# Boston & Maine Flooded Signaling Rehabilitated

DURING the March floods parts of all the main routes and most of the important branches of the Boston & Maine were seriously damaged by high water, ice jams, roadbed and bridges washed out, and land slides over the tracks. The same difficulties existed on the lines of the Maine Central, which is operated under the same management as the Boston & Maine System.

For a few days train service on the five routes leading out of Boston on the Boston & Maine was limited to a radius averaging about 35 miles. The flood in northern New England occurred in two cycles. During the first period, which reached a peak on March 1, 313 miles of B. & M. road was out of service, 240 miles of which was restored to service by March 17. The second stage of the flood was particularly disastrous to the Boston & Maine. On March 20, 1,127 miles of road was out of service, out of a total road mileage of 1,997 miles.

Eight signals were washed away

## Survey of Conditions

Highways were impassable and pole lines were destroyed in so many places that communication of all kinds was completely disrupted. Therefore, about two days elapsed before partial data could be assembled as to the extent of the track, bridge and signaling damage, this information being gained primarily by inspections made on foot, by rowboat, motor car, automobile and by airplane. Communication with headquarters of the New Hampshire division at Concord, N.H., was dependent upon a single commercial telephone circuit routed from Boston to Concord via Albany, N.Y., and Montreal, P.Q. Some messages were put through by means of amateur operators using short-wave radio.

Tentative dates were established as to when track and bridges could be rehabilitated, so that trains could be operated, and then the signal department organized its replacement work so that the signaling would be ready for service at the same time or in advance of the tracks.

## Repairs in the Field

In the meantime, prior to the reestablishment of wire communications, signal forces had been organized on outlying districts and had proceeded to restore the signaling. On one line, eight automatic signal locations had been demolished or completely washed away by the floods. At these locations the signals were replaced and the pole lines rehabilitated. On an outlying section on the Fitchburg division a temporary means of drying out apparatus was used for about 90 pieces consisting of relays, transformers and rectifiers. This scheme consisted of using a portable drying oven made of a 50-gal. sheet-iron oil drum. The top was cut out and hinged as a cover. Holes were punched in the sides through which ½-in. rods were pushed to be used as supports for the relays and coils while being dried. A thermometer was hung inside the drum to indicate the temperature. Then the drum was set up on its end and heated from the outside by means of a portable oil-burning snow-melter device. The heat entered through a hole in the side of the drum and was regulated by the distance of the heating device from this hole. By maintaining a temperature of 200 to 250 deg., the apparatus could be dried in the course of about two hours.

However, as soon as complete data was available as to the dates on which train service could be reestablished, it was evident that time would be available to bring all of the remaining flooded relays to the signal shop at Billerica, Mass., for a complete overhauling.

## Baking Oven Used Effectively

Investigation revealed that an electric baking oven ordinarily used for baking armature and field coils for motors was available for use at this location by the signal forces. This oven is about 6 ft. wide, 8 ft. long and 6 ft. high inside, so that up to 125 relays could be dried at one time. The temperature in the kiln could be regulated up to 180 deg., but experience demonstrated that 100 deg. was the best temperature. During the drying process an exhaust fan was operated so as to carry the excess moisture out of the oven. From four to eight hours was required to dry all the moisture out of a relay. As a test to determine the time necessary, the coils of some of the older types of relays were broken open and observed as to moisture in the inner windings.

After all parts of the relays were thoroughly dry, the relays were torn down completely and given a thorough shop overhauling, the same as on the standard schedule. Therefore, each relay damaged by the floods was completely rehabilitated before being returned to service. The relays which had been overhauled temporarily in the field after being dried by means of the portable ovens, although giving all appearances of satisfactory operation, are now being sent to the shop for complete schedule overhauling.

## Bridges Out in C.T.C. Territory

Two important bridges and considerable roadbed were completely washed out on a five mile stretch of the main line of the Fitchburg division in the territory over which all of the heavy east and west freight traffic is operated. This is in C.T.C. territory having either-direction signaling on the westward track and one-direction signaling on the eastward track. As soon as temporary

See the May issue of *Railway Signaling* for an account of the damage to signaling on other large eastern railroads, beginning on page 251.

single track was established in this territory, using the eastward track part way and the westward track the remainder, the signaling was changed over to provide temporary single-track signaling in order to facilitate movement of traffic. Interlocking signals were provided to govern movements over the double-track switches at each end of this territory, and an electric power-switch layout was installed on the easterly switch, the switch and signals at this location being handled by the train dispatcher at Gardner as a part of the regular C.T.C. operation. The westerly double-track switch was hand-operated and this switch and the interlocking signals were controlled by a telegrapher-switchman on the ground under the direction of the dispatcher. This operation will remain in service until new double-track bridges can be installed.

SUMMARY FLOOD DAMAGE

| | Boston & Maine | Maine Central | Total |
|---|---|---|---|
| OUT OF SERVICE | | | |
| Interlocking signals | 24 | ..... | 24 |
| Automatic block signals | 233 | 22 | 255 |
| Highway crossing protections | 16 | 2 | 18 |
| DAMAGE CAUSED TO: | | | |
| Line poles | 237 | 115 | 352 |
| Line wire—miles | 88 | 10 | 98 |
| Relays | 753 | 65 | 818 |
| Primary battery (cells) | 5,002 | 1,955 | 6,957 |
| Storage battery (cells) | 108 | ..... | 108 |
| Signal motors | 166 | 7 | 173 |
| Switch motors | 8 | ..... | 8 |
| Signal mechanisms | 101 | ..... | 101 |
| Switch mechanisms | 3 | ..... | 3 |
| Rectifiers | 29 | ..... | 29 |
| Slot-arm coils | 203 | ..... | 203 |

### Emergency Power at Interlockings

At Lawrence, Mass., where the rising Merrimac river caused complete suspension of power, lighting and telephone service, a portable gas-electric generator outfit was rushed to the interlocking tower and the 110-volt storage batteries were thereby kept from exhaustion. This was particularly important as for two days this became the "end of line" on this main route and all trains had to be turned back at this interlocking, causing many extra movements.

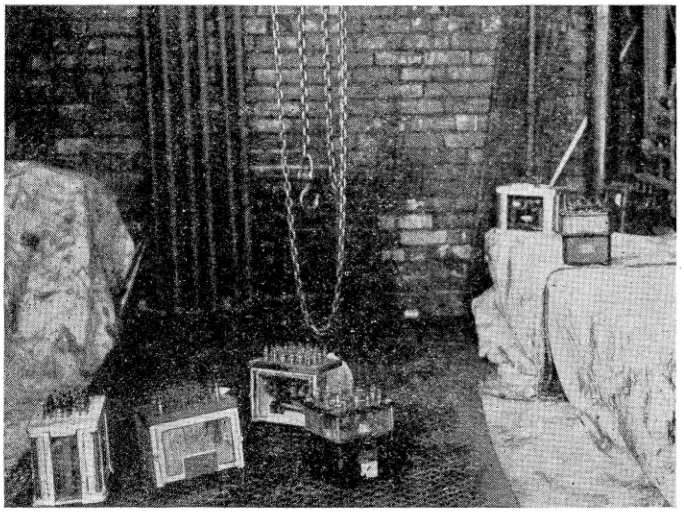
At Lowell Jct. tower, also without power at the same time, a temporary power line was run from another source 2½ miles distant. Until this line was run, the lights of all the color-light interlocking signals at the tower were controlled through switches in the tower and were turned on only as needed for train movements.

Many other temporary signal layouts and circuit arrangements, too numerous to describe in detail, were used for short times to meet the exigencies of the occasion. In all, about 24 interlocking signals, 255 automatic block signals and 18 highway crossing signal locations were flooded. These locations involved 173 signal motors, 8 switch motors and 818 relays that were overhauled in the shop at Billerica. In all, about 108 storage cells and 6,957 primary cells of battery were flooded. Excepting in instances where the cells were tipped or the jars broken, the battery was returned to service, after dipping off the water left over the electrolyte.

# New Haven Uses Heating Room to Dry Signal Apparatus

During the disastrous floods in March, considerable damage was done to the automatic signals, interlocking plants, and the car retarder equipment in the vicinity of Hartford, Conn., and Springfield, Mass., on the New York, New Haven & Hartford. About fifteen miles of double-track a-c. automatic block signaling, with wayside cab signal and train stop apparatus, was flooded in the territory between Hartford and Springfield. With the exception of the apex of the hump, the entire classification yard at Hartford was flooded for a week or more. A remote control interlocking near Hartford, including eight derails, one switch, and several signals, together with the large concrete instrument house, containing relays, 60 cells of storage battery, oxide rectifier and accessory parts, was all under water. At Springfield a portion of a large all a-c. electric interlocking was flooded, including eight switch machines and eleven motor-semaphore dwarf signals.

The automatic signal system, exclusive of the cab signal and train stop apparatus, was soon reestablished by material from stock. Some of the wayside cab signal apparatus had to be kiln dried before it could be used; however this was not a factor in regard to reestablishing train blocking because there were no trains. The tracks in the north part of Hartford were nearly ten feet under water so that by the time the water had receded to a point when trains could be operated, the automatic system had been completely restored.



The New Haven drying room solved a serious problem

The electric switch machine motors and the electric motors for the car retarders and skates as well as all of the relays, rectifiers, etc., which had been subjected to flood waters, were taken out of service as soon as possible after the floods receded, and delivered to the signal repair shop at New Haven. The accompanying table lists the materials which were handled on rush schedule.

### Drying Kiln Provided

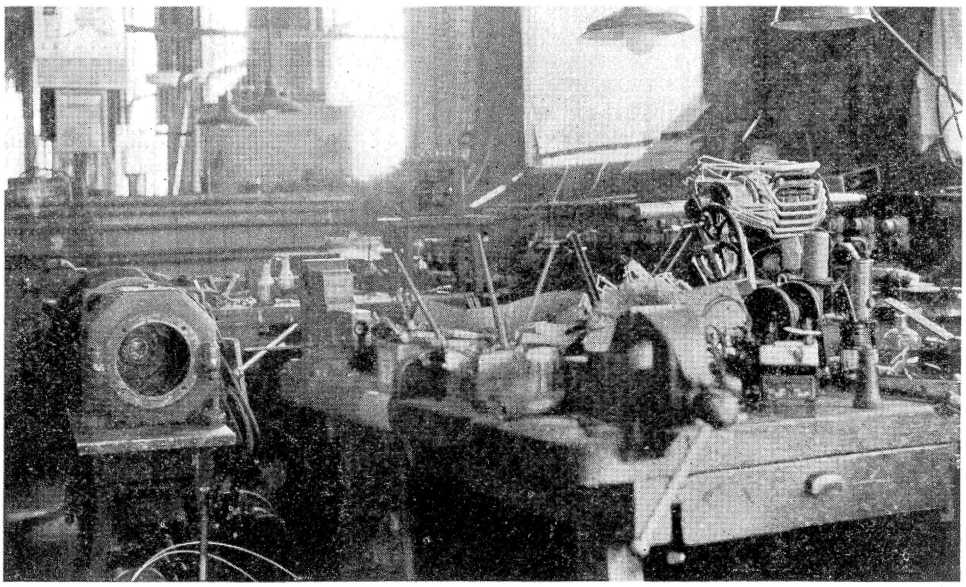
Anticipating the arrival of water-soaked and damaged apparatus at the shop, a drying kiln was provided. A brick enclosed room, 11 feet by 20 ft. was used for this purpose.

Radiators made of 2-in. steam pipes were placed on the floors and walls of the room, with four ½-in. bleed pipes extending to separate blow-off cocks on the outside of the building. This special heating system was installed in about six hours. Pieces of locomotive front-end screening were placed over the radiators on the floor on which to place the damaged equipment.

As each of the 31 retarder motors weighed 465 lbs., it was advantageous to install an overhead track way for a traveling crane thus eliminating the necessity of handling these motors by hand. Also steam, compressed air, and water were made available.

The signal material was delivered by trucks as removed from the flooded territory, dismantled, parts were thoroughly cleaned by the use of water, steam and air, after which they were placed in the heating room. The blow-off cocks were used to drain the steam pipes and to adjust the temperature which was maintained at from 180 deg. to 195 deg. F. A large motor-driven blower was used to keep the air in the drying room circulating and to maintain the same temperature at all levels. A small amount of fresh air was drawn into the room near the floor level, and roof ventilators kept partially open to relieve the water vapor from the drying room. The results were very satisfactory.

Insulation resistance readings were taken periodically and recorded. Some of the coils, such as for transformers and relays rang clear within 48 hrs., whereas some of the retarder motors, which had been under water for ten days, required from four to seven days for drying. As a general rule, a piece of equipment was left in the heating room until the coils rang clear, and then this particular apparatus was left for an hour more before it was taken out. As the apparatus was satisfactorily dried out it was transferred to the electrical repair room and put in first class condition before being returned to the field, that is, all parts were cleaned and polished. Coils were tested carefully and then painted. New relay contacts and ribbons were installed as required, so that the instruments were in first-class condition before being returned to the field. The commutators on all signal, switch and retarder motors were dressed down, and of course all coils were tested. In only one instance was it necessary to rewind a motor.



All signal equipment was thoroughly overhauled—View shows retarder motor being rewound

## Work In the Field

In the meantime the field forces had used various unique methods to clean the remaining apparatus in the field. By using a locomotive with live steam, hot water and air pressure available, the switch mechanism and retarder mechanisms were washed out clean and dried without taking the equipment apart. The 110 cells of Exide 320-a.h. lead storage battery for the retarders at Hartford were returned to service with no other attention than washing off the cells by hose and siphoning off the flood water which had been left on top of the electrolyte, to be followed by a good over charge.

The mud was cleaned from the signal instrument cases by washing them out with water, using brushes, brooms, etc. However, it was noted that the mud left on the porcelain based terminals and arresters was effecting corrosion on the bolts and washers. Therefore all of the terminals and arresters are being removed and sent to the shop in large lots, to be cleaned and then reinstalled.

The field rehabilitation and the shop repairs of the signaling was scheduled to coordinate with the work of the track and bridge forces so that the signaling and interlocking would be ready for service as soon as trains could be operated. This was accomplished readily in connection with the automatic signaling, and no serious delays were occasioned at the interlockings. Likewise about two weeks were required to clear the yards at Hartford, so that the signal forces were ready to return the retarders to service by the time classification work was again started.

List of Flood-Damaged Signal Apparatus Reconditioned

| | |
|---|---|
| 153 | Transformers—Track, Lighting, and Train Control |
| 103 | Reactors |
| 29 | Resistors |
| 13 | Rectifiers—Copper Oxide Type |
| 93 | Relays A.C.—Track and Line |
| 78 | Relays D.C.—Track, Line, Flasher and Interlocking |
| 122 | Motors, Switch, Signal, Retarder and Skate |
| 1 | Motor—230 Volt D.C. |
| 26 | Mechanisms—Retarder Skate |
| 26 | Circuit Controllers—Type F and Solenoid |
| 10 | Slot Coils—Style B |
| 4 | Slot Arms—Style B |
| 11 | Coils—Switch Magnet |
| 4 | Coils—Solenoid Dwarf Signal |
| 1 | Switch—D.P.S.T. |
| 1300 | Terminals—A.A.R. |
| 60 | Cells Storage Battery |
| 40 | Lightning Arresters |
| 40 | Resistance Units |