



Station at Louisville, L. & N. general office building at the right



Home signal on C. & O. of Ind. on the approach to Cincinnati Union Station from the north

# Ohio Flood Damages Signaling



Wreckage of mechanical interlocking machine with tower washed away at Oklahoma plant on Big Four in Cincinnati

AS THE worst flood in history of the Ohio river and several of its tributaries subsided last week, more than a dozen railroads began the task of rehabilitating signal and interlocking equipment which had been inundated for periods varying from several days to as much as two weeks. Fed by excessive rains which fell on half-frozen ground, the headwaters of the Ohio river and many of its tributaries reached flood stages about January 15 and continued to rise for another 12 days. As the crest of the flood moved downstream, high-water marks far in excess of all previous records were established successively at Wheeling, Parkersburg, and Huntington, W. Va., Portsmouth and Cincinnati, Ohio, Louisville, Ky., Evansville, Ind., Paducah, Ky., and Cairo, Ill. Except for a few rare instances, the damage

done in these recent floods consisted of extended submersion and deposits of mud rather than damage by force of stream current, as was the case in many instances during the 1936 flood at Pittsburgh and points throughout the East. The communication facilities of all roads in the territory flooded were affected, many pole lines being covered completely or washed out.

## Damage at Cincinnati

Numerous interlockings and extended sections of signaling were flooded in the vicinity of Cincinnati, where the water in the Ohio reached a stage of 79.99 ft. on January 25, which was 9 ft. higher than the previous record established in 1884. The tracks at the highest point in the Union Station at Cincinnati were not

submerged, being out of the water about three feet. The Southern bridge over the Ohio, as well as the approaches on the Cincinnati side extending into the station, are at high level and this road continued service into the station during the flood period. All other train service into or out of the Cincinnati Union Station was abandoned.

Efforts of signal department forces to place equipment out of danger as the water rose were defeated, in most instances. The estimated crest was given, previous to the rise, as 71.5 ft. A considerable amount of signal equipment, such as relays, rectifiers, batteries, etc., was placed at a height of approximately 75 ft. When the water continued rising, reaching almost 80 ft., this material was flooded. The speed with which salvaging had to

be done may be appreciated when it is realized that the water rose at a rate of approximately six inches per hour.

The loop track located north of the station, used for turning trains, was under several feet of water. The machine for controlling operation over the loop is located at cabin "C" where the water went over the top of the roof. A 7-lever table-interlocker and a 7-lever mechanical machine, including all control equipment, was submerged at this point. Attempts were made to get the loop equipment above the predicted high water level. Although much of this material was disconnected and placed high enough to be dry in a 75-ft. crest, the flood stage of 80 ft. nullified these efforts. Similar difficulty was encountered with the handling of the material in the signal storeroom. Although the equipment in the storehouse was placed at 75 ft., the material was flooded by the water which went ceiling high. However, enough relays were carried out of the flood to get the loop installation back in service.

On the Union Station interlocking proper, 90 switch machines of the Union A-5 type were flooded. Before the water rose, signalmen retrieved 75 C.P. valves and the rotors of the circuit controllers. In some cases, the rapidly rising water did not allow time for disconnecting the wires, so that many of the valves were pulled out hurriedly, the wires being cut or pulled loose. This equipment was stored out of reach of the flood waters.

A matter of special interest was that the underground cables and wiring throughout the station interlocking went through the floods without damage. After the water receded, tests were made and all the cable wiring rang clear.

The regular electrical energy for supplying the interlocking facilities was discontinued on January 24, due to 9 ft. of water in the main sub-station. The supply point of compressed

air was flooded out at about the same time. For a few days, the only trains handled were those of the Southern and Chesapeake & Ohio of Indiana. When the electric power and air supply failed, a 1,000-watt gasoline-driven a-c. generator, maintained as a stand-by source of power, was immediately placed in service to provide for control of the switches. Signals

the Cincinnati terminal handled, with some slight delay, all trains that could get into the terminal. Considerable danger was present at the crest, due to the presence on the surface of the water, of gasoline from upset tank cars and storage tanks.

The track circuits, switch valves and rotors were placed in service as soon as possible after the waters receded. Relays and other equipment were replaced from stock, and the wet equipment repaired in the shops. The entire interlocking was returned to service at 5 p.m. on February 2. Regular air service was resumed at 10 a.m. on February 4. As soon as the water receded at Hoppel street, the Baltimore & Ohio tracks to Ivorydale Junction were clear for traffic by the Pennsylvania, the Cleveland, Cincinnati, Chicago & St. Louis, the Norfolk & Western, and the Baltimore & Ohio. Any inbound trains which were able to reach Ivorydale Junction were handled into the station, effective midnight, February 3. Outbound service was resumed at noon, February 4.

During the emergency, none of the signal department forces were allowed to leave the company property. These men, consisting of 15 regular signal department men and 4 extra helpers, were housed in Pullman cars.

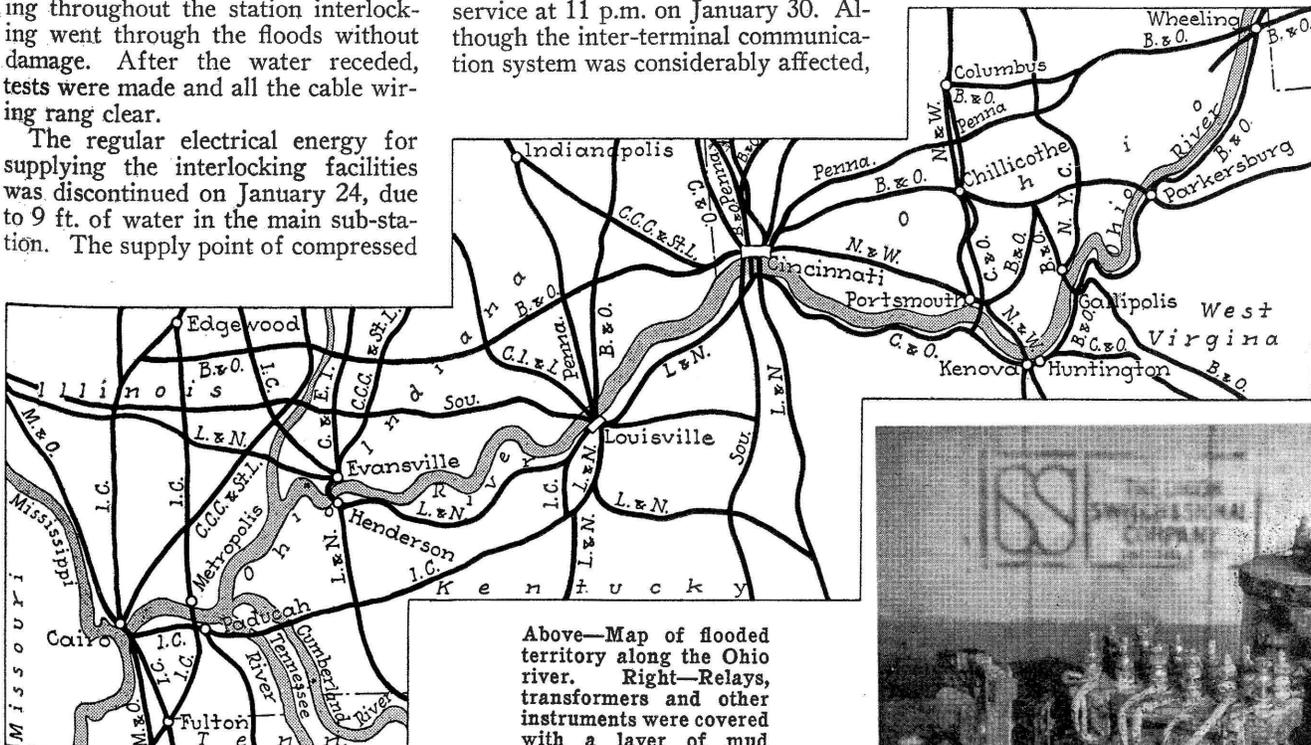
**Most of the information in this article was assembled by E. J. Phillips, Associate Editor, who made a trip to the flooded territory and was able to have the article ready for publication by writing it on trains and in unheated stations. Our thanks are extended to the numerous railroad men who cooperated in furnishing this information.**

and track circuits were discontinued so that the detector locks had to be picked when routes were set up. A locomotive was provided to maintain air pressure for the operation of switches. The gasoline-driven generator was maintained in service until January 30, when a temporary 2,300-volt line was completed into the Union Station yards by the Union Gas & Electric Company.

The interlocking for one-half of the north throat, including the Chesapeake & Ohio of Indiana, was returned to service at 11 p.m. on January 30. Although the inter-terminal communication system was considerably affected,

**The Baltimore & Ohio at Cincinnati**

The lines of the Baltimore & Ohio, which extend from the Union Station up Mill Creek Valley on routes to the east and northeast, were flooded for



Above—Map of flooded territory along the Ohio river. Right—Relays, transformers and other instruments were covered with a layer of mud

about 5 miles. On the route to Cleveland, the Big Four uses the B. & O. tracks from the Union Station to Ivorydale, 5.4 miles, and the Pennsylvania and the Norfolk & Western use the B. & O. tracks from the Union Station through Ivorydale to Norwood Junction, 7.7 miles; therefore, these roads were cut off from the Union Station. The Pennsylvania maintained service into Norwood and used bus service to the business district of Cincinnati. In the territory between the Union Station and Norwood, the B. & O. has an interlocking at Cumminsville which, together with the automatic block signaling in this section, was also flooded up to 12 ft.

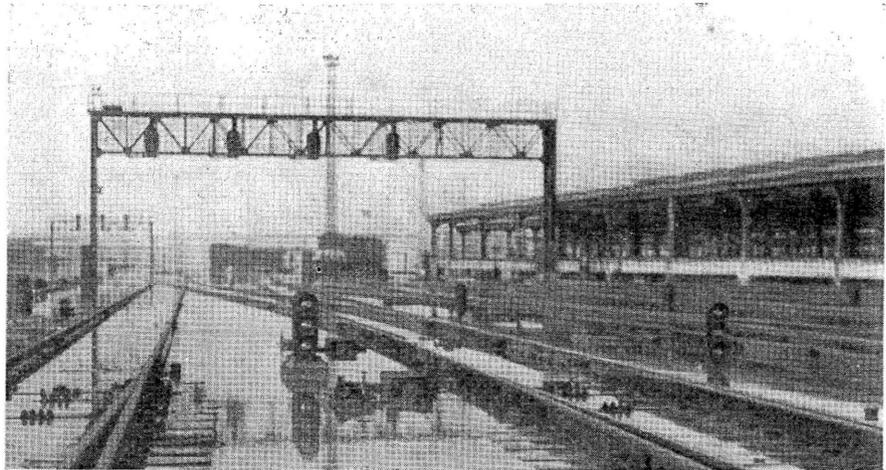
Color-position-light and semaphore signals with storage battery track circuits were subject to water as high as 12 ft. above the tracks. Since this was all back-water from the Ohio, there was no current, considerable dirt and silt being left when the water receded. Dry-plate rectifiers, relays, transformers, etc., in this territory were all submerged, although in some cases efforts had been made to get equipment out of the way. Battery wells were filled with water to prevent them from floating away. The relays and rectifiers are being sent to the B. & O. signal shop at Zanesville, Ohio, for cleaning and drying.

The plant at Ivorydale Junction was not touched by the river water. However, another tower, Cumminsville, nearer into Cincinnati and a junction of four tracks and two tracks, was under water to a height of four feet on the first floor of the tower. Due to the fast rise of the water, only two of six G.R.S. Model 5-D switch machines at this point were taken out ahead of the flood. After the river had receded, the submerged machines were cleaned with water, placed in a heated room for air drying, and were oiled. Service was resumed between Ivorydale and the Union Station, trains operating on time-interval system, on February 4. This operation will continue until the signaling is rehabilitated.

The portion of the St. Louis division of the Baltimore & Ohio, which runs westward along the Ohio, 19 miles to Columbia Park, and then crosses the Miami river near its confluence with the Ohio, continuing westward through the Miami River valley to Cochran, Ind., a distance of 28 miles from Cincinnati, was under water to depths as great as 22 ft. Part of this territory is single track and part is double track. Color-position-light signals with trickle-charged storage battery track circuits were in service. The rising water submerged all of the signal equipment in the

territory and two interlocking plants, "Dearborn" and "Cochran" were also involved. Dearborn is a mechanical plant at the crossing of the B. & O. and the Lawrenceburg & Aurora. The plant at Cochran is a G.R.S. all-electric, with Model 2 and Model 5-A switch machines, located at the end of double track at Cochran. The switch machines at this tower were taken out of service and placed, together with the storage battery, at a height of approximately 75 ft., which was higher than the predicted river crest, but when the water rose to 80

bles in four towers, "Wade," "King," "Stores," and "Oklahoma." At "Wade," which is a Union all-electric plant, 6 switch machines and practically all the control equipment was under water. The major portion of the equipment, relays, rectifiers, batteries, etc., at this point was moved three different times, finally being placed on the front porch of a private home. The fast rising water finally caught up, and the equipment was covered 18 in. "King," another Union all-electric plant, involving 14 switch machines, was submerged, although the switch motors,



View at Cincinnati Union Station showing north throat as water receded. Note that the CP valves have been removed

ft., this equipment was all submerged. At a number of locations on the St. Louis division, the river current washed out the concrete signal foundations. However, since these were of the pre-cast type and cylindrical in shape, they are being picked up and reset.

### Big Four at Cincinnati

The trains of the Big Four between Cincinnati and Cleveland are operated over the B. & O. tracks from the Cincinnati Union Station to Ivorydale Junction. The Big Four line from Cincinnati to Chicago follows down along the north bank of the Ohio from Cincinnati to Lawrenceburg. In this 22-mile, double-track territory, seven interlockings and the color-light automatic signaling was submerged. At Lawrenceburg Junction, the interlocking, including 9 G.R.S. 5-A switch motors, was covered by 2 ft. of water. At Valley Junction, a mechanical plant, 3 ft. of water covered the plant. At "Fernbank," a mechanical plant, just the roof of the one-story tower remained above high water, and all electrical equipment was submerged. In Cincinnati, the water rose approximately 14 in. above the telegraph ta-

control relays, batteries, etc., were salvaged by placing them in the loft of the tower. The "Stores" plant consists of mechanical switches and power home signals with top-mast motor signals. The battery, consisting of 55 lead cells, the lever locks, relays, etc., at this point were all under water, and one of the home signals was broken off at the base of the mast, presumably by floating wreckage. At "Oklahoma," which was a mechanical plant controlling 3 switches and 2 sets of movable point frogs, the tower was broken up and washed away, the signals were knocked down, and the interlocking machine transformed into a mass of twisted wreckage.

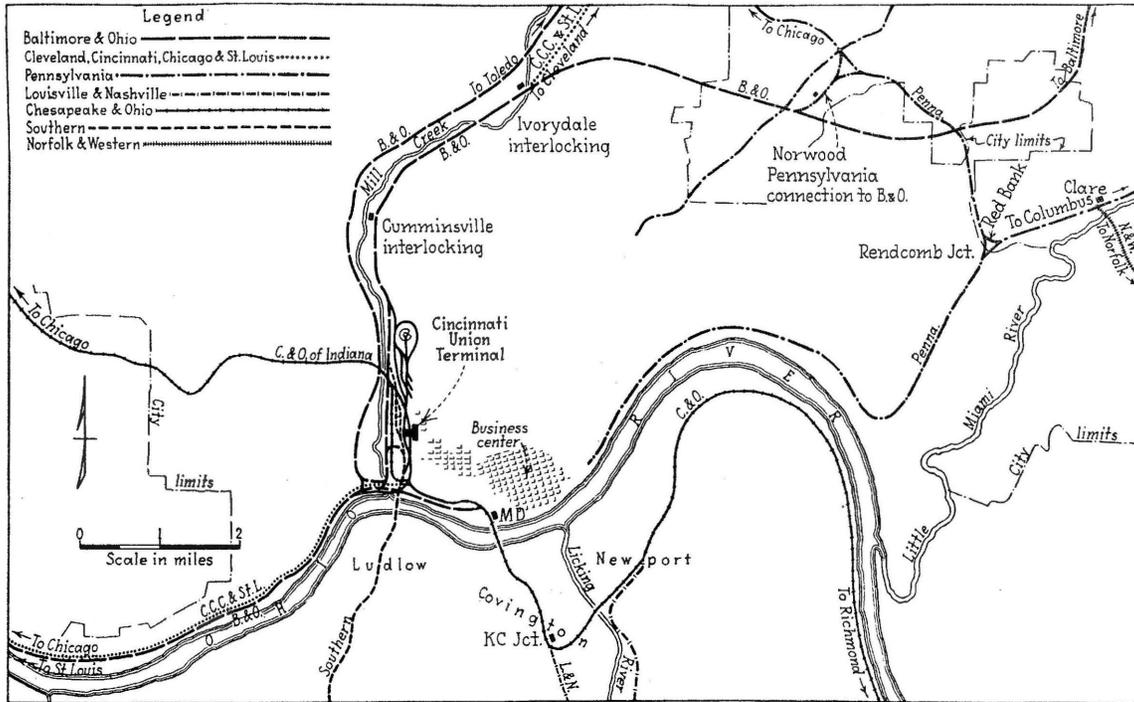
No service was possible on this line, therefore C. C. C. & St. L. trains bound for Cincinnati were routed by way of Ansonia, where a connection was made with another line. Trains were run as far as Lockland, about 7 miles out of Cincinnati. As soon as the tracks are clear and safe operation possible, operation is contemplated under manual block rules until the signals are back in service. Switches are to be rolled over and spiked, it not being planned to install switch stands.

All communication lines were disrupted, the pole line being washed out

and poles and crossarms broken by drifting material. In some cases, the signal relays filled up with water and, after the river receded, froze with the dropping temperatures so that the glass portions, in many instances, were broken. At the automatic signals, where batteries were disconnected,

relays and other equipment, all material in stock being used for replacements. A portable 64-cu. ft. (4 ft. by 4 ft. by 4 ft.) charcoal oven is being used to dry out the rectifiers and switch motors, while an electric oven was available at the signal repair shop for drying the relays. A sufficient sup-

ply of already mixed electrolyte was on hand in the storeroom for servicing the submerged batteries, while gas-driven generators were used to give the batteries a quick charge. Lawrenceburg Junction was back in service on February 4. The tracks of the remaining section became visible about February 3, after having been under water for 12 days.



Map of Cincinnati showing location of signaling and interlocking damage

they were found to be satisfactory after a little servicing. Where they were left connected, they became completely discharged. In some cases, the batteries, like the relays, froze up as the water fell, breaking the glass jars.

As soon as the equipment was accessible, work was started drying, cleaning, repairing, and adjusting the

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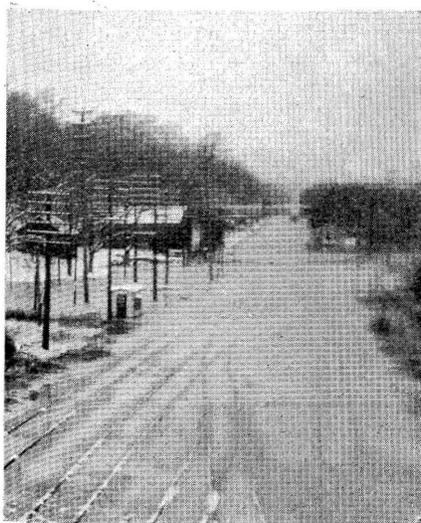
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### Pennsylvania at Cincinnati

The Pennsylvania line from the east via Columbus follows down the valley of the Little Miami river via Clare to the Ohio, and on to the old passenger station, as well as the yards and industries in Cincinnati. The water flooded out the old Pennsylvania Station on January 23 and 24. By 9:30 p.m. of the 24th, at which time the water was 15 ft. above street level, a temporary train-dispatching office, together with an emergency P.B.X. and a Cincinnati-Chicago teletype machine, had been set up in Court Street freight station. The train dispatchers, on the second floor of the old station, were moved out in boats. The control circuits for the emergency set-up had been strung along the Cin-

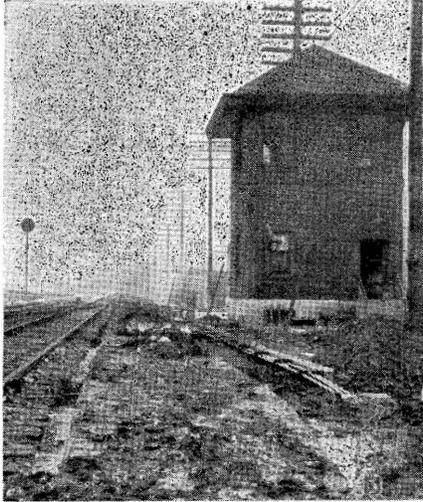
cuits, was completely under water.

Probably the greatest damage to Pennsylvania signaling in the Cincinnati territory occurred at a C.T.C. installation, the control tower of which is located at Clare, at a crossing and connection of the Pennsylvania and Norfolk & Western, approximately 12 miles east of Cincinnati. The two-story tower at this point, which houses a mechanical interlocking plant for the operation of Type G switch and lock mechanisms at this location, as well as a 25-lever C.T.C. machine, was flooded to a height of 1 ft. above the second floor, the water coming to a point just below the locking bed of the mechanical machine. The C.T.C. machine at Clare was operated until the water rose to a point where the machine became shorted. A lot of the equipment was removed and salvaged by boat as the water rose, the code units and graph of the C.T.C. machine being cut loose from the machine proper when it became evident that it might be submerged. Many relays, etc., on the first floor of the tower, however, were caught in the rising water. Chemicals, from unknown sources, present in the water throughout this area, which apparently were acid in nature,



The remotely-controlled switch machines and instruments at Rendcomb Jct. on the Pennsylvania were flooded

caused considerable damage to metal parts of the relays and to the straps of the terminals. A considerable quantity of mud was deposited on the tracks at this interlocking, primarily due to slides from higher ground about 200 ft. in the rear of the tower. When the water receded, the Type G switch mechanisms, switch points,



At Clare interlocking on the Pennsylvania the flood water came up to the locking bed in the interlocking machine—  
Note mud left on switch layouts

pipe line, and other equipment were heavily caked with dirt. Freezing temperatures further complicated the rehabilitation of the plant.

Three of the remote plants controlled by the Clare C.T.C. machine were flooded by back-water from the Little Miami river. At Red Bank, 1.2 miles west of Clare, one line extends to the old Pennsylvania Station and the other diverging north through Norwood to make a loop through Cincinnati to the Union Station. The code circuit for the former is known as Line A, while the code circuit for the latter is designated Line B. "Valley," a remote station on Line B which controls one Union M-2 switch machine, had water up over the tracks. At Red Bank, on line A, the water rose to the eaves of the one-story concrete control house, submerging 3 Union M-2 switch machines, 2 coding units, and approximately 56 relays. At Rendcomb Junction, also on line A, the water rose completely over the one-story instrument house, submerging 7 Model M-2 switch machines, 5 coding units, and approximately 176 relays. Although the regular shop and test house in this territory was badly flooded, the material was removed by boat and transferred to a temporary repair shop located in a vacant store on high ground.

Almost all the instruments were replaced by new equipment from the Logansport, Ind., storehouse or from

manufacturers as soon as the water receded. At Clare, the signalmen worked on the second floor before the water was out of the first floor. Later, two stoves were installed to heat the downstairs and melt ice which had formed. Two men from the Union Switch & Signal Company were called in to rewire the C.T.C. machine. The remote stations on Line B were placed in service almost immediately with full-circuit protection by knife switches, the knife switches being so inserted in the circuits at each remote station as to take the place of the final code selection under normal operation.

The instrument houses at Red Bank and Rendcomb Junction were cleaned out with a Homelite pump of the type normally used for pumping out man-holes, the outlet side being reduced to produce a force stream of water. The M-2 switch motors were baked out by a motor repair shop in downtown Cincinnati, while a 1,500-watt oven was used to dry the rectifiers, relays, coding units, etc. Rectifiers were used to recharge the batteries. Equipment in this territory was removed from service as the water receded, other signalmen following up immediately and putting the new equipment in service. As a temporary arrangement to open up service through Red Bank and Rendcomb Junction, communication and a 440-volt line was re-established between these points and Clare, and knife switches provided for the operation of the switches. Rendcomb Junction was placed in service under this plan two days after the water was off the tracks. Wiring of the Line B section of the control machine, about 50 per cent of the re-wiring job, was completed and placed in service on February 4.

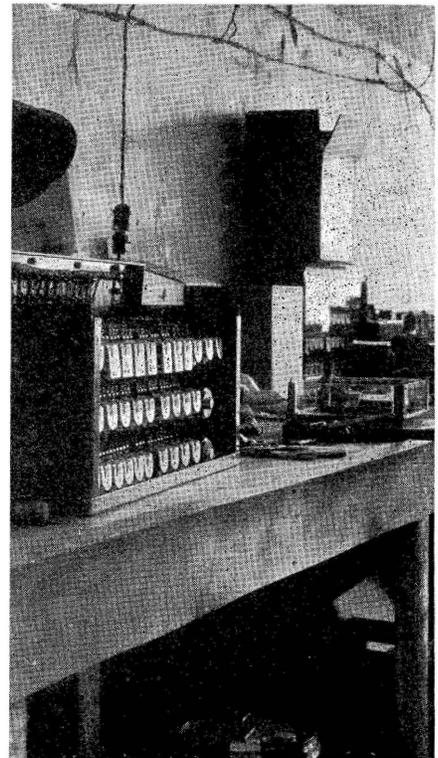
#### Pennsylvania at Louisville

On the Pennsylvania at Louisville, the basement of "Clagg" tower, located at the south end of the Pennsylvania bridge crossing the Ohio river, was flooded and the plant itself, of the mechanical type, was covered with 2 ft. of water. Electrical connections on the tail and latch levers at Clagg are used to control "Orr," a remotely-controlled layout at the north end of the bridge, involving two M-20 switch machines. The motors of these machines, however, were removed before the water reached them. Instrument cases at both Clagg and Orr were flooded, approximately 32 relays, 10 transformers and rectifiers, and 60 primary cells being affected. Considerable damage of lesser importance occurred in the vicinity of Louisville, a mechanical plant known as "Mark," and several pneumatic crossing gate

installations being under 2 to 5 ft. of water.

#### L. & N. at Louisville

At Louisville, the flood reached a stage of 57.1 ft., or 10 ft. higher than in 1884. The Louisville & Nashville abandoned service on January 22, when the tracks in the station at Tenth and Broadway were flooded several feet, as shown in one of the illustrations. On the Louisville-Cincinnati line of the L. & N., the tracks were flooded at Worthville, Ky., and Eagle, and at numerous places on the Louisville, Ky.-Evansville, Ind., line. The L. & N. office building, adjacent to the station, was surrounded by water, all heating, power and communication facilities being cut off. Communication was so badly disrupted and so much of the railroad was affected by water that at the time of this writing, February 8, it was difficult to learn the extent of the damage to signal facilities.



The Pennsylvania established an emergency repair shop in an empty store building on high ground

However, "MN" interlocking, a G.R.S. electric plant with 18 switches, and "6th & A" interlocking, a Union electric plant with 21 switches, at Louisville were under several feet of water. The motors were removed before the water reached them, and the "6th & A" plant was cleaned up and returned to service on February 5. Most of the signals in the territories flooded are base-of-the-mast mechanism semaphores, so that the big prob-

lem will be the repair and replacement of motors, relays, batteries, etc. On the Evansville division, approximately 50 miles of L. & N. road, mostly single track, is under 10 ft. of water, and it is estimated that in this territory alone approximately 98 base-of-the-mast mechanism signals have been affected. A G.R.S. all-electric plant at Eighth avenue, Evansville, with 14 switch machines, is also under water. Several mechanical plants have been covered, a plant at West Point, Ky., 23 miles out of Louisville, at a crossing of the L. & N. and I. C., being under 16 ft. of water.

### N. & W. and the C. & O. Affected

Extended sections of the Norfolk & Western main line were inundated between Kenova, W. Va., and Portsmouth, Ohio, about 87 automatic signals, 7 crossing signal locations and 1 crossing gate location being flooded in this territory. Interlockings at Iron-ton, Ohio, and Portsmouth, as well as the electro-pneumatic car retarder installation at Portsmouth, were all flooded, and the complete extent of the damage has not, at this writing, been determined, although rehabilitation is being rushed as fast as possible.

The Chesapeake & Ohio main line paralleling the south side of the Ohio river from Huntington, W. Va., to Cincinnati was flooded for extended sections, numerous automatic signals, several interlockings at Huntington and Ashland and one C.T.C. installation at Limeville being damaged by high water. In the vicinity of Cincinnati, the C. & O. tracks and interlockings are at a high level and not much damage was done.

### On the C. & E. I. and I. C.

The Chicago & Eastern Illinois line into Evansville was not seriously affected, only three signal locations being damaged by floods, and this road continued to render freight and passenger service throughout the disaster.

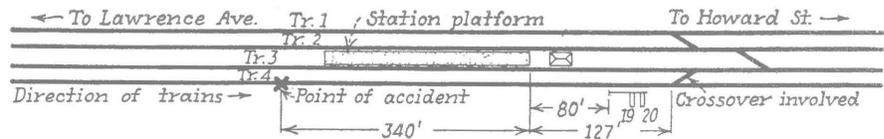
The floods affected lines of the Illinois Central at Paducah, Ky., Louisville, Evansville, and Cairo, Ill. However, the damage to interlockings and signaling was limited to about \$25,000. Only one interlocking, a mechanical plant, was flooded. Automatic block signaling was inundated on about 10 miles of line in the vicinity of Paducah and on about 10 miles near Louisville. The water did not get high enough at Mounds, Ill., or at Cairo, to cause any damage to signaling.

# Rear-end Collision

ON NOVEMBER 24, 1936, there was a rear-end collision between a passenger train of the Chicago, North Shore & Milwaukee and a passenger train of the Chicago Rapid Transit Company on the tracks of the last-named company at the station at Granville avenue, Chicago, which resulted in the death of 10 passengers and the injury of 58 passengers and 1 employee. An investigation of this accident was made by representatives of the Bureau of Safety, Interstate Commerce Commission, in conjunction with representatives of the Illinois Commerce Commission.

The accident occurred on a four-track line, illustrated in the accompanying sketch, over which trains are operated by time-table and book of

with good visibility, at the time of the accident, which occurred about 6:15 p.m. Train R-5, a northbound "L" express passenger train, passed Lawrence avenue about 6:10 p.m. and had just been stopped at the home signal at Granville avenue when it was struck by train No. 725. Train No. 725, a northbound North Shore passenger train, passed Lawrence avenue at 6:13 p.m., 14 min. late, and was running at a speed estimated to have been about 10 miles per hour when it collided with the rear of the "L" train at Granville avenue. Train R-5 consisted of eight coaches. The sixth and seventh cars were of steel construction, the first, second, and fifth cars were of steel-underframe construction, and the third, fourth,



rules, and are subject to the direction of towermen at interlocking plants. The movement from track 4 to track 3 is made by means of a crossover, the facing-point switch on track 4 being located 127 ft. north of the north end of the station platform, which is between tracks 2 and 3. The interlocking signal governing movements over this switch is located 80 ft. north of the station platform and is a two-arm, two-position home signal of the lower-quadrant semaphore type; the top arm, signal 20, governs through movements on track 4 and the lower arm, signal 19, governs crossover movements to track 3. There is no distant signal to indicate to motor-men of approaching trains the position of the home signal. These signals and the crossover switches, as well as the other signals and crossovers in the vicinity, are operated from a tower which is located 31 ft. north of the station platform. This accident occurred on track 4, at a point 420 ft. south of the home signal. Approaching this point from the south the track is tangent from Lawrence avenue, a distance of about  $1\frac{3}{4}$  miles, while the grade is practically level. The view from Lawrence avenue northward to the point of accident is unobstructed. The weather was clear,

and eighth cars were of wooden construction. Train No. 725 consisted of three coaches, of steel construction.

The first six cars in the "L" train were not derailed and none of them was seriously damaged; one pair of wheels of the seventh car was derailed and this car was slightly damaged; the eighth car was demolished, having been telescoped approximately 35 ft. of its length by the first car of the following train. None of the cars in train No. 725 was derailed and only the front end of the leading car was damaged to any extent. The employee injured was the motorman of train No. 725.

The conclusion of the report of the Bureau of Safety was that this accident was caused by failure of North Shore train No. 725 to be brought under control until it was too late to avoid colliding with the train ahead, and by the lack of any system to provide for the proper spacing of trains. It was recommended that wooden cars be eliminated from service as rapidly as practicable, that the use of wooden cars associated in trains with cars of steel or steel-underframe construction be prohibited, and that immediate consideration be given to the need on this line for an adequate block-signal system.