any benefit. If changes were being made, either a new cable or a cable considerably longer than the three feet of slack, provided for in the specifications, was required. It is now felt that the practice is not justified and only sufficient slack is allowed to prevent the cable from binding.

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Fouling Jumper Construction

"What type of construction do you use for fouling jumpers, i.e., wires in trunking or conduit, bare cable stapled to ties, or underground parkway, etc.? Why do you prefer this type of construction?"

Two Satisfactory Schemes

Otto M. Jensen

Office Engineer, C.M.St.P.&P., Milwaukee, Wis.

On the Milwaukee we use two 6-ft. plug-type galvanized or Copperweld cable bonds stapled to the side of the ties just above the ballast line. In automatic block signal territory, the fouling jumpers are located near the frog. At interlockings where the fouling jumpers must also be depended upon for detector locking, the jumpers are located at the insulated rail joints at the point of fouling, and consist of two No. 9 standard Kerite track cables buried to standard depth and brought to rails in standard bootleg trunking risers.

In both cases one connection is made on the inside and one on the outside of corresponding rails so that dragging equipment, under ordinary circumstances, will not tear off both connections. The stapling of the cables to the ties above the ballast line provides for easy inspection of the circuit and the two schemes have proved very satisfactory.

Plug-Type Cables

L. E. Carpenter

Supervisor of Signals, Pennsylvania, Philadelphia, Pa.

Our standard arrangement of fouling jumpers employs bare cables stapled to ties. These cables are applied in duplicate, one being attached to the gage side of the one of two rails to be connected and to the opposite side of the other rail. The second bond is attached in the same manner but in reverse order. The bonds are located at and stapled with 1¾-in. by ⅜-in. copper-covered staples to the last long switch timber back of the frog. Each cable consists of seven No. 10 A.W.G. annealed copper-covered steel strand, 40 per cent conductivity. A rivet-type clip is applied to each end of each bond a short distance from the point of application of the bond to the web of the rail.

Fouling connections are carried in stock in three lengths, 15, 18 and 23 ft. long for frogs No. 8 and 10, 15, and 20, respectively. Each end of each cable is equipped with a plug for bonding to the web of the rail.

Wire Stapled to Ties

E. T. Ambach

Assistant Signal Engineer, Baltimore & Ohio, Cincinnati, Ohio

For fouling wires or jumpers, two No. 6 A.W.G. soft-drawn copper wires twisted in cable fashion and stapled to the ties about one inch from the top of the tie is preferable to any other method because this type of construction permits the trackmen to tamp the ties on each side, in addition to furnishing a low-resistance shunt.

Standard Wire and Trunking

W. J. Eck

Assistant to Vice-President, Southern, Washington, D.C.

For many years the Southern railway has used two No. 9 copper wires equipped with standard rubber insulation, tape and braid, and enclosed in standard trunking for fouling connections of all kinds. Our experience with this type of construction has been satisfactory, and we have had no occasion to change our standard.

Duplex Conductor Plug-Type Bonds Preferred

W. H. Stilwell

Signal Engineer, Louisville & Nashville, Louisville, Ky.

For track-circuit fouling jumpers, we use duplex conductor, plug-type rail bonds 14 ft. long, made up in accordance with A.A.R. Specification 15133, and drawing 1631-B. Each conductor consists of seven strands of No. 12 A.W.G. copper-covered steel wire. We staple these bonds to the side of the ties 1½ in. from the top, using copper-covered steel staples for this purpose. We prefer this type of fouling jumper, first, because it is durable and dependable; second, because its condition can be determined easily and quickly; and third, we find it more economical than other jumpers previously used for the same purpose.

Open Cable Easily Inspected

P. M. Gault

Signal Engineer, Missouri Pacific St. Louis, Mo.

We are now using a bare cable made up of seven copper-covered wires for fouling jumpers on the Missouri Pacific. Two 11-ft. cables, each equipped with ⅜-in. pins on both ends, are used at each switch. These cables are stapled to the side of the tie in the second tie space beyond the insulated joint in the turnout.

We have used wires in trunking and parkway cable in the past but have changed to open cable in order to get something which could be easily inspected.

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Power-Off Lights at C.T.C. Machines

"On a remote-control or C.T.C. installation, is it desirable to provide, on the control machine, some sort of an indication as to whether the a-c. power is on or off? How can such an indication be secured effectively and economically?"

Desirable But Not Always Justified

R. W. Meek

Signal Engineer, Texas & New Orleans Houston, Tex.

It is, of course, desirable to have an indication at the control point of a C.T.C. or remote-control installation to show whether the a-c. power is on or off. On installations where the same power source serves the control point and field stations, an indication can be provided by a pilot light across the transformer secondary, which would be extinguished when the power-off relay opened.

In an installation of considerable length, served from several a-c. sources to effect economies in cop-

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per, the cost of such indications would not be justified. Our experience has been that commercial power is quite reliable, interruptions in the service being few and lasting only a few hours at a time. Storage batteries have, or should have, sufficient capacity to bridge any ordinary a-c. power failure.

Code Channel Utilized

G. H. Dryden

Signal Engineer, Baltimore & Ohio
Baltimore, Md.

It is necessary that maintenance forces be promptly informed when power is off of any power line. The Baltimore & Ohio centralized-traffic-control installations have light indications on the dispatcher's machine for supplying this information. The lamps light when power is lost. These lights are controlled through code channels which would otherwise be inactive.

Where 24-hour interlockings or other open telegraph offices are in service, it is not essential that loss of power be indicated directly to the dispatcher. Such indications may be carried into the telegraph offices, from which points the maintenance forces will be notified, in case power is off the line.

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Grounding Cable Sheaths

"Do you, or do you not, connect the lead sheaths of cables together electrically, and to a tested ground, at the cable-ends? If so, what experience has convinced you of the necessity for so doing?"

Local Conditions Determine Advisability

S. W. Rogers

Supervisor of Interlocking and Telegraph
Cincinnati Union Terminal, Cincinnati, Ohio

In my opinion the most important consideration, relative to the question of grounding cable sheaths, is the electrolysis conditions surrounding the cable when it is installed. Under some circumstances, grounds may be an invaluable part of the cable installation; in other circumstances it may be the worst possible practice to ground the ends of each cable.

When we investigated such conditions at the Cincinnati Union Terminal, it was found that a survey had been made by the government in the area around Cincinnati. The results of this survey and of the inquiries made to the local power company led us to believe that we had no electrolysis conditions to guard against. With this question removed, there are many arguments to be used either for or against grounding.

It was our judgment that inasmuch as a lead cable is likely to be more or less grounded throughout its length, it would be better to have it definitely grounded than to have it half way between a grounded and clear condition. In this connection, it should be noted that as readings are taken between battery and ground or from common to ground, any fault in the cable can be more easily detected, and the nature of the fault determined if it is known from the beginning that the cable sheath is at ground potential.

Our high-tension cable sheaths are all grounded, of course, as a matter of safety.

Electrolytic Survey Desirable

Robert B. Elsworth

Assistant Signal Engineer, New York Central
Albany, N.Y.

The lead sheath of lead-covered cables and the zinc or steel taping, where used on the outside of aerial cables, should be electrically bonded and grounded in order that the metallic covering will not be injured at points where stray electrical currents pass to or from the sheathing. Since it cannot be definitely determined beforehand that the application of the best known methods of providing protection will always be satisfactory, it is desirable that an electrolytic survey be made, if practicable, and if such a survey shows that the applied methods do not provide complete protection, additional protective methods may be applied.

In general, satisfactory protection will be provided by connecting the metal coverings at each end of each section of cable to a good electrical ground. The metallic covering of other cables at the same location, and messenger cable, if used, should be substantially connected to the same ground. A made ground for cables should be installed and periodically tested with the same care and accuracy as is done for signal-circuit lightning-arrester grounds.

Such cross bonding and grounding should reduce to a minimum the tendency of stray currents to pass back and forth between different sheaths as a result of poor electrical contact, thereby injuring the metallic coverings.

Where metallic hangers are used to support an aerial cable having an outside metallic covering, the hangers themselves may be carriers of stray current between the messenger and cable sheath, causing electrolysis at the points of contact. Metal hangers may also distort the sheath at points of contact owing to the weight of the cable and to vibration.

Hanger trouble, both electrical and mechanical, may be generally avoided by using a rubberized-fabric cable hanger, or where extra strength is required, a steel collar with a wood spool around the cable for insulation may be used.

In electric-propulsion territory it may be desirable to ground the lead sheath and metal tape of aerial cable firmly to the messenger and to the ground connection at one location only for each section of cable, preferably near the middle of the section, thereby eliminating the tendency of propulsion return currents to use the cable covering. Rubberized-fabric cable hangers used on such an installation have given satisfactory protection.

It is desirable that electrolysis tests be made occasionally in order that any cause for trouble with cable coverings may be discovered and remedied, before material injury occurs.

Sheaths Should Be Bonded

E. T. Ambach

Assistant Signal Engineer, Baltimore & Ohio
Cincinnati, Ohio

On all lead-sheath cable installations, a survey should be made to detect the presence of foreign current carried over the sheath, and to determine the magnitude of such currents. When the reading taken indicates that the cable is positive with respect to ground, all cables in each man-hole should be bonded together and then electrically connected to a low-voltage ground or the negative bus bar of a distribution system. The lead sheath and steel casing of parkway cable should be bonded together and treated in the same manner. The most convincing argument is the record of losses of lead cable on account of electrolysis.

The proceedings of the Telephone and Telegraph Section of the A.A.R. contain a number of interesting cases and an explanation of their treatment for eradication. The cost is very small compared with the cost of the damage done over a very short period of time.