

coaling trestles are to be constructed this year; two 30-stall engine houses will be built at West Albany; new shops will be built on the Pennsylvania division, and extensions will be made to the West Albany shops.

Various improvements will be made to yards and sidetracks during the year. The reinforcing of sea walls along the Hudson and Mohawk rivers is progressing and various improvements are being made in the alignment at different points.

Under the head of construction improvements to the company's terminals at Port Morris are contemplated and large improvements at Weehawken are under way, including over a mile of bulkhead, several large piers, and a 1,800,000-bushel grain elevator. This improvement has been fully described in *The Railway Age*. The double track on the Harlem division is being extended from White Plains to Mount Kisco.

On the middle division improvements are anticipated including the elimination of grade crossings at Schenectady, Utica, Troy and Cohoes. The grade crossing improvement at Buffalo

stalled on 32 miles of track between Bakersfield and Mojave, protecting that portion of the line having the heaviest grades and sharpest curvature. The crossing of the Pacific Coast Railway over the Southern Pacific main line near Edna Station, Cal., is being protected by interlocked signals and derails. Signals are also being installed for the protection of the drawbridges at Tehama, Lathrop, Avon, Teal and Sacramento.

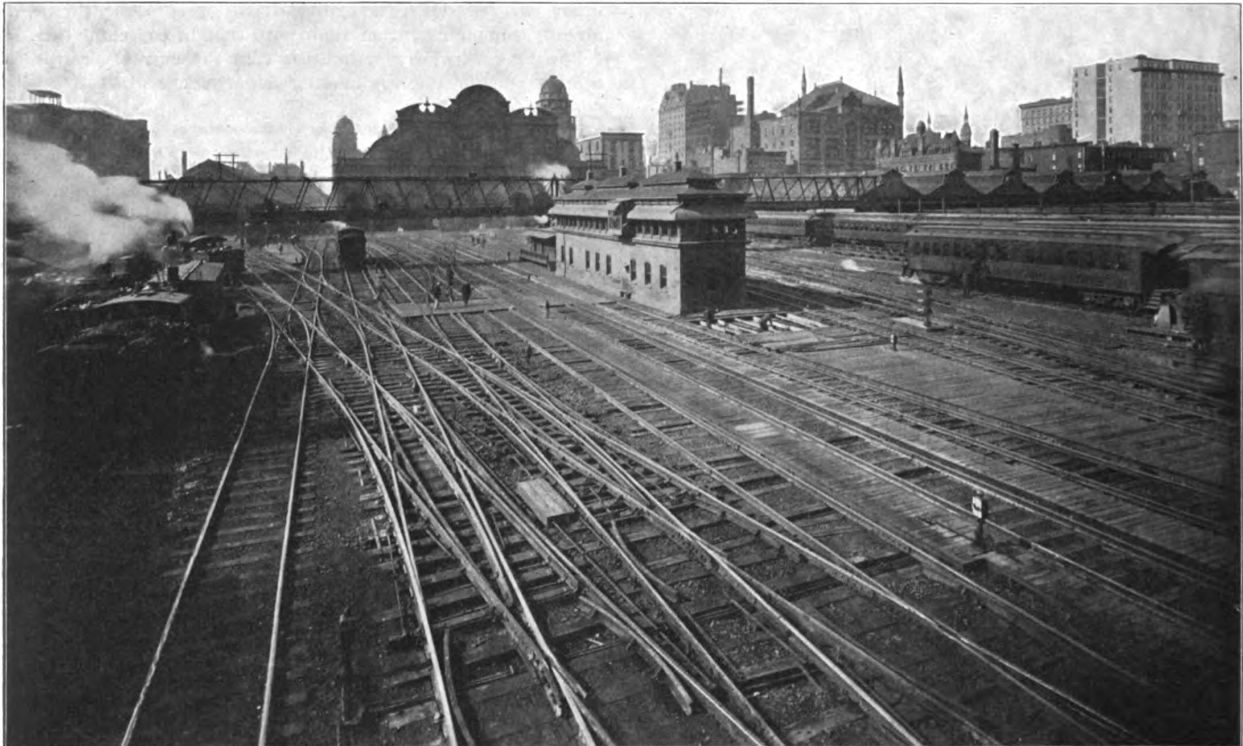
Wooden bridges aggregating 3,000 feet in length will be replaced with steel structures and a number of the older iron bridges will be strengthened to meet the demands of heavier power.

A new freight ferry slip and transfer yard are under construction at Alameda Mole, Cal.

New York Ontario & Western.

The proposed improvements for the current year are as follows:

It is expected to build an extension of the Ellenville branch from Ellenville to the city of Kingston, 28 miles.



INTERLOCKING PLANT IN THE YARDS OF THE GRAND CENTRAL STATION, NEW YORK.

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is to continue including the elimination of nine grade crossings on the main line and the elimination of five grade crossings on the Belt Line. Improvements in the way of elimination of grade crossings are contemplated at various points.

Double tracking is in progress at various points on the Pennsylvania division, especially between Jersey Shore and Corning, and a new line is under construction from Clearfield to Karthaus.

Minneapolis & St. Louis.

Among the improvements contemplated by this company during the present year are a revision of grade and alignment of 31 miles on the main line, Albert Lea division, and 51 miles of ballast work, 31 miles on main line and 20 miles on Western division. The grade for the Western division was improved last year.

Southern Pacific Company.

In the matter of reduction of grades on the Pacific system, studies are being made on the Central Pacific line between Ogden, Utah, and Wadsworth, Nev., with a view to reduction of grades to a maximum of 4 per cent in each direction, and in connection therewith reduction of curvature and shortening of the line. Between Santa Barbara and Ventura the line is being changed and sharp curvature eliminated, the work to be completed in two or three months.

It is the intention to lay about 240 track miles of 80-pound rail, replacing 50 and 62 pound.

Oil is to be substituted for coal on several divisions, and to provide for storage of fuel oil tanks with capacity of 30,000 barrels each are to be erected at El Paso, Lordsburg, Tucson, Gila Bend, Yuma and Oil City. Smaller tanks of 1,000 barrels each will be erected at a number of intermediate stations.

Automatic electric semaphore signals are now being in-

Improvements on the line will include 3 miles of additional tracks. Bridges and trestles will be built as follows: Rebuilding Mongaup viaduct at Ferndale, N. Y., a steel structure 980 feet long, deck plate girders on towers, about 85 feet high; rebuilding of about 1,300 lineal feet of bridges over Willowemoc and Beaverkill rivers, between Livingston Manor and Cadosia.

A "Dodge" coal storage plant, capacity 130,000 tons, will be built at Middletown, N. Y. One additional pier and coal shipping trestle at Weehawken, N. J., 500 feet long and 50 feet wide.

New stations will be erected at Cadosia and Bloomingburg. Steel rails will be laid as follows: 12 miles of 95-pound and 18 miles of 76-pound rails, to replace 56 and 67 pound rails.

Additional equipment will include six 100-ton consolidation freight engines, with wide firebox for burning anthracite coal; two 80-ton mogul passenger engines, with wide firebox for burning anthracite coal; six wide vestibule passenger coaches, two wide vestibule parlor cars, three baggage cars, 575 double hopper gondola coal cars, 25 pressed steel coal cars and 25 "Sterlingworth" rolled beam coal cars, all 85,000 pounds' capacity. One 50-ton steam derrick will be purchased.

Iowa Central.

This company contemplates the revision of grade and alignment over 56 miles of main line, with ballasting of about 30 miles in the same territory, and ballasting of about 20 miles on the Northern division. This work includes the rebuilding of three steel bridges, one over Lime Creek, near Mason City, Ia., another over Timber Creek, near Marshalltown, Ia., and the third over South Skunk Creek, near Oskaloosa, Ia.

Burlington Cedar Rapids & Northern.

Proposed improvements during this year on our line of railway include seven additional locomotives and 500 box cars

now under contract. Sixty-three pile bridges will be replaced with permanent structures and forty miles of track relaid with 80-pound steel rail.

Fifteen stalls will be added to the roundhouse at Cedar Rapids, and a car shop 80 by 200 feet erected at the same place. A new roundhouse of 10 stalls will be built at Albert Lea, Minn., and also passenger and freight depots at the same station. Two or three interlocking plants will also probably be put in during the year.

St. Louis Southwestern Railway.

This company contemplates some extensive improvements for the coming year, but the data are not yet all complete. Of the improvements proposed, however, is some 250 miles of ballast, or such thereof as can be placed during the working season; the replacement of about 200 miles of light with heavy

hot-pot slag, the latter coming from the furnaces at Birmingham.

It is not expected to make any alterations in the line grade or to replace any bridges. A number of trestles are being filled with earth, this work being of a permanent character.

So far as our shop facilities are concerned, orders have been placed for tools which will cost in the neighborhood of \$15,000, among which will be two air compressors and necessary appliances, to facilitate the construction of box cars at our shops which have been ordered.

Grand Trunk.

The improvements that are determined upon on the Grand Trunk system for the current year include all the bridges on the eastern division between Montreal and Portland, which will be completed with a view of accommodating the heavy



INTERLOCKING PLANT IN THE YARDS OF THE GRAND CENTRAL STATION, NEW YORK.

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steel rail; the construction of a new steel drawbridge over Red River at Garland City, and the reduction of grades, as has been done for the past year, will be continued from Camden south. As much of this work will be done as two steam shovels and outfits can accomplish during the working season.

The road will also put in an extensive yard at Texarkana, and one at East Waco; extend passing tracks to accommodate trains hauled by the heavier power now in use and that has been ordered; a number of improvements in water supply, and other minor improvements, with a view of putting the property in the very best possible condition.

Thirteen new locomotives have been received in the past few months and 17 more are now under construction for early delivery. Large additions to freight and passenger equipment have been provided for.

Minneapolis St. Paul & Sault Ste. Marie.

This company proposes relaying about 70 miles of steel, putting in 80-pound instead of 60-pound rail; also to extend some 10 sidetracks, making them standard length (2,800 feet) to provide for the additional length of trains now hauled. The company also proposes to ballast about 65 miles of track.

Central of Georgia.

For the first half of the year 1901, being the close of the fiscal year which terminates on June 30, the Central of Georgia will put into track 32 miles of 80-pound rail. The company is now engaged in ballasting the track with rock and

modern class engines that have been made standard. About 30 new engines of our standard class, which are known as the 900 series, will be provided.

The rolling stock will be increased by 1,000 60,000 pounds' capacity box cars.

Double track will be laid on about 20 miles on the middle division and the double track will be completed between Hamilton and Jordan, a distance of 26.46 miles. A little over 100 miles of double track will be laid on the Grand Trunk Western Railway.

Toledo & Ohio Central.

The following expenditures have been authorized for improvements on the Toledo & Ohio Central for this year:

Improvement of Toledo (O.) terminals, estimated cost \$100,000; additional sidetracks, Western division, estimated cost, \$15,000; new yard at or near Gloucester, O., for distribution of empties and gathering of loads from coal mines, estimated cost, \$30,000.

This company has also contracted for 1,500 gondola cars, capacity 80,000 pounds, for delivery during the months of June, July and August, 1901, and for three switching engines to be delivered in March, 1901.

Kanawha & Michigan.

The following expenditures have been authorized for improvements on the Kanawha & Michigan for this year:

For replacing bridges and trestles with permanent struc-

tures, estimated cost, \$80,185; for completing ballasting, estimated cost, \$53,637; for new rails, weight 70 pounds per yard, estimated cost, \$163,542; for additional sidings, estimated cost, \$38,371; for yard at Quincy, W. Va., \$25,075; for shop and tools, estimated cost, \$39,180; total, \$399,940.

This company has also placed an order for five freight engines to be delivered in June, 1901.

Rio Grande Western.

The principal item of betterments contemplated by this company during the current calendar year is the replacing of about 100 wooden and pile bridges with steel girders and masonry, varying in length from 32 to 85 feet.

Norfolk & Western.

The important improvements now in progress on the road are as follows:

Five and one-half miles of timber trestles and bridges are being replaced by permanent structures, i. e., by embankments and arches or by steel spans or viaducts.

Grades are being reduced as follows: Between Appomattox and Spout Spring, Va., 2.8 miles; between Pamplin and Evergreen, Va., 5.6 miles; between Davant and Hopetown, O., 3.2 miles. This work will be practically completed in February. Also between Waverly and Omega, O. (2 miles), and east of Piketon, O., 1.2 miles. Similar work is expected to be undertaken shortly east of Kingston, O.

Two miles of second track on a low grade line are being

reduction of grades at 40 places; enlarging coal and water stations at 10 places; the construction of short pieces of double track at four places; the construction of about 400 stone culverts or short I-beam or plate girder bridges; purchase of 16 new locomotives; the construction of a large addition to the freight house, Chicago; the completion of a new terminal at Kansas City, including large yard, depot and roundhouse.

Besides this, the relaying of about 100 miles of new steel and the ballasting of probably an equal amount of track with broken stone or gravel.

Kansas City Fort Scott & Memphis.

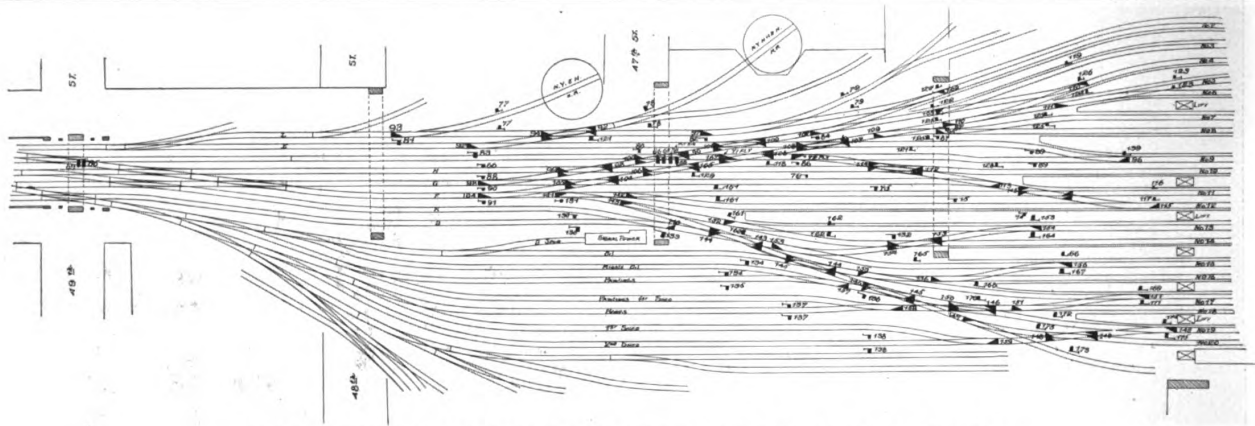
A list of such betterments as are contemplated during the year, which also includes new equipment, a portion of which has already been received, is as follows:

Ballasting Joplin district south of Cherokee, 45 miles; ballasting 17 miles of Memphis division between Memphis and Birmingham, which will complete the ballast of the Kansas City Memphis & Birmingham; reballasting 40 miles on the Arkansas a. strict between Thayer and Memphis.

Second main track will be laid between Fort Scott and Washburn, 4 miles, and a branch 11 miles long from Bergens, Ala., will be built to coal fields in Walker County, Ala.

Three new passing tracks will be laid and 40 passing tracks lengthened to a standard of 3,000 feet long.

Improvements in buildings include rebuilding eating houses at Fort Scott, Kan., and at Jonesboro, Ark.; new stone station



GENERAL LAYOUT OF TRACKS, SWITCHES AND SIGNALS—GRAND CENTRAL STATION, NEW YORK.

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constructed between Bluestone Junction and Elkhorn Tunnel, W. Va.

Second track between Elliston and Shawsville, Va., is approaching completion. One mile of second track east of Roanoke is in progress. Other sections of second track are about to be undertaken.

A ventilating plant of new type is being constructed to ventilate Elkhorn Tunnel, W. Va., which tunnel is 3,300 feet long. The plant was to be completed about March 1. Two tunnels (one 90 feet long and the other 155 feet long), located between Glen Lyn and Bluefield, are being removed and converted into double-track cuts.

A branch line 11 miles long is being constructed from Ivanhoe toward Speedwell, to reach deposits of iron ore. Five miles of this line is nearly completed. The construction of a branch line up Crane Creek, W. Va., to develop additional coal property, is about to be undertaken.

Extensive additions will be completed in February to the foundry at Roanoke shops, and extensions to machine shops and other buildings at the Roanoke shops are now being undertaken.

A steel coal pier is being constructed at Lambert's Point, Norfolk Harbor, alongside the two other modern coal piers (one steel and one of wood) now in use. This steel coal pier is to be 866 feet long, will be provided with two unloading tracks its entire length, and is especially designed to accommodate ocean steamships of large size, the pier being 70 feet above water and provided with 54 chutes for quickly unloading into vessels either coal or coke.

The depth of water provided for entrance and for anchorage of vessels at this pier and all other piers at Lambert's Point, also in the slips at the coal piers and warehouse piers, is 30 feet at mean low tide. The steel pier will be completed in April, 1901.

Chicago Great Western.

Among the improvements the Chicago Great Western will make this year are:

Additional team tracks at Minneapolis, Saint Paul, Waterloo and Kansas City; enlarging yards at Saint Paul, Oelwein, Chicago and Kansas City; lengthening passing tracks at about 30 stations; additional industry tracks at about 20 places; interlocking crossings, junctions or drawbridges at 15 places;

at Spring Hill, Kan.; banana house at Kansas City, 50 by 40 feet; an addition to machine and boiler shops and equipping same with machinery, Springfield, Mo.

Track betterments include filling three trestles; the building of a steel drawbridge over Black River, Black Rock, Ark.; a steel drawbridge over Saint Francis River, Marked Tree, Ark.; the laying of 13,000 tons of 75-pound steel rail; revision of tracks in Memphis yard; revision of tracks in yard at Amory, Miss.; the erection of a coal chute, trestle and necessary tracks to serve the same at Carbon Hill, Ala.; revision of tracks in Birmingham yard.

Chicago & Eastern Illinois.

The Chicago & Eastern Illinois is constructing large yards at Dolton Junction, 17 miles from Chicago, has bought 1,500 cars and 16 locomotives and will continue to make other improvements as heretofore.

Kansas City Southern.

This company has under contemplation the ballasting promptly of about 25 miles, the filling of approximately 10,000 feet of unnecessary trestles, and some 30 trestles are up for immediate treatment with stone culverts, stone arches or metal, whichever layouts will best fit the conditions.

Mexican Central.

Below is a memorandum of improvements contemplated by this company during the year 1901:

Extension of Parral branch, 14.27 miles; extension of Zapotlan branch, 83.63 miles; extension of Zamora branch, 11.50 miles; construction of Rio Verde branch, 26.27 miles; total 135.67 miles.

Substitution of 75-pound steel for 56-pound steel in main line and San Luis division, 130 miles; rock ballasting, 100 miles; replacement of 85 trestle and light iron bridges by new steel structures and cast-iron pipe (about 2,550 feet).

Among other works under way are the completion of hospital at Aguas Calientes, now under construction; the construction of two large reservoirs for water supply, one at La Colorada and one at Las Palmas; the construction of a complete timber treating plant at Yurecuaro; the construction in connection with the Mexican International of a union depot at Torreon, and the construction of a roundhouse, new yard and other terminal facilities at Guadalajara.

INTERLOCKING AT THE GRAND CENTRAL STATION, NEW YORK.

No less conspicuous than the transformation which has taken place in the station proper at the Grand Central terminus in New York in its influence upon the rapid handling of heavy traffic as been the change which during the last year has taken place in the system of handling trains just outside the station building. Though the number of tracks and the number of distinct roads entering the station are exceeded in the case of a few other stations in the country, the problem of handling the interlocking is a difficult one for several reasons. The entrance to and exit from the station is bottled up, so to speak, by the tunnel containing the four tracks over which every train and every engine entering and departing from the station must pass. The number of trains handled to and from the 20 tracks entering the trainshed is about 540, consisting of 2,700 cars. In addition to the movements that would ordinarily be necessary the practice of storing 50 engines and 350 cars at

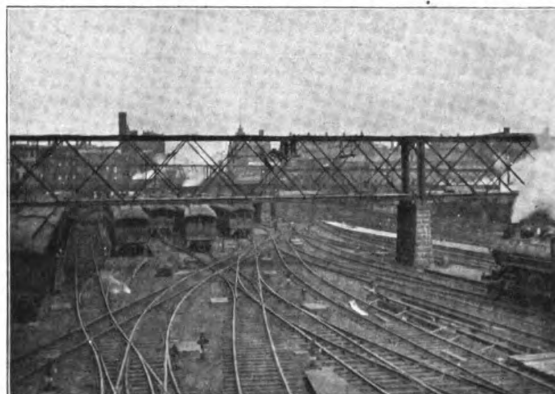


A DWARF SIGNAL.

Mott Haven, 5 miles away, each of which necessitates a going and returning movement, increases the work, while the location of the roundhouses—such that every engine entering the roundhouse must return to the yard over the same track—multiplies the number of movements. The buildings of the American Express Company on the west side of the yard and of the Adams Express Company on the east side require additional movements for each car of express matter moved out or in. The problem, then, was one requiring the quickest possible manipulation of switches and signals in order that, while having a due regard to safety, no time should be lost unnecessarily.

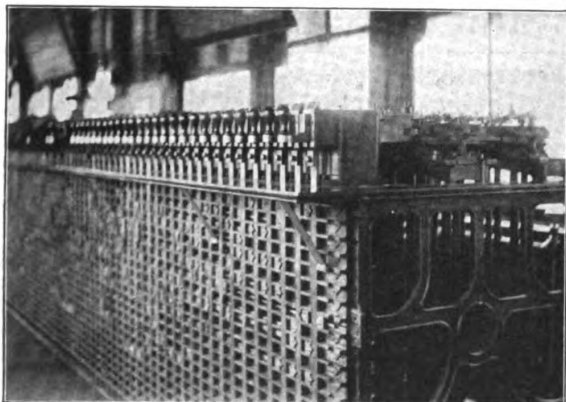
nature of the situation. Other engravings show, as well as limited space in the tower admits the use of photography, the machine by means of which the entire yard is controlled and some features of the system.

Another reason for the use of a pneumatic system of interlocking in place of the manual system formerly in use will be apparent from an inspection of the general plan. In a yard so contracted as this necessarily is, the space required for lead-outs was altogether too valuable for other purposes and the removal of the old apparatus has permitted the laying of much-needed additional tracks.

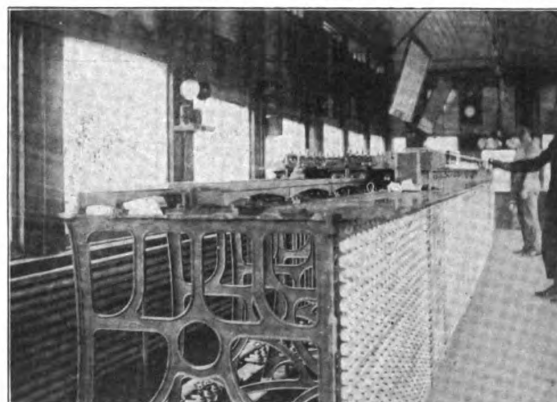


ONE OF THE LADDERS, GRAND CENTRAL STATION YARD.

The small space required for the machine itself is indicated fairly well in the engravings. It now consists of 110 working levers, though, as shown in the foreground of one of the engravings, additional space is left for levers up to the number of 176, the number of levers in the old machine. A comparison of the two is made possible by the presentation of an engraving of the old machine as it was just before its removal. The machine controls 16 double slip crossings, 28 crossovers, 13 single turnouts and 67 signals. The total of these numbers is considerably in excess of the number of working levers, a fact which is explained by an examination of the plan, the numbers



PNEUMATIC INTERLOCKING MACHINE, GRAND CENTRAL STATION.



PNEUMATIC INTERLOCKING MACHINE, GRAND CENTRAL STATION.

The result of a careful consideration of all features of the question has been the installation of the system of pneumatic interlocking controlled by the International Pneumatic Railway Signal Company, whose rights for North and South America are controlled by the Standard Railroad Signal Company of Troy, N. Y. For the opportunity to inspect the workings of the plant we are indebted to Mr. A. H. Renshaw, president of the latter company, and to Messrs. J. H. Franklin, general manager, and Lawrence Griffiths, supervisor of the Grand Central Station Company.

The general plan of the yards in which the pneumatic system of interlocking has been working since October, 1900, is shown in the accompanying line engraving. Two general views from photographs will also furnish some information as to the

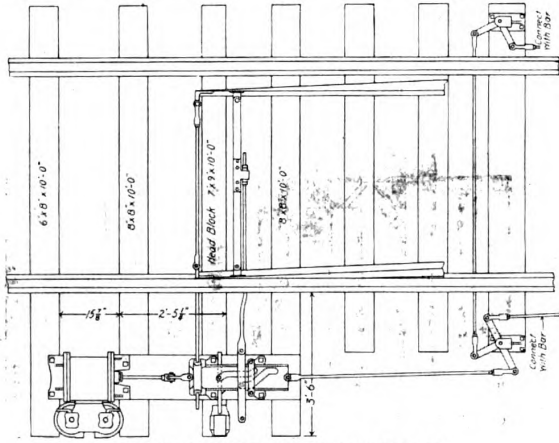
upon which indicate that frequently two and three movements in the yard are controlled by the movement of a single lever.

A feature of the yard, aside from the working of the system itself, is the quality of material used. All rails are of 100 pounds to the yard, the switch points are retained by adjustable rods of the heaviest pattern, and the switch ties are plated with 5/8-inch steel. In order to insure the yard apparatus from clogging by snow and ice, each machine is protected by a heavy cover, which insures it against any injury short of that which might be caused by a derailment.

Trains are handled into the station by means of a flying switch, by the use of which arrangement no engines enter the trainshed, but are switched to a side track, while the train continues its way. The operation of this switch is similar to

that of the ordinary with the exception that the movement is begun and completed instantaneously instead of the intervention of an interval of a few seconds between the beginning and closing of the movement in the tower. This will be better understood by a brief description of the system.

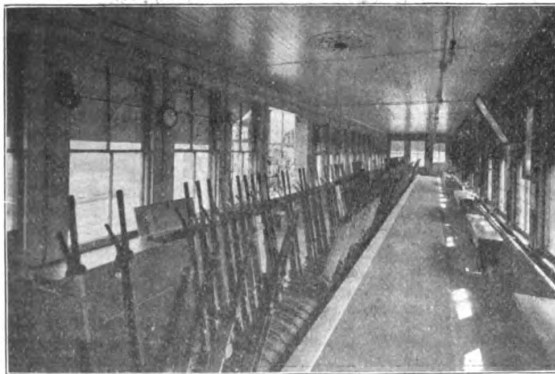
With reference to this particular yard, however, mention should be made of the manner of guarding against trouble from a possible necessity of repairs to the main air pipe or a leak in some portion of its length. The compression which furnishes air for the working of the system is located in the basement of the station and is conveyed through the yard in



PLAN OF PNEUMATIC SWITCH INSTRUMENT.

a complete circuit—that is to say, every point in the circuit is capable of receiving a supply of air from either of two directions, around the east or the west side of the yard. The practical working of this feature is that in case of any shutting off of the supply at a given point and which would ordinarily disable all apparatus beyond, the supply is received through the other arm of the circuit and no disability results on either side of the point in question.

A feature of this system of interlocking is that air is used at two different pressures, from 5 to 7 pounds for the machine and at from 15 to 20 pounds for movements in the yard. In other words, the low pressure which passes through the ma-



THE OLD INTERLOCKING MACHINE, GRAND CENTRAL STATION.

chine in the tower is used simply for the purpose of operating valves, which admit the higher pressure to perform the actual operations of controlling switches and signals. Every movement of the system is accomplished by air at one or other of the two pressures named, and, except when a switch or signal is being used or an indication is being given, all operating and indicating pipes are subject to atmospheric pressure only.

The general features of the working of the system are indicated in the accompanying diagram showing the connections between one of the levers of the machine in the tower and the apparatus controlling a switch. The diagram of the lever A will show the manner of working, which is characterized by

the fact that the movement of the lever is not completed until a return indication to the machine in the tower from the switch indicates in the tower that the switch movement has taken place. The completion of the movement in the tower—that is, the movement of the lever—is then completed automatically. One of the practical results of this feature is that the automatic completion of the stroke of the lever saves a great deal of time on the part of the tower man and enables one man to operate a much greater number of levers than was the case with the old machine. This, as indicated in the early part of this article, was one of the reasons which led to its installation at this point where rapidity of action was so essential.

It is not necessary to describe in detail the operation of all

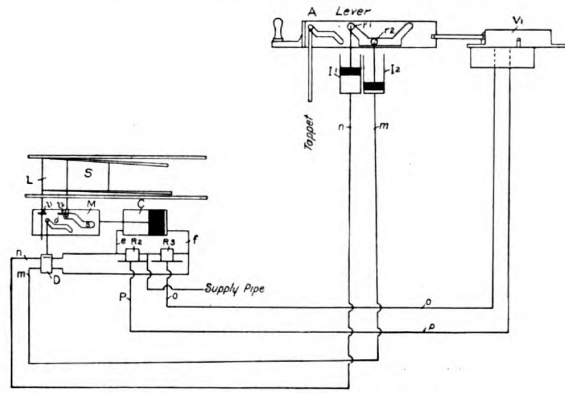
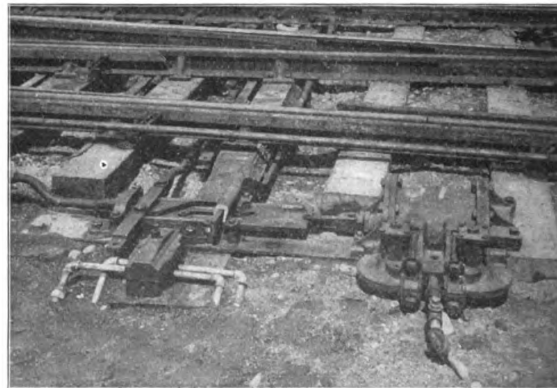


DIAGRAM OF PNEUMATIC INTERLOCKING.

the mechanism. The first movement of the lever admits air at a low pressure to one of the half-inch pipes connecting the lever valve with the switch machine. This low-pressure air acts upon a diaphragm of relatively large diameter and by the movement of this diaphragm opens a valve which admits high-pressure air to the piston which controls the movement of the switch. By the movement of the latter a return circuit of low-pressure air is admitted to the machine in the tower, and this by the construction of the slot in the lever, which is shown in the diagram, completes the stroke and at the same time performs the act of interlocking. This latter operation is done without any attention on the part of the attendant.



PNEUMATIC SWITCH INSTRUMENT.

A very important part of the mechanism is what is known as the diaphragm valve, which has been mentioned. This valve is called the relay for the reason that it performs a duty, analogous to that of the electro-magnetic relay in electrical apparatus. The work done by the low-pressure air acting on the diaphragm is simply to raise a small valve, which controls the movement of the high-pressure air by which the actual work of operating the switch or signal is accomplished. The valves and openings are so proportioned that a movement of the diaphragm of only a quarter of an inch is sufficient for all purposes. The signal apparatus differs from the switch apparatus only in the fact that there is only one indicating valve and one indicating cylinder. It is considered unnecessary to assure the signalman that a signal is in the go-ahead position.