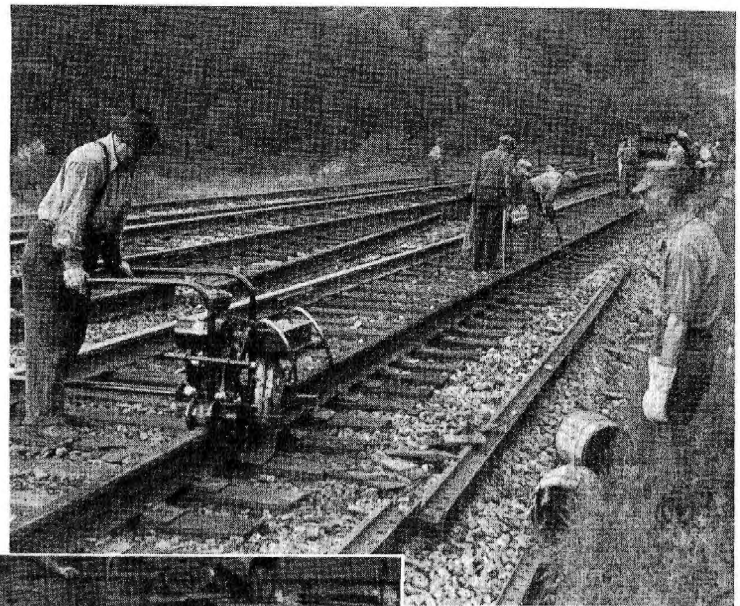
Recent Developments in Rail Bonding



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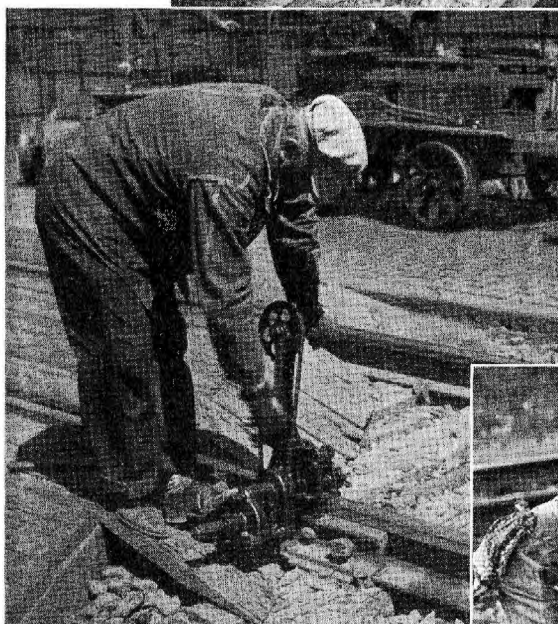
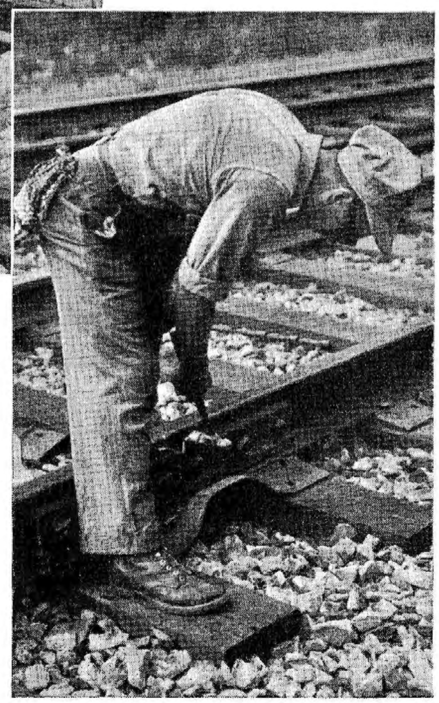


Above—Fig. 2—A machine with two drills, drills both holes simultaneously. Left—Fig. 3—Bonds may be installed in pick-up maintenance with a hand drill. Below—Fig. 4—Driving a bond with a 3-lb. hammer



Introduction of methods of extending the service life of rail brings improved design of the short rail-head type of bond and application methods

THE short welded bond for installation on the rail head was introduced into the signal field in 1919, following its general use in railroad electrification. Advantages claimed for this type of bond included: Better broken-rail protection, low bonded rail resistance, and generally improved track circuit operation. Improvements through the ensuing years resulted in welded bonds of steel and of bronze construction, with much greater fatigue resistance.

With the advent of the depression years, beginning in the early thirties, it became necessary to find methods of securing longer life for rail in main track, which heretofore had been retired to less important tracks, branch lines and sidings. Methods of oxy-acetylene and electric arc welding of battered and chipped ends were introduced, resulting in important economies due to improved running surface and to the postponement for years of the necessity of renewing the rail. Still later developments provided methods for heat treatment of the rail ends, thereby postponing the day when batter became a factor for additional expenditure.

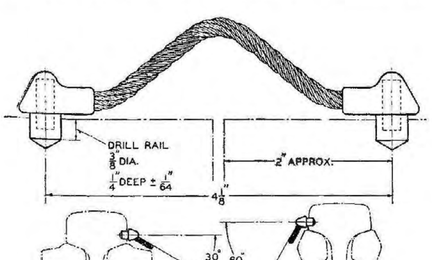


Fig. 1—Two angles of strand assembly are provided in order that the bonds as applied to different types of rail and joint bars may fit snugly

A Problem for Signal Engineers

Introduction of these heat applications to rail developed new problems for the signal engineer, not only as a result of damage to the short bond on the rail head, but in damage to galvanize protection, annealing, and frequently actual fusion of long bonds spanning the joint and applied to the rail web. It was found that even an improved welded bond, which had been designed to withstand welding heat of application, and which, therefore, suffered less than any other type, suffered from some of the more severe welding processes. Although most roads apply rail welding and heat treatment methods over such bonds with a standard of care which

Fig. 5
Bond being removed with hammer and extractor tool

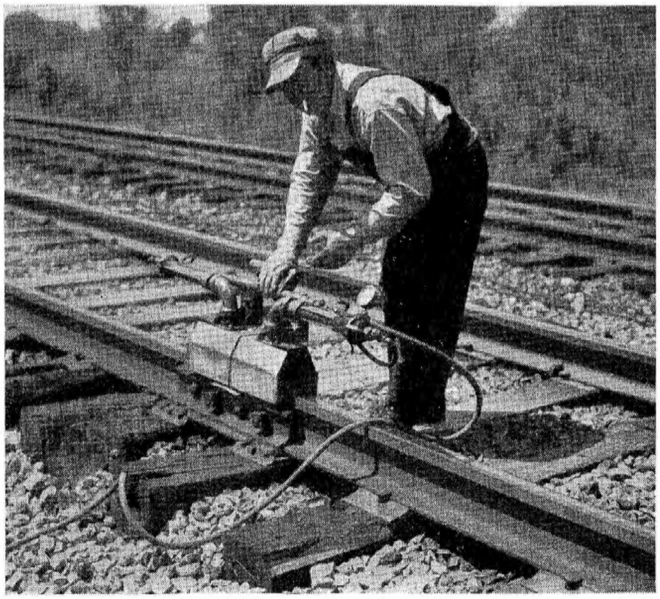


Fig. 6
A gas fired preheating furnace heats rail head to above 1200° F. If the bond had not been removed this heat would be sufficient to anneal it and destroy a large part of its ability to serve

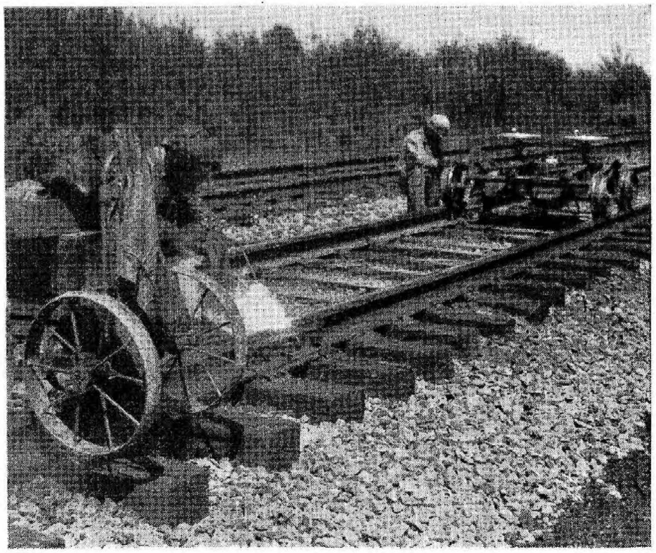


Fig. 7
The welding operation—note grinder finishing joint just previously welded.

enables the bonds to serve uniformly throughout the life of the rail, it was found necessary, on one road, because of particularly severe processes, to renew some 14,000 bonds due to actual fusion of the stranded body.

Meeting the Challenge

In order to make available to the signal field a bond which would meet these new conditions of rail heat applications regardless of the type of weld and of the super-speed applications introduced, interest centered on the development of a bond which could be removed and reliably reapplied after welding or heat treating operations, meanwhile retaining all of the advantages of the short welded bond previously mentioned. A short rail-head type of bond, with stud terminals which are applied directly into holes drilled in the head of the rail, was developed and used for this service.

Since abuses arising from the continual maintenance operations on the track and from ballast spreading and tamping operations are also factors which have a strong influence on rail bond performance, provision was made for maximum service under the most severe track conditions in selecting materials for the terminals and strands of the new bonds.

One type of bond which was finally evolved, because of lack of heat operation in manufacture or application, has been proved to have a laboratory service life 40 times that of its related welded bond after its normal welding operation. Since no such bond has been found which has failed due to fatigue in more than 10 years' service, it may reasonably be assumed that a remarkable advance has been made.

A standard of low bonded rail resistence was secured with the welded bond which was fractional as compared to the earlier methods. This desirable characteristic has been preserved in the newer type of bond with an installed resistance of 0.000,415 ohms. Two No. 8 EBB galvanized iron bond wires of 52 in. length installed will show a resistance of 0.005,210 ohms with joint plate contact neglected, a value of about 13 times the resistances of the short rail-head bond. A maximum bonded track resistance of 0.04 ohms per 1,000 ft. of track is entirely practicable with the new mechanically applied rail-head bond.

Since this new method of rail bonding involves installation in small drilled holes in the rail head, it is essential that accurately drilled holes be provided. Terminal plugs must be thoroughly tightened for mechanical

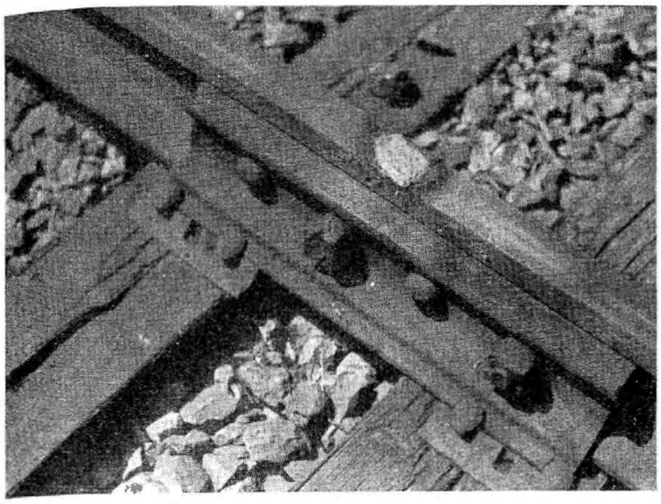


Fig. 8—The rail end batter welded in readiness for grinding operations. Note bond holes

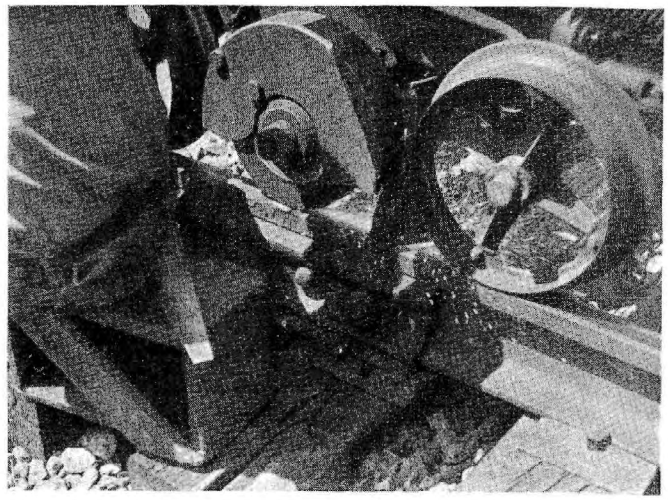


Fig. 9—The weld being surfaced with power grinder

reasons and to exclude all oxidation and possibility of progressive breakdown of electrical contact.

Twin-Spindle Drill Developed

Preparation of the rail head for the installation of the improved type of bond simply involves the drilling of two ⅜-in. diameter holes, spaced 4⅛ in. and ¼ in. depth (Fig. 1).

In order to secure the maximum in drilling reliability and costs below other methods, a twin-spindle power drill has been developed, which will apply rail-head bonds at a lower cost than by other methods. The drilling time for the two holes, with the twin power drill, ranges upward from seven seconds in very soft rail with the usual drilling time about ten seconds. From 90 to 120 bonds per hour may be installed, thus insuring that a single bonding crew of two or three men and one twin drill may easily keep up with the fastest rail-laying crew. *Railway Signaling* for August, 1937, included two articles (page 447 and page 458) in which operation of the twin-spindle drill and other machines may be compared. Analysis of these articles will show that the twin-spindle type consumed 4 machine hours and 12 man hours per mile of bonded track, whereas single-spindle drills consumed 10-2/3 machine hours and 18-2/3 man hours for the same production. About one minute is required for each hole with a hand drill machine.

Methods of drill bit grinding were developed and are placed on a basis where great accuracy of drilling rail is secured. Annual savings in cost of drill bits alone of several hundred dollars have been secured during a normal year's rail-bonding program.

The bond, of course, may be installed with twin-spindle (Fig. 2) or single-spindle power drills, or may be applied most efficiently in pick-up maintenance with hand drilling using the ordinary hand-operated signal bond drill with adaptation for rail-head drilling (Fig. 3). No limitations in installation are imposed by flange-worn surfaces of turned rail or rolled rail heads.

Installing the New Bonds

The operation of installing the bond is that of driving the terminal with two or three sharp blows of a 3-lb. hammer (Fig. 4). Where very heavily re-inforced joints are used or where double bonding is installed, some operators prefer to use a drift hammer which is placed against the bond terminal, and which receives the hammer blow.

After three years of commercial use, it is important to note that no inherent weaknesses or indicated inability to serve indefinitely have shown up in use on 37 railroads under every conceivable track and traffic condition.

Re-Application

In order to illustrate the practical adaptation of this method of bonding to rail heat treatment and welding operations, the reader is referred to the accompanying series of photographs (Fig. 5 to Fig. 10, inclusive) which will clearly explain the various steps in a rail repair program from removal of the bond to re-application after the joint is pre-heated, welded, ground and slotted.

With welding operations, the function of the signal department is usually to supply a man who removes the bonds ahead of the welding crew and makes re-application after the joints are repaired and cooled. Speed of the welding gang is such as to make it possible for one man to do this work. Because of the higher speed of heat treatment, two signal department men are usually required, one ahead and one back of the heat-treating gang.

Any joint bond which has undergone the exposure to heat of a joint weld is liable to be damaged. A practical solution for this difficult new problem, as described in the foregoing, removes the danger of early bond failures and resultant signal failures because of rail operations which are largely out of the control of the signal department.

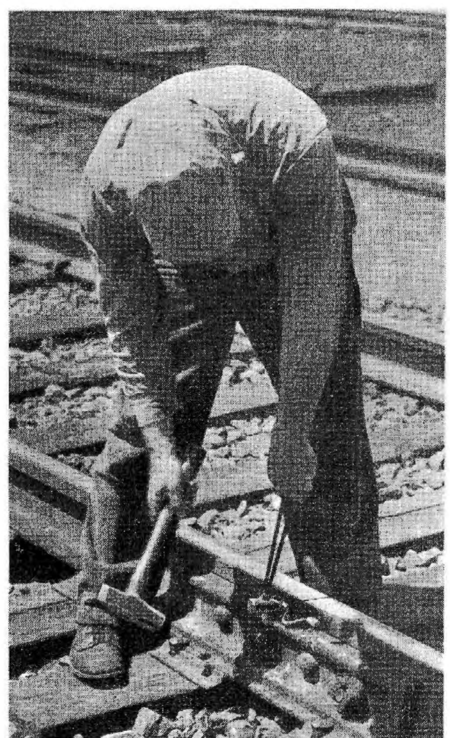


Fig. 10—A finished joint with bond being reapplied. Because of heavily beaded joint a drift hammer is used