that power distribution lines can be rendered practically immune to lightning, except, of course, in the case of a direct hit.

However, lightning reaps an appalling toll on low-voltage d-c. line control circuits, and, in spite of using low-resistance ground connections and the best arresters available, signal failures caused by lightning occur entirely too frequently, during certain seasons of the year. The subject is too extensive to attempt to present even a summary of the many clever ideas in the design and application of arresters, ground connections, etc. However, a few of the essential factors deserve consideration. First of importance is that the connections to ground should be of low resistance, not exceeding the Signal Section maximum of 15 ohms, and a lower resistance is desirable.

Another important consideration in reducing lightning trouble is to reduce the number of places where wires connected to line circuits extend underground or near metal conduits or cases that are grounded. The Missouri Pacific has a standard practice on automatic signaling to the effect that no wire connected to a line wire, nor any wire normally feeding from a battery that feeds a line circuit, shall go underground, or even in trunking on top of the ground. This practice prevents any lightning or static discharge from a line wire from going to ground through the wire insulation. A further proposed improvement of this practice is to effectively insulate the line cable from the cases and cable entrances, by placing a heavy rubber hose around the cable from the place where it enters the goose-neck or pinnacle to the point where the wires are spread out to the terminals on the boards.

By using these practices, along with several other ideas which are generally known, the Missouri Pacific, with 2,348 track miles of automatic signals, has very few failures due to lightning (22 in 1936), as compared with the number of similar failures on some other roads. Therefore, it is evident that, although lightning cannot be eliminated, the damage to signaling apparatus can be reduced by giving the subject serious thought and applying the best available protection devices and practices.

OPEN FORUM

This column is published to encourage interchange of ideas on railway signaling subjects. Letters published will be signed with the author's name, unless the author objects. However, in order to encourage open discussion of controversial matters, letters may be signed with pen names at the request of the author. In such instances, the correspondent must supply the editor with his name and address as evidence of good faith. This information will not be disclosed, even on inquiry, unless the correspondent consents.

Types of Crossing Signals Installed

St. Louis, Mo.

To the Editor:

At the annual meeting of the Signal Section last March, C. A. Dunham, superintendent of signals of the Great Northern, made the following statement:

"Approximately 40 per cent of the crossing signals installed throughout the country in 1936 were of the rotating disk type."

In the May, 1937, issue of *Railway Signaling* a similar statement is made by Charles Adler, Jr.

Please be referred to the January, 1937, issue of *Railway Signaling* where the following statement is found:

"The year 1936 saw an increase in the divergency of opinion in the various states as to the type of protection required. Flashing-light signals, the standard recommended by the Signal Section, A.A.R., were installed most extensively, totaling 1,560 signals. The use of the "Stop" or "Stop on Red Signal" sign, as a part of the flashing-light signal, as recommended by the Signal Section, has now been adopted almost universally, only 66 of the 1,560 flashing-light signals installed last year not being equipped with such signs. The wigwag signal, also one of the standards of the A.A.R., made a strong come-back, totaling 281 signals. The rotating-disk stop signal, which is not an A.A.R. standard but which is supplemented by standard flashing lights, is used extensively in Wisconsin, Minnesota and several of the other states, where a total of 315 of these signals were installed. During the year 1936, a total of 32 stop-and-go traffic type signals were installed for the protection of railroad crossings. At some locations where the use of signals alone is not considered adequate, obstructions in the form of automatically-controlled gates or barriers were installed, a total of 33 gates and 6 barriers being placed in service during the year."

From this information I have listed the number of signals of each type and the percentage of the total as follows:

Type of Highway-Grade Crossing Signals Installed in 1936

(*Railway Signaling,* January, 1937)

Type of Signal	Number	Per cent of total
Flashing-light signals	1,560	70.1
Wigwag signals	281	12.6
Rotating-disk stop signals	315	14.1
Stop-and-Go traffic signals	32	1.4
Gates	33	1.5
Barriers	6	0.3
Total	2,227	100.0

It will be noted that the rotating-disk stop signals account for about 14 per cent of the total, whereas flashing-light signals account for 70 per cent of the total.

I have delayed writing this letter in an effort to check the statement referred to, but have been unable to find any figures which would support the 40 per cent figure. Inasmuch as the *Railway Signaling* statement was made up from data collected from all of the railroads, I believe it should be accepted as substantially correct.

P. M. GAULT,
Signal Engineer, Missouri Pacific.