Spring Switches Used Extensively on Chicago & North Western

Seventeen installations on eight different kinds of layout with special signal protection, latest type buffers and rods used

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THE use of spring switches on the Chicago & North Western is not new, such a device having been in service on a switch near Ironwood, Mich., for at least 27 years. However, the general adoption of spring switches did not receive much encouragement until the Atchison, Topeka & Santa Fe developed the oil buffer to prevent pounding and excessive wear of the switch points with the passing of each set of trucks when trailing through the switch. Starting in 1924, the C. & N. W. installed its first spring switch with an oil buffer at the west end of the yards at West Chicago, Ill., which eliminated the necessity for 24-hour switch tender service and resulted in a saving of $5,000 per year. The track layout and signaling is shown as Sketch B in Fig. 1. The successful operation of this installation brought to attention numerous other layouts where spring switches could be used to eliminate train stops or the requirement for operators or switchmen at junction points, ends of double track, etc., such that a total of 17 spring switches are now in service on eight different kinds of track layouts.

Signaling To Be Used with Spring Switches

When applying spring switches it soon became evident that the unusual features of the operation of trains over spring switches would require special provision for the signaling. To serve as a guide sketches of a series of layouts were prepared and approved for use on the C. & N. W., which with slight variations will probably cover all conditions. The idea back of this chart, which is shown as Fig. 1, is that of keeping trains in motion as far as practicable and yet not spend any more money than is absolutely necessary for safety.

Sketch-A shows a trailing switch installed in automatic signaled double track territory. The siding in this case is but a train length long and, therefore, in order to allow a train on the main track to pass, the train on the siding must of necessity be stopped. Therefore, there is no need of giving information by which the train can keep in motion through the spring switch. The trainmen can go to the switch indicator and observe its position and then give necessary information to the engineman to proceed. A dwarf signal is provided on the main track to protect reverse movements, for which purpose a color-light signal is generally used although a semaphore signal can be used if desired. This signal is normally in the stop position and is operated to "proceed" through an

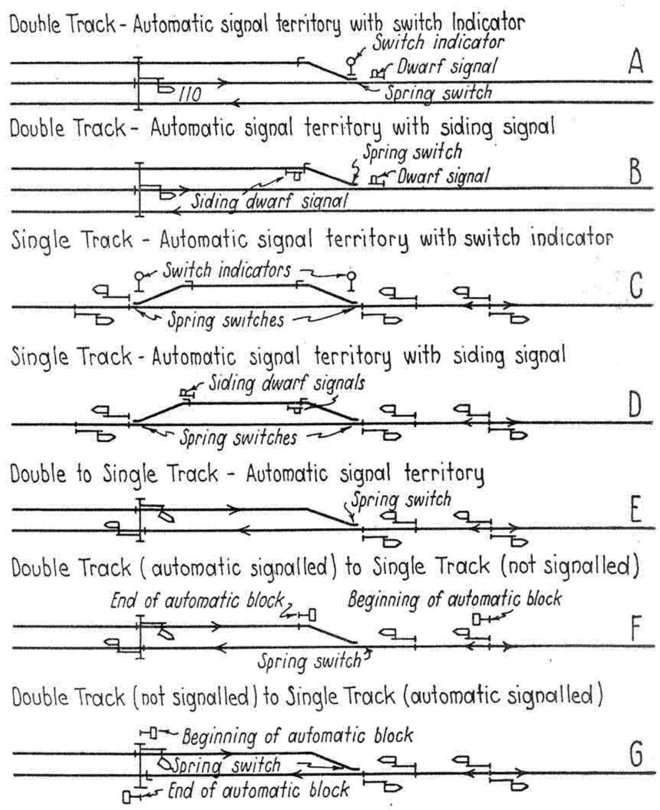


Fig. 1—Chart of signaling for different track layouts where spring switches are used

approach circuit not less than 2,500 ft. long. The signal shows red or "stop" whenever the switch is in any other than full normal position.

Sketch-B on the diagram is similar to A, except that in this case the siding is sufficiently long to hold two or more trains or is a lead from a yard and it is advisable to give information so that the train need not stop when entering the main track. The dwarf

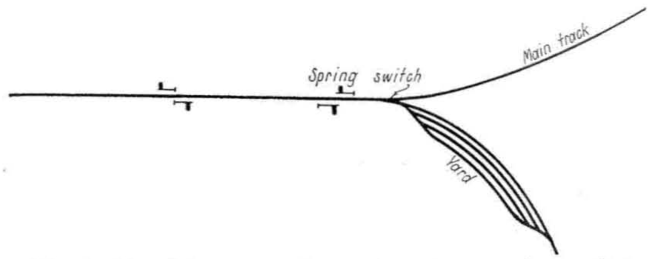


Fig. 2—Track layout at Ames, Ia., where spring switch is used on yard lead

signal on the siding is operated "normal danger" and is connected into an approach track circuit on the siding of such a length as is desirable for operating conditions and also through a circuit indicating the approach of trains on the main track.

The condition as illustrated in Sketch-C, is similar to A, and in D similar to B, except that these are for a single track instead of double track installations. Conditions in Sketches E, F and G, need no explanation. Sketch-H shows a condition wherein the switch

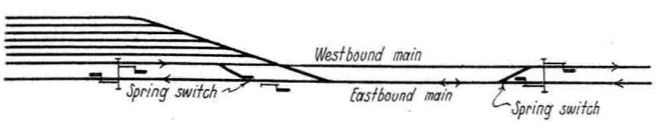


Fig. 3—Layout at end of new yard at Proviso, Ill.

at the end of a passing track in single track non-automatic block signal territory is protected by a signal. In this case a single track-circuit is installed between the clearance point of the siding with the main track and the signal, this making approximately 3,000 ft. of track circuit. The signal, therefore, gives information as to the occupancy of any portion of this territory and of the condition of the switch, the signal only being in the clear position when the track circuit is unoccupied and spring switch is in full normal position.

So far spring switches have been installed under conditions as shown in Sketches A, B, C, F and H,

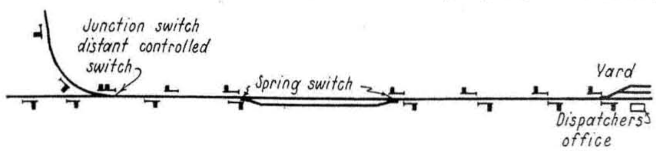
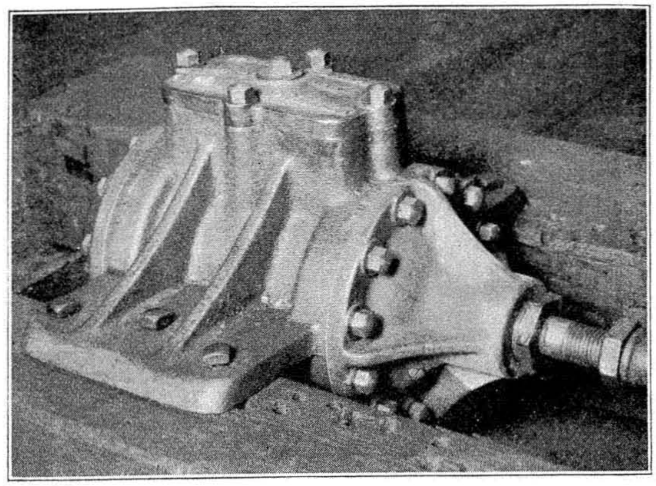


Fig. 4—Layout of spring switches on single track passing siding

and several installations of some of them, and all have so far proved satisfactory. Experience has indicated that adequate protection is being provided.

Specific Examples of Spring Switch Installations

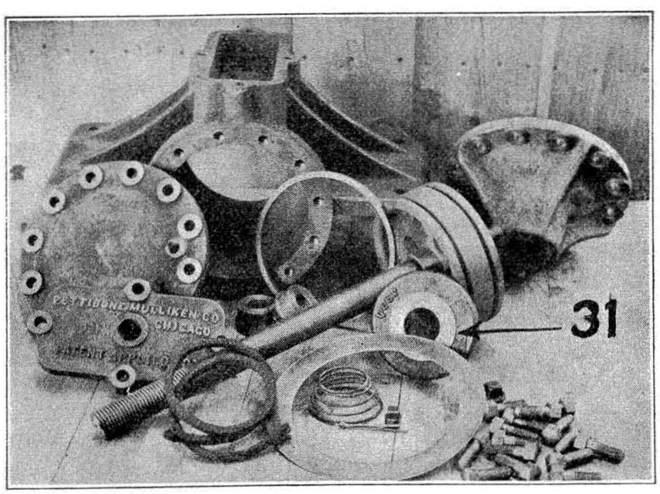
The advisability of installing a spring switch depends primarily on the train operation involved. The first installations were at the leaving ends of yards where the train movements were made at reduced speeds. Advantage was also obtained by not having to stop to close a switch. For example, trains pulling out of the yard at Ames, Ia., were required to stop to close the switch with the train standing near the bottom of a ruling grade. The installation of a



Assembled view of oil buffer

spring switch eliminated this train stop, permitting an increase of 500 tons in the ruling tonnage. A plan of this layout is shown in Fig. 2.

Authority had been granted for a remote power switch installation and work started in 1925, for the operation of the switch at the end of double track at Radnor, Ill., when it was decided to install a spring switch at this point. The track layout and signaling arrangement installed at Radnor conform with that shown in Sketch-F, of Fig. 1. This installation eliminates two stops for each eastbound train. The majority of the traffic handled on this line is tonnage freight, the speed being limited by grade in the direction against the facing point so that it does not exceed 25 or 30 miles an hour. The speed of trains eastbound to the single track when

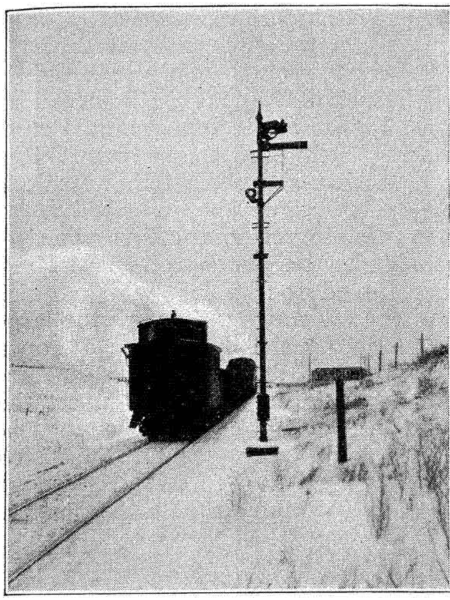


Various parts of oil buffer can be assembled to fit any track layout

trailing through the spring switch was limited to 10 m.p.h. when the spring switch was installed but later experience has led us to believe that this limit can be raised safely.

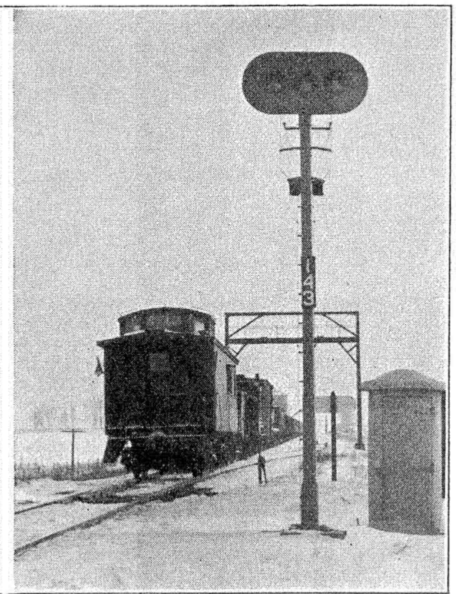
Spring Switches Applied to Passing Tracks

With spring switches in successful operation at yard leads and ends of double track the next step was to apply them for passing track switches. On this same freight line 13 miles south of Radnor, is a passing track 6,300 ft. long, which is used a great deal as it is the only siding for 12 miles on a piece of busy single track. In order to eliminate the stops required to handle the switches it was decided to install spring switches so connected as to, in effect, left-hand track on double-track lines. The switch indicator at the switch informs trainmen when the track is clear for the train to pull out. The existing automatic signal No. 110 provides protection for the train while pulling out and also indicates stop if the switch is not in the proper normal position at any



Semaphore for spring switch entering yard, South Pekin, Ill.

Color-light signal south of yard at South Pekin, Ill.



Signal for end of double track at Radnor, Ill.

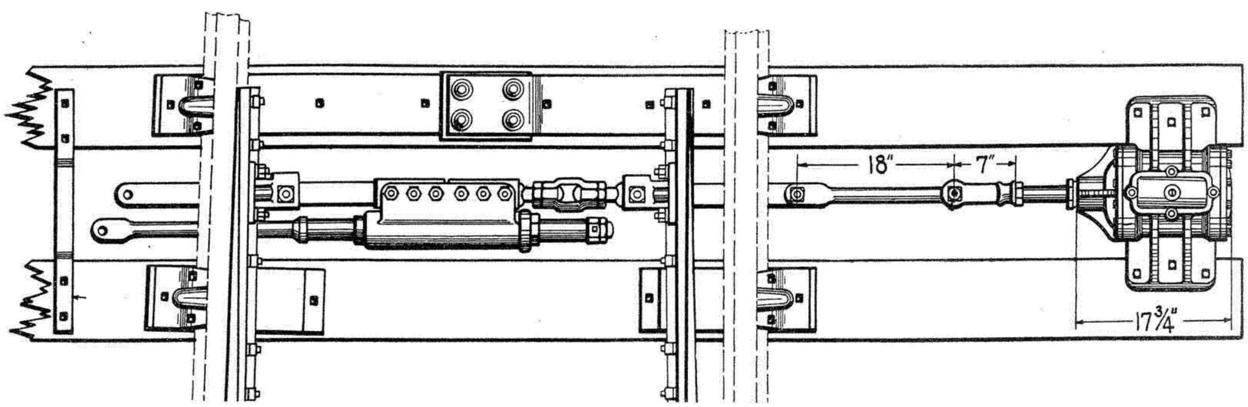
produce a short piece of double track by diverting all westbound trains through the passing track, the eastbound trains holding the main track. If no trains are to be met no stop is required, or if a good meet is made neither train stops, the trains trailing out through the spring switches without stopping. New leads with No. 20 frogs were installed to permit high-speed movements over the turnouts. Automatic signal protection is provided to stop trains if the switches are not in the correct position for the train movements as shown in Sketch-H, Fig. 1.

The use of spring switches for passing tracks on high-speed double-track territory were the next ap-

time. The dwarf signal was installed as a switch protection for any emergency reverse traffic movements and as a back up signal.

Unusual Applications at Yards and Junctions

At one of our new yards where a switching lead was not provided, considerable delay to main line trains was anticipated due to trains pulling out on the main track to switch the yard. In order to permit the use of a section of main track for this purpose and yet not hold up main line trains two sets of crossovers with spring switches at one end of each have been installed recently at Proviso, Ill., as

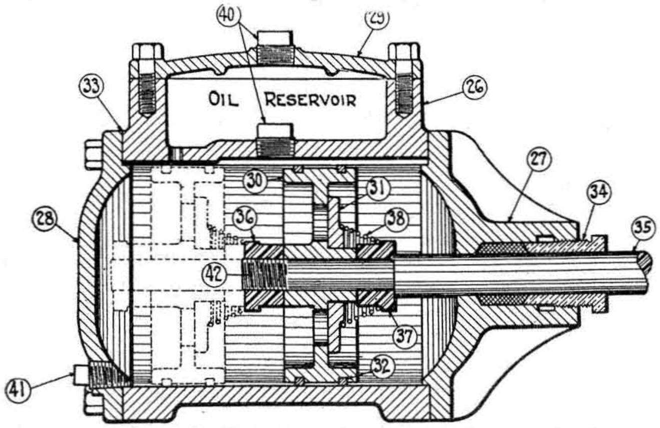


Spring switch layout showing buffer and special spring head rod—The longest rod to left is connected to switch stand

plications. At Cortland, Ill., there is a two-mile eastbound passing track which is used by many freight trains. In order to eliminate the necessity for these trains stopping to close this switch when pulling out, a spring switch was installed and additional signal protection provided, as shown in Sketch-A, of Fig. 1. The standard practice on the Chicago & North Western is to run trains normally on the

shown in Fig. 3. With this arrangement trains switch on the westbound main and the eastbound main is used for a short distance as a piece of single track.

The combinations in which spring switches may be used seems to be unlimited. We now have request for authority to install about eight miles of single-track automatic signals between the junction point, the switch of which is operated by means of a low voltage distant control switch machine, and a large terminal yard at which point the train dispatchers are located. (See Fig. 4.) Between these two points is a long passing track at the foot of a heavy grade. It is proposed to equip the two ends of the passing track with spring switches making it a short piece of double track and to connect the junction switch into and operate it from the dispatcher's office. The dispatcher will also have control of the leaving signals at both ends of this piece of track which must be used by the trains of two divisions. By this means the dispatcher, without additional



Cross-section of oil buffer showing positions of piston

operators, will handle this layout and trains can operate to or from either of the divisions and, if a good meet is made, pass at the intermediate point without stopping.

Development of Buffer Spring Switch in Brief

On account of the scarcity of men during the world war, T. S. Stevens, signal engineer of the Atchison, Topeka & Santa Fe, installed a spring switch at a branch line junction, with automatic block signal protection and found not only that it worked successfully but that he also saved the expense of maintaining two switchmen and a switch shanty. This installation included an air buffer furnished by the Pettibone-Mulliken Company to provide the slow return motion of the switch points.

This air buffer type did not prove successful on account of the condensation of water in the air within the cylinder, which froze in the colder climates. However, the advantage of the buffer was quite evident and in 1922 an oil buffer was developed by the same manufacturer and installed on the Santa Fe.* The first oil buffers had a return pipe with a check valve across the top of the cylinder. In co-operation with the several roads now interested in spring switches the Pettibone-Mulliken Company has continued developments of this type of spring and the buffer.

An action to retard the closing of the switch point is desirable up to a certain predetermined point, beyond which the speed should be accelerated in order to reduce to a minimum the time and increase the force of closing the switchpoint, to insure a tightly closed point on the return movement to its normal set position. A suggestion of F. C. Stuart, signal engineer of the Elgin, Joliet & Eastern resulted in changes of design which accomplished this result in the latest type of buffers, as will be described.

As the switch is forced over by the first wheel of a train trailing through; the piston rod, piston and attached parts are forced to the left with a quick stroke, the force of the oil pouring through the large holes in the piston forcing the disk valve 31, open against the force of the coil spring 38.

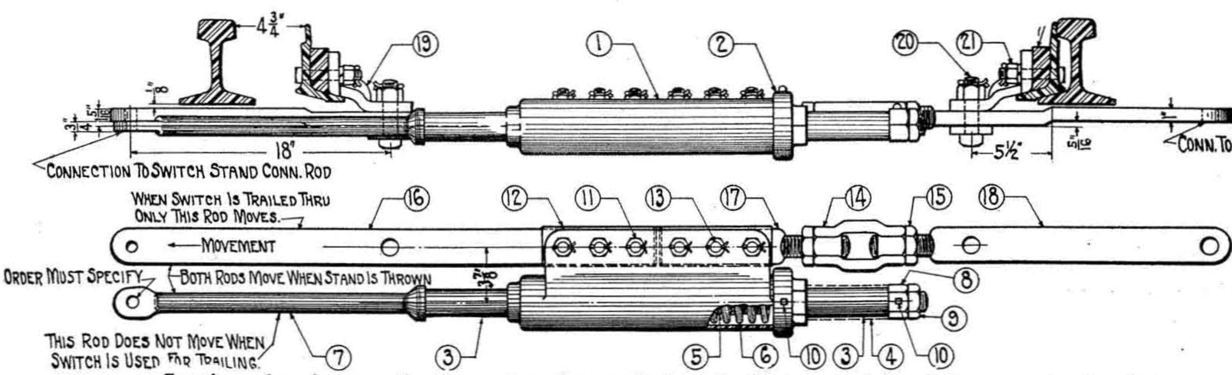
The full movement of the switch point places the piston near the left end of the cylinder leaving the force of the spring in the head rod to pull the piston back against the oil pressure thus forcing oil through the small groove as shown above the dotted position of the piston. Each succeeding wheel tends to hold the piston to the left until the entire train passes through. In the meantime the movement of the switch point is hardly perceptible if the train is moving over 10 m.p.h.

After the train passes, the oil runs around the piston through this little groove until the piston is about half-way over, and then, as the larger groove covers the piston, the pressure is relieved and the force of the spring in the head rod is more effective, forcing the piston over faster and finishing the return stroke with force enough to bring the switch point tightly into its normal position. The idea of these grooves of different sizes was suggested by Mr. Stuart.

To hold the switch against the stock rail while the train is trailing through, it is necessary to maintain a full cylinder as any air in the cylinder would cause a rapid movement of the switch point away from the stock rail between two trucks of passing train. To avoid this difficulty an oil reservoir was adopted, which serves a further important purpose of taking care of the expansion of the oil. The physical characteristic of the oil should be such that the viscosity be approximately constant to temperatures between 125 degrees above and 40 degrees below. In order to obtain this result we change the oil in the spring and fall.

The parts of this oil buffer can be assembled for application on either side of the track, on the open

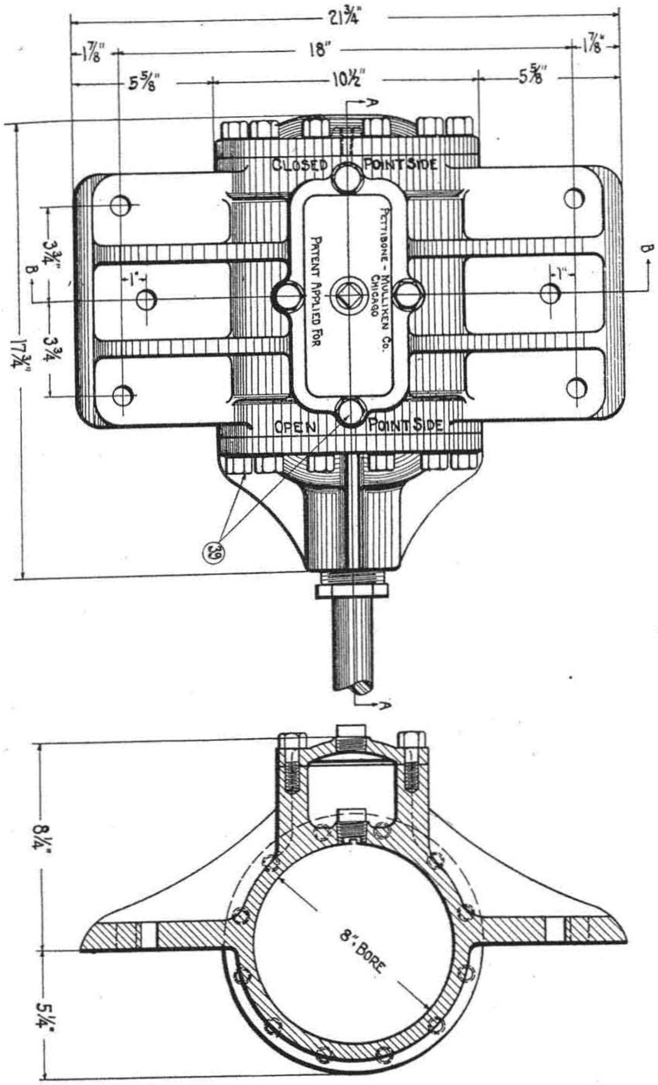
* See article in *Railway Signaling* of July, 1923, for description of early installation of spring switches on Sante Fe and details of first type of oil buffer.



Section showing application of spring switch rod—Note special reinforcement of points or closed point side. In order to avoid making these changes in the field we specify the type of connection when ordering.

Developments in Spring Head Rod

In the earlier type of spring switches the spring formed a part of the switch stand connecting rod, the regular head rod being used. The improved type of head rod for spring switches now includes a set of



Detailed dimension sketch of oil buffer

double-coil springs enclosed in a cast-steel tube and mounted on the head rod. These springs are opposite winds, heat treated, and will withstand a fibre stress of 115,000 lb. per square inch and were adopted after considerable experimenting and testing under actual service. The head rod is also provided with a turnbuckle for adjusting the gage of the switch points. An extra sleeve is furnished which can be attached to the rod to provide spring movement one way only.

Switch Must Be Well Constructed and Maintained

Through actual service it has been found that the points should be heavily reinforced. The recommended practice is 1¼ in. thick reinforcing bars on the gage side for 16 ft. 6 in. switches and shorter, and for longer points a 1¼ in. bar on the gage side with a ⅜-in. bar on stock rail or back side. These bars are attached to the switch points with high tensile bolts as it has been found that rivets become loose due to the weaving motion produced. A loose bolt can always be tightened but a rivet cannot be satisfactorily corked. The reason for the additional reinforcement is to prevent a lateral bend on the switch points, caused by the side thrust of the first trucks of the locomotive as it trails through.

The switch points are also equipped with an extra heavy forged socket clip to which the spring head rod is attached, thereby insuring a positive connection at all times between the rod and point. A heel joint is used that consists of a cast heel filler, bent and planed angle bar and pipe thimble which is securely fastened to the stock rail with four long, high tensile bolts. This joint is desirable to prevent movements and creepage of the switch points. Both main and side tracks should be securely anchored.

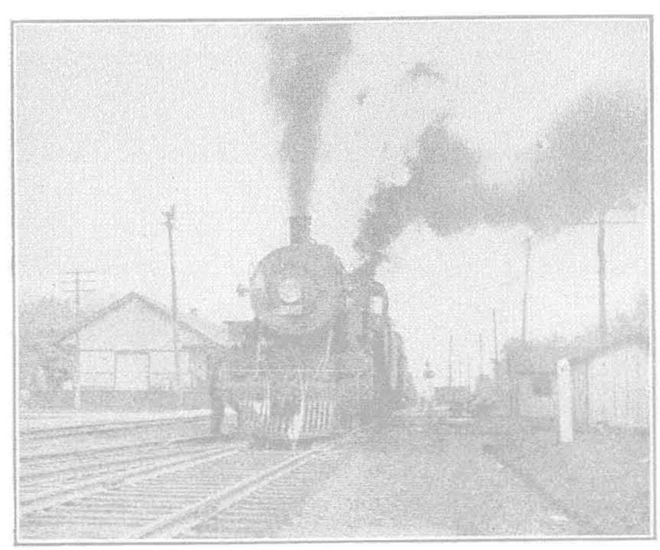
We find it advisable to provide a solid foundation consisting of good ballast, first-class ties and proper drainage for each spring switch layout. Switches of various lengths up to and including 30 ft. have been installed. No difficulty has been experienced or undue wear found which could have been caused by the wheels pushing over the switch points or on account of their riding them when so doing. C. & N. W. standard main line switch stands are used.

A Few Operating Considerations

When trainmen need to operate one of these switches for switching cars, recognition must be made of the fact that due to the resistance of the oil and springs the switchman cannot throw it over quickly by hand but must keep a slow, steady pressure on the handle until it is all the way over. For this reason a "flying switch" should never be attempted. Trains trailing through and stopping on the switch must not take up slack until the points have been thrown, otherwise the switch will be straddled, resulting in a derailment. No trouble on this account has been experienced however.

Economy

The cost of installations has varied from $500 to $2,000 and the estimated savings from $400 to $5,000 per year, while the percentage of saving per year to the expenditure varies from 40 to 300 per cent.



On the Louisville & Nashville at Worthville, Ky.