between railroad companies and employés seems to be regarded with favor.

A bill to reduce passenger fares to a uniform rate of two cents per mile will command a considerable support, and possibly may be adopted for the main lines of the Vanderbilt roads. It is hardly probable, however, as a close analysis of the traffic shows that the volume will not at present warrant such a reduction, and its effect would be to stop the building of new lines in the northern part of the state. The members from that region understand that, and are likely to be solid against the bill.

A bill to require the application of driver brakes and their use upon all mixed trains is the last to be introduced, and will doubtless have favorable consideration.

Our legislature has now adjourned until the 12th inst., to permit the several committees to inspect the state institutions. There will be twenty-four days remaining, after they reconvene, for the introduction of new bills, and doubtless the hopper will be filled to overflowing by the time the limitation shall expire. M.

## Transportation of Baggage.

TO THE EDITOR OF THE RAILROAD GAZETTE:

General Alexander, in the January "Scribner," has one or two remarks upon possible changes in some of our transportation methods which may turn out to be prophetic. One is that the carriage of baggage should be considered a charge separate from the carriage of the passenger, with the possible result that tickets for travelers without trunks could be sold at less price than now, while the price for travelers with baggage would be no more than at present. Doubtless this is a rosy view to take, but it does not follow that it has not an element of truth. We all know that in Europe there is an extra charge for luggage. Probably the American custom of allowing so many pounds to each passenger arose from the circumstances surrounding traveling 50 years ago. Then few started from home without baggage; indeed, no one traveled without full consideration and elaborate preparations. But now the case is reversed. Practically, therefore, by continuing the ancient custom, we charge upon the unburdened traveler the expenses of carrying Saratoga trunks to the summer resorts. The old need of traveling always with impedimenta has passed away. Why, then, should the old double charge without distinction be retained? The only way to discuss this question profitably is through statistics, and for these we must call upon our general baggage agents and other officials familiar with the facts. By all means let us know just how much the carriage of baggage costs our railroads—actual outlay, I mean. Then let the result be stated by the 150 pounds and by the mile. Will not some one connected with these departments devote a few hours, now while traffic is light, to collecting figures bearing upon this subject and let them be given to your readers? This would lead to the further idea whether the carriage of baggage (supposing the charge separated) could not be done better and more cheaply by a separate company than by the railroad.

It has often been remarked lately that the Inter-state Commerce Law is a powerful incentive to consolidation. Admitting the truth of this we cannot see any prospect in the near future for the union of the stronger lines, of the New York Central with the Pennsylvania for example. Nevertheless we see signs of combination in minor things. Take parlor cars, for instance. Why should a railroad not build and run its own drawing-room cars and thus secure to itself the profit? Because experience has demonstrated that there is no profit in such individual cars. It is better to pay Pullman mileage, even, than to do it. Only a large system of parlor cars running over a great many roads can make a profit for itself and be of advantage to each railroad, too. So with express companies. Amalgamation into vast systems running over many roads is the only way to combine cheapness with profit. The Baltimore & Ohio is probably the last road which will start the experiment of running its own express and parlor cars. In the Erie report President King, speaking of the sale of the Erie express to Wells, Fargo & Co., says that 40 per cent. on the large traffic controlled by the large express company is better than the whole of the local.

Now if this be demonstrated in regard to express and other matters, why not in the carriage of baggage? A large and thoroughly organized system, perhaps including collecting and delivery by team, could unquestionably do the work better and with less aggregate expense to the railroads than the present plan. If a careful study of statistics should show that the saving would sustain Gen. Alexander's position—less fare to unencumbered travelers and about the same aggregate charge to those with baggage—the public would hail the improvement with delight. Of course, the point of the economy lies in the fact that such proposed baggage department would operate over a large number of roads and so reduce the expense to each individual one, leaving still, perhaps, a handsome profit to the managers. But first for the statistics of actual cost of transporting baggage upon one or more of our large roads. For these we must wait.

T. L. G.

## The Interlocking System of the St. Louis Bridge and Tunnel Railroad.

BY N. W. EAYRS, C. E., ASST. SUP'T. OF STRUCTURE AND INTERLOCKING.

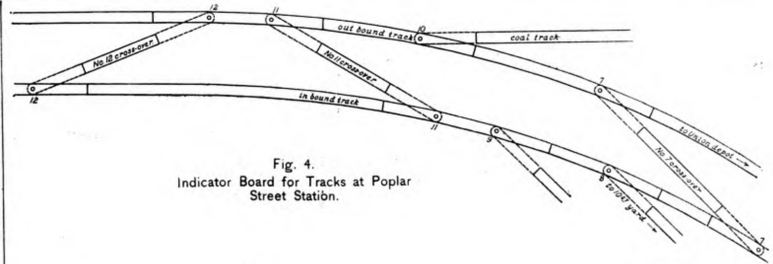



Fig. 4.
Indicator Board for Tracks at Poplar Street Station.

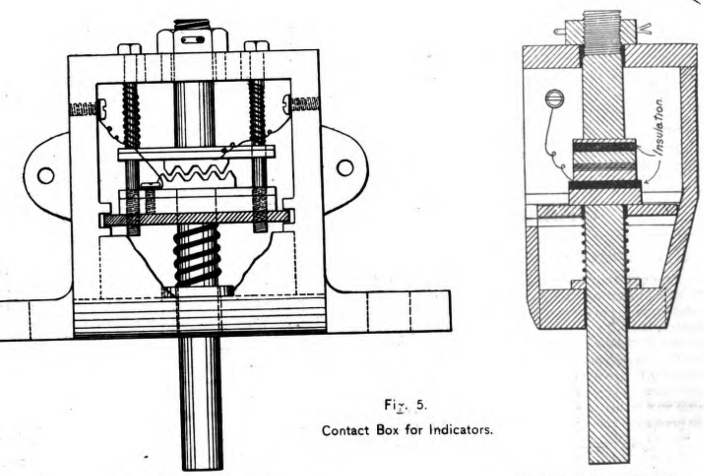



Fig. 5.
Contact Box for Indicators.

*Plan, Cover Removed.* *Section through Centre.*

INTERLOCKING AT THE ST. LOUIS BRIDGE.

The St. Louis Bridge & Tunnel Railroad Co. is a corporation formed for the purpose of facilitating the transfer of freight and passengers across the Mississippi River at St. Louis. This corporation controls the St. Louis Bridge with its approaches, and the tunnel in St. Louis, which extends from Third street (the western terminus of the west bridge approach) to Clark avenue, a distance of nearly three-quarters of a mile. The mileage operated by this company consists of about 3½ miles of double-track main line, and about 28 miles of side tracks in its yards on both sides of the river.

The Bridge & Tunnel Co. does all the passenger transfer business, and is the principal agent in the transfer of freight at this point. On the east side of the river 12 railroads deliver to the Bridge & Tunnel Company's yard, either directly or indirectly, freight destined for St. Louis or Western roads, while on the west side of the river the four great lines, the Missouri Pacific, the Iron Mountain, the St. Louis & San Francisco, and the Wabash deliver freight to the company's yards in St. Louis.

The magnitude of this traffic may be seen from the following figures from the 13th annual report of the company for the year ending Dec. 31, 1887.

| | |
|---|---|
| Tons carried | 3,042,068 |
| Cars moved over bridge | 469,661 |
| Average cars moved over per day | 1,287 |
| Trains transferred | 59,302 |
| Averaged trains transferred per day | 131 |
| Passengers carried | 1,473,638 |

The movement of this traffic and the entrance to the yards of three important roads terminating in East St. Louis, is controlled by a system of interlocked switches and signals. This system comprises three operating stations; one in St. Louis, near Poplar street and the western end of the tunnel, another at Main street, at the western abutment of the bridge, and the third and principal station at East St. Louis at the eastern end of the east bridge approach. The first two stations named, although essential parts of the system, are comparatively small; that at Poplar street containing 20 and the Main street station 8 levers. The former controls the movement of trains between Union Depot and the west end of the tunnel, and the entrance to Tenth street yard. The Main street station operates two cross-overs at the west approach, with the necessary signals. These two stations are interlocked with each other by an electric locking apparatus in addition to the hydraulic mechanism, by which the station at the end of the tunnel farthest from an approaching train unlocks the signals for entering the tunnel. After the train has passed into the tunnel the signals are locked automatically to danger, from which position they cannot be released until the tunnel is again clear. With the exception of this electric apparatus the switch and signal mechanism in these two stations is the same as that of the East St. Louis station, which will be described in detail.

The accompanying diagram shows the tracks controlled by the interlocking system in East St. Louis and at Poplar street in St. Louis.

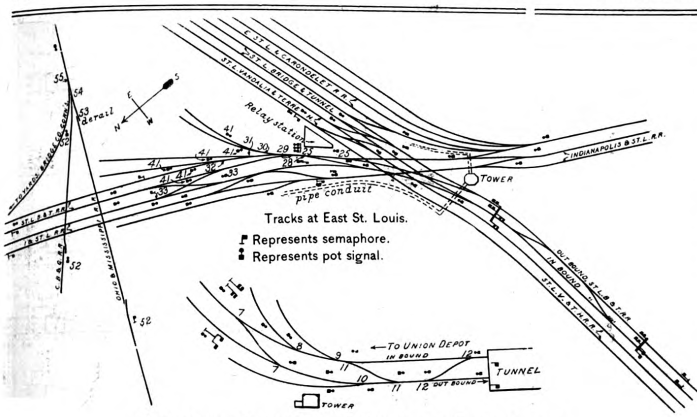
For the operation of our interlocking plant we maintain a pumping station and an air-compressing plant. These, with the necessary boilers and appurtenances, are located in the east abutment of the bridge. The waterworks consist of two Cameron pumps and one Deane pump, with the necessary amount of main and distributing pipes, stand-pipe, and two wrought-iron pressure tanks 12 ft. in diameter and 56 ft. high, situated near the Relay depot in East St. Louis. The compressor station is equipped with two Norwalk compressors, each with a capacity of 427 cu. ft. per minute, working at 150 revolutions. The steam cylinders are 14 by 16 in., intake air cylinders 14 by 16 in., and compressing cylinders 9½ by 16 in. In the large air cylinder the air is compressed to a pressure of 30 lbs. per sq. in.; the air then passes to the smaller cylinder, where it is compressed to 70 lbs. per sq. in. But one compressor is used at a time, the other being held in reserve. From the compressors a 4-in. main leads to a distributing reservoir placed in the east entrance to the bridge, and from here air is supplied to Main street and Poplar street stations in St. Louis, and to the East St. Louis tower.

In the operation of switches and signals by fluid pressure alone the use of compressed air is not essential; any motive power suitable for the purpose can be employed to drive the accumulator pumps, which is the only part in such a system that compressed air has to perform. In the interlocking plant of the Bridge & Tunnel Co. as it was originally erected by the Union Switch & Signal Co. (in 1883), the movement of the switches and signals was effected by hydraulic pressure solely, and the object had in view in establishing a compressor station in connection with the interlocking system was to supply power from a central station, thus avoiding the danger and inconvenience of separate boilers for each interlocking station and the expense of necessary attendants. But later improvements have led to the abandonment of the old hydraulic switch apparatus and the substitution of a mechanism in which the pressure of air is employed to move the switches, a column of fluid being used simply to operate the valves controlling the direction of the air pressure at the switches.* In the present state of our interlocking plant, therefore, compressed air is an essential part. These improvements, and others which will be noted, are the work of the Superintendent of Structure, Mr. Morris Wuerpel, to whose skill and ingenuity the present high state of efficiency of the system is mainly due.

Experiments have been made with various substances in order to obtain a non-freezing fluid. The liquid first used was wood alcohol, but this was found to be too expensive, and it was difficult to maintain the pipe connections and packings sufficiently tight to prevent leaking. Glycerine and solutions of various salts were tried, but they all had their disadvantages. The liquid now used is plain water during the warm weather, and a solution of chloride of calcium during the time when danger from frost is to be apprehended. The substitution of one fluid for the other is effected with no hindrance to the working of signals or switches.

As the East St. Louis station is the most important and extensive of the three, a description of it will cover the entire interlocking system at this place. The movement of all trains entering upon or leaving the Bridge & Tunnel Co.'s tracks in East St. Louis, and the crossings of those tracks by

*The same principle is used in the Westinghouse pneumatic interlocking described in the *Railroad Gazette* Dec. 21, 1888.—EDITOR.



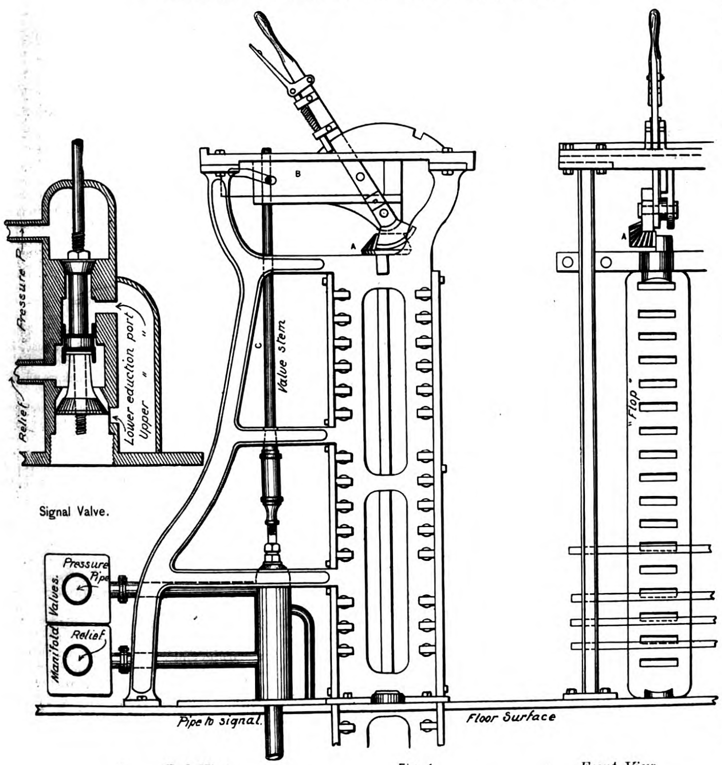

Tracks between Poplar Street and West Mouth of Tunnel, St. Louis.

the Indianapolis & St. Louis, the Vandalia, the Ohio & Mississippi and the Chicago, Burlington & Quincy are controlled from this station.

The station is a two-story octagonal wooden tower, with basement, placed at the intersection of the tracks of the Indianapolis & St. Louis and the Vandalia with those of the St. Louis Bridge & Tunnel Co. On the first floor are placed three hydraulic accumulators and their pumps, and an upright boiler which is ordinarily used as an air reservoir, but which can be fired up and used for generating steam in case of serious accident to the air compressing plant. The pumps are operated, as has been said, by compressed air supplied from the East abutment compressor station, and are made to work automatically in order to meet the constant demands made upon the accumulators by the operation of the switch and signal apparatus. The accumulators are so connected that they can be used singly or all together, as occasion demands.

The second story of the tower contains the telegraph operators' table, electric indicators and signal bells, and an 80-lever interlocking frame, which extends around five sides of the tower. Of these 80 levers 70 are in present use, the other ten being reserved for future extensions. But the efficiency of this system is not to be measured by the number of levers alone, for with these 70 levers we operate 138 switches and signals; and since one signal lever may operate, in a manner that will be explained later, nine different signals these 70 signals do the work of about 200 of the ordinary type of interlocking. Moreover, the levers being so small and so easily handled, it is necessary to have but one leverman on duty at a time. Three lever-men are regularly employed at this station, working in shifts of eight hours each.

The locking frame is of the Saxby & Farmer type, which is too well known to need further description; but the levers are adapted to the use of hydraulic pressure for operating the switches and signals, instead of the wires or rods in ordinary use. End and front elevations of a section of the locking frame, showing a signal lever and its connections, are




*End View.* Fig. 1. *Front View.*

Interlocking Frame and Section of Signal Valve.

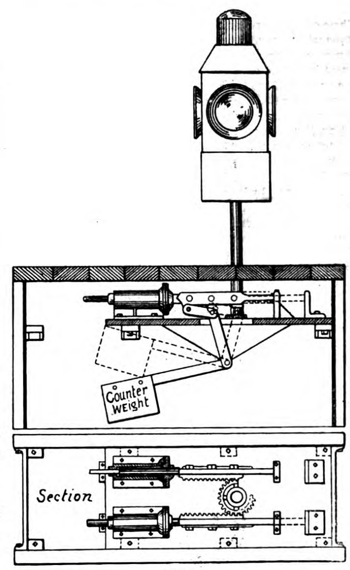
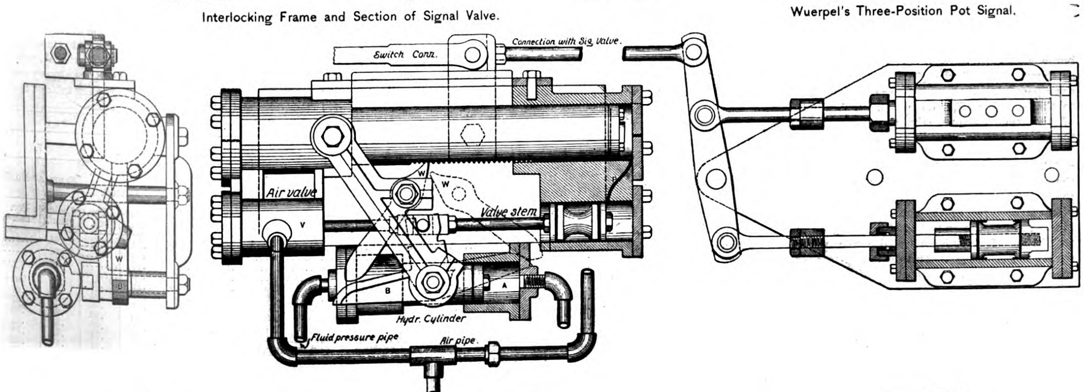



Fig. 3.

Wuerpel's Three-Position Pot Signal.




*Switch Apparatus.* Fig. 2. *Signal Valve.*

Wuerpel's Hydro-Pneumatic Apparatus.

INTERLOCKING AT THE ST. LOUIS BRIDGE.

given in fig. 1. The locking frame is divided into five sections of sixteen levers each.

In front of the frame, between it and the sides of the building, is a series of "manifold" valves (shown in section in fig. 1), the upper pipe of which, called the pressure pipe, is filled with fluid, under pressure, from the accumulators; the lower pipe, called the "relief," is not connected with the accumulators, and the fluid it contains is, therefore, under no pressure except that due to the hydrostatic pressure.

Upon reversing the lever (which is here shown in its normal position, that is to say, giving a red signal) the flap is revolved a quarter turn by means of the bevel gear segment *A*, by which motion the locking is effected. At the same time the cam plate *B* is drawn back, lifting the valve stem *C*, which raises the upper part of the valve off its seat and closes the lower portion. Communication is thus established between the pressure pipe and the upper eduction port, whence the pressure is transmitted through the lower eduction port to the column of fluid in the distributing pipe. At the signal end of this pipe a simple ram is used to operate the semaphore or the pot signal. When the lever is restored to its normal position the position of the valves is reversed, and the lower eduction port is opened to the relief, thereby releasing the pressure from the signal and distributing pipe. A counterweight brings the signal to the normal position (danger), at the same time forcing the piston to the normal end of the cylinder. The small amount of fluid thus displaced passes back through the distributing and relief pipes, and is discharged into a tank on top of the tower, whence it is returned to the pumps.

The operation of the switch levers is precisely the same as that of the signal lever, except that, since in this case the use of a counterweight is impracticable, pressure must be applied to the piston in the switch cylinder to bring it back to its normal position; hence two pressure pipes, the "normal" and the "reverse," are connected with each switch movement and with each switch lever.

The distributing pipes pass down from the lever room to the basement, from which they are distributed through the area covered by the interlocking by means of brick conduits. These conduits are large enough to afford easy access to the pipes which are arranged upon the walls in racks. For convenience in tracing the pipes brass tags are attached at frequent intervals, each bearing a number corresponding with the number of the lever in the tower to which the pipe belongs. Over 65,000 feet of pipe is used at the East St. Louis station alone.

[Mr. Eayres gives a careful description of the hydraulic switch apparatus, which has been superseded by the hydro-pneumatic apparatus and therefore is not printed here.—EDITOR.]

The Wuerpel hydro-pneumatic switch apparatus is shown in fig. 2. This apparatus is much simpler in construction than the original one. It is very prompt in action; and as the stroke of the main piston is an inch and a half more than the throw of switch, the switch points cannot fail to close up to the rail, unless the track is more than 1½ inches out of gauge.

The apparatus consists of a hydraulic cylinder *A* into either end of which pressure can be admitted by the operation of the switch lever in the tower. The piston of this cylinder carries a forked arm which engages with a stud on the stem of the double air valve *V*. The movement of the hydraulic piston operates the air valve, by which air pressure is admitted, by means of the ports *P*, to the main cylinder. The main piston is connected, by means of the arm shown, with the switch rod, and also with the valve stems to the signal valves. The locking is effected by means of the pawls *W* which engage in teeth cut in a steel plate inserted in the lower part of the main piston. The pawls are operated by the rocking-bar *R*, whose motion is coincident with that of the air valve stem. The free pawl falls, by its own weight, into position for locking.

The semaphore signal used is of the ordinary type and needs no special mention. These, as well as the pot-signals, are operated by fluid pressure alone, acting upon a simple form of ram, the plunger of which is connected by suitable means with the semaphore blade or pot signal.

The pot-signal used is shown in fig. 3, which represents a three-position pot. On the sides of an iron box which is sunk into the ground with its top at the level of the ties, is borne a shelf which supports two rams and the signal staff, as shown in the figure. The rams are placed with their axes parallel. By means of the pinion which is clamped to the signal staff, and which meshes into either one of the racks shown, the signal is rotated either to the right or to the left, according as the pressure is admitted to one or the other of the rams. Counterweights bring the signal back to the danger position when the pressure is released. The three-position pot shows on the sides which will be opposed to approaching trains a combination of three of the four colors—red, white, green or blue. A four-position pot is obtained by an auxiliary ram, the plunger of which is connected with a vertical rod which carries a door or gate. This door is painted red and conceals the pot signal, the three sides of which are, in this case, white, green or blue. The normal position of the door is closed; when the signal lever in the tower is reversed the door opens, but the pot signal may remain stationary or may rotate toward the right or to the left, according to the position of the switches through which the train is to pass.

It is by passing the fluid pressure through one switch movement after another that it is possible to get so many different signals from the same lever. For instance, the single pot signal 25 and the group of three (all numbered 25 and shown near the relay depot on the diagram) are all operated by lever No. 25 in the tower. The single signal is a four-position one, the others three-position. Disregarding the danger signals (the red faces) either one of the three faces of the single pot No. 25 can be used either alone or in conjunction with either one of the two faces of each of the pots No. 25 in the group of three. As at present used, lever No. 25 gives nine different "clear" signals, according to the position of switches 28, 29, 30, 31, 32 and 33. Lever 41 operates six three-position pot signals for movement of trains through the same switches in the opposite direction. Again, lever No. 52 operates either a semaphore (52) at the west derailing switch on the Ohio & Mississippi crossing, or either one of the two pot signals (52) which control the C., B. & Q. crossing or the connection with the bridge yard, according as switch 53, 54 or 55 is in use.

A brief explanation may be necessary to make clear the course which the pressure takes in passing through switch movements. A simple illustration is found in switches 28 and 30. It will be noticed from the diagram that signals are placed at the right side of the track to which they refer, and that of the three pot signals, numbered 25, the right hand one (facing north) governs the right hand track, the middle governs the middle track, and the left hand pot the left hand track. The pressure-pipe from signal lever 25 in the tower goes direct to the door of the single pot No. 25, and, by a branch, enters the centre port of the signal valve at 28 switch. From the other two ports of this valve two pressure pipes leads out, the "normal" and the "reverse," the terms referring to the position of the switch. Of these two pipes the "reverse" enters the centre port of the signal valve connected with No. 30 switch, the other two ports being connected with the two cylinders of the right hand pot signal. Now, when switch 28 is set for the right hand track, and switch 30 is also set for the right hand track, the signal lever 25 on being reversed admits pressure first to the door of the single four-position pot 25, the pressure then enters the centre port of the signal valve at No. 28, passes out of the reverse port and to the centre port of No. 30, thence through the normal port to one of the cylinders at the pot signal, causing the signal to rotate to the left, and show a green signal. If switch 30 is set for the side track, the pressure passes through the reverse port and acts upon the other cylinder, causing the signal to rotate in the opposite direction and show a white signal.

Indicator boards (see fig. 4) showing fac-similes of the tracks are placed in the tower in front of the levers to which they refer. The tracks are represented on these boards by strips of metal, the switches by pieces of metal pivoted at one end, turning upon shafts which are connected with electro-magnets on the back of the board.

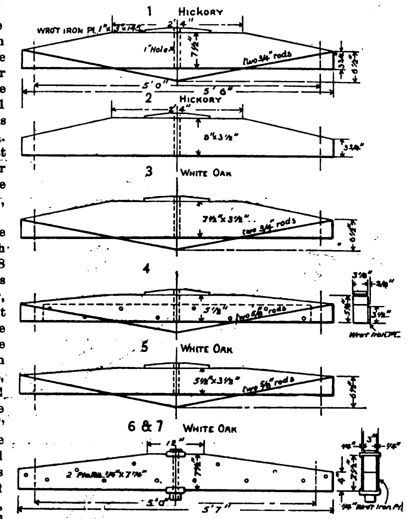
Fig. 5 shows the form of contact box used in connection with the hydro-pneumatic switch apparatus. It is bolted to the web of the rail, one on each rail opposite the switch points. The manner in which contact is effected is sufficiently clear from the figure.

With the exception of the contact boxes, all the mechanism connected with the switch and signal movements, all pipes and connections are underground and out of danger from derailments.

## Brake Beams.

In the majority of the rules and instructions for the care and use of the air brakes, issued by the various railroad companies for the guidance of their employés, particular care is enjoined not to allow the slack to become so great that the piston will travel over 8 or 9 in. On heavy passenger cars this has to be carefully watched and the slack frequently taken up by dead levers or the under connection of the trucks. That this is not always attended to as promptly as might be desired, especially if it necessitates taking up the lower connection, is apparent to all who have paid any attention to the subject. To determine how much of the piston travel is caused entirely by the springing or deflection of the brake beams in the centre when the air pressure is applied, and how much more efficient the brake arrangement can be made by the use of stiffer brake beams than those in ordinary use, were the objects of the investigations the results of which are shown in the appended table.

A passenger car weighing 50,000 lbs. would require at 80 per cent. of total weight a breaking force of 40,000 lbs. Each of its 4 brake beams would have to withstand a pull of 10,000 lbs. in its centre. Or if a car weighing 40,000 lbs. requires a braking force of 32,000 lbs., each brake beam would have to withstand a pull of 8,000 lbs. It has been found by a series of careful experiments, that with new




Brake Beams Tested. Results shown in table herewith.

NOTE.—*All brake beams were supported at 5-ft. centres. All but No. 7 were 6 ft. long and 3¾ in. wide at ends.*

white oak brake beams 3½ in. × 5½ in., supports 5 ft. apart trussed with two ⅝ in. rods, and loaded in the centre under as near as possible the same conditions as in actual use on a car, the deflection was with 8,000 lbs. loads, ⅜ of an in., and with 10,000 lbs. nearly 1⁄2 of an in. The former represents a piston travel of 2½ in. and the latter 4 in. due to the spring of the beam alone.

Even brake beams 3½ in. × 7½ in. trussed with ¾ in. rods which would be considered much larger than the average in ordinary use, deflected under 10,000 lbs. load over ¼ in., representing 2½ in. movement of piston in one case and 2 in. in the other. How much more these beams will spring after being in service for a few months and withstanding the pull of the levers several thousand times, when the truss rods have become loosened and the timber shrunk, we will not attempt to state.

A certain amount of lost motion in the pin connections, etc., is unavoidable, and as usually put up with key bolts amounts to rarely ever less than 1⁄16 in. in each hole and often ⅛ of an inch.

It will be readily seen that by adding the amount of motion necessary to take up the slack to the amount caused by the spring of the beams, quite a considerable portion of the 12 in. maximum travel of the air cylinder piston is consumed in ineffectual work. Add to this the clearance of the shoe from the wheel, say ¼ of an inch, which is a small allowance, representing 2½ in. piston travel with 40,000 lbs. braking power, and the great necessity of continually adjusting the connections and taking up the slack is in a measure explained.

From the foregoing statement it will be readily seen that much of this could be avoided by the use of stiffer beams. What would seem most desirable would be a beam combining great stiffness with say a deflection of less than ⅛ of an in. under 10,000 lbs. load, without any loose parts, such as truss rods, etc., to jar and work loose and impair the safety and strength of the beam, without being too heavy or clumsy, and on which the brake head and levers could be readily applied. Several different kinds of wrought-iron and steel beams, or combination beams of wood, plated on both sides with iron and riveted or bolted through and through, are now being made and used to a limited extent. Some of these possess considerable merit, and although when first introduced were not always entirely satisfactory in every particular, yet the defects are gradually being eliminated and are already much improvement over the old wooden beams. The table of brake

TEST OF BRAKE BEAMS, PASSENGER TRUCKS.

| LOAD. | 1. 3½" × 7½". ¾" truss rod. | | 2. 3½" × 8". No truss. | | 3. 3½" × 7½". ¾" truss rod. | | 4. 3½" × 5½". One ⅜ × 3½" plate. | | 5. 3½" × 5½". ⅝" truss rods. | | 6. 3½" × 7½". Plated. | | 7. Same as No. 6. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deflection. | Per. set. | Deflection. | Per. set. | Deflection. | Per. set. | Deflection. | Per. set. | Deflection. | Per. set. | Deflection. | Per. set. | Deflection. | Per. set. |
| 2,000 | .06 | ........ | .07 | ........ | .06 | ........ | ........ | ........ | .15 | ........ | .01 | ........ | .01 | ........ |
| 4,000 | .11 | ........ | .11 | ........ | .10 | ........ | ........ | ........ | .20 | .02 | .04 | ........ | .04 | ........ |
| 6,000 | .16 | ........ | .15 | ........ | .20 | ........ | ........ | ........ | .28 | .02 | .07 | ........ | .08 | ........ |
| 8,000 | .22 | ........ | .22 | .01 | .26 | ........ | ........ | ........ | .33 | .02 | .09 | ........ | .10 | .02 |
| 10,000 | .26 | ........ | .25 | .02 | .40 | .01 | .36 | .03 | .41 | .02 | .12 | .01 | .12 | .02 |
| 12,000 | .30 | ........ | .30 | .02 | .46 | .03 | .42 | .05 | .48 | .05 | .14 | .01 | .20 | .07 |
| 14,000 | .34 | ........ | .36 | .02 | .53 | .06 | .45 | .08 | .60 | .07 | .15 | .02 | .22 | .07 |
| 16,000 | .36 | .01 | .43 | .02 | .69 | .10 | .50 | .08 | Broke at 16,300 in centre of beam. | | .19 | .02 | .28 | .08 |
| 18,000 | .42 | .03 | .53 | .03 | .87 | .19 | .61 | .11 | | | .21 | .03 | .31 | .11 |
| 20,000 | .43 | .04 | .64 | .06 | Broke at 20,000 end casting. | | Broke at 19,500 end casting. | | | | .24 | .04 | .34 | .15 |
| 22,000 | .50 | .05 | Broke at 22,600 in centre. | | | | | | | | .28 | .07 | .41 | .18 |
| 24,000 | .66 | .09 | | | | | | | | | .37 | .13 | .50 | .24 |
| 26,000 | .76 | .14 | | | | | | | | | .44 | .21 | Failed at 27,400 lbs. by plates buckling; wood crushed betw'n 10,000 and 12,000 at supports. | |
| 28,000 | End casting broke at 28,000 lbs. | | | | | | | | | | .56 | .33 | | |
| 30,000 | | | | | | | | | | | Failed at 30,000 lbs., plates buckled. | | | |

Centre of shoes with pieces 6" wide, same as shoe.