

IT&T

Sequence Switch Interlocking System



DIVISION OF
IT&T

IT&T

*Sequence
Switch
Interlocking
System*

Developed and manufactured by
Standard Telephones and Cables, Limited
London, England
An IT&T Associate

Distributed in the United States by
Federal Telephone and Radio Company
Clifton, New Jersey

A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION



Figure 1—Sequence Switch Interlocking Control Desk

introduction

The IT&T SEQUENCE SWITCH INTERLOCKING AND PANEL CONTROL SYSTEM provides completely safe and efficient route interlocking capable of handling modern railroad traffic. Such interlocking is obtained by the use of a small number of sequence switches as compared to a relatively large number of route working relays used by other systems. The result is that automatic ROUTE SETTING type of interlocking is provided:

- ... AT LOWER CAPITAL INVESTMENT
- ... WITH SIMPLER CIRCUITS
- ... FOR EASIER MAINTENANCE

The IT&T Sequence Switch (S/S) Interlocking System:

- ... Moves more traffic faster, safer and more dependably.
- ... Allows one operator to handle more traffic and additional territory.
- ... Requires a minimum of training (break-in) time for operators.
- ... Lends itself easily to consolidation of interlockings.

The IT&T S/S Interlocking System is a Panel Controlled Route Setting Type of interlocking which provides the operator with:

- a.) Full information on the location and movement of trains in the plant area.
- b.) The condition of track sections, switch points, signals and other functions.
- c.) Controls with which he can set routes easily and quickly with complete safety.

It introduces new and novel apparatus and methods into the field of signaling, many of which were derived from the related field of telephony where basically similar problems have been solved at the cost of much time and money. In adapting to the signaling application all apparatus and most circuits were redesigned to conform with the recognized concepts of safety accepted by the railroad signaling field.

Installations of the S/S Interlocking have been in service in England since 1949, during which time they have proved the dependability of the system.

description of system

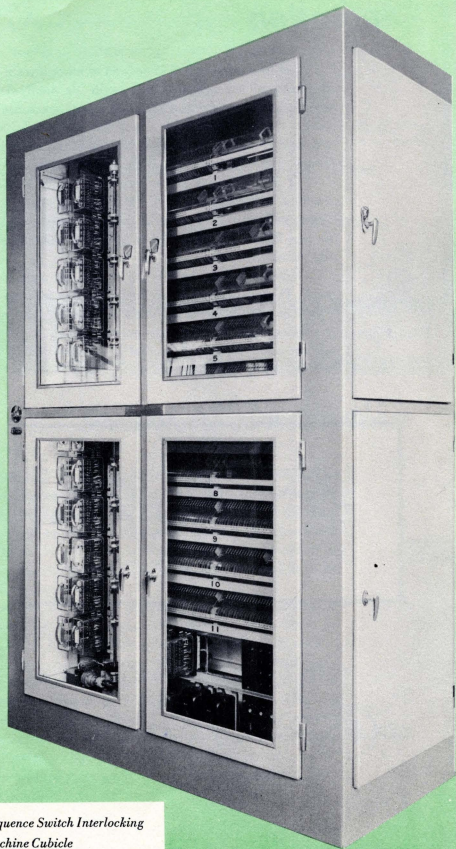
The Sequence Switch Interlocking System is composed of the following elements:

- a.) **Control Desk**, Ref. Figure 1.
The control desk mounts the control panel and provides space for terminals, communication equipment and other accessories.
- b.) **S/S Interlocking Equipment**, Ref. Figure 2.
The S/S Interlocking Equipment is mounted on angle iron racks and is completely enclosed in a dust-tight cubicle which is equipped with suitable access doors. A multiposition motor-driven S/S which is capable of providing the route locking for a number of conflicting routes is the basis of the system. Associated with it both physically and circuit-wise are a number of special relays which are called S/S auxiliary relays.
- c.) **Function Control Relays**
The S/S circuits control relays of conventional signal design which in turn control such field functions as switch point machines and signals.
- d.) **Field Functions** are such as switch point machines, signals, and other functions.

description of control panel *

On the control panel is shown a track and signal layout which approximates sufficiently that of the controlled plant. At the approximate geographic location of each controlled signal is a Route Selecting Key (1), mounted in the center of an Escutcheon Plate (2), the point of which shows the direction in which the signal governs. The signal identification (3), is shown in the Escutcheon point. Around the periphery are numbers or characters (4), which designate the exit point of a route which starts here. Example: Route B starts at Signal 21 and ends at Signal B. Tracks are shown in colored lines (9), and track occupancy by a luminous indicator (7). Switch point indication is shown by an appropriate line of light through a circular indicator (8).

*See Figures 3 and 4
Page 6



*Figure 2—Sequence Switch Interlocking
Machine Cubicle*

operation

Let us assume that it is desired to move a train from signal 21 to signal B. Normally the operator will begin his manipulation when the machine announces the presence of the train on approach track indicator 65. First he selects the route to B by rotating the Route Selector Key Control Knob to position the Index Pointer at B. Next he plunges the Knob in toward the panel. These two movements are all the manipulation required to set up the route.

If it is safe and proper for the route to be established, then the S/S machine will cause crossover 66 and single switch points 62 to be properly lined and indicated. As soon as this is accomplished and the tracks 66A, 66B, 62 and 22 proved clear, signal 21 clears showing the proceed indication on the panel.

When the train accepts the signal, the operator withdraws the control knob. This completes the total manipulation for a normal move.

The S/S Interlocking System is of the "Free Lever" type, i.e., the operator is able to move any control knob at any time. However, the machine provides all necessary safeguards so that it is impossible to cause a dangerous condition by any manipulation.

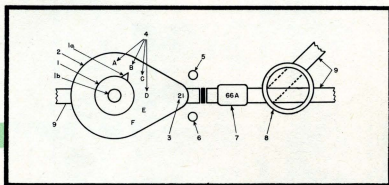


Figure 4—Control Panel Detail

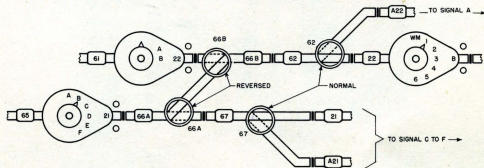


Figure 3—Diagram of Control Panel

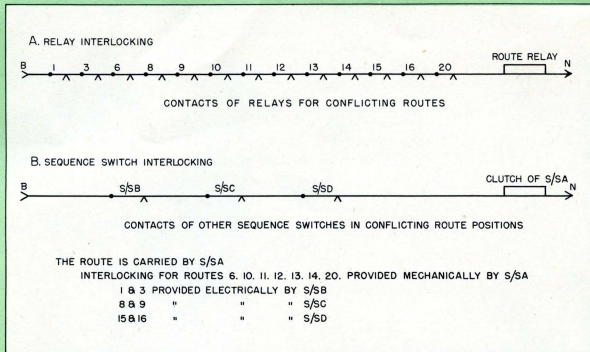


Figure 5—Comparison of Route Interlocking Contacts Required

technical description

As stated before, the S/S is a multiposition motor-driven switch. The manner in which it effects the necessary interlocking is as follows: A number of routes which interlock with each other are controlled from a corresponding number of rotary positions on the one sequence switch. The immediate advantage of this is that the interlocking between these routes is obtained mechanically, since it is physically impossible for the sequence switch to be in more than one position at any instant.

It is not always possible, however, to obtain all the necessary interlockings by the mechanical method. For example, two routes A and B, which do not interlock with each other, both interlock with a third route C. Routes A and B cannot be carried on the same sequence switch, since it may be necessary for both to be set up simultaneously while the route C may be controlled from the same sequence switch as either A or B. If route C is controlled by the sequence switch which controls route A, then electrical interlocking between the two switches will be necessary to provide the interlocking between routes B and C. Since electrical interlocking, in the Sequence Switch System, can be obtained by connections between cams on the sequence switches themselves, route relays are not required.

The IT&T Sequence Switch Interlocking System shows a very considerable saving in the number of contacts required in the interlocking circuits;

S/S INTERLOCKING — BLOCK DIAGRAM

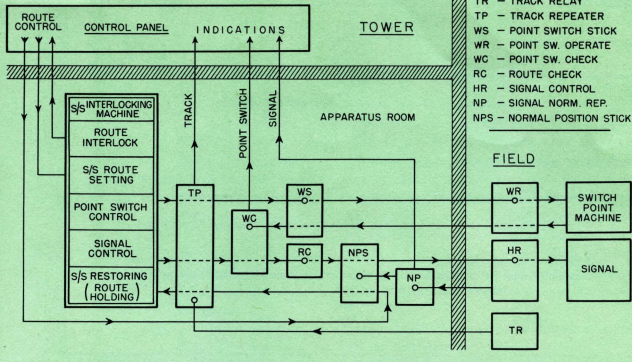


Figure 6—Block Schematic Diagram—Sequence Switch Interlocking

firstly because electrical interlocking between routes on the same sequence switch is completely unnecessary, and secondly because a single contact on a sequence switch may frequently be employed to provide the electrical interlocking required by several of the routes associated with one sequence switch. This is illustrated by Figure 5 which compares the contact arrangement for a relay interlocking with that for sequence switch interlocking.

The saving in the number of contacts is much more marked in the case of a complicated interlocking circuit than in the case of the simple typical circuit shown.

technical description of operation

The basic principles of S/S Interlocking are briefly described with reference to the Block Schematic Diagram, Figure 6.

When the towerman operates the Route Selection Key for a particular route, the sequence of events is as follows:

1. A sequence switch drives to the required route position, having first proved that no conflicting route is set.
2. An Auxiliary Relay in the S/S Machine operates to guarantee that the S/S is correctly set and locked.
3. S/S contacts complete the necessary Switch Point Control circuits to set and lock all the switch points required for the route, provided that said switch points are not already locked in the adverse position.
4. S/S contacts complete the Signal Control or Route Checking Circuit which also checks the relevant point switches and tracks.

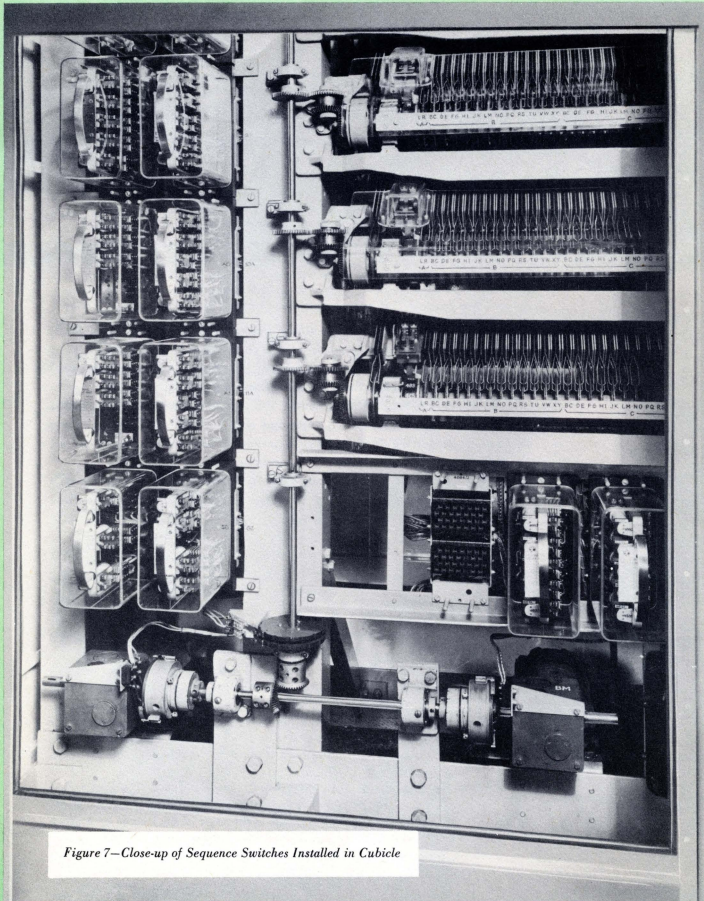


Figure 7—Close-up of Sequence Switches Installed in Cubicle

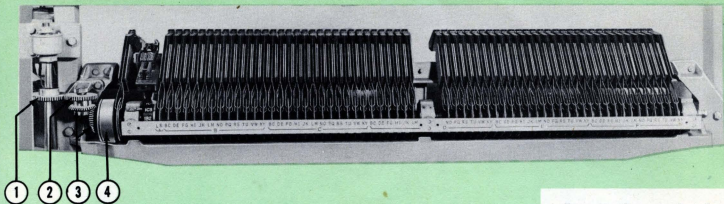


Figure 8—Sequence Switch

When the towerman restores his Route Selection Key, the S/S still holds the route as long as it may be required; the restoring control of the S/S being dependent on timing or approach locking until the train has accepted the signal and on track control after the train has passed the signal.

In addition to the S/S Interlocking Machine, the Block Schematic shows one form of conventional switch point and signal control, the typical relays being designated in the standard way. Variations in these circuits are, of course, possible in conjunction with the S/S machine.

Where it is necessary to provide for sectional release of a route, then two or more sequence switches are used, each S/S releasing its own section of the route after the train has passed.

maintenance

The use of a small number of sequence switches to replace a large number of relays simplifies the maintenance problem for the following reasons:

1. Reduction in the number of contacts used in any interlocking circuit not only reduces the liability to contact trouble but also reduces the number of points where the maintainer must look for a fault.
2. The use of contact brushes making contact with motor-driven cams permits relatively high contact pressures to be used, while the wiping action of the motor-driven cam has a self-cleaning effect on the contacts. This makes for less contact trouble.
3. An indicator wheel, clearly marked with the route numbers, is provided on each sequence switch so that when searching for a fault, the maintainer can frequently get a quick and easy clue to the cause of the trouble by a glance at the indicators on the various sequence switches.
4. The compactness of the interlocking equipment centralizes the area of wiring and apparatus over which a maintainer must look should a fault occur.

equipment and apparatus

Sequence Switch—Figure 7 shows portions of three mounted sequence switches, the vertical drive shaft, and the two motors at the bottom of the cubicle. In Figure 8, is a completely equipped sequence switch. The gear on the vertical shaft (1), drives idler gear (2) and drive gears (3), and hence drives magnetic clutch (4). Figure 9 shows further details more clearly. The rotor is normally locked in position by lock arm (5) which engages slots in lock wheel (6). Lock assembly (7) also carries lock proving contacts (8). Route position indicator (9) shows the actual position of the switch at any time. Adjacent to the clutch are the Lock and Clutch control cams (10).

A sequence switch is capable of carrying as many as 120 cams, as in Figure 8. While electrically independent, cams are provided mechanically in pairs. For example, in Figure 9, the second disk to the right of the lock mechanism consists of insulation disk (11), which carries two phosphor bronze contacting rings, called cams; cam B-B (12) on the left side, and cam B-C (13) on the right side. Two bronze wiper springs or brushes (14) bear on cam B-B and two (15) bear on cam B-C. The four wiper springs are part of wiper assembly (16).

Figure 10 shows a wiper assembly and associated cams removed from the sequence switch. Assuming these to be the apparatus just described, cam B-C (13) and cam B-B (reverse side) are held in place on insulation disk (11) by four insulated rivets (14). Segments, such as (17) are cut away as required so that contact with the associated wiper springs is made only in positions where required. The disk (11) and

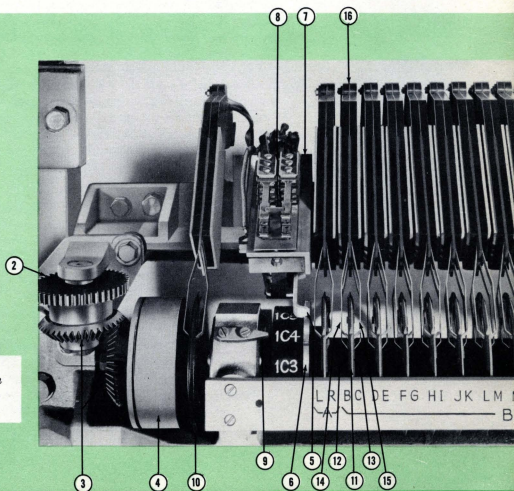


Figure 9—Sequence Switch
Details

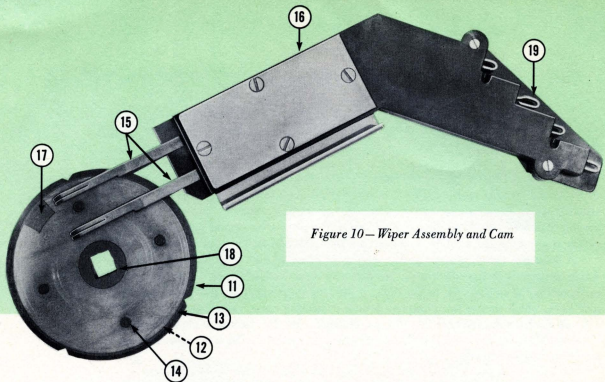


Figure 10—Wiper Assembly and Cam

its spacing boss with square hole (18) are molded in one piece. Since the disks are mounted on a square shaft, it is quite impossible for them to be rotated relative to each other. The wipers have double contacts, and there is a very large clearance between the contacts in the open position. Wire connections to the wipers are made to 4-wire terminals (19) conveniently located to the rear of the assembly.

Special care has been taken in the design of the sequence switch to arrange for easy replacement of complete rotor assemblies and also for the rapid changing of a cam on the rotor. In the event it becomes necessary to make circuit changes which require some cam revision, the cams required for the new circuits are cut beforehand and the change from one set of cams to the other is done in minutes.

In order to demonstrate the reliability of the sequence switch for signal use, tests have been carried out in which a sequence switch was made to set up each of 12 routes in succession, restoring to normal between routes. A total of approximately 1,500,000 routes were set up in the same manner. This is equivalent to over forty years of actual service in a typical plant. At the end of this test, the switch was still giving perfect service and detailed examination of the parts showed very little wear.

The principle of the sequence switch is not new. In a different design, it has proved itself for many years in the field of telephony.

Motor-Drive Unit—A motor provides the power to drive all the sequence switches, and normally two such motors are mounted together so that either motor can carry the entire load. See bottom part of Figure 7. In the event of a motor failure, switching is provided so that the stand-by motor can immediately take over the drive. This changeover can be effected either automatically or on the operation of a sealed switch. In either case an indication that the stand-by motor is in service is given.

Relays—The proving relays used in conjunction with the sequence switch are of a special type utilizing the efficient operating mechanism of the IT&T telephone type relay, together with a contact assembly using relatively large non-welding contacts and providing a very much improved insulation between contact springs. This relay is provided with a plug-in base permitting the rapid interchange of relays. It is enclosed in a sealed, transparent case. Ten such relay assemblies may be seen in the close-up view of the interlocking machine cubicle, Figure 7.

Control Panel—Control panels are constructed of sheet steel with a matte green finish mounted on a secondary sheet steel backing so that all the apparatus is screwed to the secondary plate without the need for any mounting screws appearing on the face of the panel.

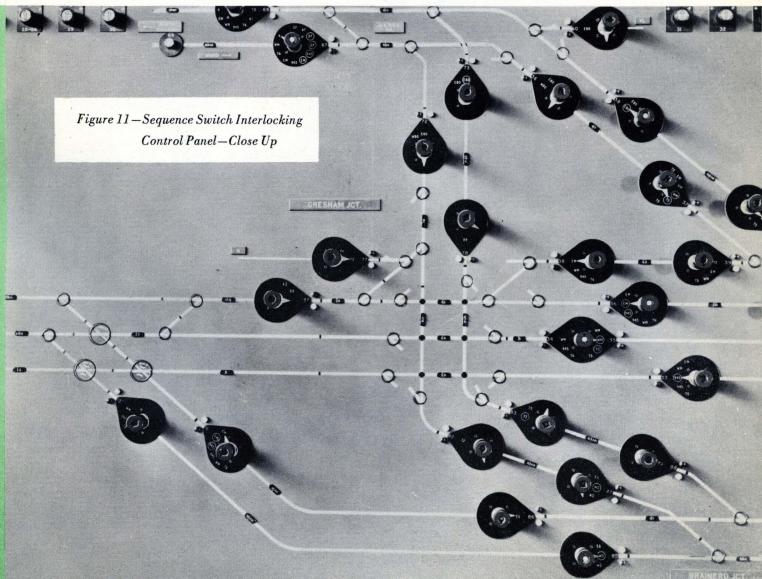
As shown in the panel close-up view, Figure 11, the diagram takes the form of 3/16" wide painted lines, the track sections being indicated by black divisions in the colored lines at the point of the insulated rail joints.

Control Desk—Control panels may be mounted on a desk of the type shown in Figure 12, which provides space for such related equipment as train describers, and telephone and yard intercommunication systems. Other designs can be supplied as desired.

The desk framework also contains the necessary terminals to handle the interconnecting wire between the panel and the interlocking cubicle.

Multiposition Route Selecting Key—A front view of mounted Route Selecting Keys will be seen on the panel layout, Figure 11.

*Figure 11—Sequence Switch Interlocking
Control Panel—Close Up*



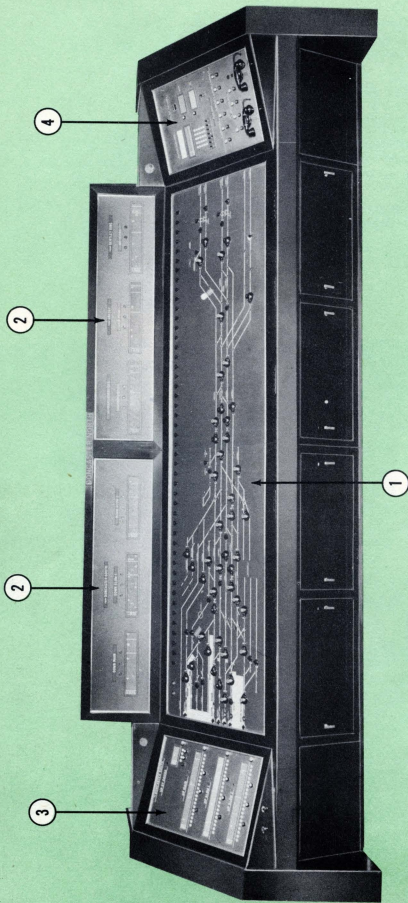


Figure 12—Sequence Switch Interlocking Control Desk with Train
Describers and Telephone Equipment

- 1—S/S Control Panel
- 2—Train Descriptor Receivers
- 3—Train Descriptor Transmitters
- 4—Telephone Communications Panel

The control knob is free to rotate to any position and is provided with a snap action detent between adjacent positions. No effect on the control circuits is produced, however, until the knob is "plunged" in the selected route setting position. It is impossible for the operator to plunge the knob unless it is accurately centered in a route position and, conversely, it is impossible to rotate the knob after it has been plunged. The plunging movement on this key has been made relatively long in order that it will be very clear to the operator whether any Route Selecting Key on the panel is plunged or not.

When it is desired to restore the route to normal, it is only necessary to withdraw the knob of the Route Selecting Key, whereupon the route set up will be restored subject to the usual locking requirements.

remote control

The Sequence Switch Interlocking and Panel Control Systems are admirably suitable for use in areas where it is desirable to employ Remote Control, since the Control Panel can be situated at any convenient location while the sequence switch interlocking portion can be placed adjacent to the layout to be controlled, operations of the interlocking equipment being fully safeguarded independent of the remote control system employed.



Foreground: Federal Telecommunication Laboratories and famous Microwave Tower—"The Center of Federal Research"—in Nutley, N. J. Background: Modern manufacturing plant of Federal Telephone and Radio Company, in Clifton, N. J.

picture credits

*Figures 1, 2, 7, and 11,
courtesy of
Chicago, Rock Island and
Pacific Railroad Company.*

*Figure 12, courtesy of
London and North Eastern
Railway Company.*

