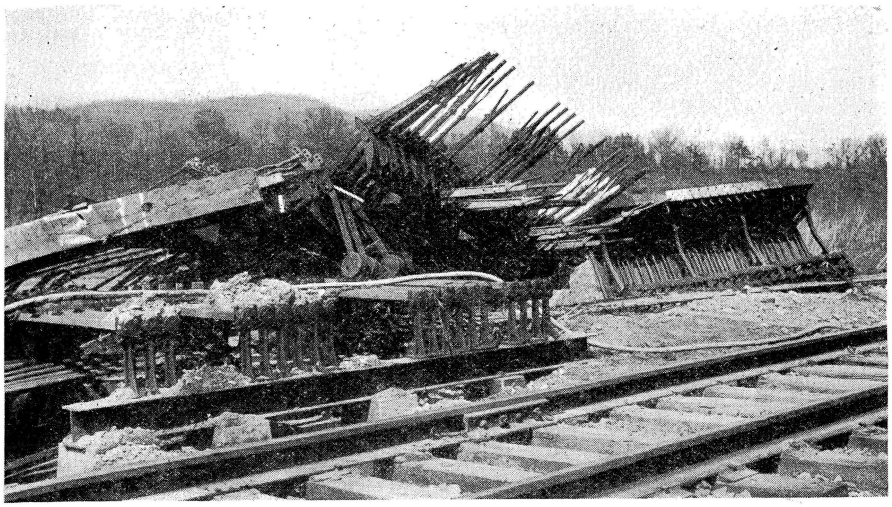
Railroads Clean Up After Flood Waters



Left—The interlocking machine at Sir John's Run, Md., on the B. & O. was held by the up-and-down rods but the building floated away. Above—Demolished trunking on the Pennsylvania near Pittsburgh—wires were returned to temporary service

During March, widespread floods resulted in unprecedented damage to the railroads throughout several eastern states. By field inspection and correspondence, *Railway Signaling* has assembled information concerning the methods pursued in replacing and rehabilitating the signaling and interlocking facilities after these floods receded.

On the Baltimore & Ohio the most serious damage to signals and interlocking by the March floods was on the main line along the Potomac river between Cumberland, Md., and Point of Rocks. Extended sections of the line were flooded from 6 ft. to 19 ft. 7 in., the most serious damage being done by the force of the water rather than by the deposit of mud. One interlocking tower was washed away entirely. Two signal bridges were torn down, as were one bracket signal and eight single-mast signals. The pole line was entirely washed away in stretches of one-half mile to as much as nine miles. The crest of the flood struck at Cumberland Tuesday evening, March 17, and in the course of two days passed Point of Rocks 103 miles below Cumberland.

The 48-lever electric interlocking at Patterson Creek, 7.5 miles east of Cumberland, was flooded about 6 ft. in the ground floor, the relays and battery being submerged. The damage to the tracks and interlocking was so extensive that about two weeks were required to make replacements and return the plant to service. In the meantime such switches as were needed were equipped with handthrow stands and a switchman was on duty.

The eastbound home signals were washed away and had to be replaced, new color-position-light signals being used. The tracks were washed so badly that practically all of the track wiring in the plant limits had to be replaced, and much of this work could not be started until the track work was done. Some of the relay cases at the signals were washed away or demolished. The signal pole line from the tower to the westward distant signal, about 4,000 ft., was washed out entirely, only three of the poles being recovered. The Kerite aerial cable on this line, attached to Copperweld messenger, was anchored where the messenger was tied in to a concrete foundation. This cable was recovered and placed in service again temporarily by hanging it on the communication pole line on the hill side of the tracks. The Model-4 switch machines were cleaned out, all of the coils being removed and hung up around stoves to dry for about 10 days. This procedure was successful in that all of these machines went back in service successfully on Tuesday, April 7.

Realizing that it would require a week or more to make replacements of the tracks and signals, no effort was made to clean the relays, new or repaired relays being ordered for delivery in time to be installed before the remainder of the plant was ready. As soon as the flood receded, the relays were removed from the shelves, the mud was washed out of the racks and a coal stove fire was kept burning continuously to dry out the moisture.

The power battery, consisting of 55 Exide lead cells with sealed covers, went through the flood without damage. The water line was raised in some of the cells on which the screw plug was evidently loose, but no mud was deposited in the cells. The Waterbury primary cells on the track circuits

were, of course, filled with mud, and, rather than try to clean them, they were emptied and new elements were set up.

Polarized Track Circuits Utilized

On the nine miles of three-track line between Patterson Creek, Md., and Okonoko, the signals were flooded, and 1.5 miles of the signal pole line was washed away. Realizing that it would be some weeks or more before the pole line and line cable could be replaced, polarized track-circuit control was installed for the automatic block signals on the two outside tracks, one eastbound and the other westbound. One of the westbound automatic signals was washed away, and for temporary operation the block was extended through to the next signal. New polar relays were secured on a rush order and this section of automatics was returned to service April 7. The shipments of new relays used on this section and other similar territories in the flood section include 117 new two-ohm Style-K General Railway Signal Company relays and about 75 500-ohm slow-acting Style-K relays, which were used as pole-changer relays where the mechanisms were not equipped with pole changers. On the middle track, which was previously equipped with lock-and-block traffic direction for train movements in either direction, this system of control was abandoned temporarily and the automatic signals cut out of service because it was impossible to control such a system without line wire. Until the pole line is replaced, trains are being operated on this middle track by manual block between the towers at Patterson Creek and Okonoko. In this manual block operation each train, before proceeding past a tower, must receive a Form A when it is to use the track in the direction for which it is assigned according to rule. If the train is to use the track in the direction opposite to that assigned by rule, a train order is used.

Between Okonoko and Orleans Road the original double-track line follows along the south side of the river on a route 17 miles long, while the Magnolia cut-off, a double-track line constructed above the flood level on a more direct route, is only 10 miles long. On the 17 miles of the old line the floods washed out seven signals so that the masts, mechanisms, relay cases and battery housing were practically demolished. As the ballast, and in places the entire embankment, was washed away, one track of this line was not restored to service until April 13; the other track was expected to be restored about April 27. The track that is in service is operated under manual-block rules. When the second track is placed in service, automatic signals for both tracks will be restored. In the meantime, trains are being operated over the cut-off line on which the signal damage was of minor consequence and was easily corrected before traffic was restored on Sunday, March 22.

The 48-lever mechanical interlocking at Okonoko was flooded to a depth of 21 in. on the operating floor. The locking and circuit controllers on the interlocking machine had to be cleaned of mud, and the relays were all replaced. The two-mast double-arm bracket for the westward home signal on the old line was washed out but need not be replaced until the old line is reconstructed.

No flood damage occurred throughout the interlocking at Orleans Road because the tracks are at an elevated location in this territory. On the three-track line east from Orleans Road, the pole line was down for a mile in the vicinity of Great Cacapon. The automatic signaling on the two outside tracks was restored to service on April 9 by installing polarized track-circuit control, as explained previously. The lock-and-block either-direction operation on the middle track will not be restored until the pole line is rebuilt.

Interlocking Damaged Beyond Repair

At Sir Johns Run, 11 miles east of Orleans Road, the electro-mechanical interlocking was completely demolished by the flood, which rose to a depth of 19 ft. 7 in. over the tracks at this point. The frame tower was washed away, one half of the building being found 3.2 miles down the river. The relays, battery, etc. in the tower are gone beyond recovery. The up-and-down rods held the interlocking machine as shown in one of the illustrations. The westbound distant signal bridge was washed out and fell on the tracks. Extended sections of the track and pipe lines were washed out, and the pole line was completely demolished for a distance of about a mile east of the tower. In view of the fact that this interlocking was so completely destroyed, it is not to be replaced in kind, but plans are being prepared to install power switches and signals and to control the layout remotely from the Hancock interlocking 5.6 miles east. In the meantime, hand-throw switch stands operated by switchmen are in service at Sir Johns Run, automatic block signal protection being provided for the layout.

As a part of the new remote-control installation, the automatic signals between Sir Johns Run and Hancock are to be respaced, using two bridges instead of the four formerly in this territory. On the 5.6 miles of four-track line between Sir Johns Run and Hancock, the pole line was washed away in various sections and the signaling was restored to service on the two passenger tracks April 9 by installing polarized track-circuit control.

The electro-mechanical interlocking at Hancock was flooded but was returned to service without much delay to traffic. On the 10-mile territory of three-track line between Hancock and Miller, the pole line was washed out for nine miles. The automatic block signals on the two outside tracks on this section were restored to service on April 9, by installing new polar relays for polarized track-circuit control. Between Miller and Cumbo, 10 miles, three signals were flooded but were restored to service in a few days. Between Harpers Ferry and Weaverton all of the signals were flooded but none were washed away.

At Brunswick, 6 miles east of

The Sir John's Run tower on the B. & O. was found three miles down stream.

Harpers Ferry, the layout of a 35-lever electro-pneumatic plant was flooded and covered with a layer of mud. At this plant, water was used profusely to wash the mud out of the switch machines, electro-pneumatic valves, circuit controllers and relays. When dried as much as possible by using cloths, the interior parts were washed with alcohol which further tended to eliminate the water. The apparatus was then restored to service and the interlocking was placed in service. New or shop repaired relays were used throughout the flood territory.

Unusual Means Used During Floods on the Boston & Albany

The main line of the Boston & Albany was affected by floods in the territory between Albany, N.Y., and Springfield, Mass., train service being suspended for three days on account of track washouts in the vicinity of Huntington.

At a 44-lever mechanical interlocking near Pittsfield, Tower 53, the pipe-line foundations were washed out, so that several car loads of cinders had to be thrown in to replace the embankment, after which the pipe line and foundations were jacked up to the proper position. All of this work was finished in time to return the plant to service before through train service was resumed. At Tower 42, at the east end of the West Springfield yard, the tracks, pipe line, and trunking were flooded. After the water receded, the capping was removed, the mud cleaned out of the trunking, and the wiring was inspected and meggered before being returned to service.

At two automatic signal locations near West Springfield, the floods submerged the batteries and the lower section of the instrument housings including the arresters. The storage batteries are equipped with sealed tops and vent plugs, and did not appear to take in much, if any, water. The lightning arresters were replaced. One highway crossing location was completely under water. The light units were taken apart to clean out the mud. The transformers were dried out and the relays and rectifiers were replaced with repaired apparatus.

Special Power Supply for Interlocking

The most important problem brought about by the floods on the B. & A. was to keep the electric interlocking at the Springfield station in service. The Connecticut river flooded the commercial power plant supplying power to this interlocking, connections being interrupted at 1:30 a.m. Friday, March 20, and power was not restored until the following Friday.

This interlocking at Springfield, serving the entire station area, is a 248-lever General Railway Signal Company all-electric plant with continuously burning 10-volt 40-watt lamps, a-c. repeating relays and a-c. track circuits being used. The connected load is about 12-kw., 440-volt 2-phase. As an emergency supply for alternating current, there is a d-c.—

On the B. & O. the force of the flooded streams broke poles to pieces

a-c. motor-generator set, fed from the 110-volt battery through an automatic cut-over panel.

Following the disruption of the a-c. power source, the main battery carried the interlocking plant load for about 14 hours, the plant being shut down when no train movements were being made. Industrial-truck batteries from four station tractors were assembled and connected in series to form a secondary 110-volt main battery which carried the plant for six or seven hours longer.

In the meantime, it became apparent that the a-c. power outage would be prolonged indefinitely and that an independent source of a-c. power was required if the interlockings were to be continued in service. A thorough canvass of all sources of equipment revealed that no portable outfits were available at any price. Arrangements were then made to assemble eight turbo-generators of the type used for steam locomotive head-lighting service, these machines being taken from locomotives temporarily out of service on account of the flood. Each of these generators is rated at 800 watts, 32-volts d-c. and can be adjusted to deliver about 1,000 watts at 35 volts. Four generators were connected in series and two sets of four in multiple to deliver about 60 amp. d-c. at 140 volts, and this source was connected to the 110-volt interlocking battery, which permitted full operation of the power switches as well as the d-c.-a-c. motor-generator set to supply the alternating current required. By shutting down the interlocking whenever train movements permitted, the battery was charged and the interlocking kept in full operation. Steam for the operation of the turbo-generators was supplied from a road locomotive which was run in on a track adjacent to the tower.

Damage Slight on L. V.

Damage to the signal apparatus on the Lehigh Valley was comparatively slight, the signal forces having been able to restore signal, interlocking, and communication facilities to normal operation by the time the railroad became passable. There were many places along the Susquehanna river, in the low lands at the eastern end of Cayuga lake and a few places along the Lehigh river where the tracks were inundated. The Vosburg tunnel, which runs parallel with the Susquehanna river, was flooded to an average depth of 3 ft., a portion of the river running directly through the tunnel. In the vicinity of Pittston, Pa., and Wilkes Barre, the tracks were flooded by about 6 ft. of water.

The greater portion of the signal apparatus flooded on the Lehigh Valley was at the Union Street interlocking at Allentown, Pa. Floods are not unusual at this point, as they sometimes occur twice or three times in one year, and the water generally reaches a height of 4 ft. to 6 ft. over the rail. For this reason, the apparatus in this tower, including the batteries, was installed above the high water mark.

As the water usually rises gradually, the signal forces were able to remove the dwarf signals, switch motors and relays, which are in vulnerable locations. In some instances, however, such apparatus has been covered

with water and mud. The practice on this road has been to clean the equipment that has been submerged as soon as possible, exposing the parts to the air for drying. In some instances, particularly around switch machines, fires have been built with kerosene and waste to hasten the drying process.

Several of the rectifiers and a few relays have been damaged during the recent flood. These were replaced by apparatus in good condition taken from stock, the damaged equipment being overhauled and returned to stock. No batteries were lost even though some were flooded. Storage cells with sealed tops were unharmed in spite of the water. Five battery wells of the concrete or sheet-iron type were floated out, but the batteries were recovered before any interruption was suffered.

Rehabilitation of Pennsylvania Signaling Damaged by Floods

THE SECTION of the Central Region of the Pennsylvania on which flood water and mud most seriously affected the signaling and interlocking, was on 22 miles of four-track main line between Jacks Run, mile post 4, from Pittsburgh, and West Rochester, mile post 26, which section is on the main line between Pittsburgh and Chicago. In this territory the Ohio river flooded all four main tracks to a depth varying from 6 to 10 ft. The tracks were inundated in the afternoon of Tuesday, March 17, the crest being reached Wednesday evening, after which the water gradually receded so that the rails and ballast were clear of the flood on most of the territory by Friday morning.

In this 22-mile section, the four main tracks are equipped with automatic block signaling and there are five interlockings, Jacks Run, an electric plant with 31 working levers and 9 working spaces; Leetsdale, an electro-mechanical plant with 42 working levers; East Conway, an electric plant with 32 working levers and 13 working spaces; West Conway, an electric plant with 26 working levers and 10 working spaces; and Rochester, an electric plant with 36 working levers and 9 working spaces.

The signals are all of the position-light type and, at all but two locations, the high signals are on signal bridges. Counting the home signal bridges as well as those at automatic block locations, there was a total of 30 bridge and signal locations with attendant instrument cases, battery boxes, etc., which were entirely submerged by flood waters for periods ranging from 24 to 36 hours. The water came up in the five interlocking towers to heights ranging from six to eight feet, or more. Besides the damage done by the water, the silt in the flood water formed a layer of mud in the instrument cases, towers and switch machines, varying in thickness up to three inches.

In the territory under discussion, straight a-c. signaling with a-c. track circuits was in service on about 9 miles of main line; on the remaining 13 miles, the a-c. floating system of power supply was used with d-c. track circuits, each fed from a storage cell, and d-c. line circuits each fed from a set of 6 storage cells that also acted as a stand-by for the signal lamps which were normally fed from the a-c. source. The power houses, which normally supply a-c. power for the signals and interlocking on this territory, were all flooded and so seriously damaged that there was no hope of securing power from these sources for several days or perhaps longer, after the flood receded.

At one location the flood washed out all four tracks, and at several locations washed out the two tracks adjacent to the Ohio river, leaving a layer of mud over everything. The water receded to a level with the ties on most of the territory by 6 p.m. on Thursday, March 19. An inspection was made of the roadbed and steps taken immediately to place the tracks in safe operating condition. The first train passed through this territory about noon on Friday, March 20.

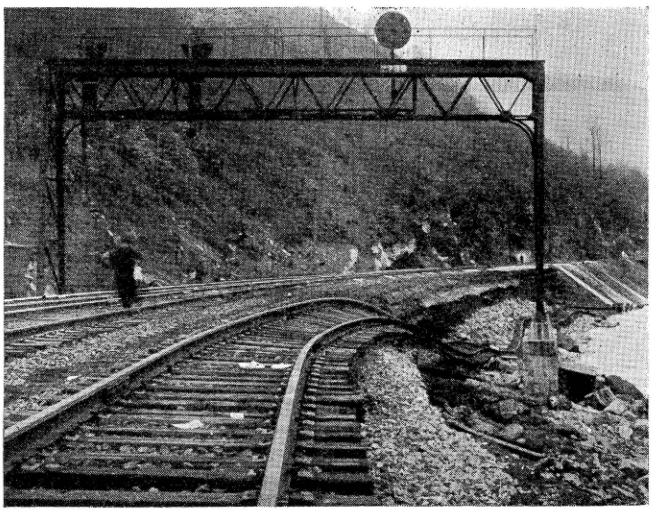
Replacement Work Started

In the meantime, the signal department had made complete plans to cope with the situation. Relays, battery, wires and cables were ordered for immediate delivery. Signalmen had been assembled from other divisions of the Central Region as well as from the Western Region of the Pennsylvania. Also, six relay repair men from the signal shop at Verona, Pa., were sent out on the road. In all, about 100 men were assembled in the signal forces on this job. Some of these men worked continuously for as much as 18 to 24 hours at a time. Some of them went as long as 72 hours without going to bed, catching a short nap now and then.

As soon as the flood water receded from the track, all hands got busy cleaning the mud out of instrument cases, battery housings, switch machines, dwarf signals and towers. Various types of paddles, hooks, brushes and brooms were used to remove the mud. Relays were opened, cleaned as much as possible, and laid out in the sun or hung up around stoves to dry, after which they were assembled, tested and, if satisfactory, were returned to temporary service.

In the meantime, the officers of the signal department anticipated that the operating department would want to run trains as soon as the water receded and would want signal protection as soon as possible. Faced with the fact that a-c. power would not be available for several days or perhaps a week, and, furthermore, that the storage batteries on the a-c. floating territory and in the interlockings were no doubt discharged or damaged by the flood so as not to be depended upon, it was decided that the best means would be to switch over to a straight d-c. system throughout.

About 150 d-c. track relays were purchased from the Union Switch & Signal Company and about 100 were



Signal bridge foundation and No. 3 main line undercut near Johnstown, Pa.

assembled from other divisions of the railroad. The a-c. track relays on the straight a-c. signal territory were all replaced with d-c. relays, and the d-c. relays on the remaining d-c. territory, which were damaged beyond immediate repair, were replaced by other d-c. relays. Storage batteries, fully charged, were assembled and delivered to each location, one cell for each track circuit and a set of six cells for each signal bridge. Most of these batteries were new signal type lead cells from the manufacturer, while others were borrowed from the car-lighting department. As no battery housings were available at these locations, each temporary battery was left in the packing box which was set on the ground near the instrument case during this temporary service. Furthermore, many of the storage cells which had been through the flood were cleaned, recharged and returned to the field.

In the meantime, main tracks No. 2 and No. 4, one eastbound and one westbound, had been cleared for through movements throughout the 22-mile territory, all switches at interlockings being spiked and blocked in the normal position. Block offices were established at each of the five interlocking towers and at three other points, Ben Avon, Haysville and Economy, and trains were operated by manual block, a clearance card being issued at each interlocking block office.

Manual Control of Approach Lighting

By midnight Friday, March 20, the signal department was ready to operate the automatic and interlocking signals to move trains straight through on these two tracks, using the 45-deg. aspect. This was accomplished by having all the track circuits in operation with d-c. track relays each fed from a storage battery. In view of the fact that there are three 9-watt lamps in each aspect of a position-light signal, it was obviously impossible to feed two such signals very long from a set of six cells of 120-a.h. storage battery. The temporary solution of this problem was the use of "manual approach lighting" in which a man was stationed at each signal location, and, when a train approached, he connected the battery to light the signal lamps. By this means the signal forces were able to provide automatic block signal protection by the time the line was ready for the movement of through passenger trains, and by 6 a.m. Monday, March 23, these signals were all in complete service, operating to 90 deg. as well, so as to permit trains to operate at the maximum speed permissible with track conditions. Meantime, the other westward main track, No. 3, had been cleared ready for service, and the signaling was complete ready for operation for through moves on this track. The system of portable storage battery feed using "manual approach lighting" was in service on certain sections from Friday evening until some time Monday, at which time a-c. power was cut in on some of the sections, and the a-c. feed was available throughout by Tuesday noon.

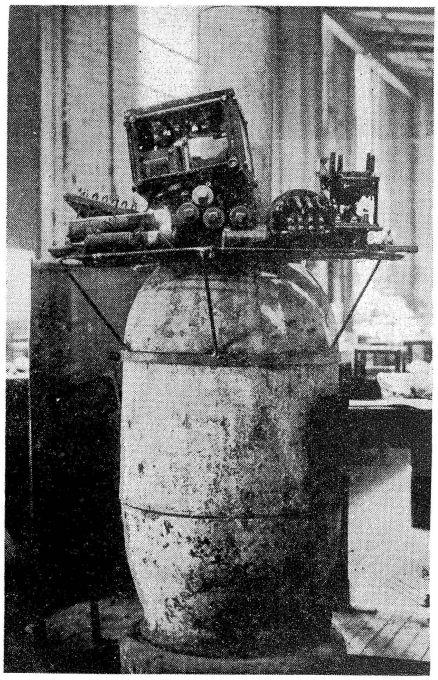
Work at the Interlockings

The interior of the interlocking towers were flooded from six to eight feet, leaving a layer of mud over the relays and batteries. An open bucket of black paint, in the tower at Leetsdale, floated to the top and spread out on the water. As the water receded, a coat of black paint was left on all the walls, relays, terminals, racks, battery, etc.

First the mud was cleaned out and then everything possible was done to dry out the moisture. Where stoves were not in service on the ground floor of the towers, such stoves were installed and good fires were kept going to produce as much heat as was consistent with safety. Relay repair men were busy taking the instruments apart, cleaning and drying them around the stoves and then, when tested, restoring them to temporary service. One reason why it was necessary to do this temporary repair work in the towers was that the regular Central Region relay repair shop at Verona, Pa., had been flooded with eight feet of water and could not be used at that time.

The switch machines of the Model-2 type were, of course, filled with mud. By using shovels, brooms, and water carried in buckets from the river or from locomotives, the mud was cleaned out. However, in most instances it was necessary to take the gear frames apart to clean out all of the dirt. Likewise, the motors had to be taken apart, cleaned and left to dry in the sun. With this treatment, these machines were returned to service. However, some trouble was occasioned by the pole-changer coils in the switch machines, and these were changed out as soon as possible. The dirt did not get into the Model-4 and Model-5A switch machines as much, but these machines had to be washed out and in some instances taken apart for cleaning and oiling. However, they were all returned to service.

The main wiring on the four all-electric plants consisted of single-conductor insulated wire, mostly No. 12, run in wooden trunking on concrete foundations. In many places the force of the stream washed off the capping or, in a few places, washed the trunking away. However, except in a few instances, the wires remained intact. When the water was gone, the remaining trunking was opened and the wires pulled out on top of the trunking or on the ground to dry. Having repaired the breaks, the wiring was returned to temporary service until it could be replaced with aerial cable which was ordered and received within a few days. The old wiring was, therefore, left in service until such time as replacements with new aerial cable were completed.



Drying shelf built up of ⅜-inch round iron rods welded together

By Monday noon enough of the switch machines were in operation to handle the crossovers required for through routes. These machines were operated from the 110-volt interlocking batteries, of the lead type, which had retained enough charge to handle these switches for a short time.

A-C. Power Cut in Again

While the signals were in temporary service on storage battery for each track circuit and at each signal, the rectifiers had all been removed and taken to the shop of the Union Switch & Signal Company where they were cleaned, placed in baking ovens, and then inspected. These rectifiers were then restored to service.

As soon as commercial a-c. power was available for any section, it was cut in service, the first power being available Monday and the final section was cut in on Tuesday. On the

a-c. signal territory, the a-c. track and line relays were returned to service as soon as the a-c. power was available, thus relieving the storage batteries used temporarily at these locations. On the a-c. floating territory, as soon as the a-c. power was available the storage batteries were connected to the rectifiers and the system returned to normal. Likewise, at the interlockings the batteries were placed on charge as soon as a-c. power was available to operate the rectifiers.

By Saturday, March 28, the entire signal and interlocking system on this territory was operating normally. However, the rehabilitation is not yet complete. There is much work to be done in cleaning the instrument cases and relay racks in the towers. Every relay that went through the flood is to be shopped, even though it may appear to be operating satisfactorily. Some of the repair men are still working in the towers. Also, now that the shop at Verona has been cleaned of its flood condition, extra relay men, in addition to the usual force, are busy overhauling relays.

Service Maintained on Lackawanna

No tracks were washed out on the Delaware, Lackawanna & Western during the recent high water. However, the height of the water at certain locations delayed and even prevented the movement of trains for short periods of time. Some of the signal and interlocking facilities were under water and this resulted in damage to relays, signal mechanisms, battery and rectifiers.

The water covered the main line at various points between Nichols, N. Y., and Hallstead, Pa., and at Delaware Water Gap. On the branch lines, the worst damage was done in the vicinity of Kingston, Pa., on the Bloomsburg branch. Some damage was done on the Ithaca branch and on the Utica branch near Chenango Forks. The following list indicates the extent of damage suffered by the Lackawanna:

Relay cases flooded	38
Relays	93
Primary battery cells	943
Storage battery cells	20
Rectifiers	1
Signal mechanisms	6
Signal motors	8

Of special interest is the fact that with a single exception, automatic signals and interlockings were working at all times when trains could be run. The signaling was impaired for only four hours on a few miles of one of the branch lines.

Line Breaks Repaired

A number of line poles were broken by ice floating on top of the high water. However, wires were run around such gaps and there was no disturbance of sufficient magnitude to delay trains. The automatic cab-signal power line feeding three substations suffered interruptions of a few hours at a time, extending over three days. Automatic signals continued to provide protection during this period. In order to minimize delays, the signal forces were transported within the flooded areas by automobiles and trucks.

Signal motors, mechanisms and relays were supplied from the signal repair shop in sufficient quantities to provide for replacement of damaged parts as the flood receded. The damaged equipment was later shipped to the storeroom for cleaning, repair and test. Thus, it was unnecessary to continue in operation parts that had been submerged and might be subject to failure. Primary battery that showed over 50 per cent exhaustion was given a complete renewal; that of less than 50 per cent had part of the solution drained off and new oil added. The electrolyte of flooded storage cells was renewed, although the batteries continued to function satisfactorily until new electrolyte could be delivered.

Coincident with the flood, there was an excessively heavy sleet and snow storm between Cohocton, N. Y., and North Alexander, which caused more than 100 cases of line trouble, varying from broken wires to crosses due to trees falling on the line. Line repairs were facilitated by transporting the linemen by a special work train.

Equipment Replaced on Western Maryland

The flood damage on the Western Maryland was confined to the section along the Potomac river between Williamsport, Md., and Cumberland. The automatic block signals on this territory are the Style-S using double instrument cases, the lower section housing the relays and the upper section the signal mechanism.

The railroad signal storeroom in Cumberland, Md., was flooded, so that all signal stock was rendered unfit for use. Therefore, all equipment needed for replacements on the flooded signaling had to be ordered from the manufacturers. In all, about 23 signal locations were flooded, 12 Style-S signal mechanisms and 80 relays being damaged beyond repair. Rush orders were placed for 12 new top-post mechanisms and modern relays for these replacements.

This signaling is operated by the straight primary battery system of power supply, using 500 a-h. Edison cells. About 500 of these cells were located in the 16 battery wells and boxes which were flooded. Where the housings were not overturned, the water was pumped out of the wells or boxes, the battery being continued in service and is apparently undamaged. At some locations the wells and boxes were washed out or overturned, about 50 cells being destroyed by breakage.

Only certain locations here and

An instance on the Baltimore & Ohio where the foundation held but the signal mast bent over

there on the division were affected. Therefore, in order to have as much continuous automatic signal protection as possible, pending receipt of new materials, one section of signals not affected by the flood was taken out of service and the mechanisms and relays were transferred to the locations in the flood territory. By this procedure the signaling on the entire division was soon restored to service, with the exception of the one short territory. Then when the new mechanisms and relays were received, they were quickly installed on the one remaining section.

On the Eastern Region of the Pennsylvania

The most serious damage to signaling on the Eastern region of the Pennsylvania was on the Williamsport division, a double-track main line which follows along the Susquehanna river from Harrisburg, Pa., northward through Williamsport to Renovo. The various locations where tracks, signals and interlockings on this line were flooded to depth ranging up to 12 ft., totaled 45 miles. The flood occurred Wednesday, March 18, and receded on March 20.

This double-track line is equipped with automatic signals spaced about two miles apart, with one cut section for each block. The signals are of the position-light type, the a-c. floating system of power supply, with a 440-volt a-c. distribution system, being used. One cell of lead storage battery is used on each track circuit and a main storage battery of 12 volts is used at each signal location to feed line circuits and to act as a stand-by in case of an a-c. power outage. Fourteen interlockings are in service at various junctions and terminals, including Sunbury, Williamsport, and Lock Haven. Highway crossing signals are in service at 40 locations.

At several locations the foundations were washed out so that the signals fell down or were leaning. However, the most serious damage to the signaling was done by the water and mud. The pole line was washed out in numerous short stretches, and a total of about 400 poles had to be replaced and many poles reset and strengthened.

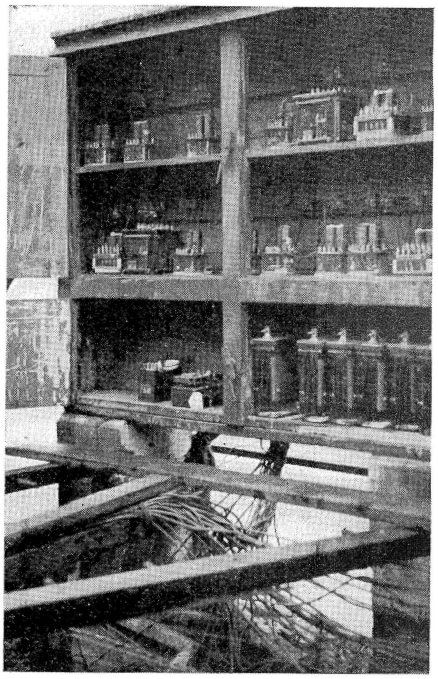
As soon as the flood water receded, the regular telegraph and signal maintenance force, supplemented by about 180 experienced men assembled from other divisions, got busy. The signals which were washed out or leaning were quickly replaced. Other crews replaced the line poles or strung temporary wires to bridge the gaps of lines down or washed out. The storage cells were, of course, flooded and covered with mud. The lead cells equipped with sealed top were not damaged, and mud did not get into these cells except in a few instances. Cells damaged beyond recovery were replaced with new cells.

In the meantime, attention was given to the major problem, i.e., to get the water and mud out of the relays, rectifiers, switch machines and other electrical and mechanical equipment. All of the relays, rectifiers, etc., were removed from the cases and rushed by trucks and automobiles to headquarters at Williamsport. On the basis that a little more water would not cause more damage, the mud was washed off the exterior, as well as the interior parts, by using buckets of water, water from hoses, etc., after which the interior parts were dipped in a bath of tetrachloride and then rinsed in clean water.

Cloths and sponges were used to remove as much water as possible. Ordinary portable electric hair driers were used to drive off the moisture quickly. Electric sun bowl heaters were also used effectively to dry the metal parts. Incidentally, the electric hair driers were used also in the field wherever 100-volts a-c. was available to dry out switch circuit controllers and numerous other devices which were left in place.

Reconditioning of Relays

The coils were placed in ovens. Portable sheet-metal ovens as ordinarily used on cook stoves were used for this purpose, the ovens being placed on coal or gas stoves. The metal parts were cleaned, special care being taken to clean and adjust the relay, armature, pivot bearings, contacts, etc. The flood water seemed to have a chemical action on the ribbons, in that many of them were broken or fell apart when touched. A total of over 1,000 new ribbons was required. Likewise, many of the relay contact fingers were pitted, this being caused, no doubt, by electrolytic action from current passing through while the relay was flooded. The coils of the relays and rectifier transformers were, of course, thoroughly baked before assembly. The dry-plate rectifier units were thoroughly cleaned and dried. However, many of the rectifier stacks were found to be damaged, and had to be replaced.

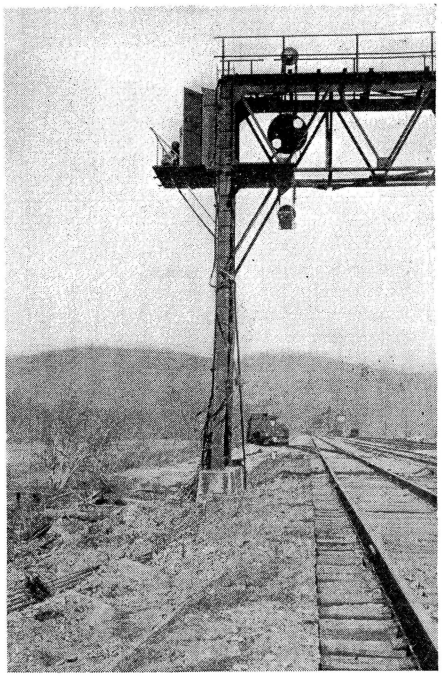


Instrument case at signal bridge on Pennsylvania near Pittsburgh, which was flooded

The important point is that every relay and other instrument which was flooded on this territory was given a thorough overhauling before it was returned to service. The relay shop was operated day and night, as many as 20 men being employed at one time on this work. Keeping this fact in mind, it is of interest to note the speed with which the signaling was returned to service. The damage to the tracks was repaired so that the first train was operated on Sunday, March 22, and by noon Monday the signaling was returned to full service on the 53-mile section between Harrisburg and Sunbury. The 40-mile section between Sunbury and Williamsport was placed in service on March 22, and the section on west to Lock Haven on March 24, the remainder of the signaling through to Renovo all being in service by noon on March 26, six days after the flood receded. The 24-lever electro-mechanical interlocking at Lock Haven, which was flooded to a depth of 12 ft., suffered the most severe damage of any of the plants. The switches at this plant were placed in service on March 24, and the plant was in full service by noon on March 28.

Damage on Middle Division

On the Middle division of the Pennsylvania, between Altoona, Pa., and Harrisburg, which is a section of the through route between Pittsburgh and New York, the Juniata River flood resulted in serious washouts to the tracks and two signal bridges were washed out. About six



Instrument case located near top of bridge leg at location on B. & O. where water rose to depth of 20 ft. over the rails

other signal locations were flooded but otherwise not very much damage was done to the signaling. The pole line was washed out at various places, totaling about 14 miles; also, in addition, many poles had to be straightened and strengthened by guying and banking. The 3,300-volt underground signal power line was washed out and damaged on extended sections, totaling about 12 miles, and this is being permanently replaced by aerial cable construction.

The delays in returning the signaling to service were occasioned by the outage of a-c. power sources more than by the work in replacing the signaling. Some sections of the signaling were restored to service within 24 hr. after the flood receded, while on other sections two or three days elapsed before power was available.

At a mechanical interlocking near Mt. Union, Pa., on the Middle division, the pipe lines west from the tower were washed out. Four crossovers in this part of the plant were made electro-pneumatic, compressed air being supplied by two compressor units, each having two motor-driven compressors of 3-cu. ft. capacity.

Other Divisions Affected

On the Philadelphia division at Columbia, Pa., also on the Susquehanna river, the foundation for the tower of a mechanical interlocking was washed so that the building was leaning at a hazardous angle, and considerable work was required to save it. The leadout and nearly all the pipe lines, cranks and compensators and also wire lines at this plant were washed out. Also many poles of the telegraph and telephone lines were leaning and washed out. The interlocking was restored to full service on April 13.

At Harrisburg, water from the Susquehanna river flowed back on the tracks to the Harrisburg station, doing considerable damage to telegraph and telephone and signal equipment not only at and in the vicinity of the station, but for six miles eastward.

Communication between Harrisburg and Philadelphia and other points eastward was interrupted by damage to the cable between the main frame in the station and the cable house where the aerial line begins, just east of the station. In restoring this service, twisted pair was run overhead between the main frame and aerial line terminal pole, and men motorboated out of the station and down the tracks along the pole line to remove debris from the crossarms and wires. These cables were replaced. Telephones and associated equipment along the tracks and in buildings in the flooded area were damaged and had also to be replaced. The pneumatic tube system, for delivery of messages in the station territory, was affected until repaired. Power lines for service at the station and in adjacent territory were damaged and had also to be repaired.

An interlocking, a short distance east of the station, was flooded to within two feet of the first floor ceiling, and the relays and other electrical equipment were damaged. Equipment and wire lines outside were also badly damaged. Emergency methods, similar to those previously mentioned, were used in quickly restoring this plant to service.

For a distance of about six miles east of Harrisburg, metal cases containing transformers, cutouts and oil sectionalizing-switches connected with the 3,300-volt signal power line were under water. As soon as the water receded, the cases were opened and the oil drained from the switches and transformers, and new oil put in. The line was then energized, and the automatic signals affected were restored to service.

There were 634 poles to replace and 300 to straighten or reset on the Philadelphia division. On the Eastern region, as a whole, 12,000 poles were affected, requiring replacement, straightening, guying or banking.

On the Maryland division, the Columbia and Port Deposit branch, running along the Susquehanna river, Columbia, Pa., to Perryville, Md., was flooded at various locations and some damage was done to signal and telegraph and telephone equipment, and the submarine cables at the Susquehanna River bridge, Perryville, Md., were also slightly damaged. On the Baltimore division, line poles were down at numerous locations, and signal and telegraph and telephone equipment was damaged at the Anacostia and Potomac river bridges, in the Washington, D. C., territory. Service was quickly restored on both these divisions when the flood subsided.

Signaling on the Pittsburgh & Lake Erie

That section of the main line of the Pittsburgh & Lake Erie which parallels the south banks of the Monongahela and Ohio rivers from Riverton through Pittsburgh to Stoops Ferry, a section of 26.5 miles, excepting 5 miles through Homestead, was flooded to a depth ranging from 6 to 10 ft. The water came up over the tracks on Tuesday, March 17, reached the crest about 9 p.m. on Wednesday, and receded clear of the rails about noon on Friday.

In part of this territory the P. & L. E. has a four-track main line equipped with straight a-c. automatic block signaling using position-light and color-light signals and intermittent inductive train stop. About 38 automatic block signal locations are in this territory and, including the instrument cases at these signal locations, at the home signals at interlockings and at highway crossing signal locations, a total of about 90 instrument cases were flooded and damaged with mud.

Also included in this territory are five large interlockings: A 42-lever electric plant at Beck's Run, 3.7 miles east of Pittsburgh; a 68-lever electric plant, DX, at the west end of the Pittsburgh passenger station track layout; a 49-lever electric plant, CH, at McKees Rocks, the east end of the freight yard and engine terminal; a 71-lever electric plant, FM, at Neville, the west end of the freight yard; and a 36-lever mechanical interlocking, MR, at Montour Junction.

As soon as the water receded every available man in the signal force of the railroad got busy to clean out the mud and water from the signal apparatus. In view of the fact that all of the equipment had been under

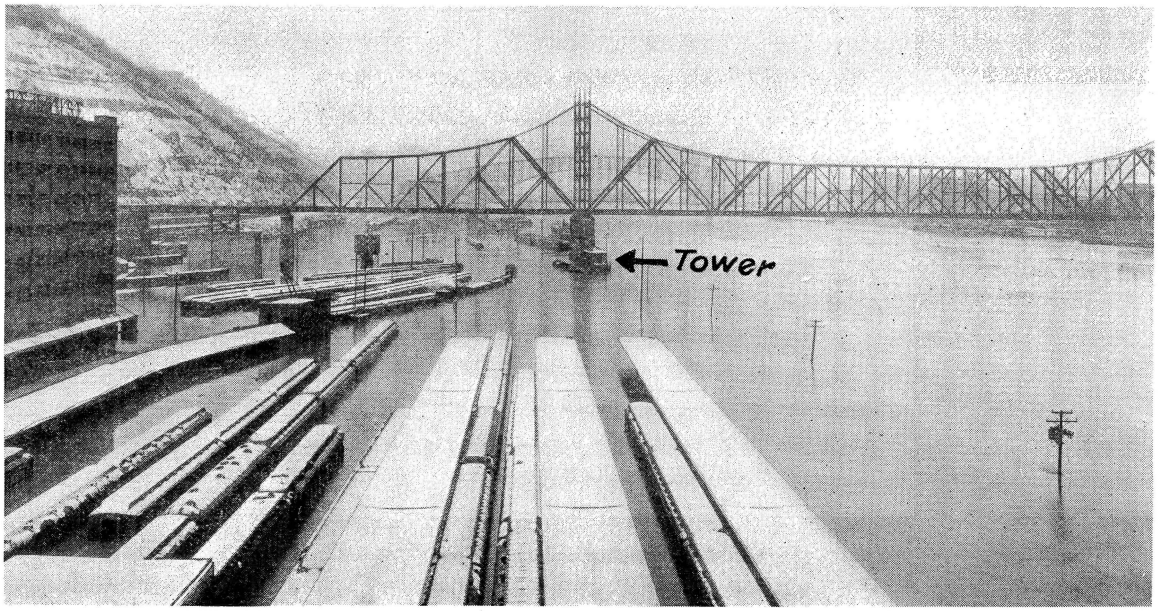
water for about 24 hours, it was decided that a little more water would not cause much additional damage. Therefore, the mud was washed off of the equipment with buckets of water, with water force from a hose, and in some cases locomotives were used to pump warm water through the switch machines to rinse out the mud.

As soon as the mud was cleared away, it was apparent that the most important limiting factor in hastening the return of the signaling to service was the necessary attention required to clean and dry out the relays. Track transformers, reactance coils, train-control wayside inductors, and wiring in the towers and cases as well as over the plants, were all returned to service requiring less labor than relays for reconditioning. However, when a relay is full of mud and water there is no choice but what it must be opened, cleaned and dried before returning it to service.

Temporary relay repair shops were set up in the electrical shop at McKees Rocks, at Montour Jct., and at Pittsburgh. The relays, which were fouled with mud, were taken apart, cleaned and the parts were placed in sheet-metal ovens which were set on gas and coal-burning stoves set up temporarily in the towers, switch shanties or other buildings. The advantage claimed for the use of an oven, as compared with the method of placing parts on racks around a stove, is that in an oven each part is subjected to even temperature of heat all over, and there is not so much likelihood of overheating the insulation on coils.

At DX interlocking at Pittsburgh, the track circuits, as well as the control circuits, are operated with d-c. relays, all of the relays on this plant being flooded. A large percentage of these relays which had seen years of service were scrapped at once, being replaced by new modern relays.

A matter of special interest was that in numerous cases the ribbons on the relays were broken or would readily fall apart when touched, thus showing the evident effect of electrolysis or chemical action in the flood water. In addition to the relays which were overhauled and returned to service at a rapid rate, about 75 new relays and other apparatus were purchased from the Union Switch & Signal Company.



The track layout and interlocking on the P. & L. E. at Pittsburgh, Pa., were flooded more than 8 ft.

Batteries Survive Flood

At the electric interlockings, such as at CH at McKees Rocks, the power battery was flooded. This battery consists of 55 Exide Type-DMGO-7 lead cells, which are equipped with sealed covers and vent plugs. Although the solution line in some of these cells raised during the flood, no noticeable amount of dirt entered the cells and they were returned to service. The signal supervisor was at this tower when the flood water was rising, and he disconnected this battery in an effort to keep it from discharging while flooded. Results proved that this method was successful, for as soon as the switches were cleaned, it was practicable to operate the switches from this battery again although no power was available at that time for charging.

At the interlocking in Pittsburgh where d-c. track circuits were each fed by two cells of Le Carbone primary cells, these batteries, which were in cast-iron chutes, were completely filled with mud and flood water. Rather than attempt to rehabilitate these cells, they were replaced at once by new cells of the same type.

At Beck's Run interlocking, as well as at the Pittsburgh interlocking, the main wiring runs over the plant are in aerial cable run on creosoted pine poles. Although the flood water got up over these cables, none of the poles was washed out and no harm was done to the cables, all of the wiring being returned to service without any trouble. At McKees Rocks interlocking, the single-conductor wiring in wood trunking was surrounded by mud so that the capping was removed and the wires laid out on the ground to dry. However, this wiring all went back into service with very little trouble.

During the flood, several large coal barges floated over the P. & L. E. tracks and at one place demolished the signal line, tearing down 10 poles at a location about one mile west of the Pittsburgh station. Normally the 6,600-volt single-phase signal power line is fed from the power station in the railroad shops at McKees Rocks. However, this plant was damaged by the floods, and it failed at midnight March 17. When commercial power was cut in at Aliquippa to feed the signal power line from the west end up to the FM Tower Neville, at 5 P.M., March 24th, the line was replaced and a-c. power was available throughout the territory from Ali-

(Continued on page 282)

penditure. By improving the power factor at each load point, they make possible minimum current in all portions of the line resulting in minimum line-voltage drop. Furthermore, they reduce transformer losses and thus save in cost of power.

Any piece of apparatus connected direct to the transmission line, no matter how well it is protected, is more subject to damage than secondary apparatus. Hence, the failure of a high-voltage capacitor due to line disturbances, though a rather remote possibility, will entail an appreciable monetary loss, and at the same time will disrupt line-voltage conditions. Small capacitors installed on the low-voltage side of the step-down transformers are practically immune to high-voltage disturbances, but in case of a possible failure are replaceable at a trifling expense.

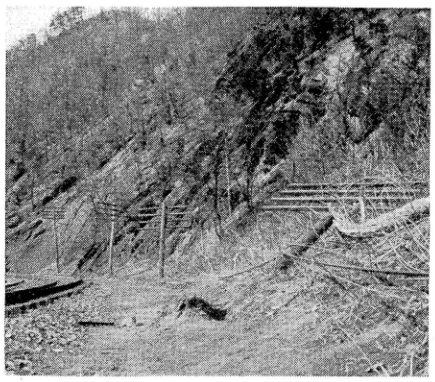
The additional first cost of installing low-voltage capacitors instead of high-voltage capacitors can be justified by improved operation, reduced maintenance, and saving in power.

Floods on P. & L. E.

(Continued from page 259)

quippa to Pittsburgh and on the 25th, Pittsburgh to Becks Run.

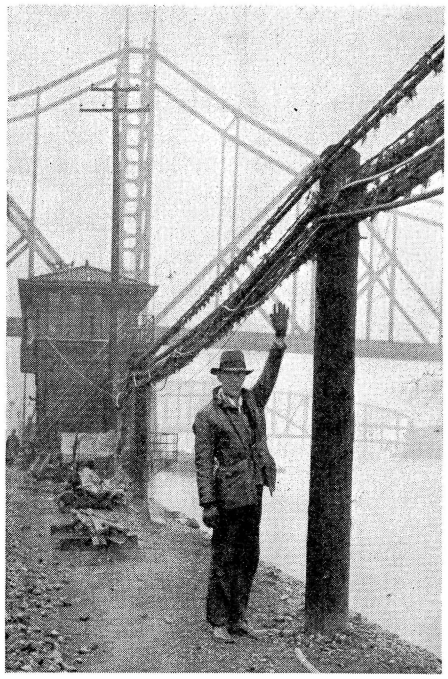
As there was not much current in the overflow water, no embankments or ballast were washed out so that not much damage was done to the tracks other than depositing a layer of mud. Therefore, as soon as the tracks were inspected and cleaned off somewhat, the operating department was ready to move trains. Incidentally, two of the coal barges, mentioned previously, had settled across the four main tracks. At first one main track was moved to clear the two barges; later the coal was unloaded from the barges and they were placed on rollers and launched in the river again.



Hundreds of poles were washed out on the Baltimore & Ohio

While the line was being cleared, the signal forces concentrated on the interlockings to get the switch machines clean enough to be operated by hand cranks. Then by means of switchmen and the use of hand signals, it was possible to move trains at reduced speed. During the first 24 hours after the flood receded, all railroad wire communication facilities, including block phones, telephone train dispatching and Morse telegraph were out of service. Each track when cleared was used exclusively for trains in the established direction and train speeds were limited.

In a short time the signal forces were able to get the relays, switch machines, battery, etc., at the interlockings returned to temporary service so as to operate the switches and provide call-on, slow-speed signals at the home signals. A bulletin was issued authorizing trains to proceed in the



On the P. & L. E. at Pittsburgh, these cables were flooded but not damaged

normal direction of traffic from tower to tower on the authority of these aspects, train speeds being limited to 30 m.p.h. This seemed to be the only logical means of moving trains for, as mentioned above, no wire communication was in service; therefore, manual block could not be used.

Having extended the a-c. power over the entire territory and gotten the interlockings all back in service, a part of the force was left to complete the rehabilitation at these plants while the remainder of the men started on the automatic signaling.

The operating superintendent advanced the theory that it would be

The base casting of this B. & O. semaphore was broken

desirable from his view point to restore the automatic signaling to service in sections, starting with the sections most remote from Pittsburgh. His reasoning was that these sections, as brought into service, would connect up with the territory beyond the flood zone, and thus permit uninterrupted maximum permissible speed up to certain points so that a train coming into Pittsburgh could be operated normally up to a certain tower and, from there on in, the 30 m.p.h. rule would apply. Likewise, in departing from Pittsburgh, the 30 m.p.h. rule would apply to a certain tower beyond which operation would be normal. This method of procedure proved to be very successful.

Signals Restored to Service

From the signal department standpoint, this procedure gave an opportunity to concentrate the forces and the assembly or repair of relays on one territory at a time. The section most remote from Pittsburgh on the east end, a 11.7-mile territory from Riverton to the west end of the tunnel, was completed and placed in service on April 1. The section most remote from Pittsburgh on the west, i.e. the 2.7 miles between Stoops Ferry and Montour Junction interlocking, involving several highway crossing signal locations, was brought into service on April 4. On the same day, a 2.1 mile section on the east end from the tunnel to Pittsburgh station was placed in service. Then on April 6, the section from Montour Junction to Neville interlocking, 4.3 miles, was completed, and on the next day this was extended 2.2 miles from Neville to McKees Rock. On April 7, the remaining section of 3.5 miles between McKees Rocks and Pittsburgh was completed.