The Transportation Show at Paris.

We continue our translation and condensation from the pages of the *Journal des Transports* of its description of the show of locomotives at Paris.

The Western of France exhibits at Vincennes three powerful locomotives, two of them for fast express trains and the third for heavy trains running on a broken profile. Two of these locomotives were built by the company at its own shops, and the other was built at Creusot. One of these engines (Class 900) for fast express work, was shown by the company in 1899. The revision of that class, into Class 500, was made in 1899 and 1900.

The company, in its studies for engines of greater speed and power, designed a new bogie, carefully studying those in use in the United States and in England; and without pretending to have invented anything, it is believed that a bogie has been produced applicable to all future classes of engines which the company may build, and to several of those already in service. This bogie is characterized by considerable length, a disposition of the pivot somewhat back of the center of figure, and a lateral motion by sliding, regulated by springs. This style of bogie truck was shown for the first time by the company in the engine of Class 900 at the fair of 1889; and this is the same engine now exhibited at Vincennes. Meantime, it has run more than 310,000 miles without any other change or serious repair than replacing its smooth tubes by Serve tubes. Immediately after the exhibition of 1889, in special speed trials, this engine reached a speed of 105½ miles an hour, showing great stability.

This locomotive has two coupled axles, with equalizers, and the bogie truck described above; being, therefore, an American-type, eight-wheel engine. The drivers are 80.3 in. in diameter; the fire-box is deep, with a brick arch; the boiler, of steel; the grate surface, 21.5 sq. ft.; and the heating surface 132.83 sq. ft. The boiler pressure is 12 kilograms; the pistons are .46 meters diameter, .66 meters stroke. The engine weighs 14 tons on each driving axle and 16.5 tons on the bogie.

After the exhibition of 1889 the company built a series of these engines, two of the new engines being four-cylinder compounds, on the system of M. de Glehn. The governing consideration was not so much fuel economy (which is a variable element at best, according to the service in which the locomotive is running) but the company was much impressed by the important advantages of having the great power divided into four parts instead of two, giving much lighter parts for handling in repairs in the shops and even on the road. It was also evident that the divisions of the work into four periods for each revolution gave an extremely smooth running. Thus preserving all of the elements of stability of Class 900, the company proceeded to build the engines of Class 500 in 1889 and 1900. These have two coupled axles with equalizers, the drivers being 80.3 in. diam.; they have the leading bogie described above; fire-boxes not so deep, however, as Class 900, but with brick arch; boiler is steel, with Serve tubes; the grate area is 2.4 square meters, and the heating surface 133.9 square meters, and the boiler pressure is 200 lbs. The high pressure pistons are 13.4 in meters diameter and the low pressure 20.8 x 25.2 in. stroke. This engine has 15.8 tons on each driving axle and 18.4 tons on the bogie.

Apart from this engine, designed for extreme stability in very fast traffic, it was necessary to provide for heavy trains on lines of broken profile crossing many valleys almost at right angles, and the company brought out the tender engines of Class 2500, drawings of which are shown, and of Class 3700, one of which appears at Vincennes. The Class 2500 engine has three coupled axles, the drivers being 69 in. in diam., and has a good deal of similarity to recent 10-wheel engines of the Northern and Southern railroads, except that the Western company's special form of bogie is used. Equalizing levers are used between the axles. The fire-box is of medium depth and has brick arch; the boiler is steel, Serve tubes; grate surface, 25.8 sq. ft.; heating surface, 2,088.3 sq. ft.; boiler pressure, 200 to 213 lbs. The pistons are 13.8 in. high pressure, 21.75 in. low pressure, and stroke 25.2 in. The weight on each driving axle is 13.8 tons, and on the bogie 17.5.

The engine of Class 3700, as shown at Vincennes, has made 68.2 miles an hour. It also has three driving axles coupled, with four-wheel bogie forward. The drivers are 60.6 in. in diam. and the cylinders 18.1 x 23.6 in. This engine carries 14.6 tons on each axle and 15 on the bogie.

Mr. S. P. Bush on Brake Shoes.

At the last meeting of the Western Railway Club, Mr. S. P. Bush, who is Chairman of the M. C. B. Brake Shoe Committee, gave some reasons why more encouragement should be given to the development of high power brake shoes, and it would not be surprising if the specification for brake shoes which this committee is to present at the next Convention should set only the lower limits of the coefficient of friction without naming any maximums.

Mr. Bush said in part: "There is room for some discussion as to the maximum coefficient of friction allowable in a specification for brake shoes. We know that the friction is reduced with increase in speed and pressure, and so far as that goes it would seem desirable to keep down the brake shoe pressure. In other words, it would seem desirable if possible to obtain a brake shoe that gives us maximum friction with a minimum pressure. The shoe, developed on these lines, would certainly give a greater efficiency for retarding trains, particularly at high speeds. Further, with the constantly increasing load carried by cars, it is particularly desirable to keep down the braking pressure. We cannot very well reduce the pressure per square inch or per unit of area by increasing the size of the shoe. We have certain limitations there. On some roads it is the practice to use two shoes on the wheel, but that complicates the brake rigging; it would be exceedingly desirable if it were not necessary to have the brake rigging of the cars so heavy and so expensive.

"All these things lead me to believe that it would not be desirable to place a maximum limit on the coefficient of friction. It might be argued that it is necessary to do so for the reason that we have got to maintain the braking power on cars uniformly so that there shall not be too much variation. That is a thing that would be, while in one way desirable, almost impracticable to attain, for the reason that we have variable conditions otherwise that we cannot control. The difference in the lading of cars in the same train brings about much large variables than we would ever get from any difference in the friction of brake shoes.

"Again, from my experience, I do not believe that it is likely that any practical brake shoe will be developed immediately that will give a coefficient of friction much, if any, higher than the maximums that have been attained so far, and I think it is desirable to lend all influence that is proper in the direction of developing what might be called high power shoes. For the reasons that I have stated, I think they should be favored, and if we omit the maximum limit and leave the field open, I believe that those makers who are either in the business now or are prospective makers, or any one else with ideas on brake shoes would feel encouraged to work in that direction.

"One of the important things in connection with a good brake shoe is that the wear of the wheels should be reduced to a minimum. We know from our experience that some shoes wear the wheels much less than others. There is not the same cutting action with some brake shoes that there is with others, and it happens that those that have given the least cutting action have given the best coefficient of friction, at least from all appearances it would seem that the wear of the wheel, whether cutting or merely rubbing, is less. It is also a fact that some of those shoes that have performed in that way have also given very small wear of the shoe itself, and that is a further reason why I feel in favor of lending what influence is right in the direction of developing brake shoes having high frictional qualities."

The Taylor Electric Switch and Signal Apparatus.

The Taylor Signal Company, of Buffalo, which makes the electric interlocking machine mentioned in recent issues of the *Railroad Gazette* is now actively engaged in making at its shops, Carroll and Wells streets, Buffalo, the apparatus for a number of important switch and signal plants. The diagram shown herewith illustrates one of these plants, that at Lawrenceville, Ill.*

Electricity, from a 60-volt storage battery, is the power for all the functions in this interlocking, except the rail-circuits, which are worked by gravity batteries in the ordinary way. Current from the storage battery is used only while switches or signals are being moved, so that the consumption is very small; and at the plants thus far installed, some of which are of considerable size, the gasoline motor used to charge the accumulators is run only one or two days in a month.

The principal distinctive features of the Taylor system are:

1. The switch motor, for switches or derails.
2. The signal motor.
3. (At each switch or signal) A circuit closer to return an indication to the cabin when the switch or signal has finished its stroke.
4. Rail circuits to serve (where necessary or desirable) the same purpose as detector bars.
5. The interlocking machine, and insulated wires to connect it to switch and signal motors.

The switch motor is shown in Fig. 2. Through the gearing shown the motor *M*, turning 20 revolutions in about 1½ or 2 seconds, revolves wheel 1 one revolution to make one stroke of the switch. The switch is connected by rod 2, pivoted at *a* to cam movement, 3, revolving on pin *b*. Crank-pin *c* on wheel 1 besides moving the switch by means of the cam, moves the lock directly by rod 4, connected to the lock through 5 and 6. To the end of 6 (7) may be attached, if desired, a crank to work a mechanical detector bar. In the elevation a detector bar is shown. The lock bolt 6 is withdrawn from lock rod 9 before rod 2 begins its stroke, and it is reinserted after 2 has come to rest. The switch being locked, the final movement of the lock bolt causes the reversal of electric switch 10 which opens the power circuit and closes the indication circuit. The power for moving this circuit closer or switch is furnished by the spiral spring encircling its rod. The spring is compressed by the movement of rod 9 and, at the proper moment, by the final movement of lock bolt 6, is released so as to close 10.

The "indication" acting on the lever in the cabin, indicates to the signalman that the stroke of the track rails is completed, and permits him to finish the stroke of the lever; without this indication the lever would remain immovable; and as it is interlocked, where necessary, with any or all other levers, the clearing of conflicting levers is made impossible.

*Diagrams of two other interlockings, much larger, are shown in the advertising pages of this issue.

When a switch movement is completed and the motor circuit is broken the motor is at the same moment converted into a generator. This is done by closing the indication circuit (at 10) and this current, generated by the motor, lasting only a fraction of a second, is what gives the indication.

The movement of the switch back to its original position is accomplished by turning wheel 1 in the opposite direction, the movements of the cam being the same as before, but in reverse order. The polarity of the motor was changed (by the preceding movement) at 10. If a motor should run too long it is automatically thrown out of gear. For single switches or derailing switches a 1-h.p. motor is used, but the power required is usually only 7 amperes at 60 volts.

A signal motor is ⅙ h.p. It puts its signal in the all-clear position by winding up a chain which lifts the weighted end of the balance lever, pushing up the signal rod. This winding up requires about 2 amperes. When a signal has been put in the clear position a pole changer operates as at 10 on the switch machine, closing a circuit through a brake magnet to hold the signal down. The motor is at the same time de-energized. To return the signal to the stop position the brake magnet is de-energized and the counter-weight causes the blade to take the horizontal position. The brake magnet requires only .1 ampere.

Before proceeding to describe the machine and the connections to it we will turn to Fig. 1. This shows the arrangement of tracks and circuits at a plant employing 16 levers. Derailing switch 14 and signals 9 and 13 are shown on a larger scale in Fig. 5, in which *a* is the motor for the two signals, and *b* motor for derail 14; *c* and *d* are fixed to the post and one or the other, according to which circuit is closed, causes a hook to engage the rod for working the appropriate signal, thus performing a function similar to that of a mechanical selector. The circuit closer to open the motor circuit and close that to the electric brake is represented at *e*. At *f* are shown contact points inserted in the main wire, as an additional safeguard to insure that a high speed signal shall never be given with a facing-point switch or a derail open. When the switch or derail is closed the points *f* are closed by *g*. The pole changer is shown at *h*; *i* is the brake magnet and *j* is the track circuit battery.

In Fig. 6 *a* is the generator (or storage battery) for supplying current to the principal circuits; *b*, *c*, *d* and *e* are principal lead outs; *m*, *n*, *o*, *p* and *q* correspond with the same letters in Fig. 5; *r*, *r1*, *r2*, *r3*, *r4* are track relays. The connections to *r2* are shown at *r2 a* and *r2 b*, Fig. 1.

A front view of a small interlocking machine is shown in Fig. 10 and a rear view of two "levers," one for a switch and one for a signal, is shown in Fig. 7.

"Levers" (bars) with handles extending upward are for switches, and those with downward handles are for signals. The former, when moved, opens two circuits and closes two; the signal lever opens one and closes one.

The interlocking, which is mechanical, of the Johnson type is shown on the front of the machine in Fig. 10. The vertical tappets are actuated by the movements of a slot in the lever. See *s*, Fig. 11.

The "indication" acts by means of the solenoids *M* and M^1. When a switch (having completed its stroke) energizes one or the other of the pairs of solenoids *M* or M^1, Figs. 7 and 11, the movement of the armature *f* controls the bar *B*, supported by *L* and pivoted at *a*, Fig. 11. The armature *f* is rigidly fastened to the cores of the magnet.

In Fig. 11 the lever *L* has been pushed in about three-fourths of its stroke. The first part of the stroke, by the action of the upper left hand portion of slot *s* has depressed tappet *t* far enough to lock all conflicting levers. During the intermediate part of the stroke, while the pin of the tappet is in the horizontal portion of slot *s*, the lever *L*, through bars *B* and *r*, has changed the circuit closer or controller from the "reverse" to the "normal" position (using these terms in the sense common in interlocking practice). The controller being normal, it sends a current to the switch motor, changing the track-rails to normal. This being accomplished, the "indication," sent back from the switch, as before described, energizes magnet M^1. This attracts armature *f* and permits bar *B* to drop out of notch *h*, by which it moves bar *r*; the operator can then push *L* the remainder of its stroke, forcing tappet *t* farther down and thus unlocking such levers as it is proper to unlock after the movement of this switch. In case the indication should not come (as would be the case if the switch rails should fail to move "home") and *L* is pulled back towards the position from which it started, the pawl *d* engages the lug f^1 on the side of armature *f* and pushes the armature to the right; *d* is then lifted over f^1 by striking against another lug, *g*, extending downward from the frame. The pushing of *f* to the right prevents *B* from dropping without being released by an indication current. If there is a failure to indicate on this side also, and the operator makes a second attempt to move the switch by again pushing in *L* the dog d^1 will push *f* to the left. Bar *B* can never drop except after *M* or M^1 has pulled *f* out from under the point b^1 or *b*. It is possible to move the lever inward to the full extent of its stroke after having moved it partly outward, but it is impossible to move it through the last part of its stroke in either direction without getting a release by means of the "indication."

The dotted lines at *dd* indicate the position of bar *B* when it is disengaged from *r*. Rollers *m* and *n* support or guide the sliding bars. The function of the recess at *p* is to limit the motion of sliding bar *r*.

The movement of the switch in the opposite direction is

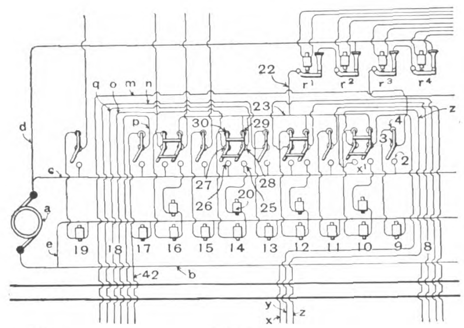

Fig. 6.

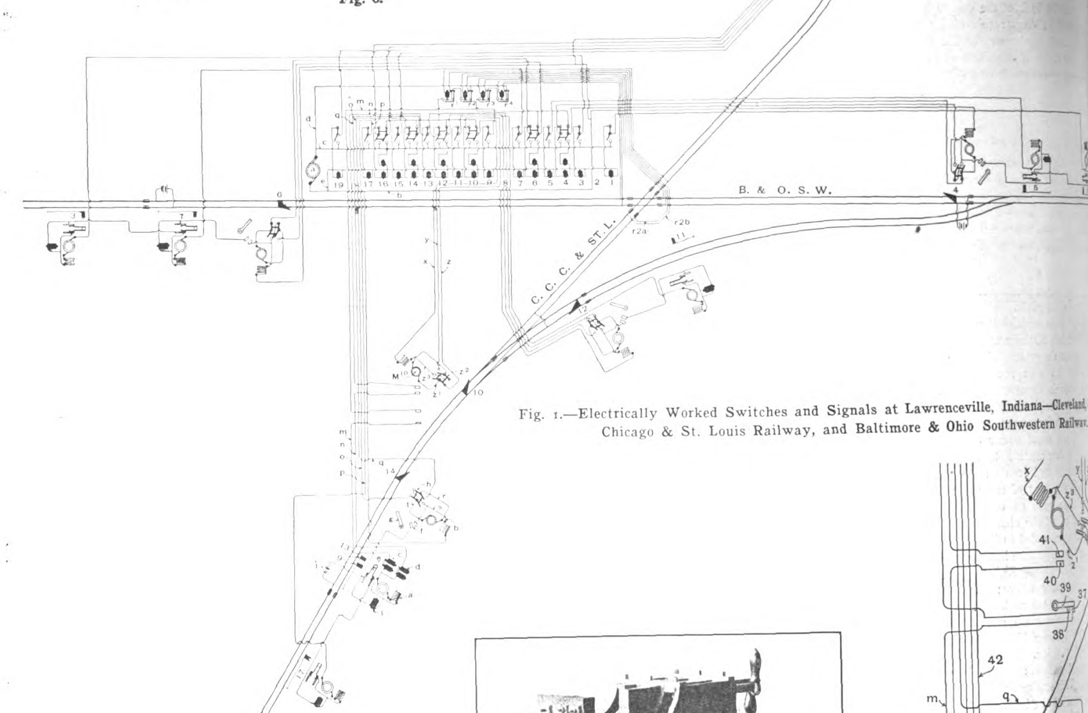

Fig. 1.—Electrically Worked Switches and Signals at Lawrenceville, Indiana—Cleveland, Cincinnati, Chicago & St. Louis Railway, and Baltimore & Ohio Southwestern Railway.

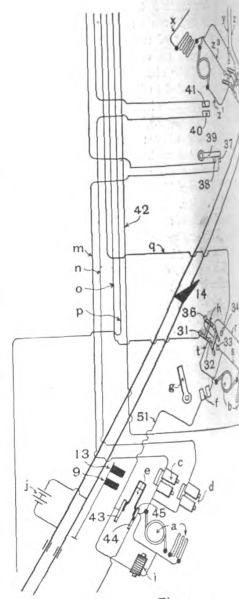

Fig. 5.

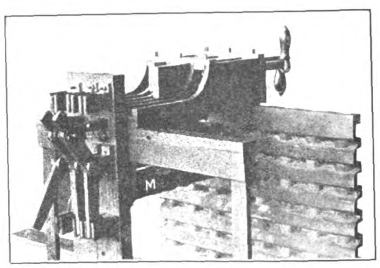

Fig. 7.—Part of Machine, Rear View.

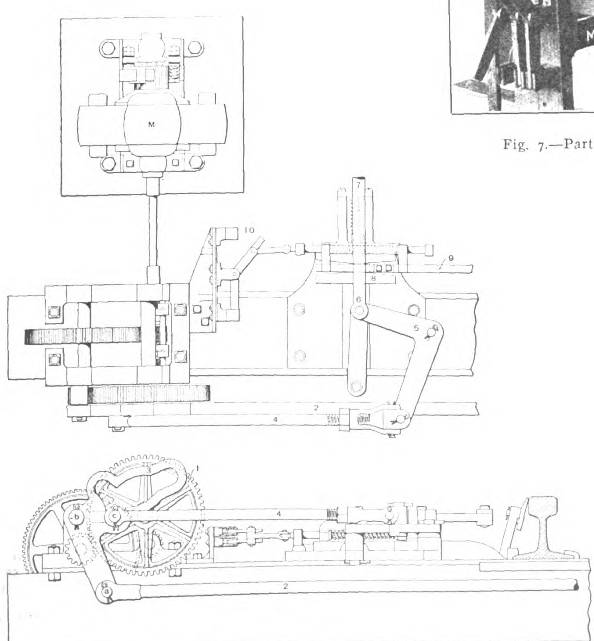

Fig. 2.—Plan and Elevation of Electric Motor for Switch.

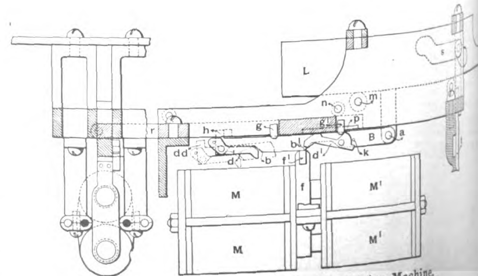

Fig. 11.—"Lever" of Interlocking Machine.

THE TAYLOR ELECTRIC SWITCH AND SIGNAL APPARATUS.

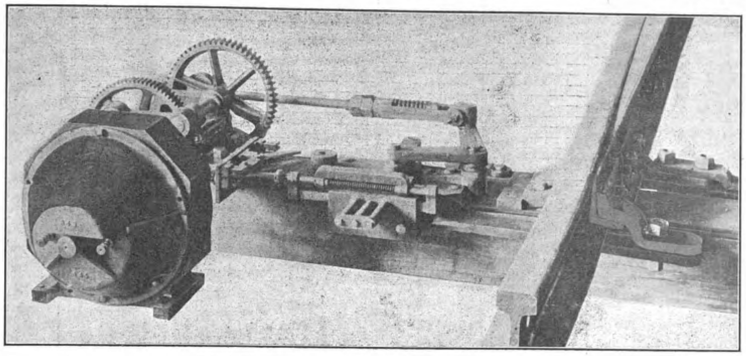

Fig. 3.—Switch Machine (Left Hand).
With cover off.

effected in the same manner as here described, but by pulling instead of pushing lever *L*.

The dwarf signal Fig. 9, is worked by a pair of solenoids *S*, *S*[1]. These, being energized by a current from the cabin, lift the connecting bar *B*, force up the signal rod *R* and clear the signal. A spring in the column, *C*, returns the arm to the horizontal position when the current is withdrawn. In this signal the indication current is closed by the contact points shown between the solenoids. Just before the signal reaches the clear position the low-resistance winding of the solenoid is automatically put in

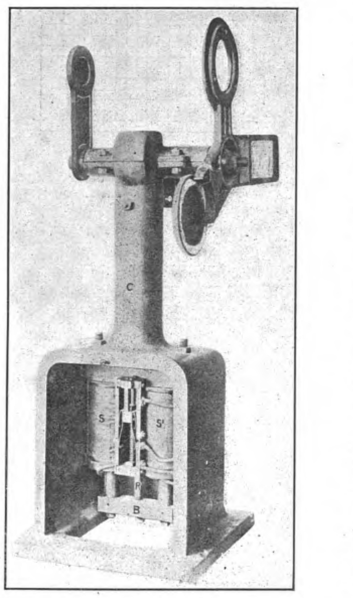

Fig. 9.—Dwarf Signal.

series with the high resistance, so that the signal is held at all-clear by ¼ ampere, although a current of six amperes was used to move it.

The arrangement of the connections between a lever and its switch or signal can be seen by an examination of Figs. 1, 5 and 6. Take, for example, switch No. 10. On closing the contact points at x^1 (lever No. 10) current from the supply *a* flows through wire *d*, forward stops and armatures of relays r^2 and r^1 (in series) contacts of circuit controller x^1, wire *z*, pole changer z^2 (Fig 5) motor of switch No. 10, wires *x* and 42 back to generator *a*. Motor M^{10}, being actuated, moves the switch. The movement of the switch changes the connection at z^2, so that the next movement of lever 10 will send a current through *y* instead of *z*.

The control of this lever by the rail-circuit is effected through track relay r^2, Fig. 6, which is actuated, through wires r^2a and r^2b (Fig. 1) by the circuit from battery *j*. The armature of r^2, when dropped, in consequence of the presence of a train on the track between *j* and the crossing, opens the circuit through which the signalman works switch No. 10.

Both the "normal" and "reversing" circuits of switch No. 10 are taken through the contacts of the relays r^1 and r^2 because a train may pass over this switch in either of its positions. Only the "normal" circuit of a derailing switch is taken through the relay contacts because a train is not to run over a derail when "normal" and it may be desirable to "reverse" it with a train on the track section.

The connections to switch 14 and the signal next to it may be traced in Figs. 5 and 6. To reverse switch No. 14, or in other words to set for the main track, lever 14 is reversed or pulled out which puts the arms 27 and 28, Fig. 6, in contact respectively with blocks 26 and 25. This closes a circuit from generator *a* through wire *c*, block 26, arm 27, wire *o*, contact block 31 (Fig. 5) arm 32. armature of motor *b*, arm 35, block 36, wire *s*, field coils of motor *b*, wire 42, back to generator *a*. When the switch is completely closed and locked the pole changer *h* is thrown over so that arms 32 and 35 are taken away from 31 and 36 and put into contact with the blocks 33 and 34 respectively. This closes a circuit from the switch motor to indication magnet 20, (Fig. 6) through wire *r*, arm 35, block 34, wire *q*, arm 28, block 25, magnet 20, wires *e* and 42 to field coils of motor *b*. This energizes the magnet 20 and releases latch *B* (see Fig. 11) so that lever 14 can be pulled to the end of its stroke. This final movement of lever 14 releases lever 9.

Reversal of lever 9 puts the arm of the electric controlling switch 3 (Fig. 6) into contact with block 2. This closes a circuit from generator *a* through wire *c*, block 2, arm 3, wire *m*, contacts 38, 39, 37, controlled by the rails of switch No. 10; it continues through wire *m*. magnet *c*, signal motor *a* and signal circuit controller *c*, wire 51, controller *f g*, operated by switch No. 14, wire *s*, field coils of switch motor *b*, wire 42, back to the generator *a*.

When the signal arm has moved to all-clear the circuit controller *e* is moved so that it no longer connects 43 and 45; but the above described circuit is shunted around this break by the brake magnet *i*. This holds the signal in the all-clear position as long as lever 9 remains reversed. The movement of the circuit controller *e* when the signal goes to clear, connects contacts 43 and 44, thus closing the circuit to the distant signal. This circuit thus depends on the home signal being clear.

When lever 9 is put back into its normal position arm 3 is put into contact with block 4. Then as the signal returns to its normal position the last part of the movement of the blade replaces circuit controller *e* so that it connects 43 and 45. This closes the circuit containing the signal motor *a* and the indication magnet 9 in the tower. The signal motor armature is rotated by the fall of the blade, and the current generated by this rotation flows through wire *m*, arm 3, block 4, magnet 9, wires *e* and 42, field *b*, wire *s*, points *f* and 43, circuit controller *c*, field coils of the signal motor *a* and back to the armature. This current serves the purpose of retarding the fall of the counter-weight of the signal and also of energizing the indication magnet 9 (Fig. 6) which releases the latch and permits lever 9 to be moved through the final portion of its stroke.

As before stated, the electric interlocking plants thus far installed have been run by batteries charged by generators run by gasoline engines. At one of these plants, that at Edgewood, Ill., on the Illinois Central, a record of the cost of maintenance for three years and six months shows an average of $10.62 a month, including one renewal of the storage batteries. In 1897 the average cost was $7.14 a month; in 1898 it was $2.18; in 1899, not counting the renewal of the storage battery, $3.17. The renewal of the battery, which was made in 1899, cost $254. The plant at Edgewood has 18 levers.

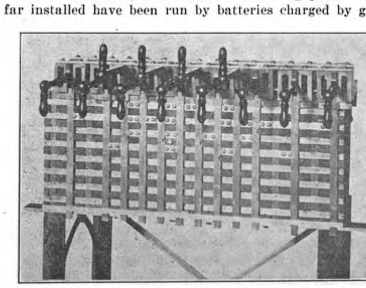

Fig. 10.—Front of Taylor Interlocking Machine.

The Effect of Temperature on the Friction of Brake Shoes.

At the meeting of the Western Railway Club, Sept. 18, Prof. R. A. Smart, of Purdue University, presented a paper on the friction of brake shoes giving results of tests on the M. C. B. brake shoe testing machine under various conditions of pressure, speed and temperature. This paper was briefly referred to last week. The tests under the first two conditions confirm the conclusions from the M. C. B. laboratory tests of 1895 and 1896, that the co-efficient of friction of brake shoes increases with decreases of speed and with decreases of pressure. The Purdue experiments, however, are the first to give conclusive data as to the effect of temperature on friction. This conclusion is that within the limits of the tests the coefficient of friction of cast-iron brake shoes is practically constant with changes in temperature. Prof. Smart says, in part:

So far as the writer is aware, no reliable information has been obtained heretofore on the effects of temperature, a fact which is easily explained by the difficulties attending such investigations. In fact, it is well-nigh impossible to carry out the experiments with a great degree of refinement or to arrive at other than general conclusions. This, however, has been done in the investigation under consideration, and the general conclusion reached is put forth with confidence as one which is accurate for all practical purposes. The tests upon which the conclusion is based involve ranges of temperature of the shoe up to 1,500° Fahr., speeds of from 40 to 60 miles per hour, and normal pressures of from 2,800 to 6,840 lbs. They also involve continuous runs of about five miles in length and from five to 10 minutes in duration. It is believed that the range of temperature mentioned is sufficiently high to embrace all but the most extreme conditions of service. The term "temperature of the shoe," as here used, is more accurately defined as the temperature of two points on the center line of the face of the shoe and near either end. It is obviously impossible to measure the average temperature of the whole shoe while running. Two points of measurement, as just noted, were chosen to represent the average temperature of the shoe.

In Figs. 1 to 4 are shown, in graphic form, the results from four continuous tests. In these tests the wheel was run at a constant speed of about 40 miles per hour, and the brake shoe pressure was 2,808 lbs. Both shoe and wheel were cold at the start. Successive readings were taken, during the run, of the temperature of the trailing end of the shoe, and these are plotted with the coefficient of friction for the same instant. It will be seen that the curve of temperature of the shoe rises during the run to several times its original value, while the coefficient of friction changes but little. The curve representing the coefficient of friction does not, in these diagrams, start at the axis of ordinates. The readings obtained at the beginning of an application are always more or less irregular, and were, therefore, omitted when plotting the curves. The lines showing the coefficient of friction are not straight, but the variations are not greater than the variations found in ordinary stop tests under identical conditions. Their character and direction warrants the general conclusion which has been drawn.

In partial explanation of the peculiar form of the temperature line, it should be said that at no time did the shoe heat up uniformly over its entire rubbing surface. The point of maximum temperature during the first part of the tests, particularly, shifted from the center to either end and back again for no apparent reason and with no observable regularity. Readings taken from both ends in quick succession would sometimes show the leading end hotter and sometimes the reverse, although at any time the difference between them was not great. The general form of the temperature curve may be explained as follows: Immediately after the shoe is applied to the wheel its temperature rises to about 500° Fahr. In this time the wheel, being of greater mass, has remained practically cold. At this point the shoe begins to impart heat rapidly to the cold wheel, thereby keeping its own temperature down, until the wheel has been heated up and the tread has acquired a comparatively high temperature, after which the temperature of the shoe again increases.

In the continuous tests just described, the initial temperature conditions of the shoe and wheel were the same. Both were cold. To show that variation in the initial temperature does not lead to different results, reference is made to Fig. 5, which represents the results of 15 stop tests in which the wheel was brought to rest from a 35-mile speed under a continuous brake shoe pressure of 6,840 lbs. The initial temperature of the shoe varied from about 200° to 600° Fahr. The temperature of the wheel varied also, following approximately the temperature of the wheel. The tests were run in several series, each series consisting of three or four tests run after the other, the final temperature conditions of one being the initial conditions for the next, and so on. The conclusion drawn from these results confirms the one already stated, *i.e.*, that within the limits of the tests the temperature of the rubbing surfaces does not affect the coefficient of friction. A number of series of stop tests were made in addition to those the results of which have just been presented. The results from these tests were irregular and unsatisfactory and no conclusion could be drawn from them.

In order to measure the temperature of the face of the shoe during the application of the shoe to the wheel, use was made of special Le Chatelier pyrometers,* one in either end of each shoe. Each thermo-electric couple or

*Described in the *Railroad Gazette*, April 2, 1897.