When new locking is to be placed in service or a change in locking is made each swing dog must be tested to see that it releases properly.

# TEST 10—Signal Indication Lock Circuits:

The purpose of this test is to insure that levers of power and electro-mechanical machines and the latches of mechanical levers cannot be placed in normal position until the corresponding control relays for position and color light signals are open (or properly poled) and the corresponding arms of semaphore signals are within 5 deg. of their normal positions; also, that the repeating indicator or light where used to indicate the position of a non-interlocked signal corresponds to the position of the signal.

Light Signals: Place signal lever at indicating position. Disconnect lock circuit wire at each relay contact in the circuit, on the side of the contact from which battery is feeding, and signal lever should not indicate to normal position.

Semaphore Signals: Place signal lever at indicating position. Move each signal arm approximately 15 deg. from its normal position and slowly return it to within approximately 5 deg. of normal position. Signal lever should not indicate to normal position.

Make careful visual inspection of each contact involved to see that it opens and closes as called for on plan, and is clean and free of any possible fouling.

Repeating indicators or lights for non-interlocked signals should be checked and observed in accordance with the above.

In C.T.C. type or relay type interlockings, proceed as above, except that lever is restored to normal position, checking the "KM" relays in lieu of the indication locks.

*C.S.E.23-C Instruction 61*—Where electrical locking is provided on a mechanical machine with Model 12 or similar electric locks, to lock the latch up, as in signal indication or similar locking, the segments of these locks must be so cut and adjusted that, with the latch held up by the electric lock, it must be up not less than five-eighths of an inch from its normal position, and with the latch raised and the lever normal the locking dog of the electric lock must not bind on the locking segment.

# TEST 11—Approach and Time Locking:

#### Approach Locking

The purpose of this test when lock is on signal lever is to insure that the signal lever or latch cannot be restored to the normal position with proper route set and the approach circuit open; when combined with switch lever locking, to insure that the switch or lock lever cannot be moved from normal or reverse position after signal lever has been reversed and restored to normal with the approach circuit open. Test to be made as follows:

When on Signal Lever:

- 1. Check approach relay by observing the shunting of each track circuit involved and, also, open or close any multiple circuits or other contacts involved, separately to insure that relays function as intended.
- 2. With lever or latch at indicating point and approach circuit closed (multiple circuits must be open) restore lever or latch to normal position. Lever or latch should be released.
- 3. With lever or latch at indicating point and approach circuit open (multiple circuits must be kept open) attempt to restore lever or latch to normal position. Lever or latch should be locked.
- 4. With lever or latch at indicating point and approach circuit open, close each multiple circuit sep-

arately and attempt to restore lever or latch to normal position. Lever or latch should release.

- 5. Check time of slow release for setting in accordance with C.E.209 and that starting of slow release opens the signal control circuit.
- 6. In C.T.C. type or relay type interlockings, proceed as above, except that in 3 and 4 the lever should be restored to normal position, checking the "KM" relay in lieu of the indication lock. Check the time of the "TE" relay in lieu of a time release.

When Combined with Switch Lever Locking:

- 1. Proceed as in 1, 2, 3 and 4 under signal lever, except lever and latch must be tested in both normal and reverse positions as required.
- 2. Check time of slow release for setting in accordance with C.E. 209; also, operation of stick relay, to insure that locks do not release unless signal lever is in normal position when release is started or if this lever is moved from the normal position at any subsequent time.

## Time Locking

The purpose of this test when lock is on signal lever is to insure that signal lever or latch cannot be restored to normal position until the specified time interval has elapsed; when combined with switch lever locking, to insure that the switch or lock lever cannot be moved from the normal or reversed position after signal lever has been reversed and restored to normal until specified time interval has elapsed. Test to be made as follows:

# When on Signal Levers:

- 1. With lever or latch at indicating point, operate time release (multiple circuits must be open) and attempt to restore lever or latch to normal position while time release is operating. Lever or latch should release after specified time interval has elapsed.
- 2. With lever or latch at indicating point and time release in normal position close each multiple circuit separately and attempt to restore lever on latch to normal position. Lever or latch should release.
- 3. Check time of slow release for setting in accordance with C.E. 209 and that starting of latch type slow release opens the signal control circuit.

When Combined with Switch Lever Locking:

1. Proceed as in 1 and 2 under signal lever, except that lever or latch of switches or locks affected must be tested in both normal and reverse positions as required.

2. Check time of slow release for setting in accordance with C.E. 209; also, operation of stick relay, to insure that locks do not release unless signal lever is in normal position when release is started or if this lever is moved from the normal position at any subsequent time.

NOTE:—Setting of time release must be kept within 5 sec. of the time designated. The time for each release as set must be marked on or near each release. Similarly, the time for time element relays used in C.T.C. or similar operation should be shown.

# C. E. 209

#### Approach Locking and Setting of Time Releases

Approach Locking: The approach locking circuit shall extend from the home signal locked to a point not less than fifteen hundred (1500) feet beyond the farthest distant signal. In automatic signal territory, it shall extend to the next signal



- Fig. 1—Where Y is full braking distance for authorized speed (Figures 1, 2, 3 and 4):
- (1) Time for release of B in seconds =  $\frac{Y + 1500}{44}$

(2) Time for release of A in seconds = X + 1500

- Fig. 3—Where X is less than braking distance for restricted speed
  Fig. 4—Where X is less than full braking
- distance for maximum authorized speed but is braking distance for restricted speed:
- (3) Time for release of A in seconds (Fig. 3 and 4) = X + Y + 1500

- Fig. 5—Where three block indication is in service (Fig. 5):
- (4) Time for release of B in seconds:  $\underbrace{Y + Z + 1500}_{44}$

beyond the farthest distant signal unless the track circuit between those two signals is cut, for other purposes, at a point fifteen hundred (1500) feet or more beyond that distant signal.

Setting of Time Releases: The basis for setting time releases shall be the time required for a train to move the distance between the distant signal and the signal locked, plus fifteen hundred (1500) feet, at a speed of thirty (30) miles per hour forty-four (44) feet per second—except that, on descending grades of one-half of one per cent ( $\frac{1}{2}$  of 1%) or more, the basis shall be twenty (20) miles per hour-thirty (30) feet per second—and thirty (30) must be substituted for forty-four (44), in the following formulae. See diagrams.

Where time locking only is used for high and restricted speed routes, the same rules shall apply, assuming the distances the same as though approach locking were in service.

Time releases for dwarf and other slow speed signals (no high or restricted speed movements being involved) shall be set for a minimum of twelve (12) seconds.

C.S.E.23-C Instruction 33—Time releases and timing relays shall be tested quarterly and the timing shall be maintained within ten (10) per cent of the predetermined time interval.

# **TEST 12—Switches:**

(a)—Switch Indication Power Switches:

The purpose of this test is to insure that controlling lever cannot be latched in either normal or reverse position, unless switch or switches operated by the lever have properly operated to the corresponding position.

Test each switch lever for each switch involved, for both normal and reverse indication, first with  $\frac{1}{2}$ -in. obstruction, to allow switch movement to operate but not lock the switch, and second, with valve stem removed from lock magnet of EP switches and with fuse removed from electric switches, to prevent any operation of the switch movement.

(b)—Restoring Feature — Power Switches:

The purpose of this test is to insure that power will be applied and restore switch movements to full normal or full reverse positions before creepage of the movement would open SS circuits.

1. E. P. Switches with friction locks :

Use bar to move slide bar toward the opposite position, and note that air comes on and restores slide bar before SS contacts have opened. Operation of contacts may be checked by visual observation, by voltmeter, or by observance of SS relay.

(Where C or CP valves are in service with Model 14 S&L movements, kick-back should be  $e_{f}$ , fective when the SS contacts  $i_{f}$  the indication box open).

Electric Switches: Remove fuse in motor circuit and crank switch movement toward opposite position until motor circuit contacts are closed in circuit controller, noting that SS contacts have not opened. Restore fuse and switch movement should restore to original position.

Check in both normal and reverse positions.

- 2. E. P. Switches without friction lock: Test same as EP switches with friction lock.
- (c)-Lock Magnet Switch Valve:

The purpose of this test is to insure that the "D" valve of old style valves (PL.0953) is properly locked.

Remove armature stem in lock valve magnet and have lever operated. If switch responds the "D" valve lock is defective and should be replaced. Check in both positions.

(d)-Valve Test:

The purpose of this test is to detect leakage in EP switch valves which might result in improper switch operation.

Test each set of valves with switches in both normal and reverse positions by holding in for approximately one (1) minute lock and reverse armature while normal is energized and lock and normal while reverse is energized. If switch changes position, valves are defective and should be replaced.

(e)—Indication Circuits, Electro-Mechanical and Mechanical Switches:

The purpose of this test is to insure that lock levers cannot be operated to the locked position unless all the switches locked by the lever involved and the levers which operate these switches are in proper corresponding positions.

On Mechanical Switches: Obstruct each point successively with 3%-in. obstruction and with switch operating levers latched F.P.L. lever should be electrically locked in normal position.

On Electro-Mechanical Switches: With locking lever at indicating point, open normal indication circuit at each indication box in the circuit and locking lever should not indicate. Repeat with switch or switches reversed for reverse indication circuit.

(f)—Indication Circuits—Style CP Valves—Type F Controller:

Where CP valves or Type F controllers are used with indication circuits selected through them, tests must be made by placing the S&L movement in the position opposite to the valve or controller and check that the switch does not indicate under these conditions. This can be done where Where Type F controllers are used open the switch motor circuit and shift controller by operation of the lever.

# TEST 13—Cross Protection Electric Interlocking Machines: (GRS and Federal Types:)

The purpose of this test is to insure that protection devices work properly to prevent movement of switches, signals, etc., when current is improperly applied to the circuits. Test should be made when plant

voltage is at the maximum. Make temporary connection be-

Make temporary connection between normal and reverse operating wires for each switch at the polechanger. This should open polar relay or circuit breaker.

Make temporary positive battery connection from the nearest switch to the signal control wire as close as practicable to the signal motor. This should open the polar relay or circuit breaker. If the signal control circuit is connected to the common return wire through one or more switch circuit controllers, the energy should be applied to this wire, first opening the connection to the main common to prevent blowing fuse in the switch circuit.

If plant is sectionalized one or more functions in each section should be crossed with wires taking energy from each of the other sections. In case functions in various sections are too widely separated, the temporary crosses can be made between the binding posts on the terminal board of the interlocking machine. This should open the section breakers.

# TEST 14—Observe "SS" Relays Opening When Switches are Operated:

The purpose of this test is to insure proper functioning of the "SS" relays.

Have switch operated, check "SS" relay while switch is operating; see that "SS" relay assumes full open position and note operation of neutral and polar contacts when relay is in both normal and reverse positions.

# TEST 15-C. E. 40 Switch Obstruction:

The purpose of this test is to insure proper maintenance and adjustment of switches.

Test shall be made in accordance with instructions on back of Form C.E.40. (Front of C.E.40 illustrated in January issue, p. 38.—Ed.)

To insert obstruction between switch point and stock rail of mechanical interlocked switches with electric locking, pry switch point open while lock lever is normal with its latch held up.

After obstruction has been inserted, attempt to lock switch.

Repeat for each position of each switch.

# C. E. 40

#### Switch Inspection and Test Report

Switch inspection, involving thorough examination of parts listed in columns 4 to 10, inclusive, measurements in columns 4, 11a and 11b, and tests in column 12, shall be made semi-monthly.

Detail conditions shall be indicated by "G" for good, "F" fair and "P" poor, do not use ditto marks.

Any defects found should be indicated under "Remarks."

Adjustments as necessary shall be made in conjunction with the inspection, and "Adj." indicated in proper column.

Necessary replacements of material shall be arranged for at once, and reports shall not be finally filed by the Supervisors until replacements have been made.

Column 1. Show location inspected.

Column 2. All interlocked switches shall be recorded in numerical order; the number of the electric lever only shall be used in reporting electro-mechanically operated switches.

Column 3. Switch points, stock rails, etc., shall be designated by a, b, c, d, etc., for each switch, crossover or combination of switches and M. P. Frogs bearing the same number. For a single switch, designate the North (West) rail "a". For all combinations, begin at the East (North) end and designate the North (West) rail "a", the South (East) rail "b", and so on.

Column 4. Record actual opening found; if adjusted, mark "Adj."

Column 5. Include surface wear and any or all parts which may in any way affect safe and proper operation of switch point, such as bolts, rivets, clips, clip fastenings, chipping of point, flange wear (rough or smooth), surface, line, or any interference of the bearing of the switch rail against the stock rail.

Column 6. Include fastening to switch clip, cotter pins, insulation where used, boring of switch rods, or any damage to switch rod which may affect safe and proper operation of switch.

Column 7. Locking edges of opening in lock rods must be square before bar or obstruction test is made. Plungers and locking dogs must be full size and corners square at locking end. Rod must be clear of locking dog or plunger (when unlocked) and must move freely when operated without binding in its guides. Bolts, nuts and jam nuts must be in place and in good condition.

Column 8. Include contact with stock rail and plate, condition of plate, holding bolts and nut locks.

Column 9. Compare surface wear of stock rail to surface wear of switch rail, check flow of stock rail metal interfering with proper bearing of switch rail against stock rail, and, if any, indicate action taken. Indicate if stock rail is not properly bent ahead of point of switch or if for other reason the switch rail strikes back of point of switch.

Column 10. Whether sound or in such,

condition that any should be renewed; also if properly tamped.

Column 11, (a) Indicate actual gage at bend in stock rail ahead of point of switch. (b) Indicate actual gage two feet back

of point of switch. Column 12. Switch lock tests are of two

general classifications.

Bar Test. Semi-monthly, except the first test of each quarter, tests of interlocked switches should be made by prying the switch point away from the stock rail, when the switch is locked. If the point can be opened 3/16 of an inch, corrective action must be taken immediately.

Obstruction Test. Not less frequently than the first test of each quarter, the test shall be made on interlocked switches with an obstruction instead of a bar, and shall be conducted as follows:—insert a plate 3/16 of an inch thick for a mechanical switch,  $\frac{1}{4}$  of an inch for a power switch, between switch point and stock rail, 6 inches back from the point, if the switch locks, corrective action must be taken immediately.

Non-interlocked switches equipped with facing point locks and other facing point switches for which the maintainer and track foreman are jointly responsible shall be tested and reported in the same manner as interlocked switches, except that obstruction test shall be made instead of bar test.

Non-interlocked outlying, normally trailing switches for which the maintainer and track foreman are jointly responsible shall be tested and reported monthly, in the same manner as interlocked switches, except that obstruction test shall be made instead of bar test.

If switch does not lock when the proper obstruction is inserted, 'or switch point cannot be pried open at point 3/16 of an inch, mark "OK", if it requires adjustments to secure above results mark "Adj." Any exceptions found shall be indicated under remarks.

This report shall be used also for the inspection of switches for which the track foreman is entirely responsible, shall be made monthly and be signed by the track foreman.

C.S.E.23-C Instruction 111— 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 locking dog or plunger by more than  $\frac{3}{8}$  of an inch.

C.S.E.23-C Instruction 112— Plungers must have at least eight inches stroke and must clear the lock rod when withdrawn not less than 1 in. nor more than  $1\frac{1}{2}$  in.

C.S.E.23-C Instruction 114—Point detector with latch must be so adjusted that it will operate if the switch point is forced open  $\frac{3}{8}$  in., with a maximum tolerance of  $\frac{1}{8}$  in. over. Point detector without latch must be adjusted to operate when switch point is forced open  $\frac{1}{4}$  in. shall be provided and maintained at

The purpose of this test is to insure

that rail locks, wedge locks, bolt locks,

circuit controllers, electric locks, etc.,

are in good condition and functioning properly to provide protection in ac-

For center pivot type bridges, test

each lift rail by inserting 1/4-in. gage

under mitre end. Rail should not lock.

Check each wedge lock or circuit con-

troller connected to wedges. Wedge

should not lock, or contacts in circuit

controllers make unless wedge is with-

in 1 in. of full position. Check bolt

locks and electric locks to insure that

levers are not released for operation until all functions involved are in

Contacts in circuit controllers at-

tached to drawbridge apparatus are to

be adjusted as indicated below:

proper position.

cordance with approved plans.

TEST 16-Drawbridge Locking:

low points.

C.S.E.23-C Instruction 115a-Holes in lock rod shall have square edges and be not more than 1/8 in. larger than plunger.

C.S.E.23-C Instruction 115b—Bolt lock shall be so maintained that signals governing movement over switch or derail cannot be cleared when derail is in derailing position, or when switch point is open 1/4 in. or more, except where derail or switch is equipped with facing point lock, the bolt lock plunger may clear locking edge of lock rod not more than  $\frac{1}{2}$  in. Signal bar shall be against the stop when signal lever is normal. Notches shall have square edges.

C.S.E.23-C Instruction 116a— Driving bar of switch and lock movement shall travel, both normal and reverse, so that locking dog will pass through lock rod 1/2 in. or more. C.S.E.23-C Instruction 110

116b— Point detector shall be so maintained that when switch mechanism is locked in normal or reverse position, contacts cannot be opened by manually apply-

Surfacing w

Rails or rail

Rail Locks

Latches

Bridge Lock

Rail Locks

Bridge Coup

Catenary Bl

Dead weight

ing force at the switch points in either direction.

C.S.E.23-C Instruction 117a-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.

C.S.E.23-C Instruction 117b-Air strainer used between air distribution system and air apparatus shall be cleaned frequently enough to avoid air pressure reduction.

C.S.E.23-C Instruction 117c-Condensers, tanks, reservoirs, and air distribution lines shall be drained frequently enough to avoid overflow of condensation into branch lines and apparatus. Means of draining con-

C.S.E.23-C Instruction 226-Rail locks on drawbridges must be adjusted so that they cannot be locked with the rails raised 1/4 in. or more from their proper position.

C.S.E.23-C Instruction 227-Wedge locks on drawbridges must be kept adjusted so that they cannot be locked unless the wedges are within

1 in. of their proper position. C.S.E.23-C Instruction 228-Circuit controllers operated by surfacing wedges on drawbridges must be kept so adjusted that the circuit will not be completed unless the wedges are within 1 in. of their proper position.

C.S.E.23-C Instruction 229-Apparatus and circuits for the protection of drawbridges must be maintained in accordance with these instructions and any special regulations applicable at the bridge in question.

# TEST 17—Switch and Traffic Lever Locking:

The purpose of this test is (a) to insure that the locks are in proper condition mechanically, free from chattering, etc., and that they will block the lever operations; (b) to insure that the controlling circuits are functioning properly and that locks will not release with a train occupying any portion of the protecting track section.

(a)—With track circuit unoccupied and no train approaching the switch or traffic section; open the lock circuit (not at lever latch), move lever sharply until locking tooth on segment engages latch, closely observing action of locking parts. Test to be made for each lever position in which the locking is effective.

(b)-With track occupied; move latch sufficiently to close latch contact or step on floor push. As each track section in the route or territory is occupied see that the lock remains de-energized, being sure not to move lever if lock should pick up. If not practicable to get track occupied test with a train in the circuit, proceed as above, having each track section involved shunted successively and carefully observe results.

(c)-Where traffic locking protection for opposing movements is provided by means of stick relays, signal lever locks, etc., test and observations should be made in accordance with the above instructions insofar as they apply.

(d)—In C.T.C. type or relay type interlockings open the track relay of each protecting track circuit and note if switch can be operated.

This test must not be made with track circuit occupied.

Test each switch in each route with the "KM" relay, for the signal governing that route, open.

C.S.E.23-C Instruction 60—Where electric locking is provided on a mechanical machine with Model 12 or similar electric locks, to lock the latch down, as in detector or similar locking, the segments of these locks must be cut and maintained so that, with  $\frac{1}{4}$ in. 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 latch cannot be raised more than a total of  $\frac{1}{2}$  in.

# TEST 19-Ground **Detector Readings:**

The purpose of this test is to detect any leakage between switch or

redges	Driven Withdrawn	1 in. full stroke 1 in. full stroke
beams	Raised Lowered	Mitre rails clear 2 in ¾ in. from seat
	Locked Unlocked	½ in. full stroke Bar clear 1 in.
	Raised Dropped	1 in. from seat 1 in. full stroke
s (Plan S-372 and S-375)	Locked Unlocked	1 in. full stroke 1 in. full stroke
(Plan S-372 and S-375)	Locked Unlocked	1 in. full stroke 1 in. full stroke
olers	Driven Withdrawn	1 in. full stroke 1 in. full stroke
ades	Open Closed	3⁄4 in. full stroke 3⁄4 in. full stroke
rollers on bridges so equipped	Each position	As near end of stroke as possible. Weight of bridge must be off roll- ers before contacts make

signal circuits and earth, or interlocking machine frame.

Observe ground detector meter daily, checking different sets of batteries with dial switch where provided. Record readings.

NOTE :---Maintainer should, as far as practicable, observe the ground detector meter while levers are being operated.

# TEST 20—Fouling Circuits on Switches:

The purpose of this test is to insure that fouling wires provide good electrical connection between main rails of a track circuit and sections of rail blocked off by insulated joints in turnouts, crossovers, etc.

Make thorough visual inspection of all parts of fouling wires on interlocked and hand-operated turnouts and crossovers which are open to such inspection. Where any part of fouling wires are concealed, connect voltmeter across main track rails and apply shunt to turnout or crossover rails, checking meter.

# TEST 21—Switch Circuit Controllers:

The purpose of this test is to insure that switch circuit controllers are in good condition and proper adjustment, as follows:

Circuit controllers directly connected at the point to hand-operated switches, without facing point lock, should function with switch point open  $\frac{1}{4}$  in.

Circuit controllers directly connected at the point to hand-operated switches equipped with facing point lock or to interlocked switches should function with switch point open  $\frac{3}{6}$  in.

Circuit controllers connected at mid-point of 45 ft. switch points should function with obstruction of  $\frac{1}{2}$  in., with a maximum tolerance of  $\frac{1}{8}$  in. over, between point and stock rail at or opposite connection of switch circuit controller rod.

Circuit controllers which are a part of switch throwing and locking or locking mechanisms should function before the operating lever has been moved far enough from normal to mechanically release the lock rod.

Point detectors with latch should function when point is forced open  $\frac{3}{8}$  in., with a maximum tolerance of  $\frac{1}{8}$  in. over.

Point detectors without latch should function when point is forced open  $\frac{1}{4}$  in.

Connect voltmeter across binding posts of circuit controller. On normally open contacts, with all other contacts in the circuit closed, it should read circuit voltage and change to zero when controller functions; on normally closed contacts zero reading should change to circuit voltage when controller functions.

C.S.E. 23-C Instruction 212-Switch circuit controllers must be kept clean and adjusted so as to operate within the prescribed limits for the circuits involved, and, where connected direct to switches, must, where practicable, be located on the side of the normally closed point. Where connected to hand-operated switches, at the point, they must be so adjusted that signals will display their most restrictive aspect when the switch points are open  $\frac{1}{4}$  in. or more. Where connected to mechanically interlocked switches, at the point, they must be so adjusted that circuits controlled will be open when the switch points are open 1/4 in. or more.

# TEST 23—(a)—Adjustment of Contact Spring With Relation to Safety Teeth on Segments of Power Machines:

The purpose of this test is to insure proper contact adjustment.

Test shall be made in accordance with C.S.E. 23.

C.S.E. 23-C Instruction 66f— 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 0.008 in. to 0.010 in.

C.S.E. 23-C Instruction 66g-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 a minimum of 1/32 in. (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 opened 1/32 in. (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.

*C.S.E. 23-C Instruction 66h*—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.

*C.S.E.* 23-*C* Instruction 62—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.

#### (b)—Quick Switch:

The purpose of this test is to insure proper operation of quick switches.

Test each quick switch by operating lever from normal against reverse indication tooth and from reverse against normal indication tooth. Quick switch should not operate.

Test each quick switch by operating lever against 3/16 in. gages placed against the normal and reverse shoulders of the lever quadrant. Quick switch should operate to full normal and reverse positions.

Manually place each quick switch in center position and operate lever between indicating positions. Quick switch should shift to normal or reverse positions.

Failure of the quick switch to operate under either of the above tests may be due to dirty or worn parts, improper lubrication, weak toggle springs, lever not properly centered with relation to roller, contact springs too tight on quick switch roller, or quick switch resting on top of supporting brackets on frame of machine.

Any defective condition developed should be corrected.

C.S.E. 23-C Instruction 57—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.

C.S.E. 23-C Instruction 58—Quick switches must operate after the lever is moved beyond the indicating point and before it reaches a point 3/16 in. from full normal or reverse position, measured by inserting a 3/16 in. gage between lever and quadrant stop.

Instructions for other types of tests, such as tests of insulation resistance, electrolysis, foreign current, relays, highway crossing signals, drag equipment detectors, conducted on the Pennsylvania, will be presented in a subsequent issue of *Railway Signaling*.