Organization of Railroad Signal Departments*

Study shows decided variations in methods of supervising installation, maintenance and operation of signaling facilities.

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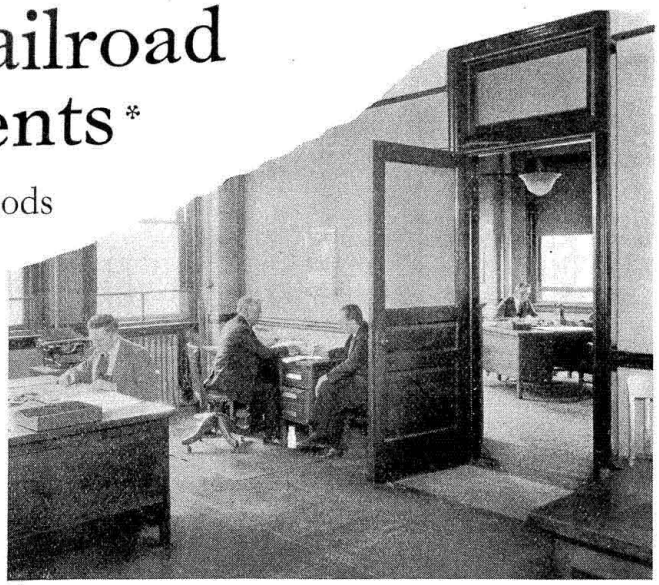

THE question of the organization of the signaling branch of railway work is one which has received very little, if any, literary attention. I am going to submit a brief outline only of what is being done in other countries. It must, of course, be understood that in each country conditions vary and usually organizations are planned to meet these conditions.

Railway signaling had its birth, I believe, in the civil engineering departments; anyway, as a general rule, such was the case, and, for that reason, signaling has been looked upon as part and parcel of the permanent way work; with few exceptions, it has continued with the civil engineer.

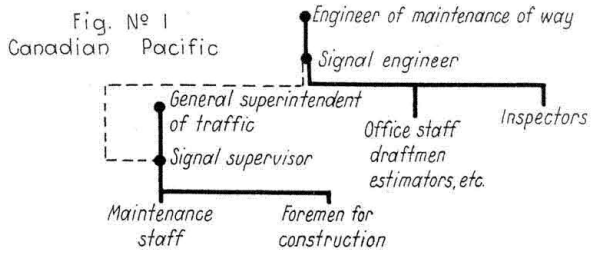

Fig. 1—Canadian Pacific signal organization

In the beginning the apparatus used and the means of operation were very crude, and were principally of a mechanical nature. When electricity began to play its part, the telegraph engineer was made responsible in most instances for such devices. The result has been that two sections of one branch of engineering have grown up side by side having their own distinct chiefs, but they in turn report to separate heads of departments.

Such an organization did not cause much inconvenience until the introduction of what may be termed "modern signaling." I mean by that, power, track circuiting and automatic. With the employment of these new devices it would appear rather difficult specifically to define the responsibilities between the signal engineer and the telegraph superintendent. In new countries and on new railways, the tendency has been to a great extent to keep everything that appertains to signaling under the signal engineer, or to combine the duties of the signal engineer and telegraph superintendent. Where a fresh start is to be made, there is no great difficulty in planning out a suitable organization, particularly as there would be no sentimental reasons or prejudices to contend with.

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It might be as well at this stage to compare the organizations of two great railway systems in Canada, the Canadian Pacific and the Canadian National. Fig. 1 shows the organization tree of the former and Fig. 2 that of the latter.

Canadian Railways

The Canadian Pacific system is divided into two districts: East and West, with a signal engineer for each district; they report to the engineer of maintenance of way; one being located for Eastern lines at Montreal and one for Western lines at Winnipeg. The signal engineers act as advisory officers; they also prepare plans and estimates for new work, control the issues of stores for maintenance purposes and carry out inspections of new installations. The actual maintenance work is the responsibility of signal supervisors who report to the general superintendents; the former confer with the district signal engineer on technical matters only. The supervisors of signals also carry out a certain amount of new construction work. The signaling staff has no jurisdiction over telegraph and telephone work or station and yard lighting.

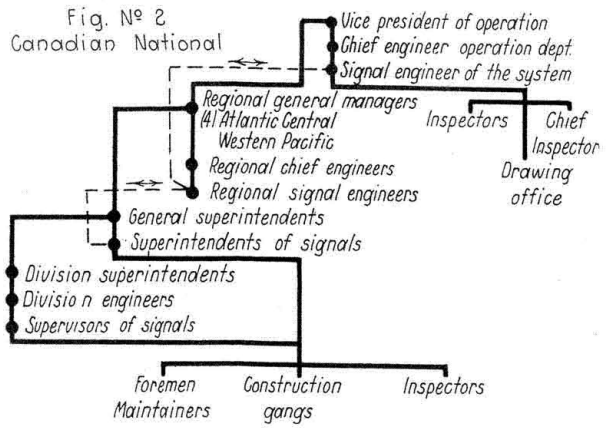

Fig. 2—Canadian National signal organization

On the Canadian National the signal engineer of the system reports to the chief engineer, operation department, who, in turn, reports to the vice-president of operation. The signal engineer is responsible for the general signaling policy over the whole system

and prepares new schemes, plans and estimates, but the execution of such work does not come directly under his supervision. He has an assistant signal engineer.

Each regional general manager, of whom there are four, has a signal engineer attached to his head office, the latter reports to the regional chief engineer. He is responsible indirectly for all maintenance of signaling in the region; he also has under his supervision the maintenance of electric station lighting and highway crossing protection; he is provided with an assistant engineer, general office staff, draftsmen and

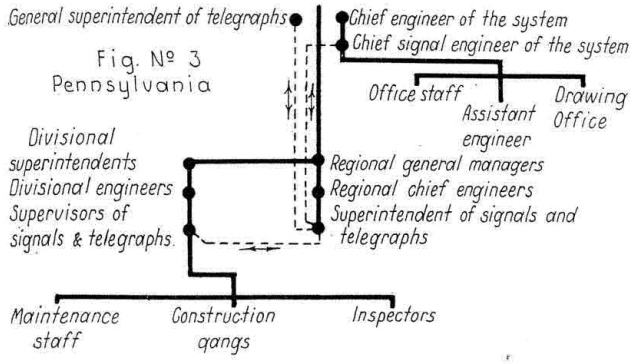

Fig. 3—Pennsylvania signal organization

inspectors. Each general superintendent has a superintendent of signals, who personally reports to him; the latter is responsible for the carrying out of new construction work as well as keeping a general supervision over maintenance.

The division superintendents have assigned to them supervisors of signals who report to the division engineers. They are directly responsible for the maintenance of mechanical and electrical signaling, highway crossing protection and station lighting. Under them are foremen of maintainers, repair men, maintainers and floating gangs for new construction and heavy maintenance work.

Organizations on Railways of the United States Differ Considerably

I will now refer to a few organizations of the railways of the United States. Figure 3 indicates the chain of connections of the Pennsylvania; the scheme is a decentralized one, the whole system being organized on a so-called divisional basis. The chief signal engineer reports to the chief engineer of the system and, as on the Canadian National, he is responsible for the general policy, and standards of signaling.

There is a general superintendent of telegraph for the system, but the regional signal officers, who are designated superintendents of signals and telegraph, have charge of telegraph and telephone work. The divisional signal officers likewise have charge of telegraph and telephone work, their rank being supervisors of signals and telegraph. In this system the signal officers have no responsibility for station lighting or electric power, except as required for signal purposes.

The New York Central Lines system is shown by Fig. 4 and here is an instance of where the signal engineers report direct to the general manager. There are two engineers, one in charge of the Eastern and one the Western lines. The organization of the Eastern lines differs somewhat from that of the Western in that it is a divisional one. The signal supervisors report direct to the division superintendents. On the Western lines, however, the signal supervisors report direct to the signal engineer, the organization being strictly departmental, that is to say, centralized.

It will be observed that there is a signal committee, the members of which are the signal engineers of the eastern and western lines as well as those lines which are affiliated; the purpose of this committee is to act as an advisory body on standards, both as to material and practice. They have as well under their responsibility automatic train control devices. A special engineer has been appointed in charge of automatic train control who reports to the chief of the legal department.

The Southern (United States) has a rather unique organization in that the signal engineer of the system is in charge of the electrical department and reports to the general manager; he has no jurisdiction, however, over the telegraph and telephone services. The system is divided into Lines East and Lines West; in each of these divisions there is a signal and electrical engineer who reports direct to the general manager of the division. The electrical and signal supervisors report direct to the signal and electrical engineer of the division. Each of the divisional signal and electrical engineers keeps in close touch with the signal and electrical engineer of the system, the latter being responsible for the general policy of maintenance and standards. The Eastern and Western Lines each has a superintendent of telegraph; these officers report direct to the general superintendents.

Referring now to the Santa Fe system (Fig. 6) it will be noted that the organization is essentially divisional, that is to say, decentralized, the signal engineer of the system reporting to the chief engineer of the system. The former is responsible for the general policy of signaling, standards, and so forth, but has no direct connection with the actual maintenance work.

There are six assistant general managers, each of whom has a lines signal engineer reporting directly

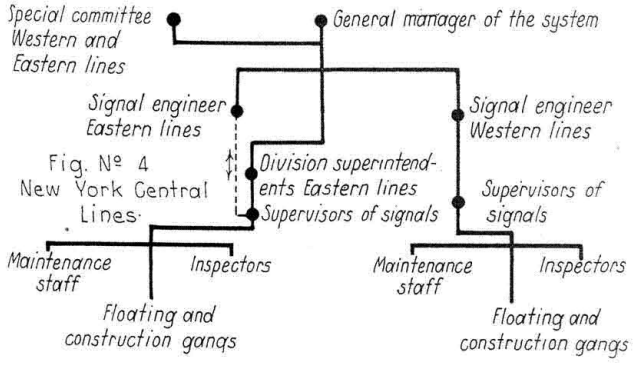

Fig. 4—New York Central signal organization

to him. The division superintendents have supervisors of signals reporting to them direct, the supervisors being actually in charge of the maintenance work. Their duties do not include telegraph or telephone services, nor have they anything to do with electric power except in so far as required for signaling purposes. There is a signal practice committee which is composed of the six assistant general managers and the signal engineer. This committee decides upon all questions of signal practice and standards. Each assistant general manager is more or

less responsible to the general manager for the results obtained by the committee.

The Great Northern has a divisional organization (Fig. 7). The superintendent of signals reports to the vice-president of operation and he is directly responsible for new construction work and improvements; he also has a general supervision over operation and maintenance of signaling.

The supervisors of signals report to the general superintendents and assistant signal supervisors report to the division superintendents. They have nothing whatever to do with telegraph or telephone

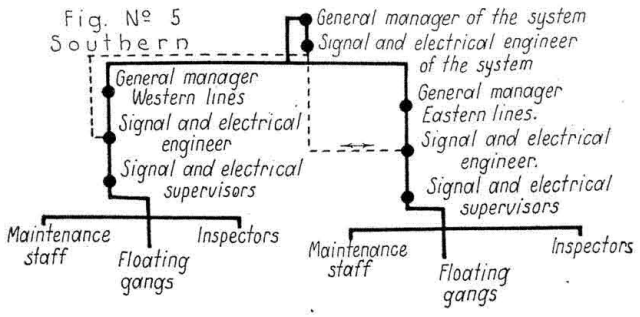

Fig. 5—Southern (U. S.) signal organization

work or electric lighting except in so far as its application to signaling.

The Northern Pacific has a strictly departmental organization, the signal engineer reporting to the chief engineer. There are three districts: eastern, central, and western, with a signal supervisor in charge of each, who reports direct to the signal engineer. One engineer of the head office is detailed to automatic train control and devotes all his time to this work. The signal engineer has no connection with telegraph and telephone work, or with electric lighting and power, except as may be required for signaling.

The signaling organizations of the smaller railways of the United States would appear to be "departmental" or "centralized," the signal engineer reporting to the chief engineer and on the larger groups "divisional" or "decentralized"; the signal engineer acting as an advisory officer, either direct to the general manager, superintendent of transportation or chief engineer of the system.

The question of automatic train control, which is a very important one in the United States today, is in nearly every case the responsibility of the signal engineer.

Commonwealth Railways of Australia

The Western Australian Government Railways have a departmental organization. The electrical and signal engineer reports to the chief engineer of way and works, and is responsible for signaling, station lighting, as well as telephone and telegraph work. The maintenance forces report to his department.

The South Australian Government Railways have a divisional organization, in so far as operation and engineering are concerned, but departmental for signaling and telegraphs. The signal and telegraph engineer, who reports to the secretary of the railway commissioner, has jurisdiction over signaling, telephones, telegraphs and other electrical appliances. He has an assistant engineer to whom the maintenance forces report; the chain of responsibilities is shown by Fig. 8.

In the case of the Queensland Government Railway, the signal engineer reports to the chief engineer, the organization being divisional. There are four divisions with a general manager in charge of each; the maintenance of way engineer is responsible for signaling maintenance as well as station and yard lighting. The signal engineer is responsible for the general policy of signaling, station and yard lighting, and is directly responsible for new constructional works.

The New South Wales Government Railway has a decentralized organization; that is divisional. The signal engineer, who is responsible for telegraphs, telephones and signaling, acts as an advisor to the board of commissioners. He prepares new schemes and carries out new constructional works. There are three areas with a commissioner in charge of each; supervisors of signals who are directly responsible for maintenance report to the area commissioners and their duties include telegraphs and telephones, as well as signaling. Refer to Fig. 9.

The organization of the Victorian Government Railway is departmental; the chief engineer of signals and telegraphs, who reports direct to the chief commissioner, has, to assist him, two engineers—one his principal assistant, and one in charge of telephones and telegraphs. All maintenance forces come directly under him, there is a supervisor of signals in charge of each district, and he is responsible for telegraphs and telephones as well as signaling.

The Commonwealth Railways of Australia have not developed signaling to any great extent. At present, signaling consists of mechanical interlocking and token instruments; the signal engineer has only a small force. He reports to the chief engineer, and is, as well, responsible for telephones and telegraphs.

It is interesting to note that the maintenance forces of the Australian Railways are trained to maintain mechanical and electrical signaling as well as telephone apparatus; also—in a number of cases—station and yard lighting.

New Zealand Railways

The New Zealand Railways have a divisional system; there being two divisions with a superintendent over each. The officer in charge of signaling has the title of signal and electrical engineer; he reports

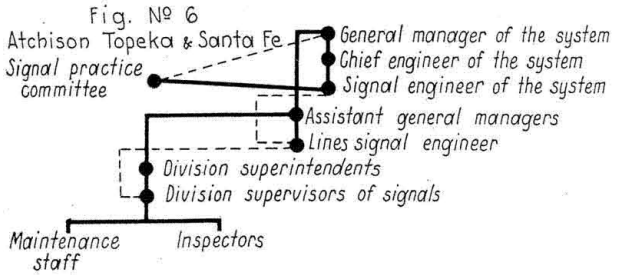

Fig. 6—Santa Fe signal organization

direct to the board of management and is responsible for telegraphs, telephones, electrical power and lighting as well as signaling. His technical staff includes an assistant signal and electrical engineer, chief signal inspector, chief electric lines inspector, etc.

In each of the two divisions there is a supervisor of signals reporting direct to the superintendent. These signaling officers have charge of all signaling installations, telegraphs and telephones, as well as electric lighting; the over-head electric conductors in connection with the electrified line between Arthur's

Pass and Otira is maintained also by the signaling forces. The chain of connection is shown in Fig. 10.

South African Railways and Harbors

The organization of this undertaking is a divisional one; the railways are divided into four systems each under an assistant general manager. The systems are further divided into divisions each under a divisional superintendent. Each system and division has responsible officers in charge of signals and telegraphs. There are two signal engineers with the title of superintendent of signals and telegraphs. These officers are responsible to the assistant general managers of the systems; one superintendent of signals and telegraphs is located at Cape Town and one at Johannesburg. The officer at Johannesburg is responsible for work on three systems.

The chief civil engineer at Johannesburg has on his staff a superintendent of signals and a superintendent of telegraphs. These officers carry out inspections and assist in an advisory capacity. The chief civil engineer, being the technical head, receives reports of inspections, progress of new works, and so forth, but all directions to the officers in charge of signaling and telegraphs are conveyed through the assistant general manager. The superintendents of

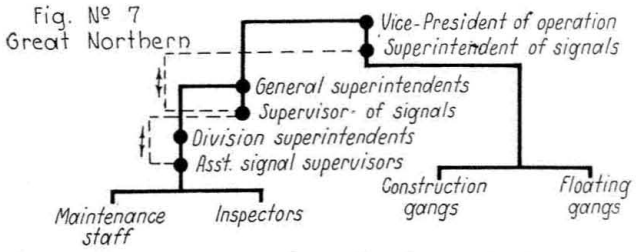

Fig. 7—Great Northern signal organization

signals and telegraphs are responsible for everything appertaining to signals and telegraph work. It is intended in the scheme of organization to appoint a signaling and telegraph superintendent to each system when the work justifies it.

South American Railways

South American Railways have, as a rule, followed the English system of organization. For example, on the Buenos Aires Pacific there is a superintendent of telegraphs who ranks as a chief officer. The signaling work, however, comes under the chief engineer. Another example is the Buenos Aires Western. There the signals and telegraph departments are combined under one officer with the title of signals and telegraph superintendent; he reports to the engineer-in-chief. There are in this case two separate branches; one the signaling side with an assistant engineer in charge, works foreman, signal inspectors, etc., and on the telegraph side an assistant for administration and a technical assitant, with works foreman, telegraph inspectors, etc.

French and Belgian Railways

The signaling departments of the French railways come under the chief engineer or the engineer of way and works. The organizations are departmental; there are cases where the permanent way forces take a hand in the maintenance of mechanical signaling appliances such as on the Chemin de Fer du Nord.

Telegraphs and telephones come under the electrical engineer as a rule, and this officer did at one time have under his charge block instruments and other electrical signaling appliances. He is now, however, becoming divorced from such works, particularly where more modern methods are being installed. Inspectors have direct charge of the maintenance forces where the permanent way men do not maintain; these inspectors in some instances report to the signal engineer direct, and in others to the permanent way engineer of the division.

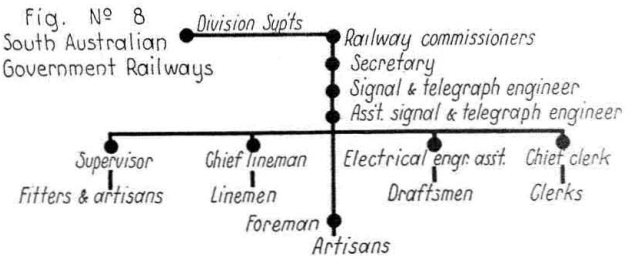

Fig. 8—South Australian Government Railways

The organization of the Belgian railways is much the same as the French, and I do not think, for that reason, it is necessary to go into details.

German Railways

The German State Railways have a divisional organization, the chief signaling engineer reports to the minister of railways; there is also a signaling committee, the members of which are chosen from the divisional signaling departments.

The divisional signaling officers report to the chief signaling officers of the division and are responsible for the maintenance forces.

Conclusions to Be Drawn

It is apparent that railways readily lend themselves to two forms of organization, namely, divisional or decentralized, and departmental or centralized. From the systems under review, it would seem that, for railways of considerable magnitude, that is to say of a large mileage spread over an extensive area, the "divisional" is the more suitable; on the other hand, railways of a lesser magnitude or having perhaps a fairly large mileage, but within a more or less confined area, the "departmental" is found to be the more satisfactory.

From the examples which have been exhibited the question now to consider is, what should be the ideal organization of a signaling department for a "divisional" system? When planning this out it should be borne in mind that the present day signal engineer must have a thorough knowledge of mechanics, elec-

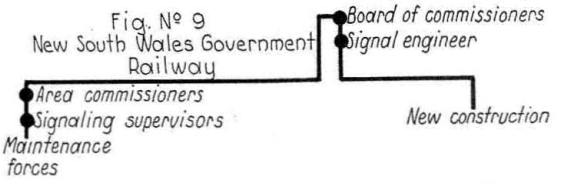

Fig. 9—New South Wales Government Railway

tricity and railway operations. He must come into direct contact with the operating department when preparing new schemes as well as schemes for improvements to old systems; he must also arrange with the electrical engineer for power supply and where automatic train control or automatic train-stops are in use, be in constant consultation with the chief mechanical engineer; he is, of course, in close

liaison with the chief civil engineer in matters concerning track lay-outs, track circuiting, and so forth.

It would appear therefore that this officer should have direct connection with the departments mentioned, and if that is the case he should obviously be independent of any of them; that is to say, as head of the department, should report direct to the general manager. In other words the signaling department should be independent.

Past experience suggests that, in so far as signaling maintenance and installations are concerned, there should be no division of responsibility. I mean by that, the signal engineer of the system should be

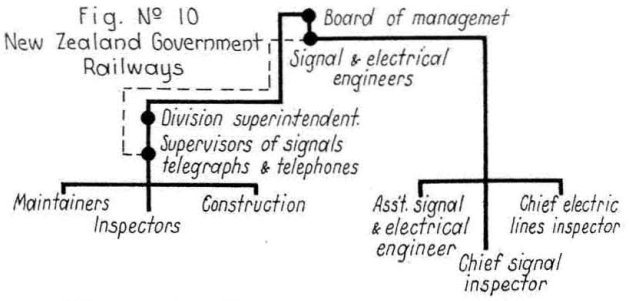

Fig. 10—New Zealand Government Railways

responsible for appliances such as token instruments, lock and block, track circuiting, power and automatic signaling, as well as other apparatus which obviously is his province. For the reason that he has lock, block and token instruments, I think it right to assume that telephones and telegraphs might also come into his department, or at any rate, that part of the telephone and telegraph system which is used for the purpose of controlling train movements and traffic operations.

When electric power is required other than from primary battery sources, it should be supplied by the electrical engineer, the signal department's responsibility starting with the main supply from the switchboard set apart for that purpose at the substation or power house.

A Specimen Divisional System

As it is a divisional system which is being considered, the signal and telegraph engineer of the system (and I believe his title should be "engineer") acts as an advisory officer to his chief, being responsible for the general policy of maintenance; preparation of new schemes and the execution of them; improvements to present systems, the carrying out of which would usually be done by divisional officers; standardization of apparatus and introduction of new appliances. He should, as a rule, have two assistants, one in charge of new construction work and the other to act as inside engineer. He should be the chairman of a committee composed of the divisional signaling officers and representatives from the operating and chief engineers' departments.

He should receive from the divisional officers a weekly report of all failures of signaling apparatus and consequent delays to traffic (if any). He should be kept advised at stated times of the cost of maintenance in each division. He should be informed of any alterations to locking, positions of signals, and so forth, or any other changes. Divisional signaling officers should report direct to the officer in charge of the region, area or division and they might be designated regional, area or divisional signal and telegraph engineers or divisional superintendents of signals and telegraphs. In the case of large railway systems, the regions, areas or divisions may be again sub-divided with a superintendent in charge, in which case a signaling officer should be appointed to report to that superintendent. This officer would have the maintenance forces directly under his charge, assisted by inspectors, foremen and chargemen. He would have floating gangs for heavy maintenance work and minor repairs and alterations to signaling. If, on the other hand, the system is not large enough to warrant a sub-division as mentioned above, the divisional signal and telegraph engineer would have directly under him the maintenance forces, probably being assisted by an assistant engineer.

In each of the divisional areas and at suitable locations, there should be signal repair shops. Signal and telegraph stores should be handled by the general storekeeper and only sufficient spare parts and stores kept by the maintenance staff to meet current and emergency requirements.

For the efficient and economical maintenance of railway signaling appliances and allied apparatus there should be only one set of maintainers; that is to say, it should be unnecessary to have, for instance, linemen or maintainers for mechanical work, others for electrical signaling and yet others for telegraphs and telephones. This high state of efficiency cannot, however, be attained without education and therefore the divisional signal and telegraph engineer should have, at certain convenient points, schools of instruction for the benefit of his staff and others who wish to imbibe a knowledge of this craft.

In order to keep the men up to a high standard of efficiency, examinations should be held and promotions made according to ability. Fig. 11 shows the chain of connection of the organization just described.

Where traffic is not too dense there is no reason why the signal and telegraph maintenance forces

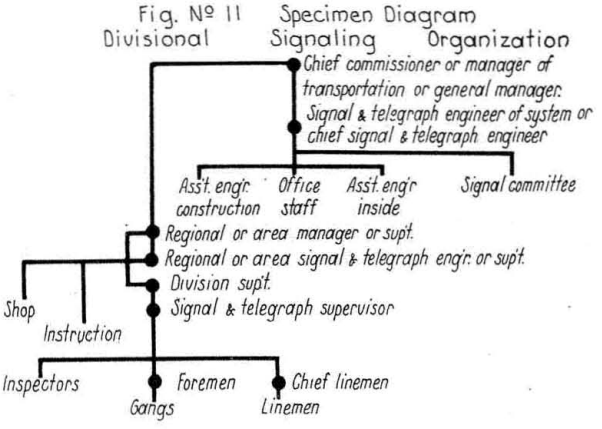

Fig. 11—Typical Chart for divisional signal organization

should not find time to maintain yard and station lighting. This scheme is being successfully carried out on the Canadian National and New Zealand railways as well as on some of the Australian and American trunk lines; it certainly tends towards economy.

A Specimen Departmental Organization

Having planned a scheme of organization for the signal and telegraph department of a "divisional system," the "departmental" should now be considered.

The qualifications of a signaling officer of a departmental organization should be just as high as

those required for that of a divisional system and perhaps I might add even more so, because to those already mentioned should be added that of "administration." It has been observed that in the case of a divisional system the signal and telegraph engineer of the system acts as a technical advisor to his chief; he rarely has however any administrative responsibilities. These duties are delegated to the divisional officers. On the other hand, in a departmental organization the chief of the department must have all of the technical knowledge of the former, but in order to be a successful officer he must have as well keen administrative ability, and this is perhaps as important, if not more so than purely technical knowledge.

Telephones and telegraphs should be the responsibility of the signaling officer of a departmental system for precisely the same reason as that given for a divisional organization.

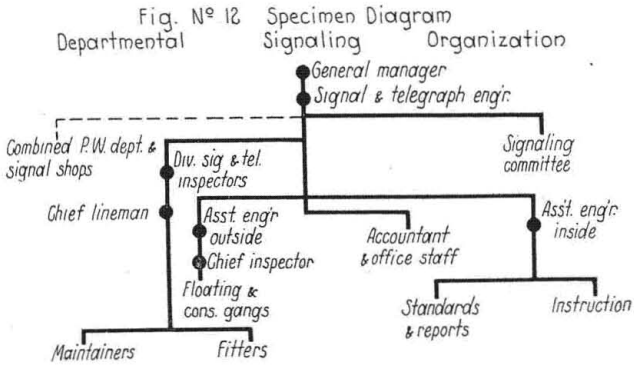

Fig. 12—Typical Chart for departmental signal organization

On a railway of considerable importance the title of this officer, I suggest, should be signal and telegraph engineer. On a less important system the title might be signal and telegraph superintendent. In the former case, the signal and telegraph department should be an independent one, the engineer of which should report direct to the chief executive officer, probably the general manager; in the latter instance he may report to the chief engineer or to the chief operating officer.

The signal and telegraph engineer should have two principal assistants; one for outside work and one for the office. The line should be divided into sections or divisions with an inspector in charge of each who should be directly responsible for the discipline and efficiency of the maintenance staff. Reports of failures, time sheets of maintenance staff, etc., should reach the head office each morning by 9:30 and be dealt with by the principal office assistant. Failure reports should be recorded on charts, one for each division; this graph is very useful for the purpose of making yearly comparisons.

As a general rule I doubt if it is advisable in a departmental system to have separate shops and stores for the signal and telegraph department. The stores should remain under the general stores superintendent and only those sufficient for current needs kept at the linemen's depots. Shop work, such as light repairs, fitting, locking, etc., should be done in the permanent way shops by skilled signal fitters under a signal fitter inspector, the shops themselves probably being in charge of an engineer of the last named department and, in a like manner, painters and carpenters would be drawn from this department as required—a certain number of each trade being earmarked for this work.

As mentioned for a divisional organization, the efficiency of the actual maintenance staff will largely depend upon the opportunity given them of learning their trade and keeping up to date. It is both uneconomical and inefficient to have various classes of linemen or maintainers with their inevitable overlapping of duties; it would appear therefore to be the obvious course to establish schools of instruction and to promote according to ability.

Constructional work and heavy repairs would be the responsibility of the outside principal assistant and such work carried out by gangs under inspectors or foremen.

Miller Train Control On the Monon

THE Interstate Commerce Commission on April 11 made public an order entered by Division 1 authorizing the Chicago, Indianapolis & Louisville to change the type of train-stop device installed under its first order, of June 13, 1922, between Hammond and Monon, Ind. This action was taken in response to a petition filed by the railroad on March 9 asking authority to stop operating and to take out the intermittent induction train-stop device of the Sprague Safety Control & Signal Corporation, which had been installed on that division under the first order of the commission and had been approved by the commission, and to substitute in lieu thereof the intermittent induction type of the Miller Train Control Corporation. It also asked for additional time within which to equip its line with the Miller device from Hammond to Indianapolis in compliance with the requirements of the first and second orders, but the commission has denied the petition as to any extension beyond July 1 under its order of January 14, 1924.

The installation is to be made under a contract between the railroad and the General Railway Signal Company, which, as previously announced, has a co-license agreement to manufacture and sell the Miller device, and this is to be the first installation of the Miller device made by the G. R. S. Company under that agreement. Work is now in progress on the 163 miles of line involved in the two orders and provision is also made in the contract for an extension beyond the two divisions. The system selected by the Monon embraces the same principles employed in the installation on the Toledo-Detroit division of the New York Central, as described in the May, 1926, issue of *Railway Signaling*.

As a result of its investigations and negotiations, the petition says, the road has decided that for various reasons it would be better to adopt the Miller device, and has made an arrangement with the manufacturer whereby it can install that system between Hammond and Indianapolis and equip all its locomotives operating over those divisions, "for little more than it would cost to go ahead and install any other reputable system of train control between Monon and Indianapolis." The petition says that in its opinion the Miller device "is better suited to applicant's requirements than any other train-stop device with which it is familiar, and applicant is also of the opinion that the expense of maintaining said Miller device will be less than the expense of maintaining the system which it now has installed between Hammond and Monon."