Railway Signaling

Annual Review and Outlook

When the year 1946 opened there seemed to be every indication that, with the war finished, our industries could change over rapidly to the manufacture of badly needed peace-time products, and accordingly the railroads could secure materials, equipment and supplies to repair or replace facilities worn out during the war years, and to provide new facilities as a means of improving service as well as meet the demands for increased passenger and freight traffic brought about by the growth of industry and increase in population during the last decade.

Hind sight, however, shows that during 1946, industry as a whole was not able to readjust itself quickly, and, as a result, the railroads were not able to plan, construct and place in service any great amount of new equipment or facilities except those which were planned during the war and, for which materials were channeled as part of the war program or by government agencies, in the post-war period.

One advantage of this situation was that the railroads have had this period to reorganize their thinking—to shake off the wartime, grab-anything-get-it-done-now practices, and to restore peacetime thinking, based on improved service to the passengers and shippers, which is accomplished to a great extent by the installation of modern signaling and communication facilities which permit improved locomotives, cars, and tracks to be utilized efficiently, without needless delays. Trains are thus kept in motion a greater percentage of the time, and more nearly at the maximum permissible speeds for which the locomotives and tracks are designed. These are, therefore, the new 1947 objectives for railroad men, and especially to those dealing with signaling and communication facilities, because in these fields the year 1946 brought forth many war-developed devices and systems, which require keen thinking to adopt that which will best increase railroad efficiency.

Getting Down to Cases

Years ago it was up to the heads of the signal departments or the telegraphs departments to go to the operating officers to sell them the idea of installing new facilities such as automatic block signaling or telephone train dispatching. A contrast nowadays is that, in many instances, the division operating officers are the ones who initiate demands for new signaling and communication facilities. For example, an assistant division superintendent stated that a recent 100-mile installation of signaling for train operation by signal indication was his idea from the date of inception to completion, and furthermore he has requested the same system for another engine district. On another road the general manager called in the superintendent of communications, and wanted to know how soon several projects could be installed, such as carrier for two long-distance telephone circuits; train communication on the through freight trains on a certain route; and radio on wrecker derricks, pile drivers, snow plows, and other special types of service trains.

1946 In Signaling

The big news in the signaling field for 1946 was the order of the Interstate Commerce Commission on May 20, requiring the railroads to show cause why the commission should not issue an order requiring the railroads "to install block signal system, interlocking, automatic train stop, train control and/or cab signal devices, and/or other similar appliances, methods and systems intended to promote the safety of railroad operation, upon the whole or any part of lines on which any train is operated at a speed of 50 or more m.p.h." The form of the questionnaire issued by the Commission, and statements made by the presiding commissioner at the hearing, made it clear that the inquiry was directed to mileage where maximum authorized speeds are 50 m.p.h. or more for freight trains, and 60 m.p.h. or more for passenger trains.

Two hearings were held, one in Chicago in June and the second in Cincinnati in October, an abstract of the proceedings of the latter hearing being published in the November issue of *Railway Signaling.* At this hearing and in their brief filed December 2, the railroads said that: "The Commission has always proceeded through individual investigation and individual show cause orders. We think that approach the sound one and that it would be facilitated by the record in this proceeding. We therefore urge that the Commission adhere to its established practice. In short, our position is that no general order is warranted."

On the other hand, the brief filed by the Railway Labor Executives Association included the statements: "It is, accordingly, the view of the railway labor organizations participating in this proceeding that a general order should be issued by the Commission in performance of the duty imposed upon it by Section 25 of the Interstate Commerce Act requiring the respondent carriers to equip that portion of their trackage now operated under timetable and train-order systems only, on which freight trains are authorized to operate at 50 or more miles per hour, and passenger trains to operate at 60 or more miles per hour, with the block signal system.

"Further, it is the view of these organizations that additional protection, in the form of automatic train stop, train control or cab signal devices, should be required on all locomotives being operated by the respondent carriers at the higher speeds; the evidence would support a proposal that such additional protection be required at speeds of 70 or more miles per hour in all classes of service."

Mileage Involved

Up to the close of 1946 no order on this docket had been issued by the Commission. Irregardless of whether a blanket order, individual orders, or no orders at all are issued, a large mileage of new signaling will be installed within the next few years, simply because of the need for protection and the necessity to reduce train delays; an added incentive being that in the majority of instances, the new signaling will pay for itself in a few years by reducing operating expenses.

An approximate measure of the mileage that more than likely will be signaled in the next five to seven years is indicated by data concerning train speeds on different territories as presented by the railroads at the hearing on October 2. On the roads of the United States, and applying to territories where train movements are authorized by timetable and train-orders without automatic block signal protection, there are 9,579 miles of track on which freight trains are operated at 50 m.p.h. or more, and 20,171 miles on which passenger trains are operated at 60 m.p.h. or more. For the most part the mileage quoted for freight trains is duplicated in that for passenger trains and, therefore, only the 20,171 miles need be considered.

Applying to territory where manual block is now in service, passenger trains are operated at speeds of 60 m.p.h. or more on 8,401 miles. Presumably this manual block would meet the commission's requirement for a "block signal system," but if strict compliance with absolute manual block rules is required, the trains would encounter too many delays, and operating expenses might be increased by requiring more open offices. Thus, for this discussion, a large percentage of the 8,401 miles of manual block may as well be added to the 20,171 miles of timetable and train-order territories, making a total of 28,572 miles.

In consideration of the speeds mentioned above, and in view of the fact that most all of the "medium" to "heavy" traffic lines have previously been signaled, it should be emphasized that most of the 28,572 miles which presumably are to be signaled, are on extended sections of single-track routes which handle important fast through trains, but in a volume which can be classed as ranging from "medium" to "moderate," as, for example, 15 to 8 trains daily. As applying to such circumstances, almost everyone concerned agrees that signaling, including track circuits throughout, should be installed to afford protection against collisions, to detect broken rails, and to check the position of switches, as well as to detect cars fouling the main track at turnouts. Also, a fact, which has been proven in numerous instances, is that while installing a system including track circuits throughout, it is most logical to provide for train operation by signal indication under control from a central office, thus dispensing with the delays to trains which are inevitable under the antiquated timetable and train-order practice.

How This Has Been Done

On single-track lines handling any considerable volume of important highspeed through traffic, experience of numerous roads has proven that the installation of complete centralized traffic control, including power switch machines, is the best policy in the long run. Several projects, each including a complete engine district of approximately 100 miles, are now in service on such roads as the Denver & Rio Grande Western, the Union Pacific, the Southern Pacific, the Burlington, the Rock Island, the Seaboard, the Milwaukee and the Louisville & Nashville.

However, with respect to a considerable proportion of the 28,572 miles under discussion, a problem arises when determining the system of signaling to be installed on a line which handles only a moderate volume of traffic, say, for example, two through passenger and a local passenger train each way daily, and about three through freights and a local each way daily, totaling 12 to 14 trains. An excellent solution of such a problem was effected on the 107 miles of the Louisville & Nashville between Sinks, Ky., and Lebanon Junction, as explained in an article in *Railway Signaling* for August. In brief, the installation of complete C.T.C. in this instance, including power switches, instead of conventional automatic block, was made because the costs were reduced by eliminating about half the sidings not needed with C.T.C., and by reducing the number of intermediate signals to those actually required by the traffic to be handled.

In case other railroads are not sure ahead of time that C.T.C. will permit the removal of half the old sidings, they can do as the Rock Island did on a project between Herington, Kan., and El Reno, Okla., i.e., install power switches and C.T.C. signals at every other siding, about 10 to 11 miles apart, and leave the intervening sidings in place with the old hand-throw stands in service. If future peaks of traffic, such as during wheat movements, can be handled with C.T.C. power sidings 10 miles apart, then the other old sidings can be retired.

Under circumstances where the continued use of hand-throw switches at all sidings is practicable, some roads have installed systems for train operation by signal indication under the control of dispatchers. For example, the Wabash developed and installed "manual block-remote control," as explained in the *Railway Signaling* for July, 1945. An installation which is somewhat similar but termed "controlled block signal system" is now under way on 92 miles of single track on the Western Pacific between Stockton, Cal., and Oakland.

Using a different arrangement of signals at sidings, the Milwaukee developed and installed "controlled automatic block." On an engine district of about 100 miles between Aberdeen, S. D., and Mobridge, on which there was previously no signaling, the problem was to install a signal system best adapted to a traffic of about two through passenger trains and a local passenger train each way daily, and three or four through freights each way. This controlled automatic block system includes no intermediates except those required as distant signals in approach to station-entering signals. At each passing track switch there is a conventional arrangement of signals, controlled by the dispatcher, to direct trains to (1) continue on the main track; (2) stop, operate the hand-throw switch, and enter the siding; or (3) if on the siding, operate the hand-throw switch, pull out on the main track, close the switch, and depart for the next town. Also, on house tracks, signals are provided to direct trains to enter the main track.

Thus, all train movements are directed and authorized by signal indication, without the use of train orders. The tack circuits are the coded type, thus eliminating line control wires, and the track circuits between towns are the new normally de-energized type, using primary battery, thereby obviating the installation of line wires for a.c. distribution. The dispatcher's C.T.C. code control circuit was superimposed on the existing line wires used also for the telephone train dispatching. Thus by perseverance and skillful adaptation of modern equipment and construction practices, the Milwaukee held down the costs of this system for directing train movements by signals without the use of train orders. The increase in cost over and above a conventional automatic block can readily be justified by train time saved, and by reductions in operating expenses because of fewer open offices. These statements, for the most part, can be applied to the installations on the Wabash and the Western Pacific, as well as, in certain respects, on some portions of three projects totaling 600 miles now being planned on the Seaboard. On these latter projects one machine at Savannah, Ga., will control 245 miles between that point and Hamlet, N. C. A machine at Tampa, Fla., will control 66.5 miles between Valrico, Fla., and Coleman, and a third machine at Jacksonville, Fla., will control 274 miles between Coleman and Miami. No track-circuit-controlled signaling is in service on most of this 600 miles.

Thus these railroads have demonstrated that signaling, including means for authorizing train movements by signal indications, can be planned to meet the requirement of almost any volume of traffic and any operating conditions. Therefore, as applying to lines not now signaled and on which the proposed I.C.C. order may be effective, a logical decision would be to install a system including means for authorizing train movements by signal indication, rather than conventional automatic block, which would afford protection, but which would continue most of the delays now involved in the antiquated timetable and train-order system.

A Different Problem To Be Met On Mileage Now Signaled

The foregoing discussion has applied primarily to territories not now equipped with track-circuit-controlled signaling, whereas attention is now directed to the 101,519 miles of track on which such signaling is in service. Much of this latter signaling has been in use for many years, and, therefore, is worn or antiquated to the extent that it cannot be maintained and operated economically. For example, several railroads, such as the Norfolk & Western, Boston & Maine, New York Central, the Reading and Atlantic Coast Line, have extensive reconstruction programs under way involving the replacement of semaphore signals with modern light signals. In some instances, as for example on 125 miles of double track between Richmond, Va., and Rocky Mount, N. C., on the Atlantic Coast Line, the projects involve the installation of modern coded track circuits and completely new control systems so that, except for reusing the existing rail bondings, the installations are practically new.

Some of these projects on single track include also the installation of centralized traffic control as, for example, on 81 miles of single track on the Nickel Plate between Arcadia, Ohio, and New Haven, Ind. As applying to double track, some railroads are adding C.T.C. to operate trains by signal indication in both directions on both tracks. By means of crossover layouts at intervals of 10 to 15 miles, fast trains can be diverted from one track to the other to run around slower trains. Thus, both tracks can be used in the direction of heavy traffic in peak periods as, for example, "inbound" in the morning and "outbound" in the evening. Such a system is now under construction on 75.6 miles of the Chicago & North Western between West Chicago, Ill., and Nelson.

Replace Old Interlockings

At the beginning of 1946 the railroads in the United States had 4,929 interlockings, of which 1,499 were electric, 419 electro-mechanical, 396 electro-pneumatic, 1,625 mechanical, 406 automatic and 522 remote control. No attendants are required for the operation of the automatic and remote-control plants, but levermen must be on duty constantly at practically all of the 3,939 remaining plants. Therefore, where old interlockings are in need of replacement, new signals and power switch machines can be installed and controlled remotely. For example, at a location near Chicago, three roads all cross each other at three crossings less than a mile apart. Old mechanical plants in service at each of these crossings are to be replaced by new signals and switch machines, all of which will be controlled by one new panel-type interlocking machine. An important advantage is that train movements will be co-ordinated under the control of one man.

Many outlying mechanical interlockings can logically be replaced by power signals and switches controlled either automatically or remotely, and the remote control may be from the nearest open office or included in a centralized traffic control project. In general, therefore, the number of interlockings as separate towers or offices will gradually be reduced. New equipment and construction work will be required in each instance, but the savings within a very few years will be more than the expenditures.

More Crossing Protection

In 1938 to 1940, inclusive, crossing protection was installed at an average of 1,000 highway-railroad grade crossings annually, but during the war years this type of construction was limited to those few crossings serving military camps or war industries. Furthermore, not enough progress was made in 1946, protection being installed at only 798 crossings; therefore, a backlog of several thousand crossings has accumulated. These projects include not only new installations at crossings not previously protected, but also complete replacements of old installations. Within recent years there has been increased preference for automatically-controlled short-arm gates at all crossings of two or more main tracks, as well as single tracks on which trains are operated at high speeds as, for example, 75 m.p.h. or more. The volume of highway traffic is, of course, a basic factor.

For many years the railroads carried the entire expense of installing and maintaining crossing protection, but within more recent years some states and the Federal government have shared the construction costs of new projects. These programs were halted by the war, but should be renewed as soon as practicable because it is an accepted fact that for the money spent, more lives are saved by installing protection than by expensive grade separation projects.

1946 In Communications

During 1946 progress was made in the development and installation of train communication, which is the newest facility in railroad communications, and rapid strides were also made in the extension of carrier on existing line wires for new telephone service, as well as printing telegraph, thereby expediting message traffic. Much new work and replacements were delayed because of shortages of certain materials and skilled men, but this situation is improving. Beamed relay radio is being developed for use in lieu of wires on pole lines, but this system is not as yet considered practicable for extensive use on railroads. The Western Union Telegraph Company proposes to change over to beamed radio for transmission of commercial message traffic between principal cities, and thereby relinquish ownership or joint ownership of pole lines on railroads.

Review of Train Communication

Being a new baby, train communication received much attention on the railroads during the past year. Many tests and developments were made but the total number of projects completed and placed in service was disappointing in consideration of the prospects at the beginning of the year. The technical developments in train and yard communication made during 1946 were discussed in detail in four papers presented at the recent convention of the Communications section, Association of American Railroads, in Detroit, Mich., November 19-21. These papers were published in complete form in the December issue of *Railway Signaling,* and, therefore, only a few of the more important aspects will be dealt with here. Space radio equipment had been highly developed for war-time uses, and, therefore, when applying such systems to railroads, the major problems were to develop housings and mountings which would protect the apparatus from dust, moisture and shock, as encountered in railroad service. Another problem was to develop an antenna short enough to meet clearance requirements when mounted on locomotives and railroad cars.

Inductive train communication, on the other hand, is purely a railroad development, which as explained has been underway for about 20 years by the Union Switch & Signal Co., with the cooperation of several railroads primarily the Bessemer & Lake Erie and the Pennsylvania. Also within the last four years the Aireon Manufacturing Corporation has cooperated with the Kansas City Southern, the New York Central and other railroads in developing a train communication system based on the inductive principle. In brief, therefore, the equipment, both inductive and space radio, is available to provide high-grade communication in road and yard service.

What F. C. C. Says

At the hearings before the Federal Communications Commission in September, 1945, the railroads made a strong plea for the need of radio for train communication on their lines, and the commission assigned 60 clear channels, as well as shared channels in the television ranges. At the recent convention of the Communications section, A.A.R., J. H. Wofford, engineering division, Federal Communications Commission, chided the railroads for failure to use the channels available, when he said: "The sharing problem is not particularly acute. The possibilities of the 60 channels now available for the service have not been exhausted. Only 18 of the nation's railroads have licensed equipment and, as of October, the licensed equipment included only 39 land stations and 531 mobile units, scattered across the country. I should like to stress that the commission has indicated its approval of radio for railroad use by making liberal provision for it and by establishing a separate set of rules for the industry."

Mr. Wofford's criticism of the limited activity of the railroads in applying radio would ordinarily be quite proper, but, as a matter of fact, the general conditions in this country were in such a turmoil throughout 1946 that there was not much opportunity for railroad managements or any one else to make decisions on long-term large-scale projects, and even if they had done so, the manufacturers would have had difficulty in supplying all the equipment and materials necessary. For example, back in 1945 the Denver & Rio Grande Western authorized the installation of train communication in 15 loco-

PERMANENT INSTALLATIONS OF TRAIN COMMUNICATION PLACED IN SERVICE 1946

Railroad	From	To	Miles of of Road	No. of Locomotives	No. of Cabooses or Other Cars	No. of Wayside Stations	Space or Inductive Equipment	Frequency	Manufacturer	Power Supply on Caboose
C. B. & Q.	Hastings, Neb.	Denver, Colo.	386	22	8	0	Space	159.690 mc.	Bendix	Axle Gen.
C. M. St. P. & P.	Milwaukee, Wis.	Kansas City, Mo.	508	2	2	0	Space	158.73 mc.	Bendix	Axle Gen.
C. R. I. & P.	Chicago	Council Bluffs, Iowa	......	1	1	4	Space	....	Sperry	Diesel Gen.
	Rock Island, Ill.	Ft. Worth, Tex.	......	2	1	0	Space	....	Galvin	Axle Gen.
	Rock Island, Ill.	Minneapolis, Minn.	......	2	1	2	Space	....	Galvin	Axle Gen.
D. & R. G. W.	Denver, Colo.	Salt Lake City, Utah	830	4*	4*	10	Both	159.81 mc.	Aireon	Eng.-driv. Gen.
N. Y. C.	Indianapolis, Ind.	Springfield, Ohio	139	10	10	21	Inductive	175 kc.	Aireon	Axle-driv. Gen.
Penna.	Harrisburg, Pa.	Pittsburgh	245	300	100	16	Inductive	88 kc. 144 kc.	Union	....
P. M.	Detroit, Mich.	Grand Rapids	152	2	2	0	Space	161.49 mc.	Farnsworth	....

Legend:
* = Equipment now being installed on 11 more.

motives, 15 cabooses and 10 wayside stations for operation on 830 miles between Denver, Colo., and Salt Lake City, Utah. The train communication equipment was delivered on schedule, and was installed in the wayside stations, 4 locomotives and 4 cabooses early in 1946. Installation on the remainder of the locomotives and cabooses, however, has been delayed because of the inability to secure conduit and fittings. This project, including Aireon communication equipment, uses space radio between the two ends of a train and between trains, and inductive equipment between trains and wayside stations.

The New York Central was able to secure all the material for an installation of Aireon inductive train communication in 10 locomotives, 10 cabooses and 21 wayside stations on a single-track line between Indianapolis and Springfield, Ohio, this project being finally completed a few months ago.

The Pennsylvania, on August 7, 1944, announced a project to install inductive train communication using equipment made by the Union Switch & Signal Co., on 245 miles of four-track road between Harrisburg, Pa., and Pittsburgh, this being in addition to a development project which had been underway for some time on a branch line between Trenton, N. J., and Phillipsburg. Numerous delays were encountered on the Harrisburg-Pittsburgh project, so that it was not until October 30, 1946, that the Pennsylvania issued an official news release stating that the installation was nearing completion, and that, including the project on the branch, the Pennsylvania had train communication in service on 150 passenger locomotives, 131 freight locomotives, 100 cabin cars, and 16 wayside control towers. The installations are on 319 miles of road, including 1,056 miles of track. New locomotives on order for service on main tracks are to be equipped for train communication. In November the Pennsylvania released information concerning the development of an auxiliary device, known as the carryphone, similar to walkie-talkie, to be used by trainmen as a part of the train phone system, when on foot inspecting a train or when flagging, to communicate with men in the locomotive, the caboose or the nearest wayside office equipped.

The Kansas City Southern was a pioneer in the field of train communication, having completed an installation in 1945 of the Aireon inductive system on 650 miles between Kansas City, Mo., and Shreveport, La., with equipment in 1 passenger locomotive, 4 freight locomotives, 4 cabooses, 1 business car, 20 wayside stations and 2 yard offices. During 1946, train communication equipment was installed in both ends of one new Diesel-electric locomotive, and equipment is being installed in seven locomotives now on order for delivery in 1947.

Installations of Space Radio

With reference to space radio on road trains, the Chicago, Burlington & Quincy completed the most extensive installation in 1946, using Bendix equipment for a project including 22 locomotives and 8 cabooses for operation on 386 miles between Hastings, Neb., and Denver, Colo. This equipment is for communication between the two ends of a train and between trains, with no wayside offices equipped. Based on the same sort of operation, the Chicago, Milwaukee, St. Paul & Pacific has installed Bendix space radio equipment in two locomotives and two cabooses being operated on through freight trains on 508 miles between Milwaukee, Wis., and Kansas City, Mo.

The Pere Marquette installed Farnsworth radio equipment on two new streamlined Diesel-electric passenger trains, the "Pere Marquettes" being operated on 152 miles between Detroit, Mich., and Grand Rapids. The communication equipment is located in the locomotives for use by the enginemen, and in the dining cars for use by the conductor or trainmen. A wayside station, in a yard office near Grand Rapids, permits communication between this office and the trains when within a range of several miles.

Yard and Terminal Communication

In the field of yard and terminal communication, the railroads made 14 installations which, on the whole, was fairly good progress considering the shortages of ma-

Tables listing the permanent installations of yard and train communication placed in service during 1946, the information concerning the project on the Pennsylvania having been given in a news announcement release by that railroad on October 30.

PERMANENT INSTALLATIONS OF YARD COMMUNICATION PLACED IN SERVICE DURING 1946

Railroad	City	No. of Locomotives Equipped	No. of Fixed Stations	Space Radio or Inductive	Manufacturer of Equipment	Frequency
A. T. & S. F.	Chicago, Corwith Yard	10	1	Space	Bendix	160.65 mc.
	San Francisco	2 4*	1	Space	Bendix	161.37 mc.
B. & O.	Baltimore, Md.	2*	1	Space	Bendix	160.410
C. & O.	Newport News, Va.	2	1	Inductive	U. S. & S. Co.	151 kc.
C. B. & Q.	Chicago	22	1	Space	Bendix	159.690 mc.
	Galesburg, Ill.	8	2	Inductive	U. S. & S. Co.	5.7 kc. 7.7 kc.
	Lincoln, Neb.	4	1	Inductive	U. S. & S. Co.	5.7 kc.
C. R. I. & P.	Armourdale, Kan.	8	1	Space	Sperry	....
D. & R.G.W.	Denver, Colo.	1	1	Space	Bendix	160.83 mc.
	Alamosa, Colo.	1	1	Space	Bendix	160.83 mc.
F. E. C.	Miami, Fla.	12	1	Space	Communications Co., Inc.	160.11 mc.
G. M. & O.	Meridian, Miss.	2	1	Space	Bendix	159.03 mc.
P. M.	Grand Rapids, Mich.	1	1	Space	Farnsworth	161.49 mc.
S. A. L.	Hamlet, N. C.	10	2	Space	Com. Co., Inc.	159.33 mc. 160.17 mc.
S. P.	San Francisco, Cal., Bayshore Yd.	9		Space	A. T. & T.	Operated through telephone company facilities
U. P.	Kansas City, Mo.	16	1	Space	Motorola	161.85 mc.

Legend:
* = on tug boats.

terials. Inductive equipment made by the Union Switch & Signal Co. was installed at three yards, one on the Chesapeake & Ohio and two on the Burlington; space radio was installed in the Chicago terminal area on the Burlington, as well as in 10 yards on other roads, as listed in the accompanying table.

The Burlington project in Chicago is of special interest because it demonstrates the benefits of train communication between the yardmaster's offices and the 22 locomotives used to serve industries throughout an extensive terminal area. Space radio equipment made by Bendix is used in this project. The fixed radio station, on top of the Burlington's general office building, is connected by telephone lines to the offices of three yardmasters.

A large project of strictly yard communication completed in 1946 is on the Union Pacific at Kansas City, Mo., where Galvin-Motorola space radio apparatus was installed in 16 locomotives and one office. In the Southern Pacific's Bayshore yard, San Francisco, Cal., nine yard locomotives were equipped with mobile space radio apparatus furnished by and operated through the facilities of the Bell Telephone Company. In its terminal area at Hamlet, N. C., the Seaboard Air Line installed space radio communication equipment on 10 yard locomotives and two offices, and at Miami, Fla., the Florida East Coast installed space radio in 12 locomotives and 1 office, the apparatus on both these projects being furnished by the Communications Company Inc., Miami, Fla.

The Atchison, Topeka & Santa Fe installed Bendix space radio in two yards, one in San Francisco, involving one fixed station, two locomotives and four tugboats, and the other in Corwith yard, near Chicago, where one fixed station and 10 locomotives are equipped. In addition to radio yard communication already in service at New Castle, Pa., the Baltimore & Ohio installed Bendix equipment in one fixed station and two tugboats at Baltimore, Md.

More Manufacturers

During 1946 several manufacturers manifested either new or renewed interest in the railroad train communication field. The Farnsworth Television & Radio Corporation developed space radio apparatus especially for railroad service; ran extensive tests on the Detroit, Toledo & Ironton, the Nickel Plate and in various yards, as well as furnished equipment for a permanent installation on new passenger trains on the Pere Marquette, as discussed elsewhere in this article.

As a part of the exhibits by manufacturers at the convention of the Communications section in November, the General Railway Signal Company exhibited to the public for the first time apparatus of both the inductive and space radio types which this company developed in cooperation with the General Electric Company. The space radio was further developed with the aid of the New York Central in several yards, as well as on tug boats in New York harbor. Other developments have been made by the G.R.S. and G.E. companies in cooperation with the Missouri Pacific, which has a project under way on 193 miles of single track between McGehee, Ark., and Alexandria, La., including 15 locomotives, 15 cabooses and 7 wayside stations. Inductive apparatus is for operation between cabooses and wayside stations, and space radio between cabooses and locomotives.

The Western Electric in cooperation with the Northern Pacific developed a system of space radio train communication and ran extensive tests during 1946 on the Northern Pacific, between Seattle, Wash., and Yakima, as well as between Seattle and Portland, Ore., as was explained in *Railway Signaling* for August. Another newcomer in train communication during 1946 was the Westinghouse Electric Corporation, which exhibited space radio apparatus for railroad service at the November convention of the Communication section. This apparatus has been and is being tested on the railroads.

Telegraph and Telephone Extended

Throughout 1946 railroad communication men devoted so much talk to train communication that very little was said about the day-to-day progress in conventional facilities such as telegraph and telephone service over ordinary line wire circuits. Here, too, however, there was considerable progress.

Reviewing briefly, an important event in October, 1945, was an announcement that the Western Union Telegraph Company planned to install high-frequency relay radio systems to transmit commercial messages between principal cities and, therefore, would relinquish ownership or joint ownership of pole lines on railroads. This proposal calls for the termination of all contracts on roads east of the Mississippi within five years and the remainder within two more years. Some well-informed men in the Western Union organization now admit that this announcement was a bit premature, but nevertheless the momentous job is under way. The technical details of the development and progress to date in micro-wave beamed radio relay systems were explained in papers presented at the recent convention of the Communications section, A.A.R. In brief, these papers reported that the radio operated as intended on the test project between New York and Philadelphia, and that projects are now under way between New York and Boston, and between New York and Pittsburgh, with tentative plans for extension of the system throughout the United States. The Canadian National and the Canadian Pacific are co-operating in tests of relay radio in Canada.

These relay beam radio systems have been under development by the Western Union in co-operation with the Radio Corporation of America as well as by the Bell Telephone Laboratories, Inc.

A micro-wave relay radio system is very expensive to install but is capable of handling a large volume of message traffic. Perhaps several railroads could cooperate in the construction and operation of such a system for long-haul telephone and telegraph message traffic, such as between New York and Chicago. Or perhaps the railroads could lease channels in such a system from the Western Union.

Regardless of policies concerning the use of beamed-radio relay systems, the railroads in 1946 went ahead in developing and improving their land lines and conventional telegraph and telephone facilities, as discussed in detail in an article elsewhere in this issue.