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THE WESTINGHOUSE INTERLOCKING SWITCH AND SIGNAL SYSTEM.

Some weeks ago we illustrated the electro-pneumatic block system of train signaling. In our present issue we present our readers with illustrations of some of the salient points of the Westinghouse interlocking switch and signal mechanism for use in train yards. It includes three operating agencies, electricity, pneumatic pressure, and hydraulic pressure. The work of throwing switches and of setting signals at safety is done by pneumatic pressure. The valves for regulating its action on signals are worked by electricity exactly as in the block system already described. The valves for regulating its action on switches are moved by hydraulic pressure.

Referring to the perspective view of the switch board, it will be seen to be a case upon whose front are two rows of handles. These handles, when moved by the operative, turn through an arc of a circle long vulcanite-covered spindles that run to the back of the case. These spindles are numbered in pairs; of similar numbers, those to the left are rotated by the lower handles, those to the right by the upper handles. On the rear end of each spindle is a quadrant with locking detent, worked electrically. The upper row of handles operates the switches; the lower row operates the signals.

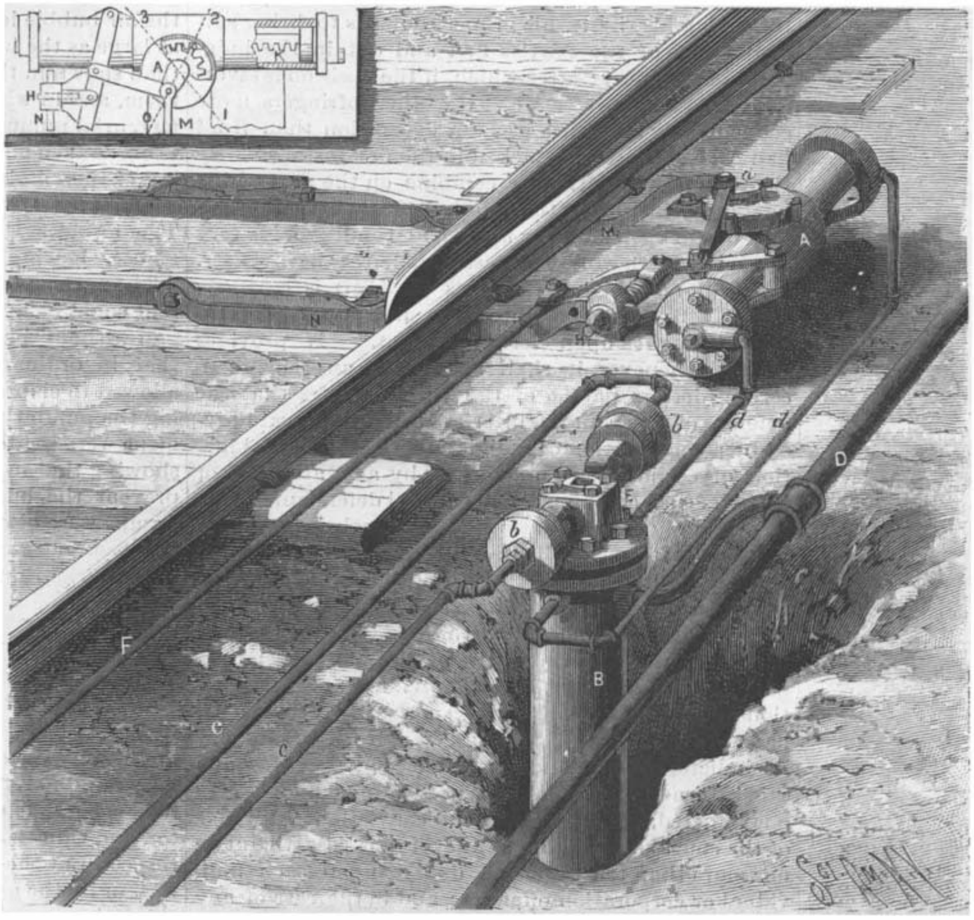

Fig. 1.—AUTOMATIC SWITCH-OPERATING MECHANISM.

At the rear of each switch spindle, that is to say of every second one, is a three-way cock attached directly to the spindle, and therefore turned by the upper handle appertaining to the spindle in question. This cock is a part of the hydraulic system. Turned to the right, it operates by hydraulic pipe connections a valve in the neighborhood of a switch which may be a mile or more distant. The operation of this valve, which is connected to pneumatic pipes, admits compressed air to the actuating cylinder and piston, and throws the switch in one or the other direction. The switch-throwing mechanism will be described later on.

When a current of electricity is passed through the actuating magnet of the signal-moving mechanism, Fig. 3, which also may be at any distance, it opens a pneumatic valve, admitting air to the signal-actuating cylinder, placed on the semaphore post. The piston is forced outward and the semaphores are depressed to the safety position. This current is sent through the switch board, when the handles are set in proper position therefor. On each of the vulcanite-coated spindles are placed strips of platinum, and between the spindles are pairs of contact springs. These, with their connections, can be arranged in any way whatever to suit the conditions of the case. The circuit, including the semaphore magnet, is completed through one or more of these spindle connections. Hence the setting of any given semaphore at safety may be made to depend upon one or more switch movements, as necessary. After the switch handles in its series are properly set, they complete their part of the circuit by means of the platinum strips and springs. Then the final turn of the signal handle moves its spindle into position and the circuit is completed, and the semaphore descends to "safety." When the switches are to be changed, the signal circuit has first to be broken. This permits the air valve to close automatically, and the semaphore rises by the influence of its counterweights to "danger." The switches can then be moved as required. At the bottom of each signal-moving mechanism Fig. 3, is a circuit closer. This keeps a circuit closed as long as the semaphore is at danger. It is an independent circuit and works the locking of one of the quadrants on the rear of the signal handle spindles.

This, in connection with our former article, is enough to show how the signals are operated. The switch-throwing mechanism has now to be described. This is placed by the side of the track, near the switch. It is shown in Fig. 1. The hydraulic tubes, *c c*, connect with two cylinders, *b b*, and force the pistons one way or the other, according to the position of the three-way cock in rear of the switch board. At B is a reservoir, kept charged with compressed air by the regular air pipe, D. At E is a D-valve, exactly such as used in a steam engine, and which admits the compressed air into either one of the pipes, *d d*, and puts the other one of these pipes in communication with the open air. At A is a double cylinder with two pistons, connected by a rack and working a pinion. The partial section is shown in the upper left hand corner of the cut, in which K is the rack and A is the pinion. The air admitted by one of the pipes, *d d*, forces the pistons in one or the other direction, regulated by the D-valve, thus turning the pinion. As the pinion turns it carries around with it an arm attached to its spindle, *a*. In its revolution through about three-quarters of a circle the pinion has to successively perform the following operations: 1. To withdraw the locking bolt, H, from the hole in the locking bar, N; 2, throw the switch, by moving the rod, M; 3, return the locking bolt, H, to the other hole in the locking bar, N.

Referring to the sectional view, H is the locking bolt, N the locking bar, and M is the switch rod. If air is admitted to the right hand end of the cylinder, the other end communicating with the open air, the pistons will move to the left. The movement of the pinion may be divided into three phases, indicated by the dotted lines. Moving from 0 to 1 it withdraws the lock bolt, but practically does not move the switch bar, or at least only back and forth through the versed sine of the arc described by the crank pin between 0 and 1. From 1 to 2 the relations are changed; here the switch rod is moved through a longer distance, corresponding to the chord of the arc, 1–2, throwing the switch, while the lock bolt is

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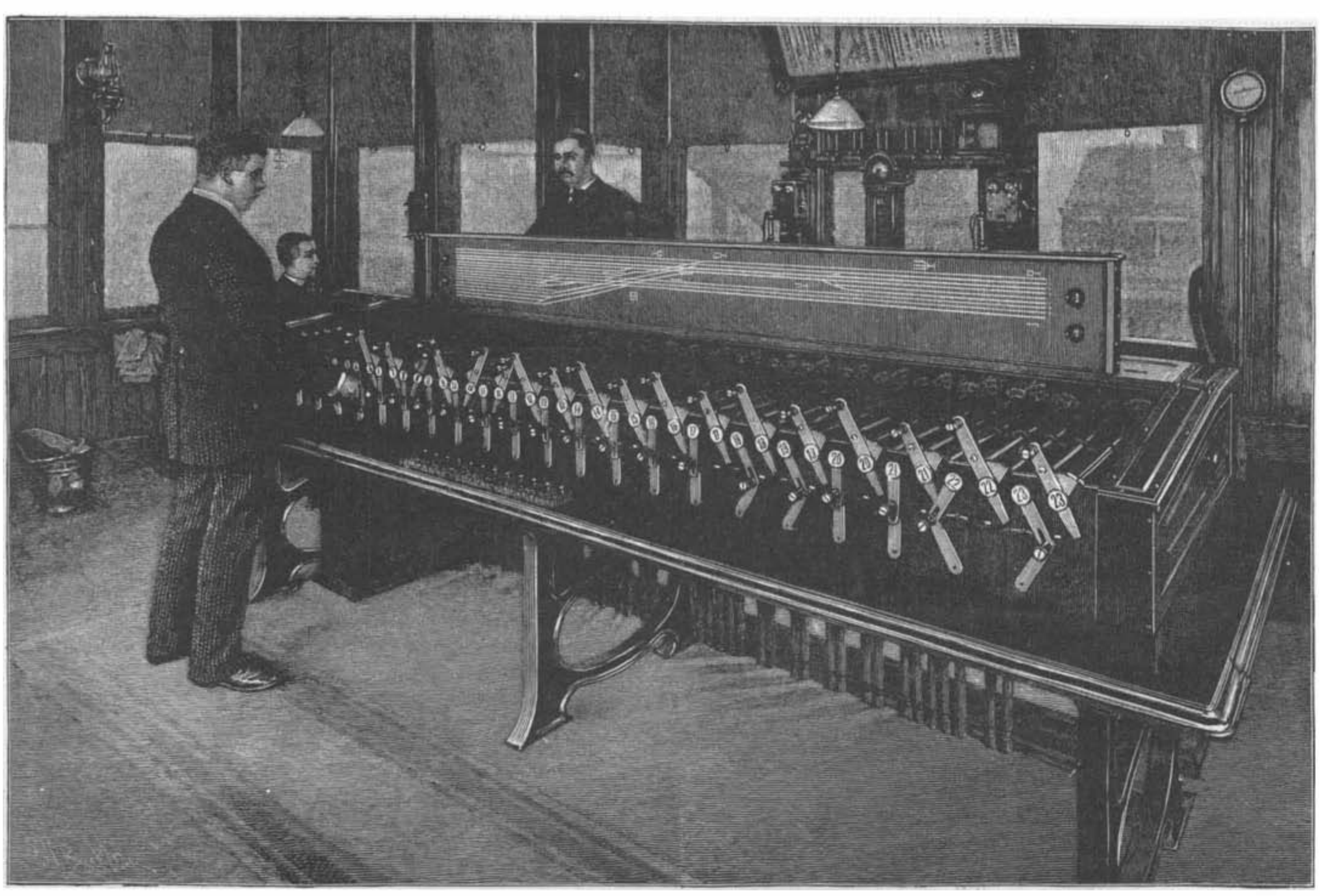


Fig. 2.—ELECTRO-PNEUMATIC INTERLOCKING SWITCH AND SIGNAL STATION AT PITTSBURG, PA.

THE WESTINGHOUSE INTERLOCKING SWITCH AND SIGNAL SYSTEM.

(*Continued from first page.*)

only drawn back and pushed forward a trifle corresponding to the versed sine of the same arc, 1–2. From 2 to 3 the first relations are re-established; the lock bolt is thrust forward into the hole in the lock bar and the switch is hardly moved at all. A detector bar is worked simultaneously with the lock bolt by means of the rod, F, of the perspective drawing.

Referring again to the cut of the switch board,* a series of studs or latches are seen projecting through holes below the switch handles. These, if moved upward, catch the lower projecting ends of the switch handles. They are raised and lowered by the agency of the signal handles. As each of these is moved it throws a notched bar that runs parallel to the face of the case to the right or left. The bar, according to the arrangement of the notches, throws upward or permits to drop any one or more of the latches. When raised a latch locks the lever above it, when depressed it frees it. Thus a mechanical interlocking of switch and signal handles is provided that by different disposition of notches may make the movements of one or more switch handles depend upon the movements of any given signal handle.

On the rear end of each signal spindle on the switch board is a quadrant which swings to right or left as the spindle is rotated. This has teeth in which a latch engages. This latch is operated by an electro-magnet in the rear included in the independent signal circuit just described. When the signal is at "safety," this circuit is open, and the magnet not attracting its armature, the latch, by gravity, locks the quadrant as to allow only a small degree of movement to the signal handle with its spindle. This movement is enough to close the main circuit and thus release the semaphore, which rises to "danger," but not enough to lower the interlocking latch or latches projecting from the front of the case, until the semaphore has risen the full distance to "danger." As it reaches this position

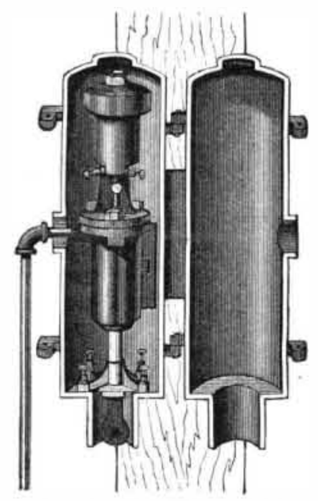


Fig. 3.—SIGNAL-MOVING MECHANISM.

the auxiliary or locking circuit is closed, the magnet attracts its armature, drawing the quadrant latch out of engagement with the quadrant, and the handle can now be swung clear over, unlocking the switch handles dependent upon it.

On the rear end of the switch spindle in the switch board are similar quadrants, whose locking latches are actuated by an electro-magnet connected with the circuit breaker on the switch-throwing mechanism. At the end of the locking bolt, H, of this mechanism, Fig. 1, is a circuit opener. When the bolt is in place and the switch locked as shown, the circuit is open. This opener is in circuit with the electro-magnet back of and actuating the quadrant-locking latch appertaining to its own spindle on the switch board. This is so constructed that a limited movement only is allowed when the circuit is open. This movement is enough to turn the three-way cock. The switch begins to move. As the locking bolt, H, Fig. 1, comes back, the circuit closes. The magnet attracting its armature unlocks the quadrant and instantly relocks it. This is done so quickly that the handle cannot be moved during the change. The switch continues its movement. As it is thrown and locked, the circuit opens, the quadrant is free, and the handle can be swung clear over. Its first movement was only sufficient to open the cocks, but not enough to close the signal-actuating circuit by the strips of metal on its spindle. This is done by the second motion. Hence as the signal cannot be moved until this circuit is closed, and as a semaphore cannot be set at safety without this closing of circuit, the protecting semaphore cannot be set at "safety" until all the switches in its system have been completely thrown and locked by the regular locking bolt.

Above the case containing the switch and signal handle mechanism and connections, and facing the operator, is a miniature model of the tracks and switches controlled by the switch board. The model has movable switches, which repeat the movements of the actual switches, so that at a glance the operator can see what position every switch in the system occupies. An annunciator drop is also placed in view of the operator. This is worked electrically by any train approaching the system, which train causes a bell to ring and also drops the shutter when it is within a mile of the track yard.

* We are indebted to Messrs. Charles Scribner's Sons for the use of this cut, which was published in "The American Railway."

New Hoisting Plant of the Calumet and Hecla Mining Company.

The new hoisting plant recently built by the Calumet and Hecla Mining Company, at Calumet, Mich., is one of the most elaborate ever erected. It consists, says the *Engineering and Mining Journal*, of three triple expansion, vertical inverted beam engines, designed to hoist 10 tons at a speed of 2,000 feet per minute. The cylinders are 18 inches, 27¾ inches, and 48 inches in diameter, all by 7 foot 6 inch stroke. Each is provided with 4 gridiron valves worked by independent cams, so made as to equalize the cut-off. The high pressure cylinder only is provided with an adjustable cut-off, ranging from 0 to nine-tenths stroke. This is automatic, and is controlled by a hydraulic governor actuated by a high speed ball governor. Between the high pressure and intermediate cylinders and the intermediate and low pressure cylinders are reheating receivers. The shaft is hollow, 29 feet long, 22½ inches in diameter, with a 7 inch hole throughout its length. Its bearings are 22 inches by 40 inches. The shafts, cranks, pins, piston rods, cross heads, and links are made of the finest quality of Krupp crucible steel. The outboard pedestal of the shaft is provided with a ball and socket shaft. The fly wheel is 30 feet in diameter.

The hoisting system is the constant motion non-reversing friction system, the drum rotating with the engine shaft when hoisting and on the shaft when lowering. The hoisting drum is conical, 27 feet in diameter at one end and 14 feet 7 inches at the other, and turned with a spiral groove to accommodate 5,500 feet of 1⅜ inch wire rope. The engine, by means of an automatic device, varies its speed from 30 to 45 revolutions per minute, thus hoisting at a uniform rate. The power is thus varied as more or less rope is to be hoisted. The engine house, which contains also the pumps and accumulators, is 112 feet long by 68 feet wide, and is commanded by a 30 ton traveling crane.

The boiler house is 76 feet by 68 feet. It contains five boilers of the Belpaire type, 90 inches in diameter. They are the largest Belpaire boilers ever built, and weigh 86,000 pounds each. The fireboxes are each 4 feet 7 inches wide inside by 9 feet long, but the last 18 inches are covered by firebrick. A brick arch extends from this wall toward the fire door. There are 201 tubes 3 inches in diameter and 16 feet long in each boiler. The flues from the firebox to the combustion chamber are 3 feet 3 inches long, and the combustion chamber is 4 feet 3 inches long. The total length of the boilers is 34 feet 5 inches, width over all 10 feet 5 inches, and height 9 feet 6 inches. The total heating surface of each boiler is 2,985 feet, and grate surface 68¾ feet. Ratio, 42·1 to 1. The circular shell is ¾ inch thick, the outer firebox $\frac{9}{16}$ inch, and the inner firebox ⅜ inch thick. Tube sheet ½ inch thick. All sheets are of Otis steel, of 37,000 pounds elastic limit, and 20 per cent elongation in 15 inches. The working pressure is intended to be 185 pounds per square inch.

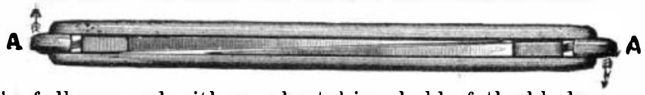
These boilers have shown themselves capable of giving out 1 horse power for each 4 square feet of heating surface when driving a compound engine. The Calumet and Hecla Mining Company has in service and ordered 46 of these boilers, 19 of which carry 185 pounds steam pressure, and the remainder 135 pounds.

Unstable Sand.

A rather remarkable accident is described by Herr Schilling in a recent number of the *Centralblatt der Bauverwaltung*. During the construction of the Neustrelitz and Wammund Railway, a small stream, the Recknitz, some 16½ ft. wide by 5 ft. deep, had to be crossed near Laage, and it was determined to span this by an arch. To secure good foundations for the abutments, it was necessary to pass through a stratum of peat 16 ft. thick, below which was found a bed of fine sand, on which the foundation courses were laid. The two excavations were made by driving steel piles around the area to be excavated and then removing soil in the usual way, and the bed of the river was not interfered with in the least. The spaces inclosed measured 28 ft. by 13 ft. each, and the piles were driven 5 ft. into the sand. There was no difficulty in removing the first 10 ft., but after that pumping had to be resorted to, a double suction and force pump being started at each side of the river. In this way another 3 ft. was removed, but to excavate the remaining 3 ft. it was necessary to concentrate all the available pumping plant in one pit, so that the other gradually filled with water up to the river level. Shortly after the masons had started work in the dry pit, the bottom suddenly burst up and the trench became half full of water, which curiously enough did not come from the river, but from the other trench, as was proved by the level of the water in this pit sinking as it rose in the other. The two pits were 50 ft. apart.

THE WILZIN AUTOMATIC KNIFE.

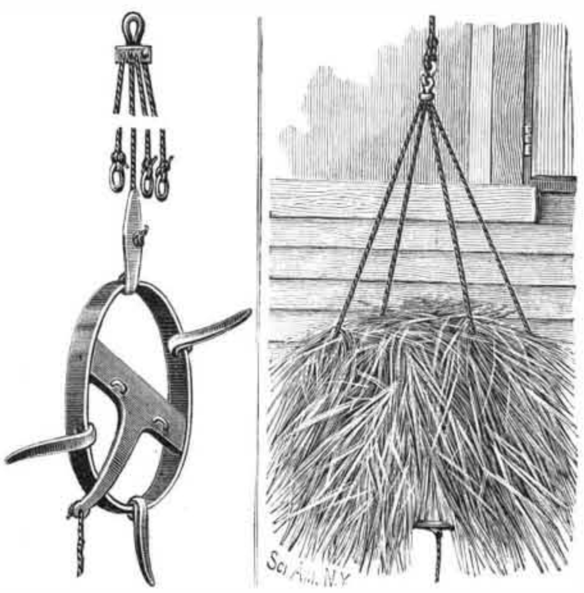
The knife represented in the engraving embodies a novel feature designed to win for it much favor. In each end of the handle, connected with the spring by which the blade is held closed, is a little tip or catch, by a slight pressure upon which, as indicated by the arrows at A, the blade flies partly open, and it can then



be fully opened with ease by taking hold of the blade. Those who have broken their finger nails and tried their temper in using knives which were hard to open will appreciate the means thus afforded of obviating the difficulty by simply pressing a catch. The knife is closed by pressing the blade into the handle in the ordinary manner. This invention has been patented in many countries, and the knives are made by the Automatic Knife Co., Middletown, Conn.

AN IMPROVED HAY SLING.

A device for lifting, carrying, and dumping loads of hay, straw, cornstalks, etc., is illustrated herewith, and has been patented by Mr. Joseph Unterbrink, of Ottawa, Ohio. It is a trip frame latch device to which a series of cords are attached to sustain the load, these cords being suspended from a plate held by any suitable overhead support or carrier to allow the loaded sling to be raised by pulley and rope or other mechanism, and moved over the place where the load is to be dumped, which is effected by simply pulling the latch string. The trip frame is a ring of metal to which are pivotally connected a series of trip arms, whose free ends are adapted to rest on or be retained by a latch



UNTERBRINK'S HAY SLING.

bar pivoted in the frame a little to one side of its center. This latch bar has an arm to which a pull cord is attached, and on one of its faces are eyes into which the free ends of two of the trip arms may be entered. Two other trip arms are adapted to rest at their free ends flat upon the opposite face of the latch. Three of the sling cords have rings at their ends, by which they are adapted to be detachably connected to three of the trip arms, but one of the sling cords is permanently attached to one of the trip arms, so that when the latch is slipped, the weight of the load will cause the cords to turn the trip arms instantly downward, allowing the rings to slip from three of these arms and cause the entire trip frame to be suspended from one sling cord, as shown in one of the views. The load is thus dumped quickly and in substantially the same condition as when loaded in the sling.

A Heavy Gun.

The first high power breech loading 8 inch rifle made entirely of American steel lately passed a successful test at the Naval Ordnance Proving Ground, at Annapolis. The gun is one of four intended for the cruiser Baltimore. Its forgings are from Bethlehem, and the machining and assembling were done at the Washington Navy Yard. With a sample of brown prismatic powder furnished by Messrs. Du Pont, of Wilmington, Del., a muzzle velocity of 2,129 feet per second was obtained with a 110 pound charge and 15·5 tons pressure. The projectile weighed 250 pounds and its velocity was the highest ever attained by an 8 inch shell in this country. Among other interesting features of the trial were the apparent ease and smoothness with which the enormous force of recoil—amounting to over 100 foot tons—was controlled in the short space of 27 inches, without jar or vibration, by the compact and light carriage on which the gun was mounted. This, says the *Army and Navy Register*, is one of the bureau's hydraulic center pivot carriages, and was constructed at the Washington Navy Yard.