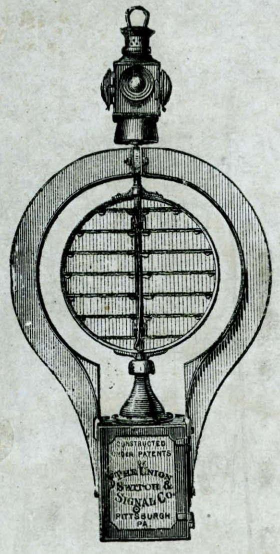
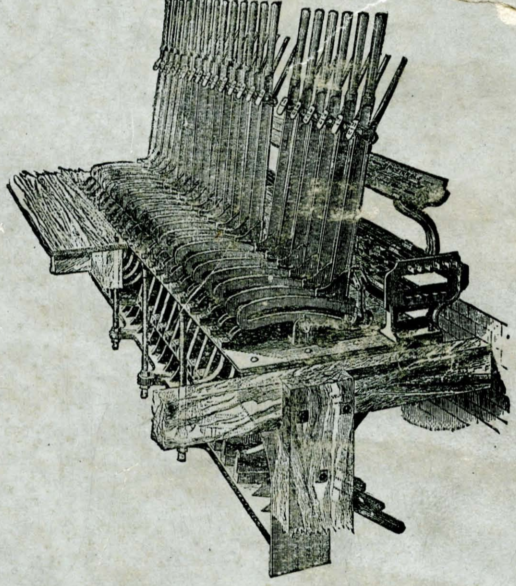


Catalogue of

The Union Switch and Signal Company.

Interlocking.



L. E. Dodge

THE UNION SWITCH AND SIGNAL COMPANY,

MANUFACTURERS OF

RAILROAD SIGNALING APPLIANCES

OF ALL DESCRIPTIONS.

FROGS, CROSSINGS, SWITCHES AND SWITCH STANDS

OFFICE AND WORKS:

Corner Duquesne Way and Garrison Alley,

PITTSBURGH, PENNA.

MAY 1st, 1883.

Press of Myers, Shinkle & Co.,
Pittsburgh.

OFFICERS.

PRESIDENT.

GEO. WESTINGHOUSE, Jr.

VICE PRESIDENT AND GENERAL MANAGER.

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CONTRACTING ENGINEER.

HARVEY TILDEN, C. E.

SIGNAL ENGINEER.

CHARLES R. JOHNSON,

Office, Smith Building, 3, 5 and 7 Cortland Street, New York.

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Robert Pitcairn,

D. M. Yeomans,

H. H. Westinghouse.

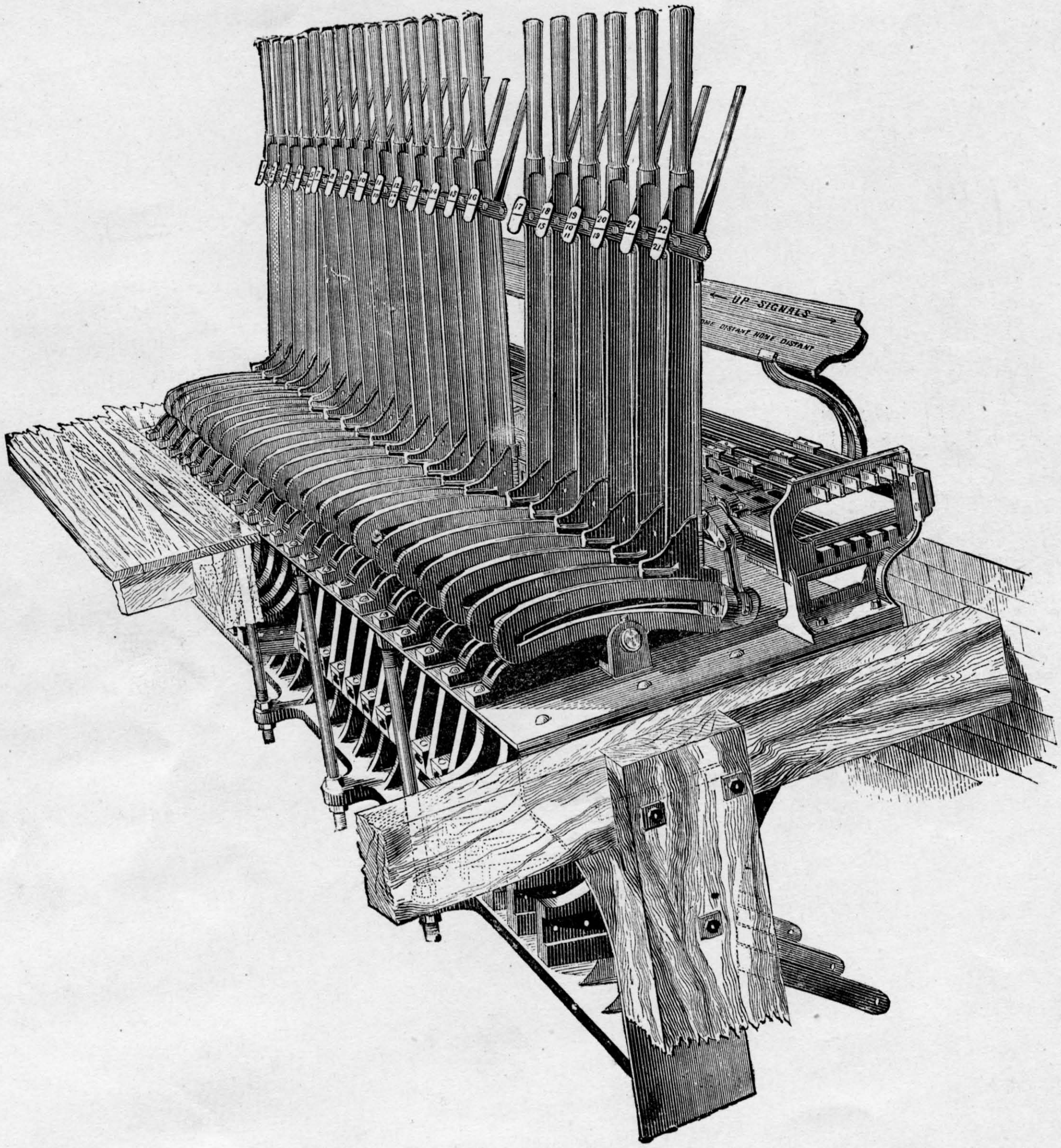
Frank L. Pope,

Henry Snyder.

CONTENTS.

Interlocking of Switches and Signals.

FIGURE 9.



Interlocking of Switches and Signals.

THE complete system of operating railway switches and signals by INTERLOCKING APPARATUS has been reached by successive steps; the gradual development covering many years. The first step was probably the combination of the stub-switch and target, still extensively used, the target standing perpendicular to indicate "main track clear," and inclined for "side track clear."

The second step, a combination of the stub-switch and revolving red and white target, coupled with red and white lights moving simultaneously with the switch.

The third step, the removal of the target and light to a distance from the switch, and operating the two separately, first the target, then the switch, either of which could be moved independently of the other, and thus the operator could break the main track without first giving the danger signal, or he could give the wrong signal.

The fourth step was the invention of a system whereby it is IMPOSSIBLE for the operator to give a WRONG SIGNAL, or break the main line without first setting the danger signal, which cannot be withdrawn while the switch is on the side track.

The last principle is the basis of the present Interlocking systems. The switches and signals of a junction, crossing, drawbridge, terminus or other dangerous points, are controlled by a single operator from a cabin. In this are placed the levers, set in a cast iron frame, by which the whole system of signals and switches is operated.

By the peculiar mechanism of this locking apparatus (Figure 9) the levers are so interlocked with each other that the switches must be properly set and locked before it is possible to move the corresponding signal levers, and the different signals are so interlocked as to protect the path of a signaled train until it has passed the danger point. In brief, the pith of the system consists:

1st. In concentrating as many signal and switch levers together as can be worked conveniently from one station.

2d. The switches and signals of any danger point, however complicated, are connected in such a way that it is mechanically impossible that the position of the switches should ever be contradictory to that of the signals, or that incompatible signals should be given.

No matter how complicated the junction may be, if there are twenty, one hundred, or any number of levers brought together in a "signal cabin," there is no possibility of the signal man making a mistake.

This is illustrated in the words of Mr. J. W. Barry, in his excellent book on "Railway Appliances." He says: "If a man were to go blindfolded into a signal-box with a interlocking apparatus, he might, so far as accordance between points and signals is concerned, be allowed with safety to pull over any lever at random. He might doubtless delay the traffic, because he might not know which signal to lower for a particular train, but he could not lower such a signal or produce such a combination or position of points and signals as would, if the signals were obeyed, produce a collision."

In describing the various methods of accomplishing the interlocking of switches and signals, that system in which *leverage* is used as the motive power, will be called the Mechanical in contradistinction to Hydraulic or Pneumatic Interlocking.

The Saxby and Farmer Interlocking Apparatus.

FIGURE 10.

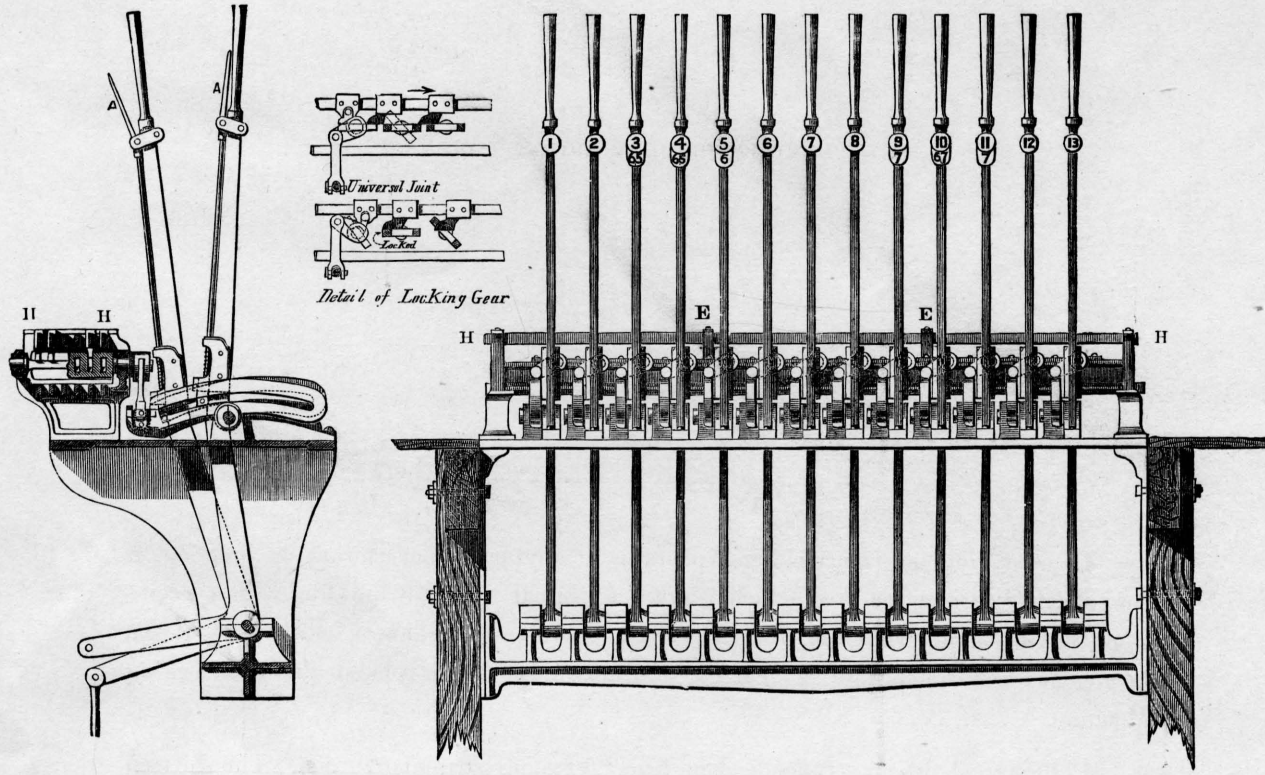
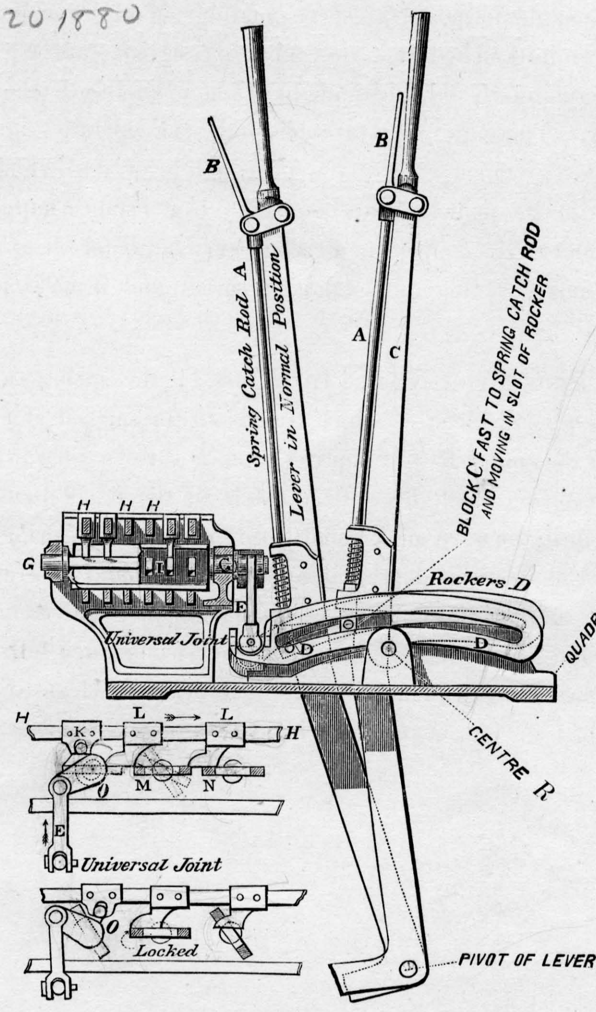


FIGURE 11.

J. Saxby #230200 July 20 1880
104-121



The Saxby and Farmer Interlocking Apparatus.

In arranging an Interlocking Apparatus at any particular station or junction, a convenient site is selected on which is erected a signal tower, or building with a second story having large windows, from which the operator may have a clear view of the arrangement of tracks and movements of trains. In this is placed the Interlocking Machine.

Figure 10 shows an arrangement of levers for some particular station. The thirteen levers are so interlocked that the switches must be properly set and locked in the right position before it is possible to move the corresponding signal lever, or levers; and the signal levers also are so interlocked that no conflicting signals can be given. It will be noticed that each lever is numbered, and some have one or more secondary numbers under the principal number. These numbers are to guide the operator, and the secondary numbers specify the levers which control the principal lever, and which must be moved before any movement of the principal can be made. For instance, suppose lever No. 11, having under it secondary No. 7, operates a certain switch; before it is possible to use it, lever No. 7 must be moved, acting on the danger signal, and protecting the opening of this switch by No. 11.

The Interlocking Mechanism. In Figure 11, the spring catch rod A carries a stud upon which is a small block C, which travels in the curved slot of the rocker D, which is movable on the center R. When the lever is thrown forward or backward to its full position, the spring catch fits into a notch, in the fixed quadrant on which it moves. When it is in its forward or normal position, with the spring catch rod down, the left hand end of the rocker is depressed, and the right hand end raised, as shown by dotted lines. When the spring catch rod is raised the rocker moves into the position as shown by full lines, and keeps this position until the spring catch falls into the notch at the rear of the frame, when it assumes the third position, elevated on the left and depressed on the right. A jaw at the left hand end of the rocker carries a universal jointed vertical link E, giving motion to a small crank at the end of a spindle, the bearings of which are shown at G. G. there being a spindle for each lever.

These spindles lie directly under a series of horizontal rectangular bars, as shown at HH, called locking bars, and to these are attached pieces of iron LL, called locks.

The spindles are flat in their central portion, as shown at M and N, and when they stand in their normal position they are horizontal, and the locking bars and locks are free to move forward and backward over them. When turned up, however, out of the horizontal, as shown at I, and in dotted lines at M, they catch on the locks and stop their movement, and that of the bars to which they are attached. Some of the spindles are required to work locking bars, and are provided with a short vertical crank, the stud of which works between two lugs on the locking bar, as shown at K, giving a horizontal motion to the bar at any movement of the spindle.

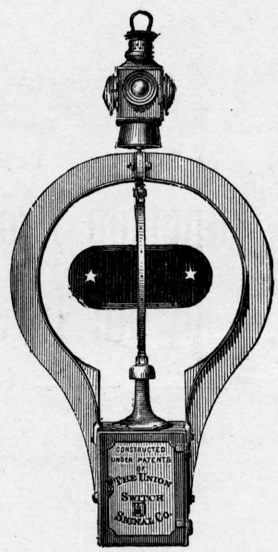
It will be seen that the locks and crank attachments may be fixed at any location desired on the locking bars, by means of tap bolts or keys, some being made to allow of free movement of one spindle as at M, while at the same time another spindle, as at N, is locked.

Whenever the spring catch of any lever is raised, its rocker is lifted and the corresponding spindle turned. If the spindle is locked it will be impossible to move the spring catch.

A very small movement of the spring catch, if the spindle is free, will tilt it up sufficiently to lock the locking bar upon which it works, and prevent any movement of by other levers.

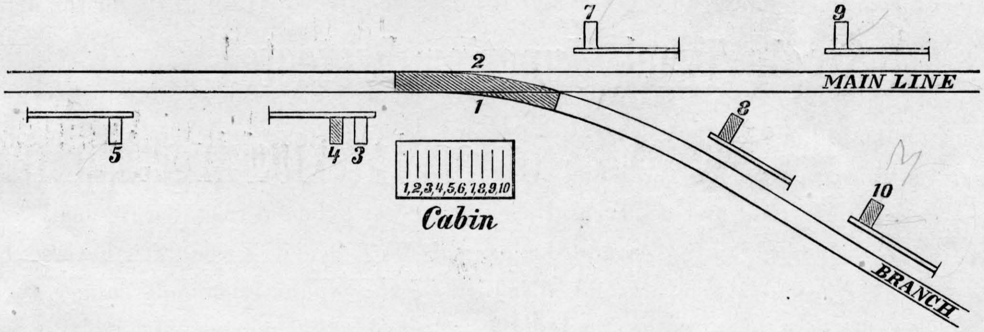
The spindle can occupy three positions, as shown at M: First, the horizontal, when the lever is in its normal position; Second, slightly inclined, as shown by dotted lines, when the lever is being moved; and, Third, a more inclined position, also showu by dotted lines, when the lever has been pulled to the full extent of its stroke, and the spring catch released. The third position is a very important one, some of the locks not being released until this position is attained. Thus the spindle N is not released until that at O is in the third position, and the lock over N has been moved sufficiently to the right to enable it to enter a slot in spindle N. The spindle N, then, by its new position shown at I, prevents a return movement of the lock, or any change of the spindle O, until brought back to the horizontal position corresponding to the lowering of the spring catch into the forward notch of the quadrant. As has been mentioned, it is impossible to move the spring catch rod when its spindle is locked, consequently the attempt to move a locked lever is instantly checked, mistakes on the part of the operator prevented, and much unnecessary wear to the locking apparatus avoided.

The connections from the levers to the switches are made by rods or pipes, and sometimes to the signals by the same, but usually by wires or wire ropes.


CONSTRUCTED
UNDER PATENTS
OF
THE UNION
SWITCH
SIGNAL CO.

A Single Track Junction Protected by an Interlocking Apparatus.

FIGURE 12.



A SINGLE TRACK JUNCTION PROTECTED BY AN INTERLOCKING APPARATUS.

The switch, its lock, and the signals, are numbered, and heir numbers correspond for convenience of illustration with those of their respective levers in the cabin, as shown in Figure 12. No. 1 is the switch, No. 2, the switch-lock, No. 3, the main line up home signal, No. 4, the branch up home signal, No. 5, is the distant signal for the main line up, and the branch up, No. 7, is the main line down home signal, No. 8, the branch down home signal, and Nos. 9 and 10, the respective distant signals for the main line down and the branch down.

THE NORMAL POSITION.—All signals show danger; the switches are unlocked and set for the main line; the lock levers are forward, locking all signal levers to "danger." Should a train approach on the main line up, the junction being free to permit its passage, lever No. 2 would first be reversed, locking the switch and releasing the main line signals. As soon as this is accomplished, signals Nos. 3 and 5 would be lowered by reversing their respective levers, and all other signals would remain at danger, their levers, together with that of the switch-lock, being locked by the movement of the lever No. 3. Similar action would take place if a train were to approach the main line down, in which case signals Nos. 7 and 9 would be lowered, locking all others in the danger position, and the switch could not be moved. If an up train were approaching for the branch, the lever No. 1 would be reversed, setting the switch for the branch, thus locking the main line signals; then the switch would be locked by reversing lever No. 2, which action would release the branch signals, 5, 4, 8 and 10, and their levers being reversed will lock for the second time the main line signals. The order in which the levers have to be manipulated is therefore, 1, 2, 4, and 5, and in exactly the reversed order if the switch had to be moved back again, namely, 5, 4, 2, and 1.

Finally, when a branch train is approaching the junction for the main-line, the levers could be moved only in the following order: 1, 2, 8, and 10, and the normal position again restored only by moving the levers in the reversed order.

THE UNION SWITCH & SIGNAL COMPANY.

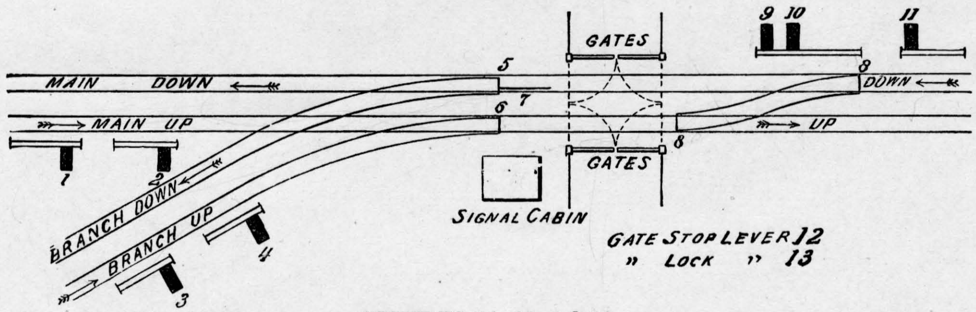
MANUFACTURERS OF ELECTRICAL APPLIANCES for RAILWAYS.

SAFETY

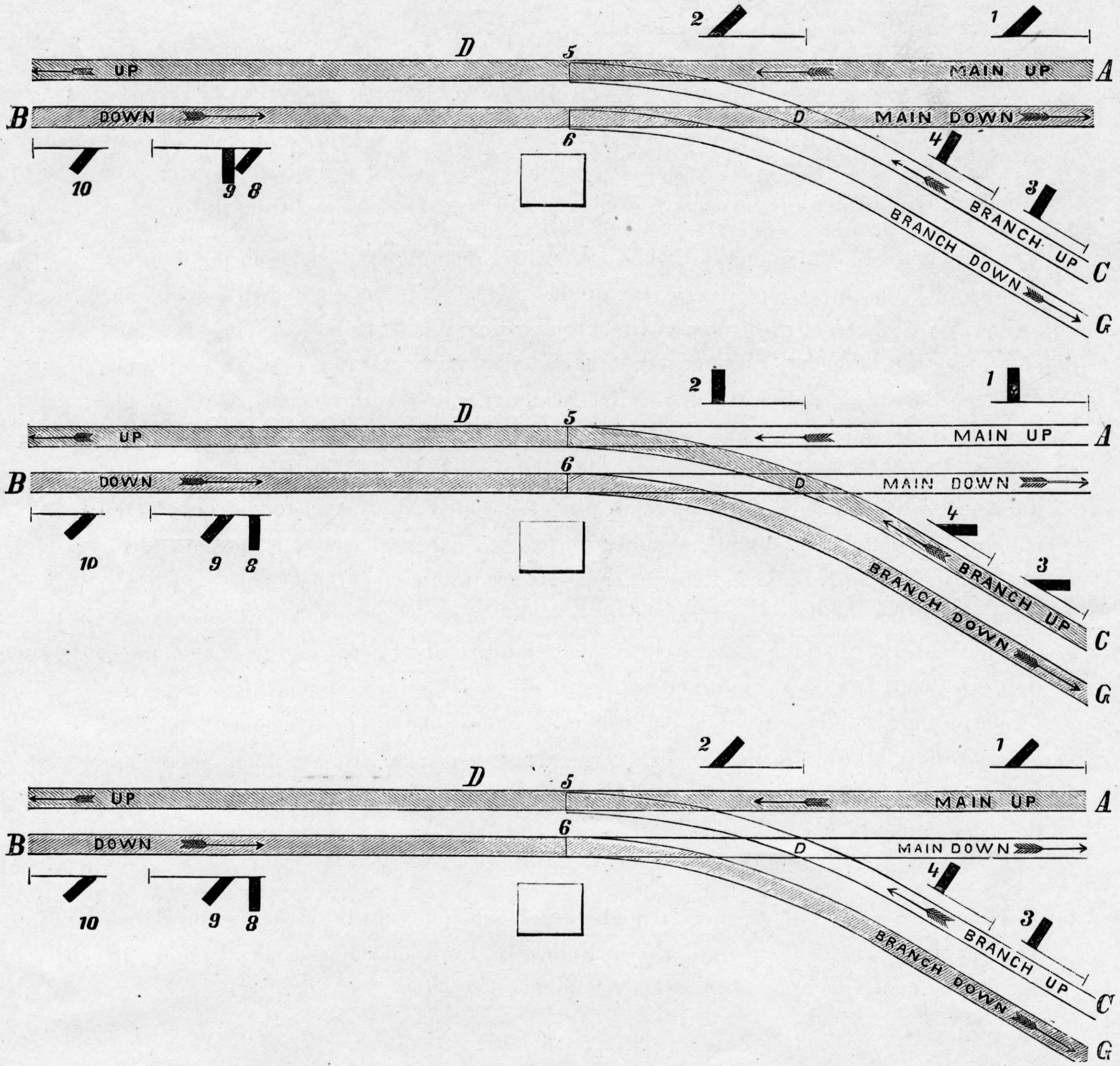
T. U. S. & S. Co. Pat. Pittsburgh, Pa.

A Double Track Junction Protected by an Interlocking Apparatus.

FIGURE 13.



FIGURES 14, 15 and 16.



A Double Track Junction Protected By an Interlocking Apparatus.

In addition to the usual signals and switches it has also a roadway-crossing protected by gates, which can be opened, or closed, and locked in position, from the cabin.

In Figure 13, the signals, switches, and switch-lock are numbered, and the numbers correspond with their respective levers in the cabin. No. 7 is the switch-lock for the switch No. 5; but it will be observed that the switch No. 6 has no lock since it is used only as a "trailing point." When a train passes from one line of rails to another, all other traffic on these lines and on the line or lines which it crosses must be stopped. If, for instance, a train were to enter the branch from the main down line, a collision might occur on the crossing, if at the same time a train on the main up line were to approach the junction. It is, therefore, neccessary that when the switch No. 5 is set for the branch, the main up line signals, Nos. 1 and 2, should be locked, to "danger," as well as the main down-line signal. No. 9, No. 11, and No. 10 being already set for the branch. The switches in their normal position being set for the main lines, the branch-line signals are then locked to indicate danger. Trains passing from the main down to the branch, and from the branch up to the main line do not interfere with each other, and on this account their respective levers of signals and switches do not need to be interlocked. The cross-over track, No. 8, is also interlocked with the signals. The gates are operated from the cabin, and have a "gate-stop" lever, and a "gate-lock" lever, so interlocked with the signal levers that the gates cannot be opened unless all the track signals indicate danger, and no signal can be lowered to safety while they are open.

Figures 14, 15, and 16 shows a double-track junction with the switches and signal set: in Figure 14, for the main lines; in Figure 15, for branch lines, and in Figure 16, one for the main line up, and the other for branch down.

FIGURE 17.

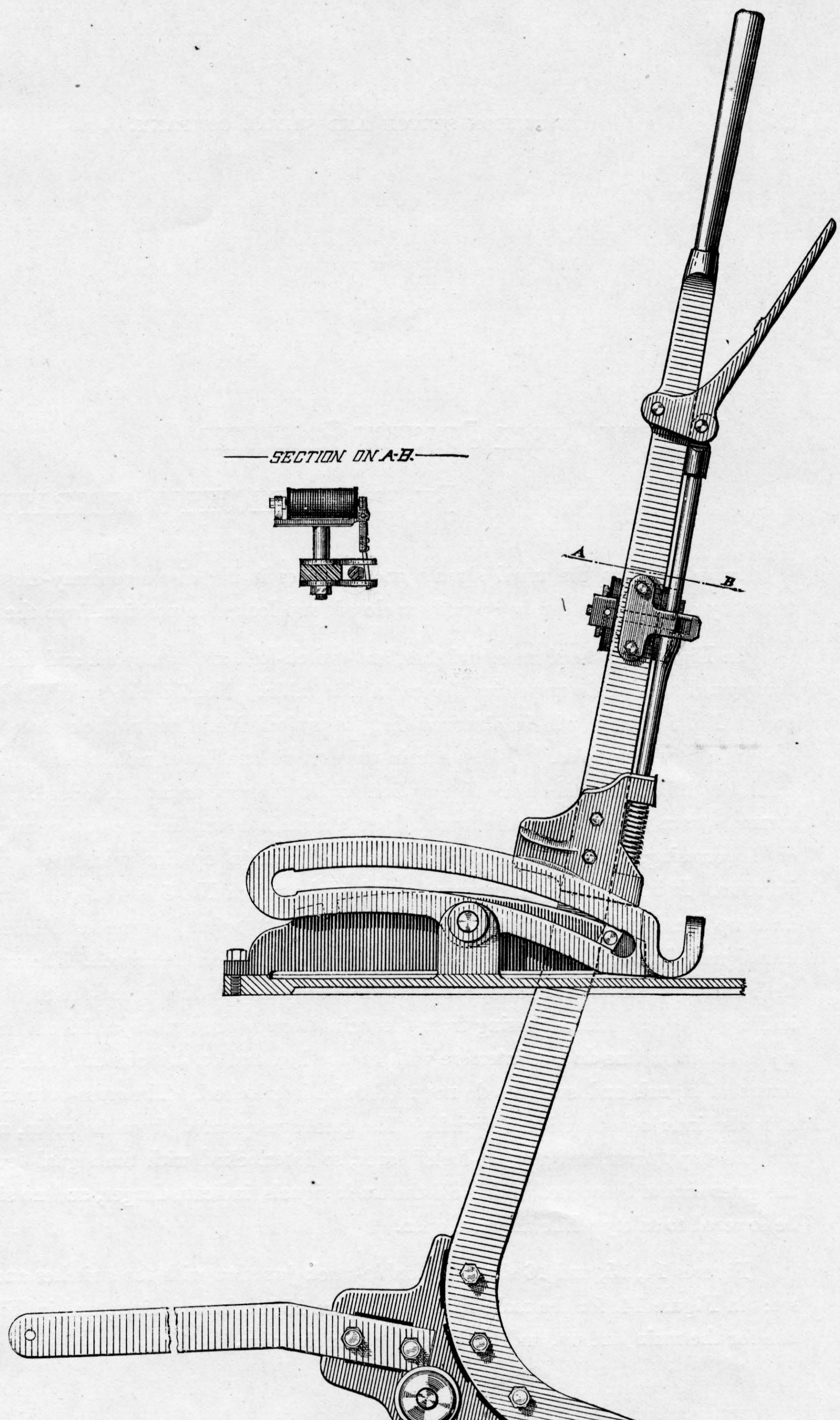
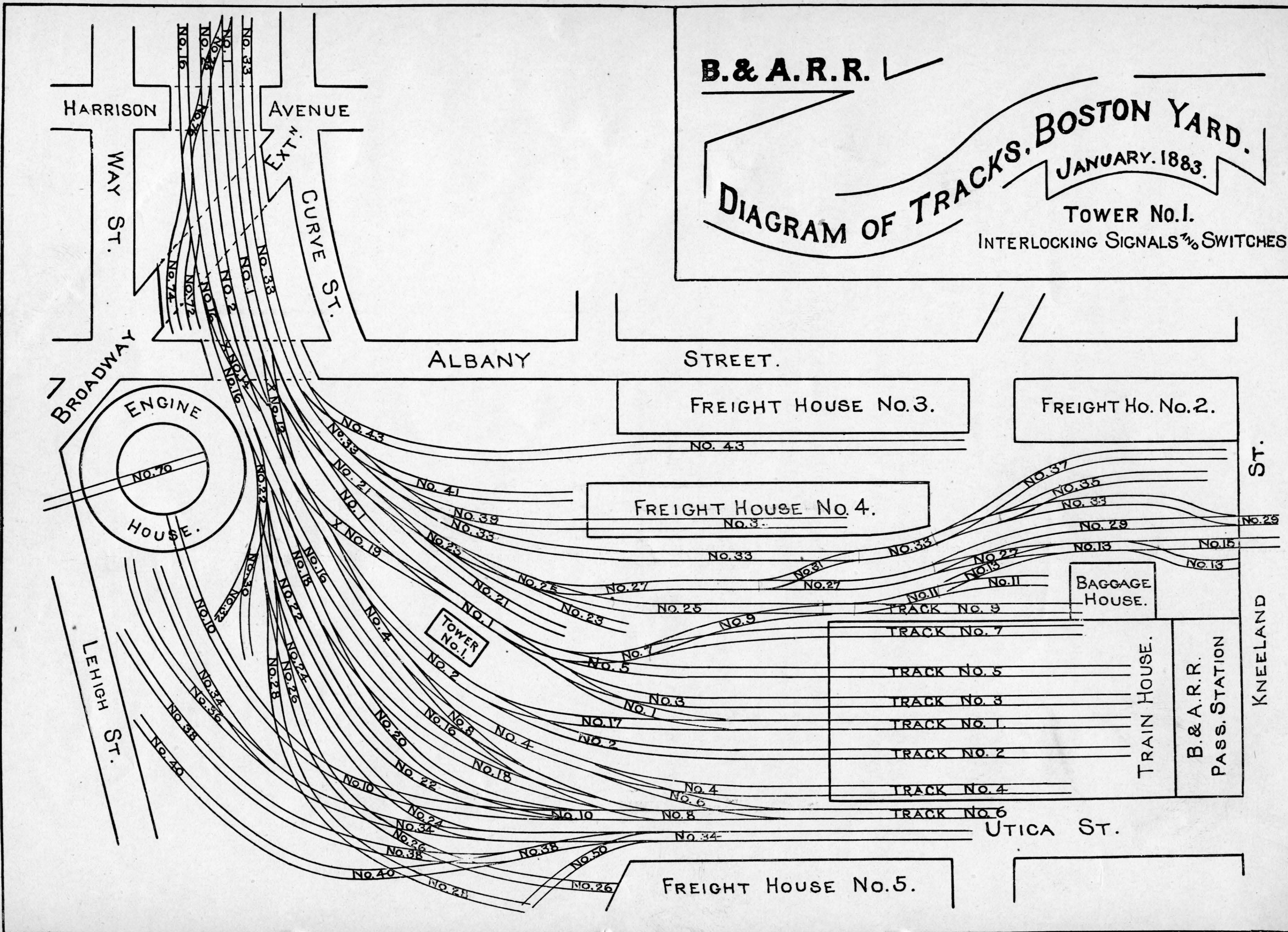


FIGURE 18.


B. & A. R. R.
DIAGRAM OF TRACKS, BOSTON YARD.
JANUARY. 1883.
TOWER No. 1.
INTERLOCKING SIGNALS AND SWITCHES.
HARRISON AVENUE EXTN.
WAY ST.
CURVE ST.
BROADWAY
ALBANY STREET.
ENGINE HOUSE.
FREIGHT HOUSE No. 3.
FREIGHT HO. No. 2.
FREIGHT HOUSE No. 4.
BAGGAGE HOUSE.
TOWER No. 1.
TRAIN HOUSE.
B. & A. R. R. PASS. STATION
KNEELAND ST.
LEHIGH ST.
UTICA ST.
FREIGHT HOUSE No. 5.
TRACK No. 9
TRACK No. 7
TRACK No. 5
TRACK No. 3
TRACK No. 1
TRACK No. 2
TRACK No. 4
TRACK No. 6

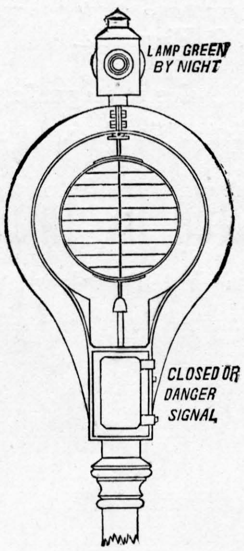
The switch-lever for the up track, and the switch-lock lever for the down track have the electric lock attached, and are automatically locked by the presence of a train upon the track. The tracks are all insulated at points on both sides of the junction, and a train having passed an insulated point, with the distant signals at "safety," is positively insured against any change of switch or signal, until it has passed beyond the junction. For instance, a train arriving at A, Figure 14, finds the distant signal 1, at "safety" and this being the case, is assured that the "home" signal 2, is also at "safety" and the switch properly set, it is now impossible that any change whatever should be made while the train is passing from A to D, that is, past the switch and out of the insulated section.

A train is similarly protected on arriving at B, Figures 14, 15, and 16, at C, Figure 15, and at A, Figures 14 and 16, and C, Figure 14.

Figure 17 shows a lever with the electro-magnetic lock. A is the magnet, and B the armature by which the catch-rod is held in place. See description, page 47.

The number of combinations that can be made to interlock different levers is unlimited, and can be arranged to suit any conditions.

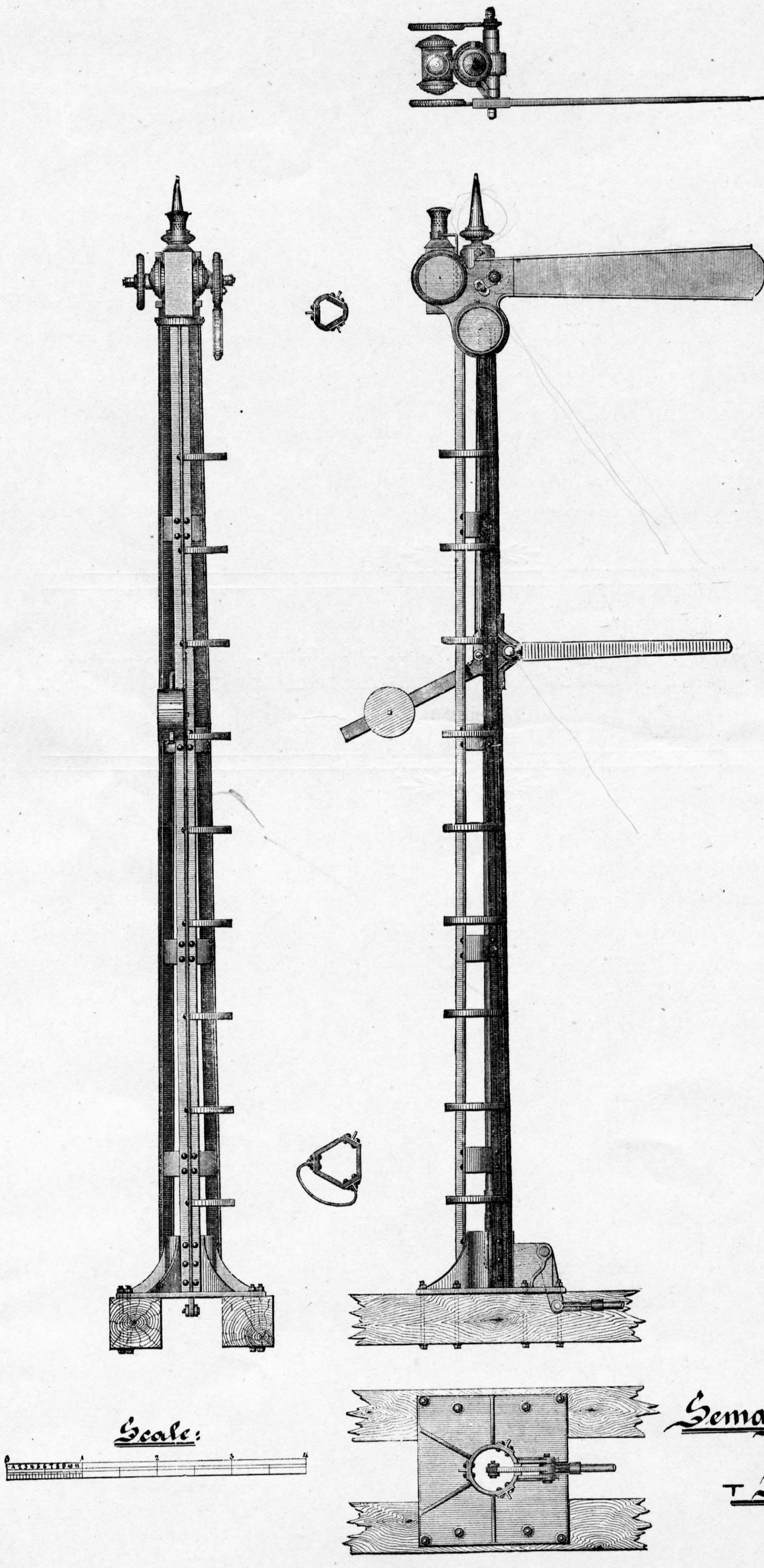
Figure 18 is an example of a complicated yard, where a machine of sixty-four levers is used.


LAMP GREEN
BY NIGHT
CLOSED OR
DANGER
SIGNAL

Drawbridges Protected by Interlocking Apparatus.

? C. H. Jackson #230418 July 27 1880 - 104 - 67

FIGURE 19.



Semaphore Signal
on
T Iron Post.

Drawbidges Protected by Interlocking Apparatus.

The interlocking of drawbridges with signals is effected in the same manner as that of switches.

Any mechanism is absolutely dangerous which does not compel the setting of the danger-signal before the draw is unlocked, or the locking of the draw in position before the signal is restored to safety. Numberless facts may be cited to corroborate the truth of this. Our interlocking mechanism *positively* prevents such mistakes. See also Catalogue of Block Signalling.

We have other devices to warn the engineer of danger should he overlook the danger signal on account of fog, storm or darkness. One consists of a *contact-bar*, which is attached to the semaphore-signal, placed at such height as to strike the lccomotive cab and warn the engine-driver that the signal is set at danger, or which shatters a glass tube and automatically applies the air-brake. This bar, R, is moved simultaneously with the arms taking with it a similar position, as shown in Figure 19. Another device is the derailing switches, referred to under the head of "Protection of Railroad Grade Crossings."

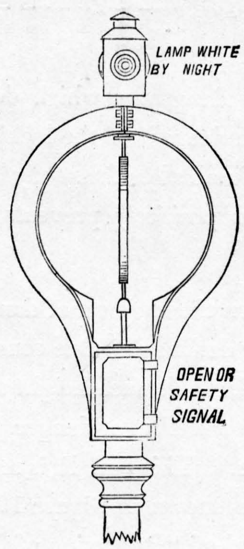

LAMP WHITE BY NIGHT
OPEN OR SAFETY SIGNAL

FIGURE 20.

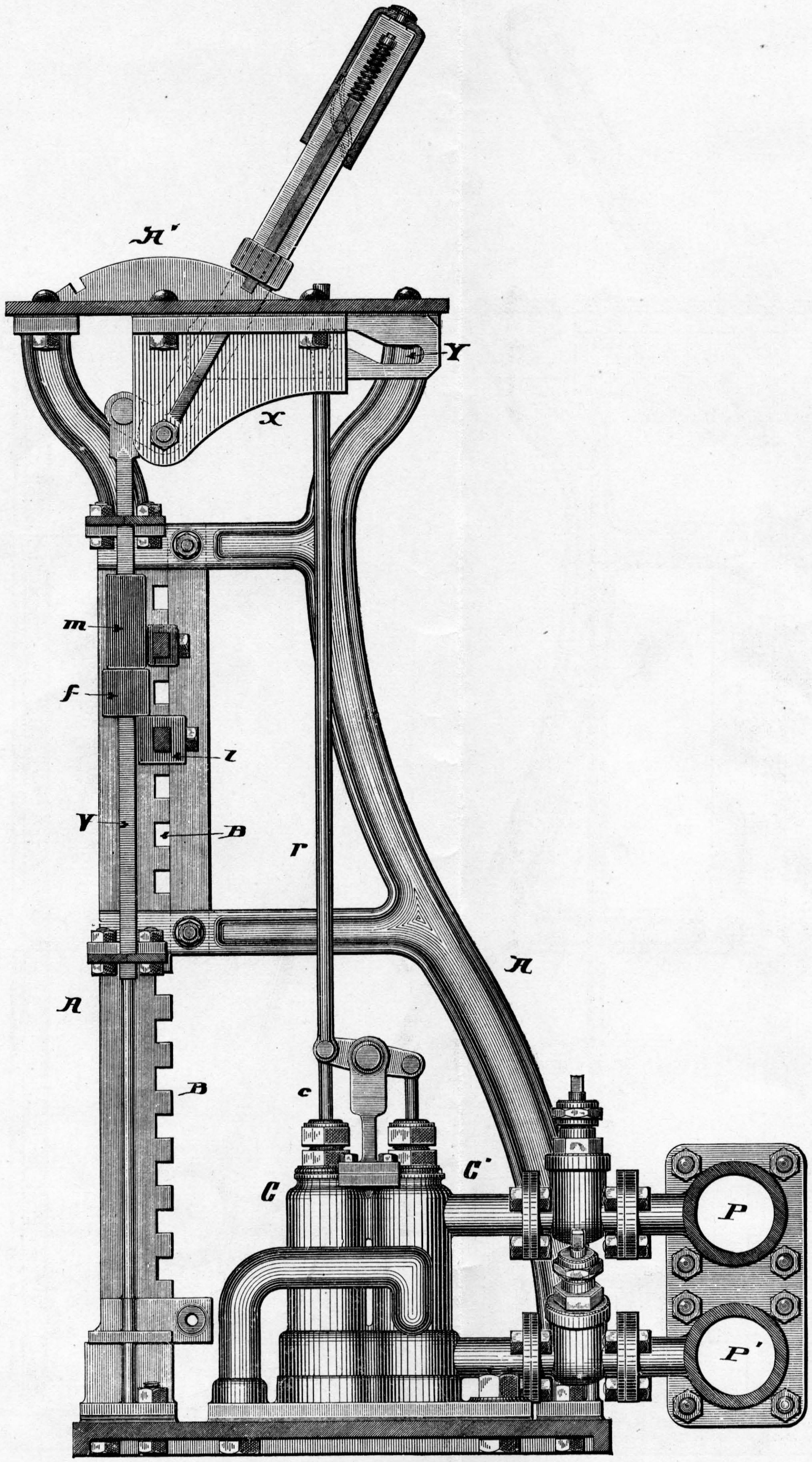
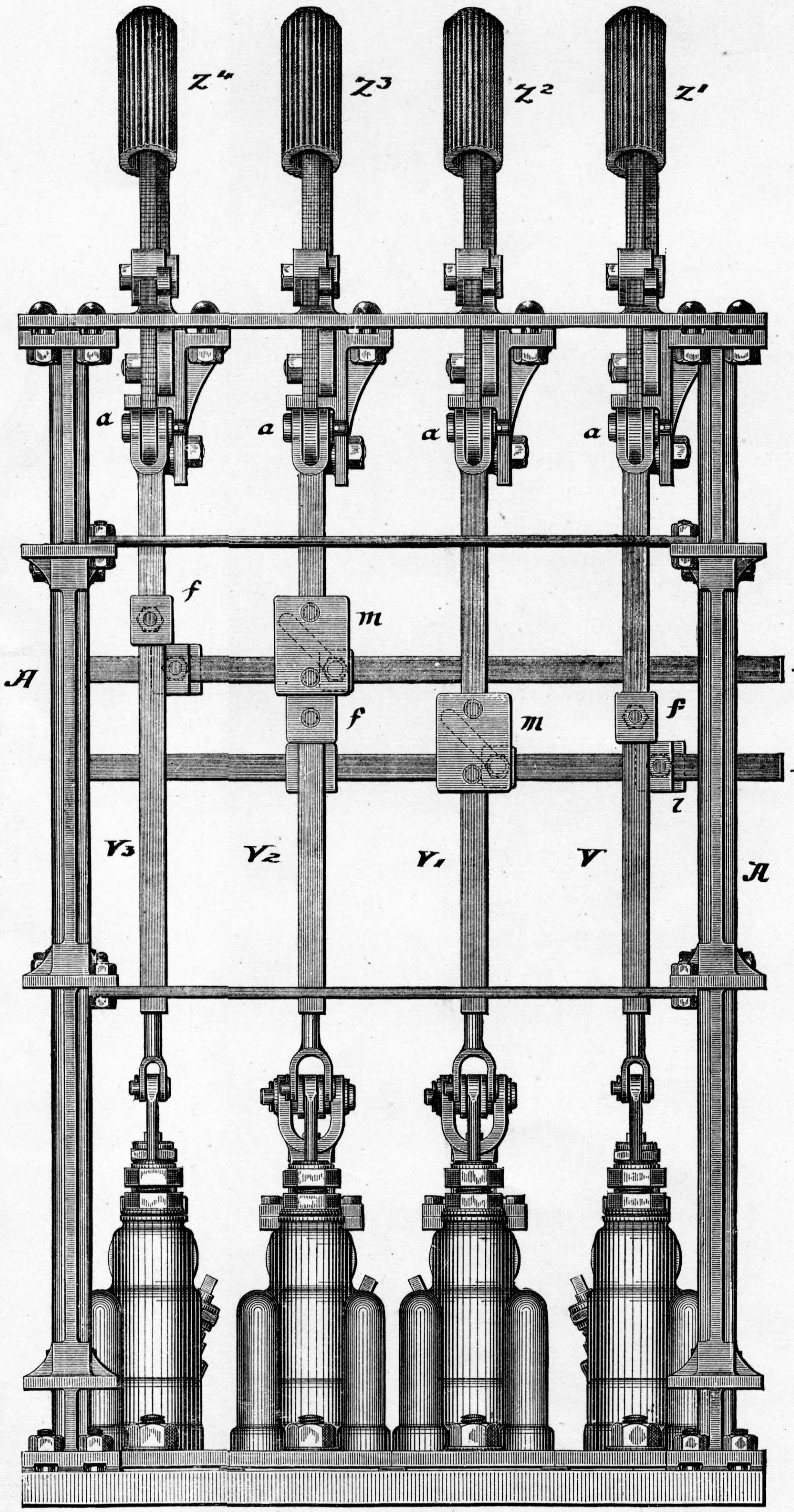


FIGURE 21.



HYDRAULIC INTERLOCKING APPARATUS.

In Hydraulic Interlocking the actuating force is applied by fluid pressure, conveyed through pipes to the requisite points, the pressure being regulated by valves, which are controlled by levers connected with any approved system of interlocking, for instance, the Saxby and Farmer, described on pages 13, 14 and 15, or the apparatus illustrated in Figures 20 and 21.

The Hydraulic levers are small, since they are required to move the locking apparatus and valves only.

By reference to Figures 20 and 21, the construction will be readily understood. A is a frame in which the whole interlocking apparatus is secured. A' is the quadrant, the distance between the notches at the front and back determining the length of stroke of the lever. The front part of the frame has slots B, to receive and guide horizontal locking bars, shown at H, in Figure 21.

A vertical locking bar is connected by a crank *a*, with each lever. These bars are supplied with shifting locks *m*, (Figure 21), as well as fixed locks *f*, similar to the locks *l*, on the horizontal bars. There may be any number of horizontal bars and of course the vertical bars may have the corresponding number of locks.

P and P', are the main pipes for carrying the fluid, and act alternately as supply and relief pipes.

C, C', is a double cylinder containing what are called duplex valves, which work in concert, so that while one opens its supply pipe the other opens its exhaust.

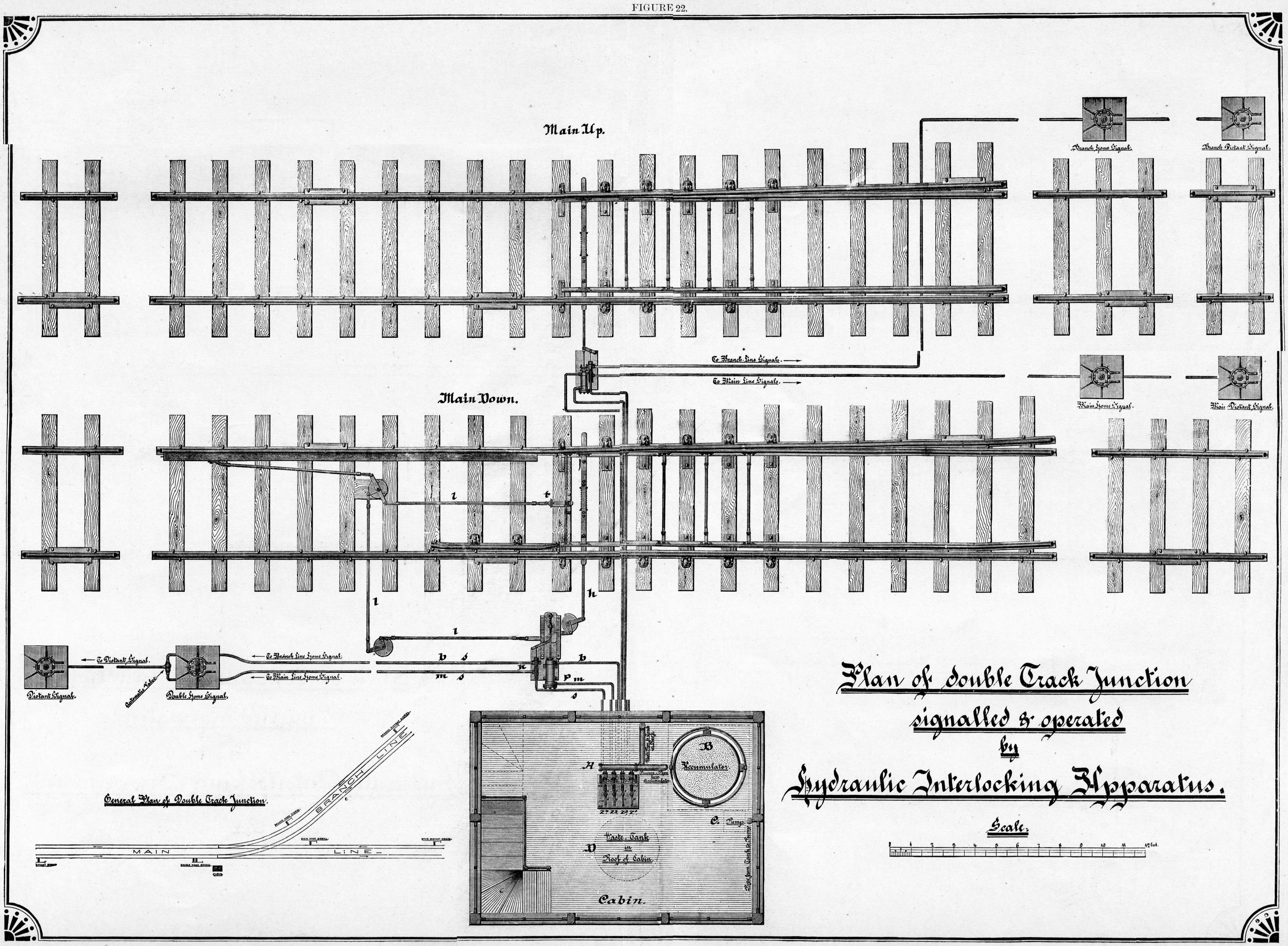
The plate *x* is an important adjunct to the interlocking. In one end is the slot *y*, shaped in a peculiar manner, in which plays a wrist attached to the piston rod *r*, and at the other end it is attached to the lever Z.

Suppose the spring catch of the lever Z to be raised out of the notch, and the lever brought forward; during the first third of the stroke the plate X slides horizontally without moving the rod *r*, but the bar V is forced down and all the necessary *locking* accomplished. During the second third of the stroke, the rod *r*, and consequently the piston of C, is forced down by the incline in the slot Y, while the piston of C is lifted; during the last part of the stroke the slot in the plate X is again horizontal and does not affect the piston rod *r*, but the bar V is forced down to its fullest extent and is now made to do all the needed *unlocking*.

In Figure 21 the levers and interlocking apparatus needed for a double track junction are shown. The two end levers Z^1 and Z^4 are connected with single valves and are used to move the signals.

The middle levers Z^2 and Z^3 are connected with duplex valves and move the switches and facing point lock with safety bar attached.

FIGURE 22.



Main Up.
Branch Home Signal.
Branch Distant Signal.
To Branch Line Signals.
To Main Line Signals.
Main Home Signal.
Main Distant Signal.
Main Down.
To Distant Signal.
To Branch Line Home Signal.
To Main Line Home Signal.
Distant Signal.
Double Home Signal.
General Plan of Double Track Junction.
BRANCH LINE
MAIN LINE
Accumulator.
Waste Tank in Roof of Cabin.
Cabin.
Plan of double Track Junction signalled & operated by Hydraulic Interlocking Apparatus.
Scale.

Double Track Junction Signalled and Operated By Hydraulic Interlocking Apparatus.

Figure 22 shows the plan of a Double Track Junction with the Hydraulic Interlocking Apparatus just described. The apparatus is contained in the cabin and includes the four lever machine A, an accumulator B, pump C, and relief tank D. The fluid used may be any non-freezing liquid. The relief tank is put on the top floor of the cabin, high enough to keep the operating pipes always full.

The accumulator B is a large cylinder, into which the fluid is pumped from the relief tank and kept under pressure by a weighted piston.

In Figure 22, representing the normal condition of the apparatus, the switches are set and locked for main line and the corresponding signals at danger.

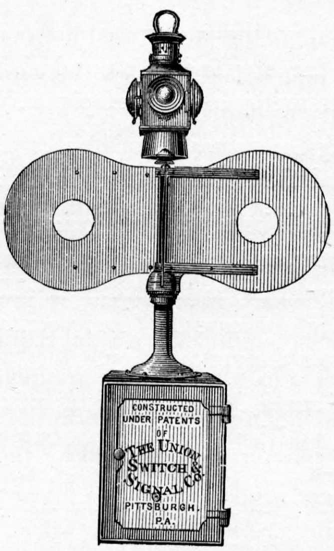
The switch on the down track being a facing point, has lock and safety bar. On the up track these are not necessary, as the switch is used as a trailing point. This being the normal condition of the apparatus, to pass trains in either direc tionon main lines it is only necessary for the operator to reverse the levers controlling the signals on the main lines when they will change from danger to safety.

To set the switch for the branch down the operator first returns the main line signal levers to their normal position, which relieves the pressure on the main signal pipes M S, and the signals being counter-weighted go to danger; as the switches stand now for the main line, pressure is carried along the pipe M to the double acting piston in the cylinder P, and the operator reverses the switch lever which relieves pressure in M and sends it along B to the other end of the cylinder. The piston is forced down and actuates first the rods *l*, *l*, *l*, which draws out of its socket the switch lock; next, the lever *h*, which sets the switch for the branch; and third, the lever *l*, *l*, *l*, are again actuated and re-lock the switch. The movement of the piston also opens a valve in the small cylinder K, which admits pressure to the branch signal and closes the valve for the main signals.

The signal lever is now moved and pressure transmitted along the pipes *s*, and *b*, *s*, to the branch signals.

To re-set the switch for the main line it is only necessary to follow the reverse order of the movements just explained.

For the up track the same number of levers, hydraulic pipes and cylinders are used, but as there is no lock the rods *l*, *l*, *l*, are omitted.


CONSTRUCTED
UNDER PATENTS
OF
THE UNION
SWITCH &
SIGNAL CO.
PITTSBURGH.
P.A.

THE ELECTRO-PNEUMATIC INTERLOCKING APPARATUS, FOR STATIONS, YARDS AND DRAWBRIDGES, ETC.

In this system, compressed air is the power used for moving the switches, signals, locking bolts, etc. One line of pipe is laid through the yard and from this branch pipes are led to the switches and signals, as desired.

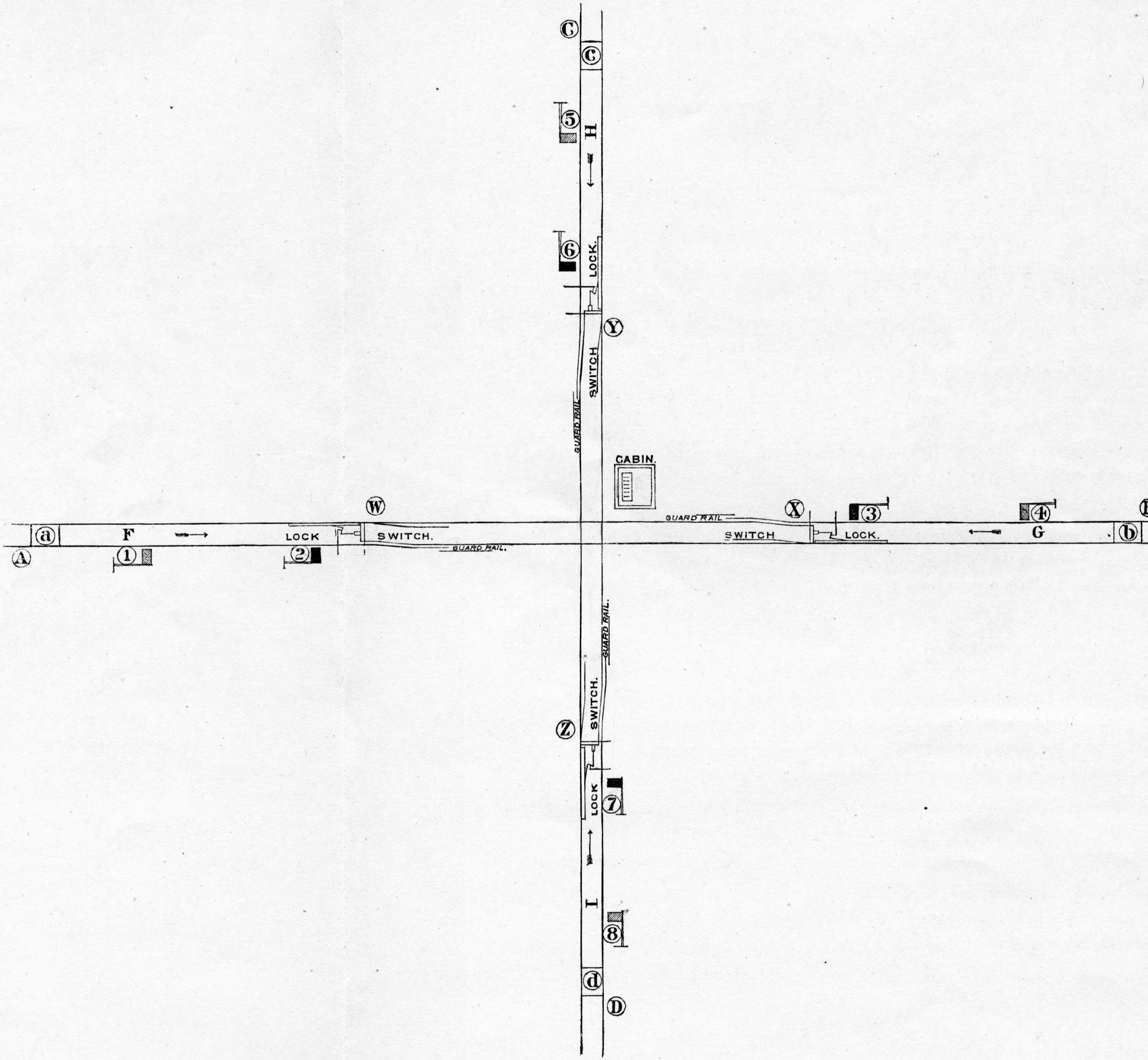
The air in the main pipe is compressed by an air pump, which is kept constantly forcing air into a main reservoir, from which the main air pipe leads.

Each switch is provided with a double acting cylinder, which gives the necessary movements to the switches and locks. Each signal is provided with a single acting cylinder. These cylinders all being equipped with the required valves for admitting and discharging the air, the movements of which valves are governed by an electric circuit the making and breaking of which admits or discharges the pressure from the cylinders. The electric current through the circuits is controlled by small levers, which are so inter locked that conflicting switches and signals cannot be given.

This system is so simple in its construction that it is much cheaper than any interlocking heretofore offered to Railway Companies, and the small levers used are so easily worked that a child can operate the most complicated junction or yard, if capable of understanding the various movements of the trains.

The system is of such a nature throughout that any additions can be made to the number of switches and signals, from time to time, as the traffic may require, with comparatively small expense. Signals and switches can be operated a greater distance from the tower by this than any other system.

FIGURE 23.



C
c
5
H
6
LOCK.
Y
SWITCH
GUARD RAIL
CABIN.
W
X
3
4
B
a
F
LOCK
SWITCH.
GUARD RAIL.
SWITCH
LOCK.
G
b
A
1
2
GUARD RAIL.
SWITCH.
Z
LOCK
7
I
8
d
D

Protection of Railroad Grade Crossings by Interlocking Signals and Derailing Switches.

Compulsory stops at Crossings are very expensive and inconvenient on account of the delay they occasion, and are only comparatively safe at best. There is always danger of a train becoming unmanagable, and the possibility of an engineer mistaking or disobeying the signals, but with the use of derailing switches in conjunction with interlocking mechanism there is no necessity for a stop, and crossings may be run at full speed with perfect safety.

The derailing switches are simply "facing points" placed in all the tracks, at suitable distances from the crossing, and so interlocked that to set the switches for one of the lines, those on all conflicting lines must be set for derailment.

For a single track, Figure 23, the derailing switches must protect both sides of the crossing, but for a double track, Figure 24, a switch is placed in each track on the side facing the trains. When the crossing is not in use the switches are all set for derailment and the signals are all at "danger." Should a train approach from any direction the signalman would immediately set the switches for its line and give the proper "safety signals," and allow the train to pass the crossing without any delay, its safety being positive since no other train could by any possibility reach the crossing.

The principle is applied with equal efficiency to double and single track junctions.

By referring to the accompanying plan, Figure 24, it will be observed the switches W, X, Y, Z, are placed in their respective tracks from three to six hundred feet from the crossing, depending upon the grade, fifty feet more or less from the switches W, X, Y, Z, are placed the home signals Nos. 2, 3, 6 and 7, and from these one to two thousand feet away are placed the distant signals Nos. 1, 4, 5, and 8.

A signalman's cabin, located at the crossing, contains an interlocking apparatus, which is connected to the switches and signals in such a manner that it is impossible to set switches W and X for main line, or clear signals 1 and 2, or 3 and 4, unless switches Y and Z, in opposing tracks are set to derail the train or to run it on a siding, and signals 5 and 6, and 7 and 8, are set to danger. A mile or more from the crossing short sections tracks (*a*, *b*, *c*, *d*,) are insulated, and the nearest end connected by wire to annunciators in the cabin, whereby notice of the approach of trains is given to the operator.

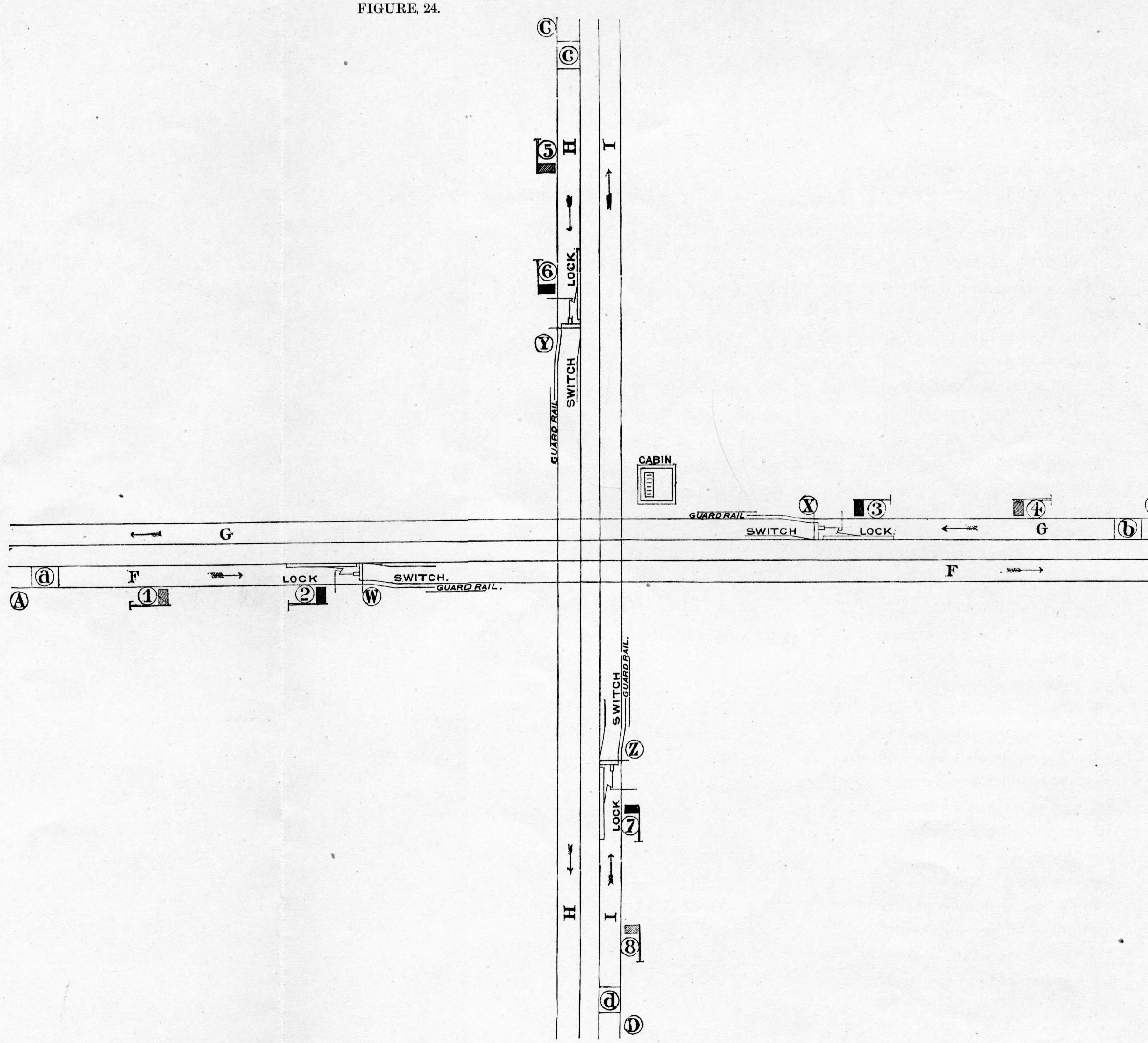
In addition to the mechanical interlocking on the apparatus the levers of the machine are electrically locked in such a manner that the operator is powerless to change any of the switches after a train has received a clear distant signal, until said train has passed entirely over the crossing and clear of all danger from the other tracks. He can, however, place the signals to danger behind the train to stop a following one.

The manner of operation is this: a train approaching from "A" passing over insulated section of track at "a," rings a bell and causes an indicator to be displayed in cabin, announcing its approach, and if there is no train on the crossing road, to which the right of way has been given, the operator sets switches W and X to main line and clears signal No. 2, and then signal No. 1, which cannot be accomplished, however, unless the switches Y and Z are first set to derail and their corresponding signals at danger.

The train approaching distant signal No. 1, and finding it clear, is insured that signal No. 2 is clear also, and switches W and X set right for its passage over the crossing, and all conflicting signals are at danger and locked there. This being the case the train arriving at signal No. 1, automatically locks by electricity everything in this condition excepting signals Nos. 1 and 2, which can be put to danger after engine has passed, to stop a following train, if desired. When rear of train has passed the crossing the length of two rails, or say 60 feet, it releases the electric locks above referred to; the operator, having put signal X on tracks, A and B to danger, and set switches W and X for siding can let a train over crossing from C or D by setting switches Y and Z for main line and clearing signals 5 and 6, or 7 and 8, (depending upon the direction in which the train is coming.) When the train arrives at signal 5 or 8, the same electric locking takes place as on the other track.

Should a train come from A or B while one is crossing from C or D, signal 1 or 4 will be found at danger, which will insure No. 2 or 3 being also at danger, and switches W and X are set for siding or derail, and the train must come to a stop before passing

FIGURE 24.



signals Nos. 2 or 3. In this case, when signals are at danger no electric locking takes place, but when the train on the crossing has unlocked the levers and movements of them have been performed so that switches W and X are set for the main line, and signal 2 or 3 are cleared, the train from A or B immediately locks the levers, and they cannot be changed until rear of train has passed the crossing.

The Automatic Electric Locking of Switch and Signal Levers.

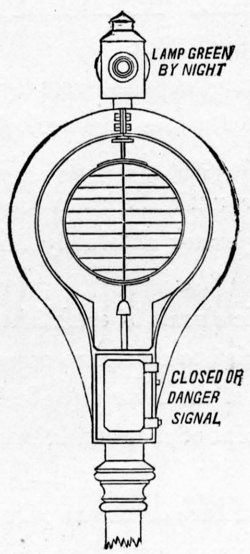
With the interlocking systems previously described, it is impossible to set conflicting switches and signals for approaching trains, yet the operator may change a distant signal as soon as the engine has passed it, and then reverse the "home" signal and move the switch in front of the train. This source of error needs to be positively guarded against as it has led to very serious accidents. No interlocking system is trustworthy which leaves open the door to any such possibility.

The automatic electric locking of the levers by the presence of a train upon the rails, is one of the most important features of interlocking switches and signals, for the reason that after a clear signal has been given and a train has passed it, it is impossible for the operator to move any lever until the train has passed beyond the danger point, thus rendering mistakes by the operator absolutely impossible. No interlocking is perfect without it.

To accomplish this, an electric circuit is established through the rails or track instruments used, and the wires carried to an electro magnet which is preferably attached to the spring catch-rod or spindle of the lever to be locked, see figure 17, but the locking may be done at any convenient point of the connections from machine to switch signal or switch locking bolt.

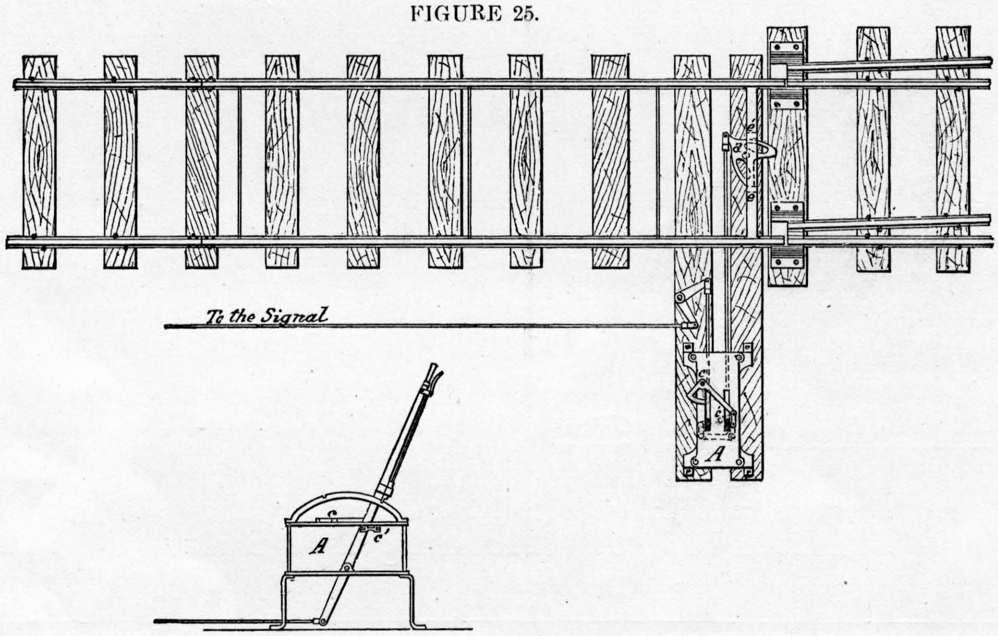
By means of a spring the armature of the magnet is made to lock the catch-rod in position when the current is interrupted, but when the circuit is completed the magnet draws the armature away and leaves the catch-rod and its lever free to be moved. The mode of operation is this: as long as there is no train on the insulated portion of the track the circuit is unbroken and the magnet draws the armature away from the catch-rod, leaving the signalman at liberty to set the switch and signals for a coming train. As soon as the train has passed the insulated point, the current is short circuited and the armature released, and by action of the spring is drawn into a slot of the catch-rod, thereby locking it and its lever in place, and it is impossible to move the lever until the train has passed entirely off the insulated section, the circuit thereby being restored, the armature is drawn away from the catch-rod and the lever may again be moved.

The locking of the levers by the simple presence of a train upon the track, is one of the most important of our late improvements.


LAMP GREEN
BY NIGHT
CLOSED OR
DANGER
SIGNAL

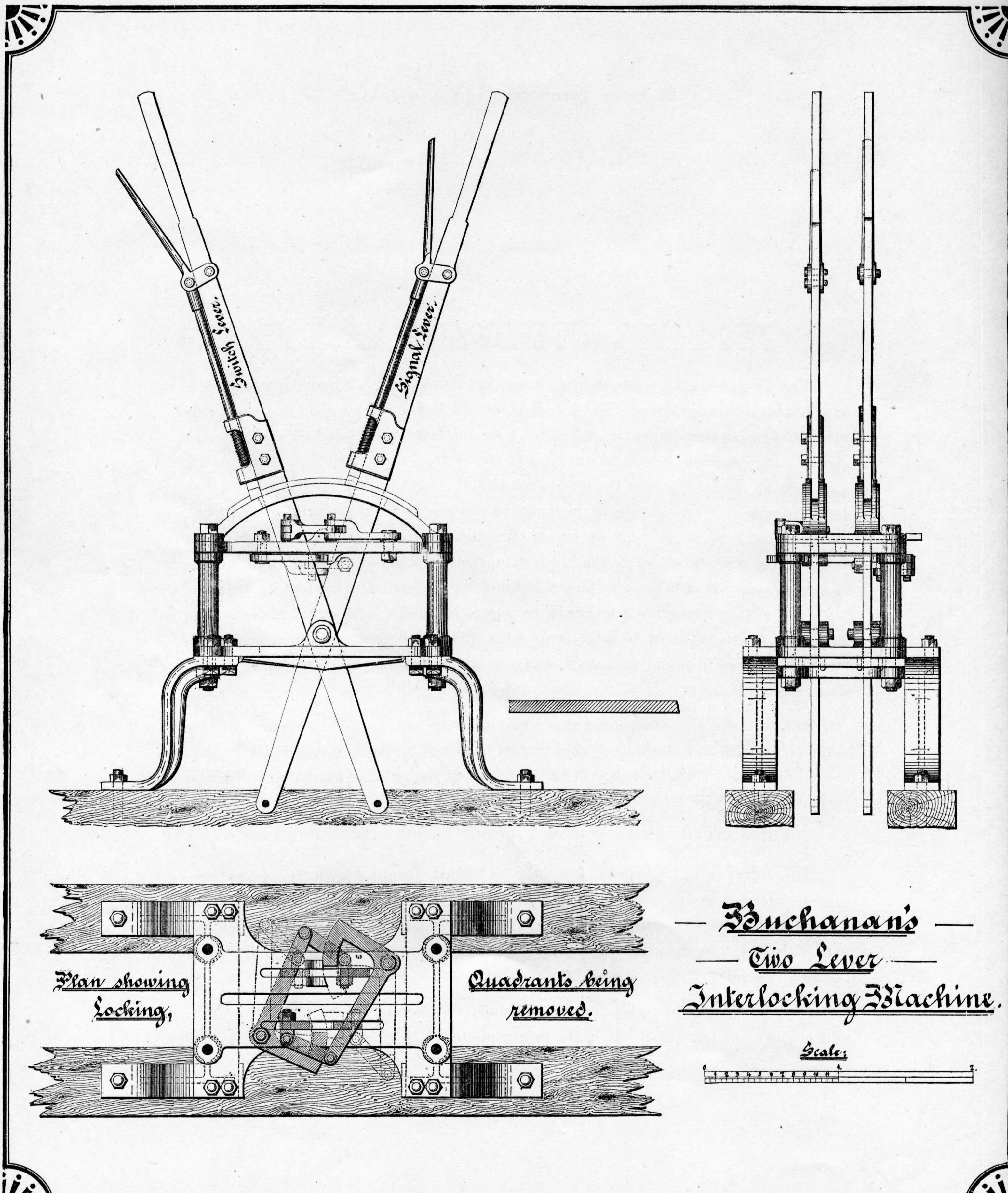
Two Lever Interlocking Machine.

FIGURE 25.



C. H. Jackson #250075, Nov. 29, 1881, 104-120.

FIGURE 26.



TWO LEVER INTERLOCKING MACHINE.

Fig. 25 represents a very simple device for interlocking an out-lying main-line switch with its distant signal. The switch is set and locked in position by one movement, and therefore requires but one lever, a second lever being used for operating the signal. The mechanism will be easily understood from the plan in figures 25 and 26. In figure 25, eccentric, *a*, is pivoted on a frame and is acted on by a rod connected to a lever on the stand A, (shown in plan and in side view.) The eccentric acts on a bar, which connects the switch rails by means of small projections, *e*, *e*, at the bottom of the bar. In the position shown in the illustration, the switch is set for main-line, and the eccentric, with one of its arms, presses against the projection, *e*, holding the switch in place. The two levers are interlocked by means of hooks, *c*, *c*, in such a way that the signal can be lowered to safety only when the switch is set for main-line and is locked in this position, and the switch cannot be set for branch until the signal is first set to indicate danger.

This device is also so arranged that where there are one, two, three or more outlying switches, contiguous to each other, they can all be locked by the same signal lever, making it impossible for the switch-tender to move any of the switches until after the danger signal is set.

Union of the Interlocking and the Electric Block Systems.

The Interlocking System, as has been explained, furnishes security against misplaced switches or conflicting signals at junctions or other dangerous points, but with its use alone there is still danger of collision between stations. It is only by combining with it the electric system that safety is insured to the entire route. By this combination the following necessary points have been realized:

1. To make it impossible for the signalman to telegraph "Line Clear" until the switches and out-door signals are in the proper position.

2. To make it impossible to move switches for shunting or giving access to a line which has been signaled as "Clear" for an expected train, or in any case to make such movement of the switches until *after* the "Line Blocked" signal has been sent to the station on either or both sides.

3. The signal "Train on Line" must be transmitted to the station in advance before the out-door signal for a train to enter a block section can be given, so that it is not possible for a train to enter a block section unannounced by telegraph to the station in advance.

4. The out-door starting signal can not be given to permit entrance into a block section without the consent and concurrent action of the signalmen at both ends of such block section.

5. The mechanism makes it compulsory that the out-door starting signal shall be re-set to danger behind every train, and that upon the entrance of a train into a block section, the signalman at the station in advance, shall give to the signalman at the station in the rear, the proper signal of "Line Blocked" behind the coming train.

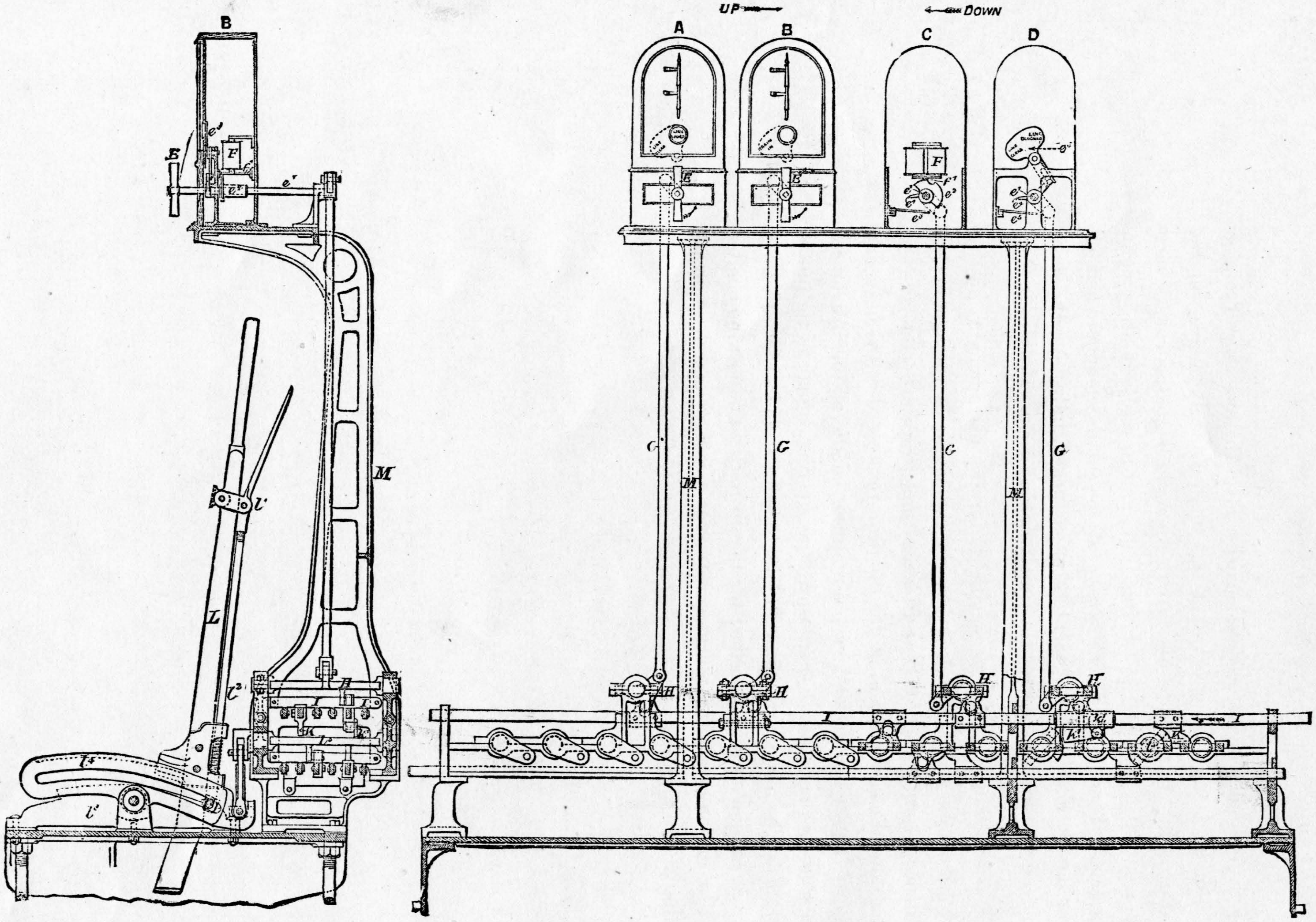
The accompanying illustration, Figures 27 and 28, represents an interlocking apparatus, consisting of fourteen switch and signal levers, combined with four electric signaling instruments, two for the up and two for the down line of a railway. Figure 27 represents a transverse section through the lever frame, with one of the levers, L, in its normal position; and Figure 28 represents a front view, partly in section, the fourteen levers being removed for convenience of representation. The exterior of two and the interior of two of the instruments are shown in this figure.

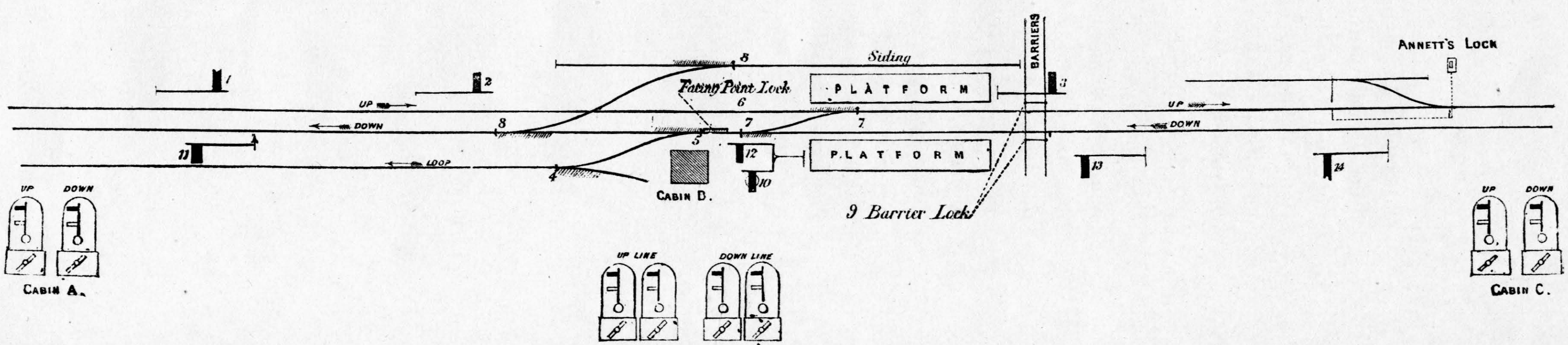
The instruments are interlocked with the levers of the interlocking apparatus, and each instrument has on its face two small semaphores, by means of which signals can be exchanged between the stations, and below them circular openings, through which a blank, or "Train on Line," or "Line Clear," or "Line Blocked," are seen.

In order to understand the plan of operation we will suppose a warning received on an electric bell which announces that a train is in the next rear section and is ready to come on.

The signalman must first place all his levers in their proper "safety" position (if they are not already so), and then, and not till then, can be sent the return message "Line Clear" to the rear section, which he does by turning round the handle E of the

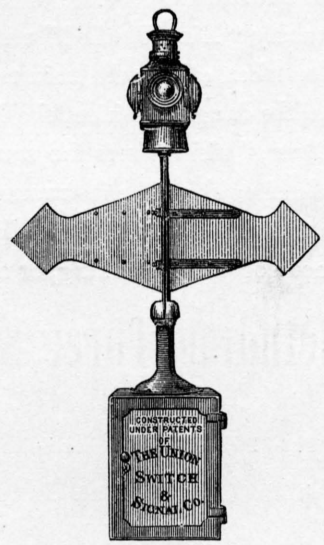
FIGURES 27 and 28.





instrument A; having done this his levers become locked. Then the message "Train on Line" is indicated to him by change of position of the small semaphore arm on the upper portion of the instrument A; it is now his duty to warn the signalman at the next station in advance, by means of a bell, of the coming train, and in reply, if all is right, he will receive the message "Line Clear" by lowering of the small semaphore arm on instrument B; now the handle E of the instrument B can be turned, unlocking the starting signal lever, which can then be lowered for the train to proceed.

The locking is also so arranged that the handle E of the instrument A must be returned to its normal position of "Line Blocked" before the handle of the announcing instrument B can be turned; consequently "Line Blocked" must be sent to the rear station before the starting signal can be taken off for the train to proceed to the next, and until the starting signal is returned to the danger position, the handle of the instrument A cannot be turned to send "Line Clear;" this insures the starting signal being put to danger behind every train. The mode of working the instruments C and D for the down line is, of course, precisely similar to that described for the up line. The locking combinations may be varied to suit any mode of block-working, or any kind of telegraph instruments or interlocking apparatus.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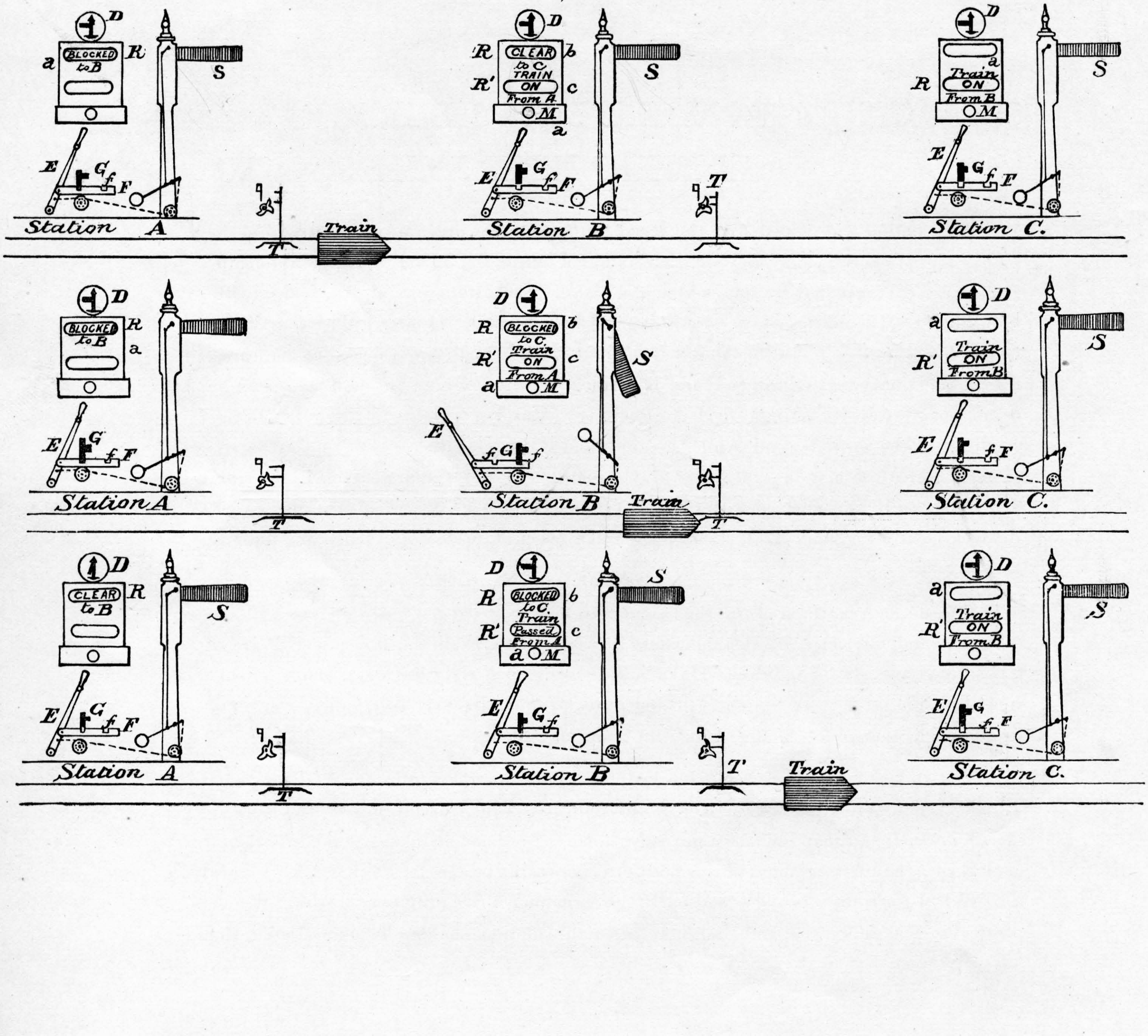
UNDER PATENTS
OF
THE UNION
SWITCH
&
SIGNAL CO.

Sykes' System of Lock and Block Signaling
Including Three Signal Stations.

FIGURES 29, 30 and 31.



SYKES' SYSTEM OF LOCK AND BLOCK SIGNALING, INCLUDING THREE SIGNAL STATIONS.

Each station is provided with the usual train signaling apparatus, ordinarily semaphores, signal levers, etc. Beyond each station, Figures 29, 30 and 31, is an automatic track treadle T, actuated by the passage of a train. Each station is also provided with indicator D. It is not necessary here to explain the method of the electrical locking of the levers, but it may be useful to show that in front of the signalman is placed an indicator case *a*, containing two indicators R and R^1, which show respectively through the opening, *b* and *c* of the case. The indicator R, reads either "clear," or "blocked," and refers to the condition of the track beyond, while the indicators R^1, reads either "train on," or "train passed," as the case may be, and refers to the condition of the section of track in the rear. The indicator R, is connected with the lock G, in such manner that when it reads "clear" the lock G, is lifted, and the lever E is free, but when it reads "blocked," the lever is locked.

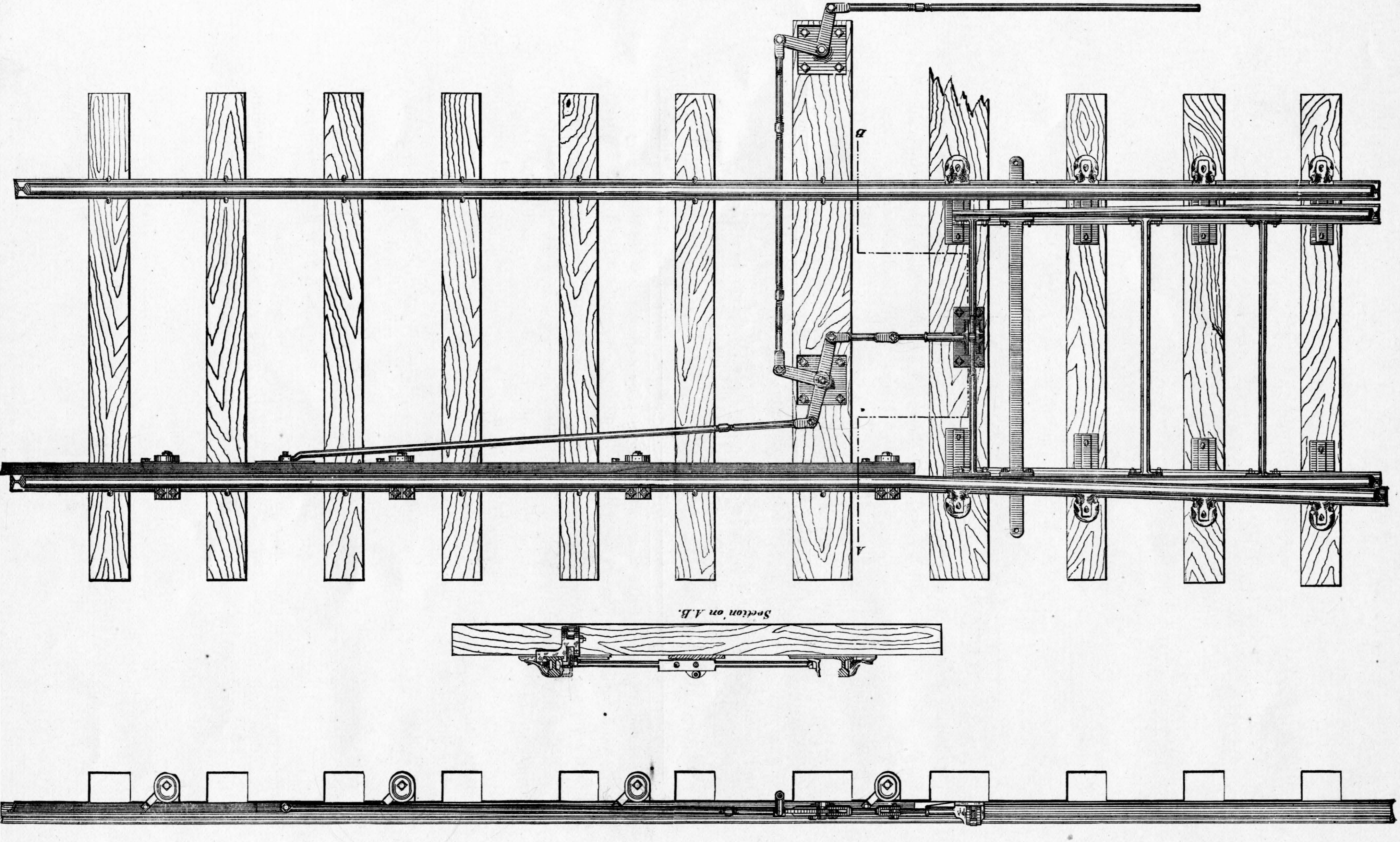
The normal position of all the semaphore arms is "danger," all the levers E, are "home" and unlocked, all the indicators R, read "clear," all the indicators R^1, read "train on," and all the indicators D, have their arms up at right angles, as shown at station B, in Figure 29. A train at A, being ready to start, the lever E is pulled over, thus dropping the semaphore S, after which the train may start.

The indicator R, now reads "blocked," the indicator R^1 "train on," and the lever E, is locked. When the last carriage of the train passes the track treadle T, the lever at A is unlocked, and may now be returned "home" by the signalman when it will again be locked; the parts are now in the positions shown in stations A, B, and C, in Figure 29. When the train approaches station B, the signalman there pulls over his lever E, and drops his semaphore, that the train may pass; this motion changes his indicators in the same manner as at A, and locks his lever in its "clear" position; the parts are now as shown at stations A, B, and C, in Figure 30. Meanwhile the lever at A, is locked, and to unlock it, B must press in the knob or plunger M, which is arranged on the front of his case A, but this he can not do until his lever has been unlocked and returned "home." When the train passes B's treadle, T, his indicator R shifts to "clear" and his lever E is unlocked and then may be returned "home,"—this act sets his indicator R to "blocked" again, locks the lever, and sets his indicator R^1 to "train passed," it also sends a current through the indicator D, at station A, in such direction that its arm drops to indicate that the section between A and B is "clear,"—the parts are now as shown at station A, B, and C, in Figure 31. B, may now unlock A's lever; this he does by pressing in his plunger M which sends an electric current to A, unlocks A's lever, shifts A's indicator R to "clear," and causes the arm of A's indicator D to rise. When B releases the plunger and it springs back, his indicator R^1 shifts to "train on," (meaning that the section from A to B is in condition to receive a train), and it is then locked, so that the plunger can not be worked again until the lever E has been pulled over and returned, the lever E remains locked until the train has passed C's treadle, and C has pressed in his plunger.

Should another train approach B from A before C has thus unlocked B's lever, B cannot lower his semaphore (even should he attempt to do so), and the train must stop until B's lever is unlocked by C. Thus it is evident that it is not possible for one train to approach nearer to its leader than the distance between a signal station and its track treadle.

Switch Locking Bolts and Safety Bar.

FIGURES 32 and 33.



Switch Locking Bolts and Safety Bar.

Facing Point Switches require the Switch Locking Bolt, which is used to insure the proper position of the switch points after they have been moved, and to securely lock them, to guard against their being moved by the shock of the passing train.

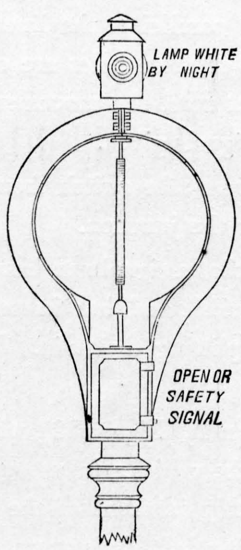
A bar, C, (Figure 32), with two holes in it, connects the points, and a bolt B, is fixed between the rails and moved parallel to the line of the rails through the holes in the connecting bar. When either of these holes are opposite the bolt, it can be moved forward and the switch locked; but until the movement of the switch is completed, the bolt cannot be thrown and safety signals given.

The Switch Safety Bar prevents the switch from being moved by the signalman until the train has passed beyond the junction.

It has sometimes happened that a signalman has changed his signal to "danger,' while the train was passing the switch, and has immediately after reversed the switch lever and produced a disaster by splitting the train. When the "Safety Bar" is used, such accidents become impossible.

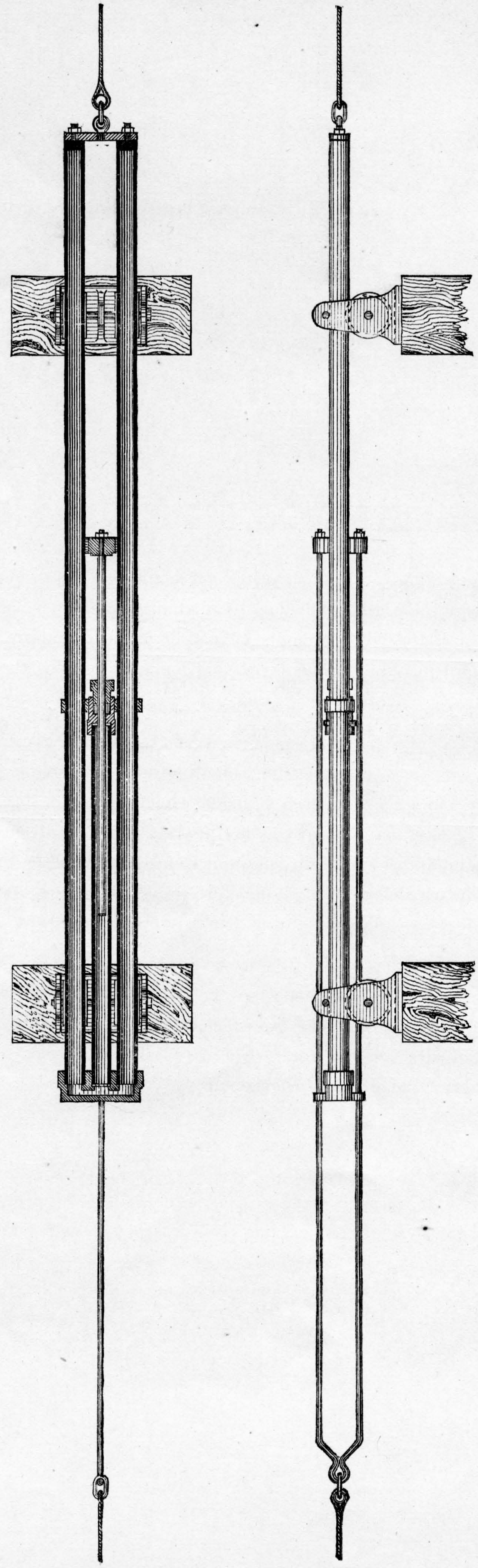
The device consists of the bar Y, (Figure 32), which is as long as the greatest distance between any two wheels of the vehicles in use on the railway, and is placed at the inside of one of the rails immediately in front of the switch, and is connected with the bell crank A, by which the locking bolt B, is operated. It is hinged or supported on short links, *l*, *l*, (Figure 32), so that it cannot be moved lengthwise without at the same time being raised.

The bar is level, or nearly level with the top of the rails when it is in the middle of its stroke; but when at the end of its stroke, and the locking bolt B, is at home, and the switch locked, the safety bar stands two inches or more below the top of the rail. As the bar is longer than the greatest distance between any two wheels, it follows that from the time the first pair of wheels of a train comes over the bar, till the last pair leaves it, it will be held down by the flanges of the wheels. Consequently it is impossible while there is a train moving over it, for the signalman to unlock the switch.


LAMP WHITE
BY NIGHT
OPEN OR
SAFETY
SIGNAL

Liquid Compensator for Signal and Switch Wires.

FIGURES 34 and 35.

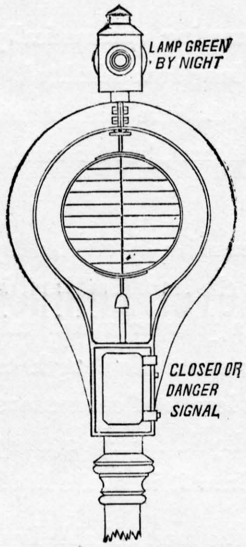


LIQUID COMPENSATOR FOR SIGNAL & SWITCH WIRES.

The importance of compensating, automatically, for the constantly varying lengths of signal wire connections, has long been admitted, and an efficient Compensator is one of the wants of railways. Attempts have been made to supply this want by means of weighted appliances of various forms, but for many reasons these have failed to meet all requirements.

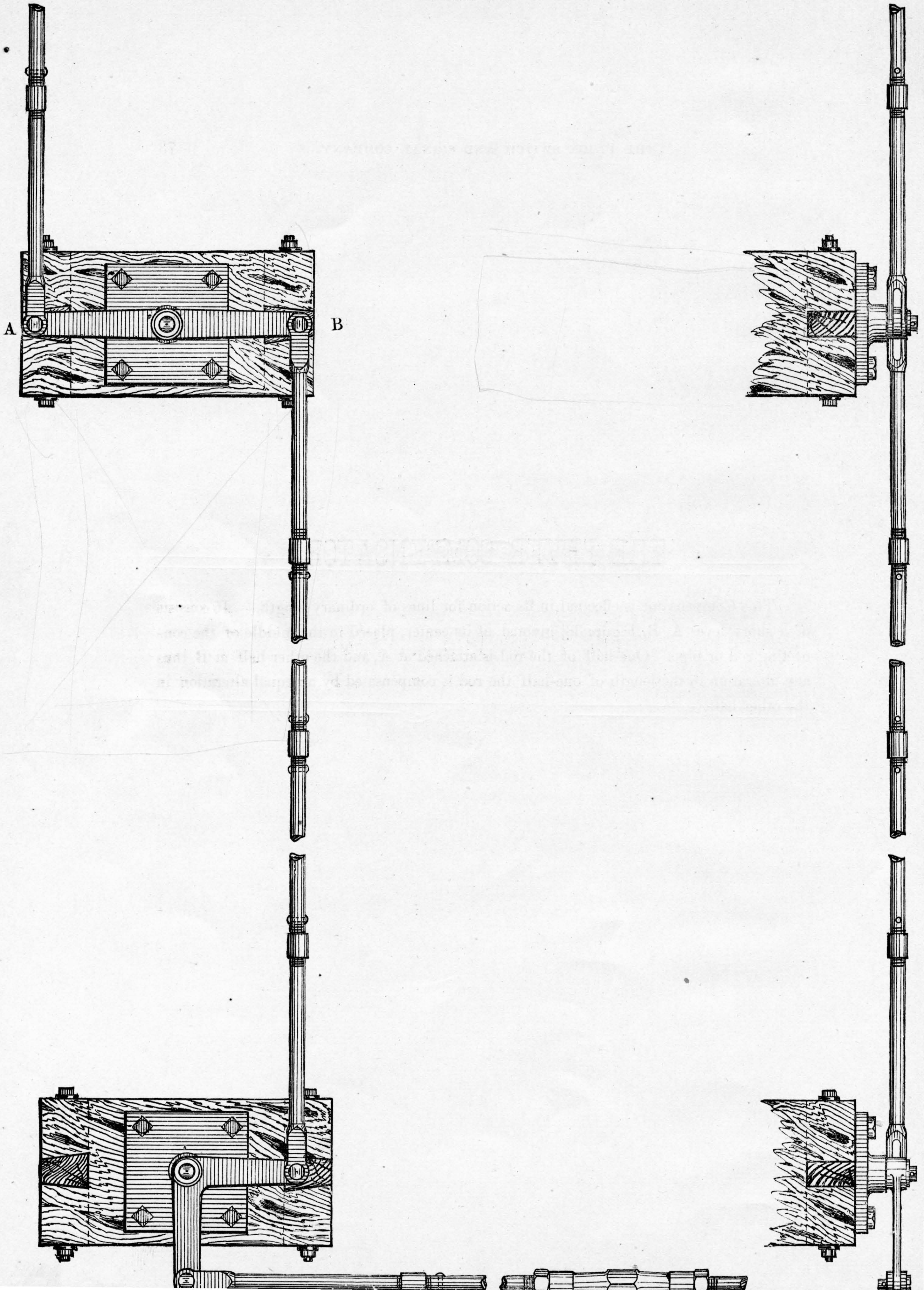
In this device the compensation is effected by means of liquid confined in tubes, which expands and contracts at the same time, and in the same proportion, as the connections. The liquid acts upon a plunger which takes up the length given out by the expansion of the wire, and gives out the length taken up by contraction of the wire, thereby maintaining a uniform length of connections between the operating lever and the signal. The expansion of the liquid forces out the plunger, and the ordinary strain upon the connections is sufficient to draw it in as the liquid contracts.

Glycerine has been found the most suitable liquid, and has been in use with temperatures ranging from twenty degrees below zero to over one hundred degrees above Fahrenheit, showing the most satisfactory results. The Figure 34, shows a sectional view of the wire compensator. Figure 35 shows the compensator in perspective, as attached to the line of signal connections.


LAMP GREEN
BY NIGHT
CLOSED OR
DANGER
SIGNAL

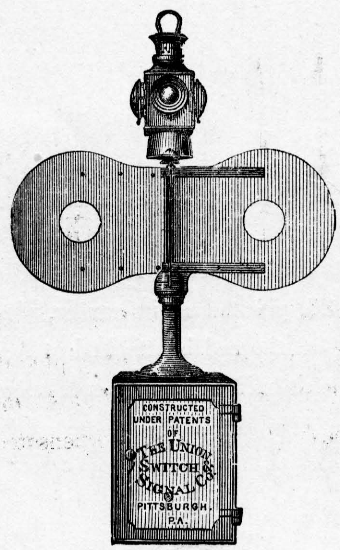
The Lever Compensator.

FIGURE 36.



THE LEVER COMPENSATOR.

This Compensator is effectual in its action for lines of ordinary length. It consists of a short lever A, B, Figure 36, pivoted at its center, placed in the middle of the connecting rod or pipe. One-half of the rod is attached at A, and the other half at B, thus any alteration in the length of one-half the rod is compensated by an equal alteration in the other half.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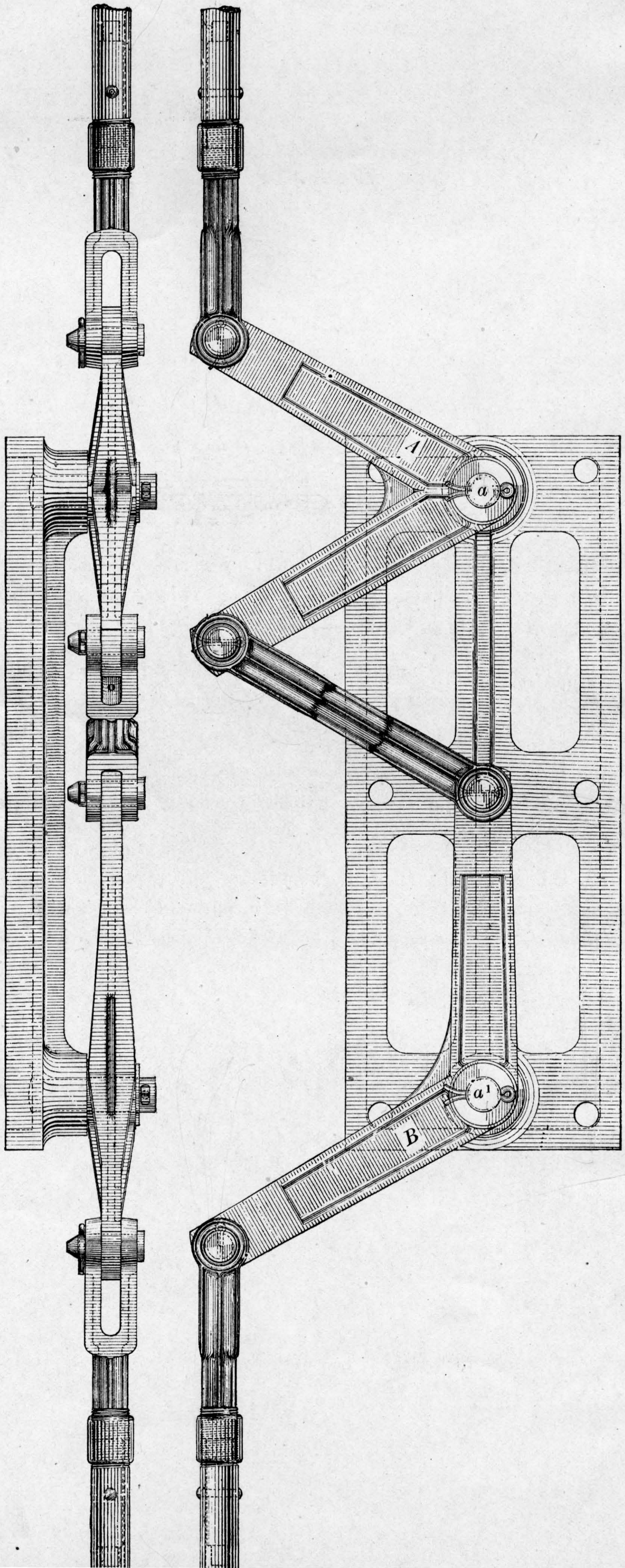
OF
THE UNION
SWITCH &
SIGNAL CO.
PITTSBURGH.
P.A.

FIGURES 37 and 38



BELL CRANK COMPENSATOR.

Figures 37 and 38 represent a Compensator which is very simple, and easily attached to the rod or pipes of the switch and signal connections. It consists of two bell cranks A and B, pivoted at a, a^1, to shafts which are securely fastened to strong base pieces.

When the arm of either bell crank is actuated, the other receives an equal and simultaneous movement in the opposite direction, in consequence of which, perfect compensation will be made for the expansion and contraction of the connections under changes of temperature.

Provision can be made for sections of different lengths, by varying the length of the lever arms relatively to each other.

The chief advantages of this plan of compensation are, the small space in which the apparatus may be placed, and the ease with which any number of compensators may be attached to the same base piece and shafts. It can be placed in either a vertical or horizontal position.

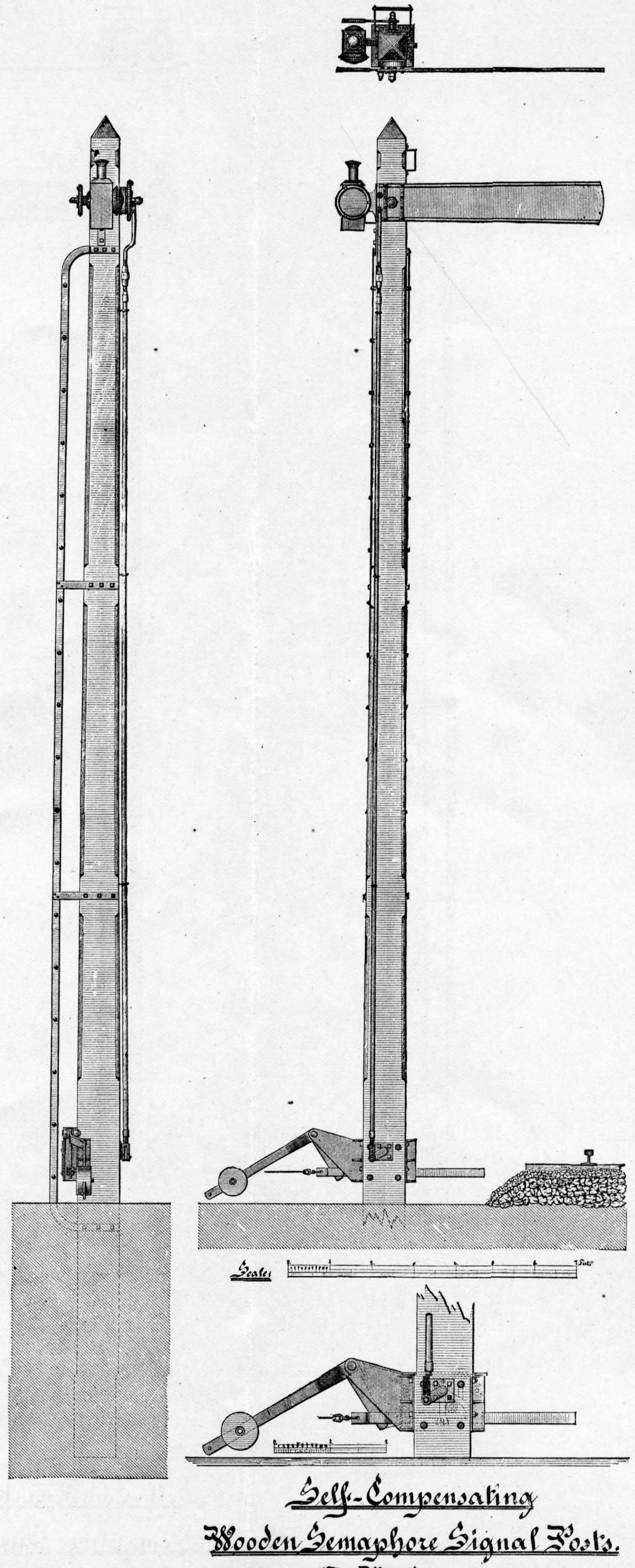
THE UNION SWITCH & SIGNAL COMPANY.

MANUFACTURERS OF ELECTRICAL APPLIANCES for RAILWAYS

SAFETY

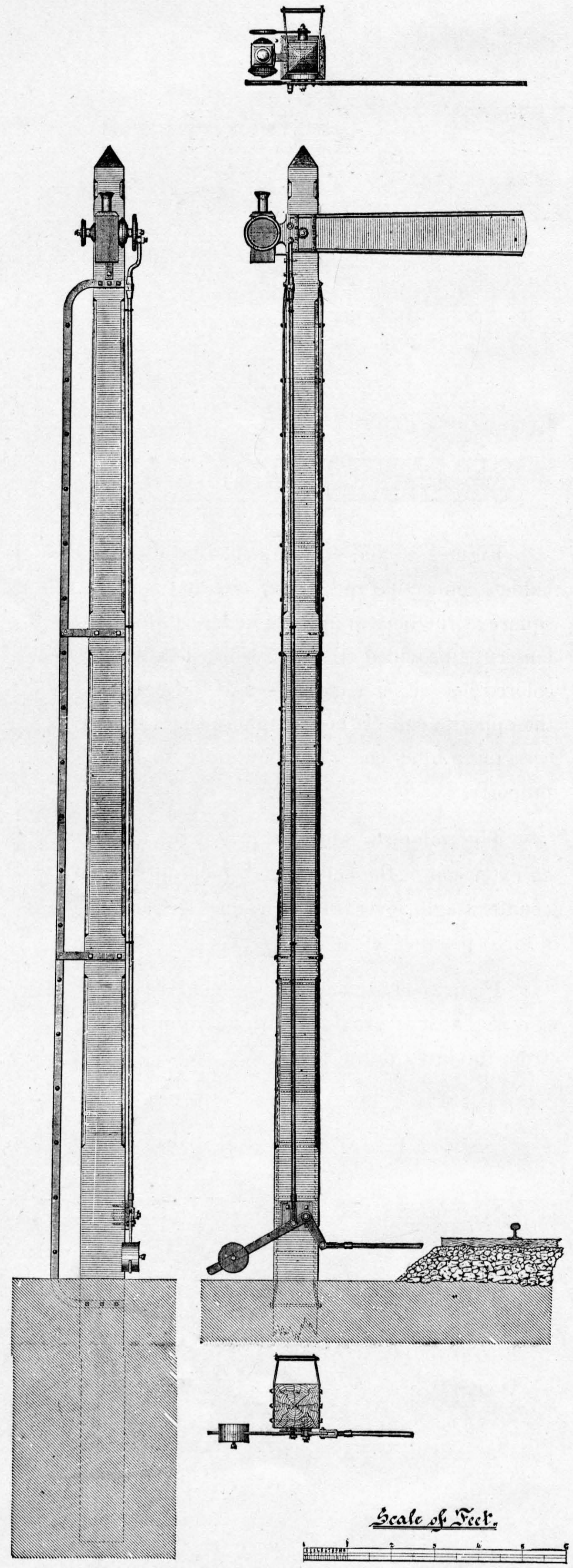
T. U. S. & S. Co. Pat. Pittsburgh, Pa.

FIGURES 41, 42 and 43



Self-Compensating
Wooden Semaphore Signal Posts.
For Wire Connections.

FIGURES 39 and 40



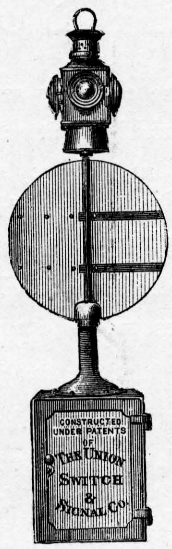
Wooden Semaphore Signal Post.
Pipe connected.

SEMAPHORE SIGNALS ON WOODEN POSTS.

Figures 39 and 40 represent the ordinary semaphore signal on a wooden post with ladder, connecting rod, semaphore and lamp attached. The post being about ten inches square at the bottom and six inches at top, varying in height to suit conditions. The lantern is provided with two white lenses, and the semaphore blade has on its end a colored lens either red or green as the signal is intended to denote danger or caution. On the opposite end of the semaphore shaft and attached to it is the back light, a small ring carrying a blue lens which indicates to the operator that the semaphore is working properly.

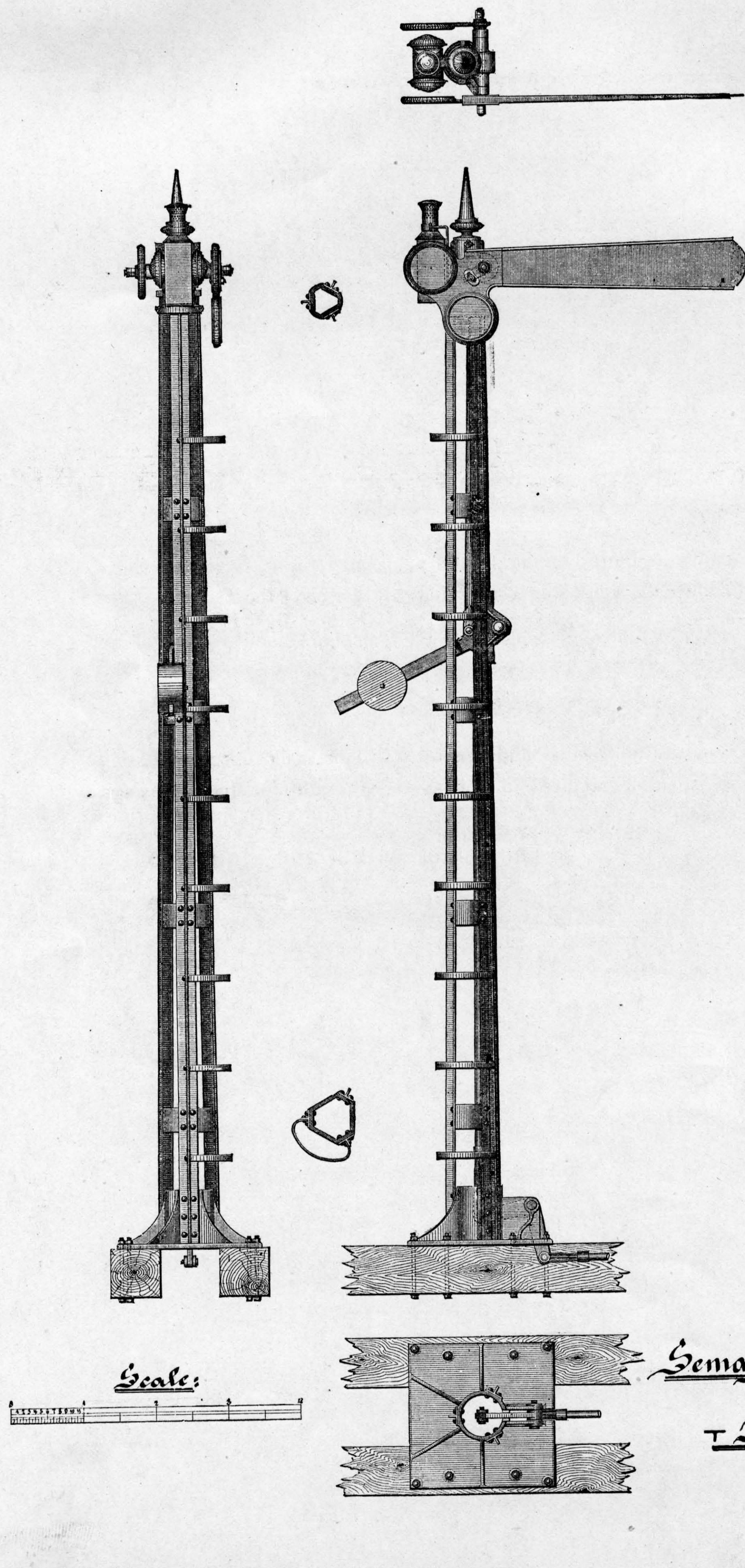
The counterweight is shown at the foot of the post, the arm carrying the same being an extension of the bell crank which operates the rod connected with a semaphore. This counterweight lever, however, may be separate from the bell crank and placed at any desired position on the post.

Figures 41, 42 and 43, represent a post of similar construction to that just described except that it is provided with an automatic compensating movement for the connections from the lever to the signa.


CONSTRUCTED
UNDER PATENTS
OF
THE UNION
SWITCH
&
SIGNAL CO.

FIGURES 44 and 45

See Fig. 19.



Semaphore Signal
on
T Iron Post.

IRON SIGNAL POSTS.

The signal post shown in figures 44 and 45, are made of T irons riveted to hexagonal rings, and the ladder is formed by riveting steps to the web of the T irons.

The connection at the foot of post for operating the semaphore may be a bell crank or other suitable device.

Correspondence respectfully solicited, and proposals will be made upon application for any or all kinds of signaling required in railway service; also, for frogs, crossings, switches, and switch stands.

The Union Switch and Signal Co.

PITTSBURGH, PA.

List of Railroads using the Union Switch and Signal Company's Interlocking Apparatus.

HYDRAULIC.

The St. Louis Bridge Co. and Tunnel R. R. Co.

East St. Louis, 80 Levers. Main Street, St. Louis, 8 Levers.

Poplar Street, St. Louis, 20 Levers.

Cincinnati, New Orleans and Texas Pacific R. R.

Cincinnati Bridge, 2 Levers.

The C. C. C. & I. Ry. and Wheeling and Lake Erie R. R.

Grade Crossing at Wellington, Ohio, 6 Levers.

The New York, Chicago and St. Louis Railway.

Cuyahoga River Draw, 3 Levers.

MECHANICAL INTERLOCKING.

Manhattan Railway.

Rector Street,
53d Street and Sixth Avenue,
53d Street and Ninth Avenue,
57th Street and Sixth Avenue,
59th Street and Ninth Avenue,
104th Street and Ninth Avenue,
127th Street and Second Avenue,
127th Street and Third Avenue,
124th Street and Third Avenue,
98th Street and Third Avenue,
Chatham Square,
Chatham Square Terminal,
City Hall Station,
Battery Place,
155th Street and Eighth Avenue,
156th Street and Eighth Avenue.

The Pennsylvania R. R.

East Liberty,
Marion Station,
Overbrook,
West Leg Mantua, " Y."
East Leg Mantua, " Y."
36th Street, Philadelphia,
Powelton Avenue, Philadelphia,
32d Street, "
30th Street, "
20th Street, Philadelphia,
Broad Street Station, Philadelphia.
Kensington Junction,
Passaic,
East Newark,
Hackensack,
East Brunswick,
Monmouth Junction.

The Boston and Albany R. R.

Boston Yard,
Brookline Junction,
Huntington Avenue,
Springfield,
West Chester Park,
Cottage Farm,
Grade Crossing at South Framingham.

The New York Central and Hudson River R. R.

Grand Central Depot, New York,
53d Street, "
59th Street, "
72d Street, "
86th Street, "
98th Street, "
110th Street, "
125th Street, "
Harlem River Bridge,
Mott Haven Junction, No. 1 Tower,
Mott Haven Junction, No. 2 Tower.
Spuyten Duyvil,
Poughkeepsie,
Morrisonia,
Fremont,
Fordham,
Jerome,
Park Place,
Woodlawn,
Melrose,

Northern Central R. R.

Union Depot, Baltimore, Md.

Baltimore and Potomac R. R.

Fulton Junction, Baltimore, Md.

Baltimore and Ohio R. R.

Bailey's Switch.

Pittsburgh, Cincinnati and St. Louis Ry.

Noblestown.

Chicago, Milwaukee and St. Paul R. R

Minneapolis.

Long Island R. R.

Bradford Junction,
Woodhaven,
Rockaway Junction,
Jamaica Bay Junction,
Pearsalls,
Winfield,
East New York,
Fresh Pond Junction.

New York, Woodhaven and Rockaway R. R.

DRAWBRIDGES.

Goose Creek, Broad Channel. Hammels.

New York City and Northern Ry.

Harlem River.

Shenandoah Valley Ry.

Grade Crossing at Riverton.

Boston and Lowell R. R.

Lowell, Mass.

Troy and Greenfield R. R. and Hoosac Tunnel.

North Adams, Mass.

C , C., C. and I. Ry.

Berea, Grade Crossing at Cleveland.

New Jersey Central R. R.

Communipaw, Oceanport, Elizabethport, } Drawbridges.

Morgan, East Rockaway, Woodbridge. } Drawbridges.

Junction R. R. (Philadelphia.)

Grade Crossing at West Chester Junction.

Carnegie Bros. & Co.

Bessemer, B. & O. R. R.

Old Colony R. R.

Grade Crossing at Walpole.

Eastern R. R.

Salem Tunnel.

Western Maryland R. R.
Fulton Junction.

N. Y., N. H. & H. R. R.
West Port Draw.

West Jersey R. R.
Sea Girt Junction. Junction with Camden & Atlantic R. R.

Camden & Atlantic R. R.
West Jersey Junction.

Philadelphia & Reading R. R.
Wayne Junction.

N. Y. & N. E. R. R.
Grade Crossing at Walpole.

Chicago, St. Louis & Pittsburgh R. R.
Richmond Junction.

Little Miami R. R.
Richmond Junction.

Cincinnati, Hamilton & Dayton R. R.
Richmond Junction.

THE NEW YORK, WEST SHORE & BUFFALO R. R. is applying our Electro-Pneumatic Interlocking System, of Westinghouse Pattern, at Cornwall Junction, and is also applying our Electro-Pneumatic Block Signals on the line of their road.

THE LEHIGH VALLEY R. R is applying our Electro-Pneumatic Interlocking System, of Westinghouse Pattern, at Bound Brook Crossing.

THE PHILADELPHIA & READING R. R. is applying our Electro-Pneumatic Interlocking System, of Westinghouse Pattern, at Bound Brook Crossing.