

With the exception of the additional colors "Lunar White" and "Purple" it is observed that the same three colors for the purposes required are proposed to be used as is now our practice, hence the ease with which such aspects can be read and understood by trainmen is apparent. This proposed system utilizes five colors and four positions to meet the five requirements under the rules, and which cannot be distinctly and properly accomplished otherwise.

Current for these lights can be obtained either by the use of battery or from a power source, and their control will be through the medium of relays as between the lights and the levers, or track conditions affecting them. The principle involved is one of causing the lights to be extinguished or lighted as the conditions require. In brief, instead of applying mechanisms with their connections and intricate gearing and parts, lamps are used both for day and night signaling.

From a study of the proposed indications in compari-

son with those now our standard, it must be concluded that the new system in its entirety is simpler than the present. The underlying color principles of present night signaling is not set aside, and this renders it much easier to commit to memory where changing from the old to the new system. A runner having absorbed mentally the present night light indications will find no difficulty in reading the same colors in daylight.

Then, again, the positioning of the lights is an added factor of distinctness, as four angles of lights are provided for the four primary conditions to be met, which, aside from color, lends itself to a more conspicuous display of the indications required.

The basic arguments in favor of the proposed system are: (1) The day and night indications are the same. (2) Instead of trainmen being required to memorize so many aspects, they are required to commit to mind but 14, as will be seen by reference to the diagram. (3) Reduction in the cost of construction and maintenance.

Railroads Argue Against Automatic Stops at I. C. C. Hearing

Carriers Claim Devices Are in Development Stage at This Time and That the Proposed Order Is Too Drastic

CLAIMING that no automatic train stop or train control device has been sufficiently developed to warrant installation on such an extensive scale as is outlined in the proposed order of the Interstate Commerce Commission and that the American Railway Association is diligently working for the development of a practical device which will meet the Commission's order and serve the purpose of the railroads, Alfred P. Thom, counsel for the Association of Railway Executives, speaking at the hearing in Washington on March 20, urged that the Commission refrain from issuing such an order. A committee of the American Railway Association, representing 40 of the 49 railroads included in the proposed order, presented supporting evidence. This evidence was presented by R. H. Aishton, president of the American Railway Association; C. E. Denney, vice-president and general manager of the New York, Chicago & St. Louis, and chairman of the railroads' committee; A. M. Burt, assistant to the vice-president of the Northern Pacific, and J. A. Peabody, signal engineer of the Chicago & North Western. The hearing was held before Commissioners McChord, Esch and Lewis. After the carriers' committee had finished presenting its data the individual roads submitted additional statements as to why the order should not be entered against them, or should be modified.

Mr. Aishton outlined the formation of the joint committee and the co-operation of the American Railway Association with representatives of the Bureau of Safety of the Interstate Commerce Commission and said that in connection with the work the association in the last 15 months has spent \$20,000. Mr. Aishton said that the carriers' committee does not represent the Chicago & Eastern Illinois, the Chicago, Rock Island & Pacific, the Long Island, the Norfolk & Western, the Pennsylvania, the Philadelphia & Reading, the Pittsburgh, Cincinnati, Chicago & St. Louis, the West Jersey & Seashore and the

Chesapeake & Ohio. Continuing, he said:

"The following questions naturally presented themselves for answer:

"(1) Has automatic train control reached a point of development reasonably justifying an order requiring its extensive installation at this time? The committee's answer to this is, No. * * *

"(2) If installation for further tests is advisable, is duplication of tests necessary? The committee expresses the opinion that such duplication will not serve any practical purpose.

"(3) Are further developments probable; or other principles than those now being advocated and under development? The committee is of the opinion that induction methods of train control are being rapidly developed and that tests now being arranged for will give valuable information and promise progress.

"(4) Are the proposed requirements such as best cover the situation? The committee will propose amendments.

"(5) The committee has not entered into the financial side of the question in any manner, but it is a serious question for this Commission whether automatic train control will provide greater additional safety for a given expense than the same expenditure will produce through the installation of automatic signals, extensions of double track, etc., * * * and other improvements which not only increase safety, but increase the capacity of the railroad and produce large economies in operation. It is an open question, whether any of the devices so far tested do not have a tendency to decrease the capacity of a railroad.

"The policy of the railroads is now, as it has been in the past, that within their financial ability they are continually seeking to find better methods for promoting safety as well as economy and the production of better service. Applications to the Commission for authority for financ-

ing disclose that a large part of the money for which authority is now asked is to be devoted to purchases which tend toward better operation, greater safety and better service. Under present financial conditions expenditures should be confined as largely as possible to known and demonstrated channels * * *."

Commissioner Esch then asked if, in the opinion of Mr. Aishton, carriers had properly co-operated in the development of automatic train control; the matter had been brought up over 14 years ago. Mr. Aishton replied that he could not say, except for the last 15 months, in which period he felt that progress had been made. Prior to that time and during the war and under Federal control little could be done except to keep trains moving. Commissioner Esch called attention to the final report of the Block Signal and Train Control Board, made in 1912, in which it was stated that ten or fifteen devices had sufficient merit to justify further test, and asked if since 1912, up to the war, whether the financial status of the railroads was such as to prevent them acting on development of such devices. Mr. Aishton, in reply, called attention to the fact that during that period legislation on electric headlights and steel cars was passed, which required large expenditures by the railroads, and that this may have diverted the railroads from the automatic train control question.

Brief Submitted by Mr. Denney

The brief of the carriers was submitted by Mr. Denney. In connection with it he said that the American Railway Association was co-operating with the Interstate Commerce Commission. Two additional installations of train control apparatus have been arranged for, one on the Southern Pacific, and one on the New York Central; and he referred to the experimental installations of the General Railway Signal Company's device on the Buffalo, Rochester & Pittsburgh; the International Signal Company's device on the Erie, and the Shadle device on the Cincinnati, Indianapolis & Western. He also referred to the Union Switch & Signal Company's plan for making an installation on the Pennsylvania Railroad. Mr. Denney emphasized the fact that it has been and will be the aim of the American Railway Association to co-operate with the Commission.

Commissioner Esch asked as to the powers given the A. R. A. committee on automatic control to secure the co-operation of the railroads. Mr. Denney replied that the committee was not authorized to spend any money. As to whether automatic stops would increase the capacity of a railroad, Mr. Esch quoted a statement made in March, 1920, by J. M. Waldron, signal engineer of the Interboro Rapid Transit Company, New York, that automatic train control had increased the capacity of these lines 43 per cent. Mr. Denney replied that conditions on the Interboro were in no way comparable to those on steam-operated railroads in the open. Mr. Esch asked about the A. R. A. inspections on the Chicago, Rock Island & Pacific, the Chicago & Eastern Illinois, and the Chesapeake & Ohio by the American Railway Association in February. Mr. Denney stated that the main purpose was to have these men watch operation during severe winter weather.

An abstract of the brief is as follows:

1. No automatic train stop or train control device has been sufficiently developed to justify the issuance of the proposed order. That the state of the art as it existed up to the beginning of the year 1920 did not warrant any extended use of the devices in question is, we submit, not open to debate. The committee of the United States Railroad Administration (1919) summarized the situation thus:

"Generally speaking, it may be said that the tests which have thus far been conducted have demonstrated that the functions of automatic train control devices are possible of

accomplishment under actual service conditions. But while these functions may be accomplished at comparatively isolated locations with the high degree of maintenance ordinarily given to test installations of this character, it is an entirely different problem, and a far more complex one, to apply these devices to the various operating conditions encountered in railroad service * * * on several hundred miles of a busy railroad. * * * Automatic train control devices are still in the development stage, and many problems in connection with their practical application remain to be solved."

These views are consonant with those of the Block Signal and Train Control Board (June 29, 1912), also with the reports of the Commission's Bureau of Safety. While progress has been made during the past two years, it is still true that many problems in connection with practical operation remain to be solved.

The only systems which have been in service under actual operating conditions and dependable and continuous observation for any considerable length of time, are those of the Regan, the Miller and the American, now in service to a limited extent on the Rock Island, the C. & E. I., and the C. & O. These three are the only installations of which specific mention is made in the Commission's report of January 10, 1922, which, we submit, warrants the inference that the Commission had them in mind when it said that "14 years of investigation have demonstrated the practicability of and the necessity for automatic train control." In any event, the failure of the Commission, in its report, to direct attention to any other particular installation, must lead to the conclusion that in the judgment of the Commission no other system of train stop or train control has been sufficiently tried out to warrant even the suggestion that it be generally adopted.

The three installations above referred to have been the subject of special investigations conducted by a subcommittee of the Joint Committee on Automatic Train Control of the American Railway Association. The report of such committee shows, among other things, with respect to each of the devices in question:

(a) Numerous objectionable mechanical and engineering features remaining to be corrected;

(b) Many operating difficulties which have not yet been satisfactorily taken care of;

(c) A relatively large number of failures.

In short, this report conclusively establishes not only that the devices in question have not yet been brought up to the point where it can be said that they show a "high degree of efficiency" under general service conditions, but also that they, like all other kindred devices, are still in the experimental or development stage and that many problems remain to be solved before they can be considered as practicable and reliable for the purposes of the Commission's proposed order.

We are dealing with a very different proposition from that of the automatic coupler, the air brake or the block signal.

The Commission's observation to the effect that the automatic coupler, the air brake and the automatic block signal were not perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted, appears to be at variance with the facts.

The records of the Master Car Builders' Association show that the automatic freight car coupler was a subject of discussion and experimentation from 1870 to 1887, a period of 17 years, before it was adopted by the association as recommended practice. It was six years later than this before its use was required by law. Prior to its requirement by law it was a well recognized safety device.

The air brake was a subject of discussion and experimentation from 1870 to 1888, a period of 18 years, before it was adopted as recommended practice, and it was 23 years before it was required by law; then it was a safety device recognized by all of the more progressive railroads of the country.

Automatic block signals had reached a much higher degree of development than train control devices have at present before any such extensive installations were made as is contemplated in the proposed order, and the installation of automatic block systems was a much simpler matter than the installation of automatic train control devices. With an automatic train control system no engines can be operated under it except those equipped with a device that will function in conjunction with the system installed upon the roadway. The adoption of the automatic coupler and air brake did not affect the capacity of a railroad; their practicability had been demonstrated beyond a reasonable doubt before their use was required by law.

2. The order would be premature if issued at this time because the carriers have not had opportunity to make

adequate service tests of devices designed to function on different principles from the devices specifically mentioned in the Commission's report. Each of the three systems specifically mentioned in the Commission's report is so designed as to require the use of a ramp located alongside or between the rails.

Efforts are now being made to develop automatic train control devices designed to function on the induction principle, and it is the opinion of the engineering and operating officers of numerous carriers that such type gives promise of overcoming many of the objectionable features inherent in the ramp type. Train control systems designed to operate on the induction principle have lately been installed or are contemplated in the immediate future, viz.: The Sprague, the Bostwick and the Union Switch & Signal devices appear to possess merit and the result of the test installations may warrant their extension. No order, therefore, should be issued until such time as the carriers have had ample opportunity to ascertain whether or not some one or more of such systems is practicable and reliable for the purposes of the Commission's order.

3. The carriers are making every reasonable effort to co-operate with the Commission in testing all meritorious devices and will continue such efforts as the Commission may direct.

In view of the activities of this committee since its appointment in November, 1920, as disclosed by this report, it would appear that the issuance of the proposed order, which cannot now be complied with, will tend to retard rather than promote the development of a proper system. The committee as well as the individual carriers will continue to render all reasonable assistance in the proper testing and development of these devices.

4. The proposed order requires a much greater number of and more extensive installations than are warranted at the present time.

Answers by all carriers named in the order of January 10 except the Pennsylvania, the Pittsburgh, Cincinnati, Chicago & St. Louis and the West Jersey & Seashore companies, to a questionnaire submitted by this committee, indicate that compliance with the proposed order by the carriers answering the questionnaire (46 in number) will require the installation of the devices in question on approximately 6,126 miles of railroad, 10,285 miles of track and 5,525 locomotives, the cost of which will aggregate many millions.

It is manifest that such systems as recommend themselves to the Commission can be just as thoroughly tried out by continued co-operation between the Commission and the American Railway Association along the lines heretofore followed, as can be done by the extensive installations contemplated by the proposed order, which would require the expenditure of vast sums of money unnecessarily.

A. M. Burt's Report

Mr. Burt presented a report on the views of the railroads' committee with respect to differences between the specifications (a) as adopted by the Committee of the American Railway Association and representatives of the Bureau of Safety of the Interstate Commerce Commission and (b) the specifications included in the Commission's proposed order. There is one difference which is felt to be important. In this connection he said in part:

"Under 'Automatic Train Stop,' the Commission in its proposed order has eliminated entirely the following paragraph in the requirements of the A. R. A. committee:

"(b) Under control of engineman, who may, if alert, forestall automatic brake application and proceed."

"The omission of this paragraph will make the use of a simple automatic train stop so restrictive that it will practically eliminate such devices from consideration. It is fundamental that trains should be stopped only when necessary in connection with their service or when necessary in the interest of safety. There are many times when it is proper for a train to pass an automatic signal in the stop position without coming to a full stop. Signals are now very generally located only a short distance from a siding switch and it is often desirable for a train to be admitted to a siding by a man on the ground, either a switch-tender or a trainman of another train. If no permissive device is allowed on the engine, it will be

impossible for the engineman of the approaching train to pass the signal and enter the siding without having his train brought to a stop unnecessarily by the automatic device.

"* * * If an order is entered by the Commission it should be so flexible as to permit the installation of the simpler devices. The most that can now be expected from any automatic device is to have it operate when the human element fails to do so through inadvertence or physical inability. An engineman must be relied upon a great many times to exercise judgment and caution and it is entirely illogical to take from him, in one particular, his right to use his intelligence and discretion and at the same time rely on such intelligence and discretion at many other points. * * *

The question of interchangeability was also raised by Mr. Burt. "In order to get full protection from an automatic train control device upon engines, it must be so designed that it will function with the roadside apparatus on any of the railroads over which these engines operate.

"* * * In considering the necessity for interchangeability it should be remembered that the railroads would have to carry a stock of repair parts at various points on their lines. Before making large installations it is of the greatest importance that, so far as possible, there should be standardization. It will readily be conceded that the need for absolute interchangeability is not the same as the need for interchangeability in freight car couplers or air brake apparatus. There is, however, a very real need and this need of interchangeability will increase as time goes on rather than lessen. The major problems in connection with it should be brought much nearer to solution before extended installations of train control devices are undertaken."

Mr. Peabody Reports on Three Devices

J. A. Peabody presented reports on the American Train Control Company's installation on the Chesapeake & Ohio, the Miller Train Control Corporation's device on the Chicago & Eastern Illinois and the Regan device on the Chicago, Rock Island & Pacific. A brief description of the device was first given and the objections raised by the chief inspectors were stated, after which was set forth the action taken by the companies to meet criticisms. He presented in each case a comparison showing how the device met the requirements laid down in the Commission's proposed order. Data sheets were presented showing the number of operations per failure, etc., and conclusions were drawn as to the effect of these devices upon train operation.

On the Chesapeake & Ohio, 32 specific points were brought up for correction; on the Chicago & Eastern Illinois, 13, and on the Chicago, Rock Island & Pacific, 29.

After the presentation of this information, in which all failures were noted, W. P. Borland, Chief of the Bureau of Safety, Interstate Commerce Commission, stated that he did not concur in this report, inasmuch as his inspectors did not co-operate with the special American Railway Association committee in the preparation of the document presented by Mr. Peabody and that a number of objections were raised which had not been concurred in by inspectors from his department. Mr. Peabody replied that he did not say the Bureau of Safety had co-operated, but that it did occur in pointing out certain undesirable features. Commissioner Esch then asked if the additional undesirable features (which had not been concurred in by the Bureau) had been called to the attention of the owners of the devices, and Mr. Peabody stated that they had not, so far as he knew; the report had only been finished during the last week. Its main purpose was to show that the train control question was in the develop-

ment stage. Commissioner Esch asked Mr. Peabody if it was the primary purpose of the committee to find defects and Mr. Peabody said that it was; this in order to determine what is necessary to get reliability.

Pleas of Individual Roads

After the conclusion of the joint presentation, the Southern Pacific and the Southern Railway presented additional briefs pertaining to their particular roads. The Southern Pacific desired to adopt the responses made by the carriers' committee and further asked to be exempted from making a double installation, the Southern Pacific and the Galveston, Harrisburg & San Antonio being parts of the same system. It was the feeling of this company that the order should not apply to it, inasmuch as it is now co-operating in the development of an induction type near San Francisco.

The Southern Railway also supported the carriers' committee report and asked that it be not required to make duplicate installations which would be necessary if the order were to be entered, as the C. N. O. & T. P. was part of the Southern system. Automatic train control devices should not be required on these lines until additional automatic signals have been installed. W. J. Eck, signal superintendent, said that "the Southern Railway and the C. N. O. & T. P. have not been remiss in the installation of safety devices of all kinds; they have been among the first in this regard.

"The management is interested in the subject, has assisted in its development and will doubtless some day have it installed on many miles. It does not believe, however, that it should be installed now upon an entire engine division so long as there are hundreds of miles of important main lines without the very great safety afforded by the automatic block system. * * *

A Plea for Signals

B. H. Mann, signal engineer of the Missouri Pacific, said that an order as to his road would be premature. It should be permitted to expend its available funds in providing interlocking for its unprotected crossings and automatic block signals for its main lines before paying for a device to compel obedience to signals. He estimated the cost of equipping the line from St. Louis to Kansas City with an automatic train control system at \$911,950, for 276 miles, and said the company should spend \$19,251,000 for automatic signals and interlocking. The estimate for automatic train control, he said, was \$1,500 per mile and \$750 per locomotive, and was based on information from other roads that have made installations. He thought the 49 roads should not be required to spend money for the installation of a device which would be scrapped when a more satisfactory type is developed. The Missouri Pacific feels that its important problem is to reduce the unproductive time of freight trains, which can be done by signals, and it trusts that the Commission will not compel it to disrupt its present plans. It hopes that it may be relieved of the order entirely and allowed to devote its available revenues to other safety devices. Mr. Mann referred to the installation of signals as preparatory to automatic train control.

Chairman McChord asked how long it would take to complete the signal program. Mr. Mann replied that it would take several years. W. P. Borland, director of the Bureau of Safety, then brought out that the Missouri Pacific has installed automatic block signals on 365 miles since 1904, and 154 miles since 1912, and said that at that rate it would take over 100 years to "prepare for automatic train control." In reply to questions, Mr. Mann said that passenger engines run through from St. Louis to Kansas City and that passenger crews run through to Sedalia. He was asked the cost of installing train control

between St. Louis and Jefferson City and said \$316,200, but that that is not a crew run. He said his company has been looking into the Bostwick device and the three ramp types investigated by the committee.

Installation Required on Entire Line

When W. D. Duke, general manager of the Richmond, Fredericksburg & Potomac, said he desired to adopt the testimony presented on behalf of the committee, Chairman McChord reminded him that he was under oath. Mr. Duke said the proposed order covers his entire main line from Washington to Richmond, over which locomotives of six foreign lines are operated. He said that in the present state of the art, his company should not be required to install a safety device not thoroughly approved in actual practice. Proprietors of three or four devices have been permitted to use the company's tracks and locomotives for experiments during the past six or eight years, but the experience has not justified adopting any of them; he thought further time should be allowed for development of the induction type. He suggested 12 to 18 months as possibly sufficient time. Mr. McChord asked if the road is taking any steps itself to make tests on its own line. Mr. Duke replied that it expected to profit by the experience of others. Mr. McChord said that it seems to be the policy of Congress that something should be done, and that he understood that many good devices have never been tested. "We think we have done our share in proportion to our mileage," said Mr. Duke.

L. W. Baldwin, vice-president of the Illinois Central, asked that an order be not issued as to his road, saying that more time should be allowed. Commission Lewis asked how much time should be allowed. Mr. Baldwin said that would depend on the period required for development beyond the experimental stage. He said he had based his conclusions on what he had read and on reports of his officers; he had not personally studied automatic train control on the ground. Mr. Borland asked Mr. Baldwin what difference there was in operating conditions on the C. & E. I., the Rock Island or the Chesapeake & Ohio (which have reported that the train control devices used by them had met their operating conditions satisfactorily) and those on the Illinois Central. Mr. Baldwin said there is a difference of opinion on that subject. While he was not familiar in detail with the operating conditions on the other roads, he did not see how it could be said that operating conditions were being satisfactorily met until those roads should be fully equipped.

Severe Winters Encountered in Maine

B. R. Pollock, vice-president and general manager of the Boston & Maine, asked that his road be exempted from any order, on the ground that it operates in a district of severe winter weather in which the practicability of automatic train control has not yet been demonstrated; and that the portion of its line designated was one of very heavy passenger traffic which would be adversely affected by any device which should cause additional stops. He said the locomotives of three other divisions also are run over this division so that the order would require the equipment of many additional engines.

C. C. Hine, general solicitor of the Chicago, Indianapolis & Louisville, said that his operating officers know very little about train control devices, but he wished to file an objection on the ground that an order as to his road would not be justified because its operating conditions are such that the additional protection is not required. Of the 475 miles of main line, 360 are equipped with automatic signals and on the lines where there are no signals there are long intervals between trains. No passenger has been killed in a train accident since 1897, except a mail clerk, in 1912, and the company feels that the money could be

spent to better advantage for additional protection at highway crossings.

C. H. Stein, general manager of the Central of New Jersey, said his company is not opposed to automatic train control, but is in sympathy with the proposition; but it has investigated 46 devices and feels that none of them has reached such a state of perfection that would warrant the expense of an installation. He believed that new possibilities are just coming to the surface and that a wireless device may be developed. Pointing out that in recent years only from 252 to 271 passengers have been killed per annum, and that only a part of these could have been saved by automatic train control, Mr. Stein said that the train control device itself might easily be the cause of accidents. Those now in service are under special scrutiny. He thought the capital required might be more profitably invested in other directions. In reply to Chairman McChord's question as to what his company is doing to help bring train control to a stage of perfection, Mr. Stein said it was keeping in touch with the experiments being carried on, but does not feel like duplicating the work being done on other roads.

"Suppose all the roads took the same position," said Mr. McChord.

"Then maybe we would take it up," replied Mr. Stein.

Mr. Borland asked Mr. Stein if he saw any insuperable difficulties in the way of standardizing the equipment to overcome the objections made on the ground of lack of interchangeability. Mr. Stein said that would be a question for the mechanical department. When he concluded, Chairman McChord asked Mr. Stein to file with the Commission the reports of the investigations of the 46 devices referred to.

Offered Prize for Device

The New York, New Haven & Hartford gave a long list of reasons why the order should not be issued on its line. No device had been found practicable for use on the lines covered in the Commission's order and the company has been trying to find a device since 1912, having offered a reward of \$10,000 for such a one. Over 1,400 patent papers have been examined and innumerable inventors and proprietors of devices had been dealt with. Inspections have been made of practically all installations on other roads, and since 1918 the company had employed a special engineer, who devoted all his time to this subject; and in addition a special committee was at work. The company showed that it had made a trial installation of the Union Switch & Signal Company's device in 1913 and of the International Signal Company's device from 1915 to 1917, but the tests were found unsatisfactory. Another objection raised to the issuance of the order was that in the operating of its trains over the Pennsylvania and the New York Central in electrified territory no automatic stop shoe could be used that would come within the allowable clearance.

During the presentation of the New York, Chicago & St. Louis road's brief, by Mr. Denney, Commissioner McChord asked about the work of the subcommittee, operating under Mr. Denney's direction, saying that Mr. Borland had no record of what occurred in connection with its inspection of the Regan and Miller devices; while the inspector of the Bureau of Safety on the C. & O. had no knowledge of what these men were doing; and that the records of this subcommittee do not check up with the Commission's records. Mr. McChord also wished to know the conditions under which this subcommittee conducted the surprise tests.

Two Installations on Union Pacific System

W. M. Jeffers, general manager of the Union Pacific, asked that that system be relieved of the burden of mak-

ing two installations, as would be required by the proposed order, one on the Union Pacific and one on the Oregon & Washington Railroad & Navigation Company, and expressed the opinion that the test on an entire engine district is not essential, but said that the road desires to co-operate in a helpful way with the commission and offered to co-operate with the Bureau of Safety in making a test of any proper device which is not being tested. Chairman McChord said it was not the policy of the Bureau of Safety to say what devices should be installed. Mr. Jeffers said he thought the Union Pacific had spent more money per mile in safety work than any other road and that 85 per cent of its main line is equipped with block signals, but it feels that train control is still in its infancy and he knew of no device that he would want to put on extensively. There are many problems to be worked out, particularly in connection with heavy tonnage trains on grades.

He also made a point of the fact that train control would tend to take control of the train away from the engineer and said it is a question whether this remedy would not be worse than the disease. Mr. Borland asked if he had any idea that it was proposed to take the responsibility away from the engineer. Mr. Jeffers replied that he did not know that it was specifically proposed but any time responsibility is divided between the engineer and a device there is liability to trouble. When Mr. Borland cited two accidents on the Union Pacific caused by the failure of the engineer to see signals, Mr. Jeffers agreed that those accidents might have been prevented by an automatic train control device, but he said the device might have caused an accident on some of the hundreds of thousands of movements made since. Mr. Jeffers said that the ramp adds an unnecessary element of danger and that it would leave insufficient clearance for the rotary snow plow. He also thought the tendency would be to reduce the air pressure in descending heavy grades, saying that it takes years of experience for an engineman to learn how to handle his train under such conditions. Commissioner Esch asked whether he thought there was any objection on the part of those interested in wayside signals for fear that automatic train control would supplant them. Mr. Jeffers replied that he thought not because automatic train control should be used in conjunction with signals.

A. W. Trenholm, vice-president of the Chicago, St. Paul, Minneapolis & Omaha, said that the division of his road mentioned in the order has been proposed for double tracking, which would necessitate changing the apparatus if it were installed at this time, and he also said that it would be necessary to install automatic block signals at the same time. He submitted an estimate of the cost, saying he did not know whether it could be relied on and that probably an order of the commission would result in increase in the price of automatic train control.

When Mr. Trenholm referred to the proposed order as arbitrary, Commissioner Esch said that Congress had passed the law two years ago and that the commission had waited this length of time before issuing an order. Mr. Trenholm replied that the law had left the matter in the discretion of the commission and he thought the burden should be on the patentees to perfect their systems until they are safe to put on a railroad. Mr. Esch said that in view of the stagnation in the development of train control in recent years Congress evidently expected some action on the part of the commission.

A. M. Burt was recalled to speak for the Northern Pacific. He described the expenditures made by this road for safety appliances and the proposed extensions of its automatic block signals. He said that the installation would not be warranted by the density of traffic on

the divisions proposed in the order and that the ramp would introduce complications in a country exposed to snow drifts, because it would promote the formation of drifts and would also be an obstruction to the snow plows.

Five Installations Required on One System

W. E. Elliott, signal engineer of the New York Central, described the work which that company has done for many years in investigating train control, after C. C. Paulding, as counsel for the road, had pointed out that the proposed order would require five installations on the New York Central System, on the Pittsburgh & Lake Erie, Boston & Albany, Michigan Central, Chicago, Cincinnati, Cleveland & St. Louis, and the New York Central itself. Mr. Elliott said he had had experience in investigating train control since 1893 when the Chicago, Milwaukee & St. Paul, of which he was then signal engineer, made an experimental installation of the Kinsman device. He said that the special committee organized by the New York Central had adopted a train control device several years ago for use in the Detroit tunnel, but had not yet been convinced of the practicability of any device for general installation. He referred to negotiations with the Sprague Company since 1914 and said that under arrangements made during the winter its device has been installed on one track $6\frac{1}{2}$ miles long, including five blocks, and on one passenger engine and preliminary tests were begun on February 20. Specific tests under the direction of the joint committee and the Bureau of Safety are to be made next week. If the tests turn out satisfactorily it is the intention to equip a double track section of the New York Central and Michigan Central between Toledo and Detroit, 54 miles, with automatic signals and an automatic train control device for a service test. He said the ramp type would not be suited to the New York Central because of interference with the third rail and because of the snow and ice conditions during the winter.

Mr. Peabody, appearing for the Chicago & North Western, said that the installation would cost \$1,657,700 and the company felt that this money could be spent more profitably for block signals. George J. Ray, chief engineer of the Delaware, Lackawanna & Western, said his company had devoted much attention to tests of automatic train control devices for many years, and it does not ask for postponement of the order because of its financial condition or because of a belief that signals should be installed first, because the greater part of its line is already equipped with automatic signals, and it is ready to install a train control device whenever it is convinced that one is suitable for its operation and would be a help rather than a hindrance, but if this order is made permanent it would have to install a ramp type device and it believes that in a year or two some other type will have been developed more satisfactorily. Meantime, it believes it ought to be allowed to continue experiments.

C. & A. Objects to Ramp Type

H. T. Douglas, chief engineer of the Chicago & Alton, said he believed that the ramp type is most undesirable and that the induction type will produce better results. He said that according to the best information he could obtain the installation on his road would cost over a million dollars and he thought it would be most unfortunate for the commission to require this expenditure for an experiment when there are so many other ways in which the money could be more profitably used, if it had the million dollars, which it has not. As various witnesses gave estimates of the cost, Chairman McChord asked for an itemized statement showing how the estimate was made up. Mr. Douglas said he had consulted men who had experience on other roads, but that the proprietors, he under-

stood, were not in a position to give prices because they have no contracts for the manufacture. J. Beaumont stated that the manufacturers would be in a position to state prices and that such information has been available for some time.

F. P. Patenall, signal engineer of the Baltimore & Ohio, described the work his company has done in the way of investigating automatic train control devices and said that 75 per cent of them are "not worth the paper they are written on." Chairman McChord asked why the railroads have not done more to develop the other 25 per cent. Mr. Patenall said that no good purpose could be served by duplicating tests and that he felt his company had been of assistance in helping to ascertain changes that should be made in those that have been installed. He estimated the cost at from \$2,000 to \$6,000 a mile and said that greater benefit would be derived from the expenditure of this money for signals. He asked that the commission modify its order and permit an installation of 10 or 15 miles in connection with a proposed installation of signals. A number of the roads were asked by Chairman McChord to file statements of the cost involved in some of the principal accidents that have occurred in recent years, and also any other accidents which could have been prevented by train control.

J. C. Mills, signal engineer of the Chicago, Milwaukee & St. Paul, asked that the commission postpone any order as to his road. The company is now under orders of states and municipalities for grade crossing separation and other safety work to the amount of \$13,000,000. When Commissioner Esch asked if this would not be spread over a period of years, he said that the date for the completion of the work had already passed, as the authorities had allowed it to be deferred from time to time; and it was now necessary to finish the work as rapidly as possible. The company cannot get the capital for automatic train control apparatus in addition to the heavy expenditures now required.

H. R. Safford, vice-president of the Chicago, Burlington & Quincy, said his company desired to indicate its sympathetic interest in train control development and to express the hope that investigations may continue aggressively, but he did not believe the ramp type would prove satisfactory. The problems of getting an impulse from the roadside apparatus to the locomotive is a detail yet to be perfected. Chairman McChord asked him to file with the commission a statement of the costs in property damage and personal injury damages of train accidents on the Burlington during the last 10 years which might have been prevented by an automatic train control.

A. W. Smith, superintendent of the Hagerstown division of the Western Maryland, asked that his company be relieved of the order, on the ground that there is practically no passenger traffic over the division contemplated by the order, only one passenger train each way a day and a maximum of nine freight trains. He said that there has been no loss of life in this territory as the result of a train accident in six years or since the installation of automatic signals. If the money were available the company should extend its signal installation before spending the money for train control.

A. C. L. Desires Continuous Control

C. J. Kelloway, superintendent of signals of the Atlantic Coast Line, declared it impracticable to install train control with wayside signals. If a cab signal were used it would distract the attention of the engineman from the lookout. He submitted an estimate of the cost of equipping 120 miles of road with a "continuous control" apparatus, the type which the Pennsylvania proposes to install, based on estimates furnished by the Union Switch & Signal Company. This covered 242 miles of track and

251 blocks and the equipment of 12 passenger, 18 freight and 13 extra locomotives, a total of \$315,785. Mr. Borland asked why he had used estimates for the continuous control type when the intermittent induction type would be cheaper. Mr. Kelloway replied that he understood that the continuous control type was the only one that would meet the specifications of the commission. He understood that intermittent induction apparatus would not meet the specifications of the commission on a number of points, but when Chairman McChord asked him to point them out, he hesitated, and finally said that he assumed that No. 5 calls for continuous control; but Mr. Borland said that it did not. Mr. Borland thought that an intermittent type, either ramp or induction, would meet the conditions of the Atlantic Coast Line, to which Mr. Kelloway replied that in the opinion of signal engineers the continuous control type is better and that if the road is going to make an installation the best is none too good.

The Erie's Desire for Other Facilities

R. S. Parsons, general manager of the Erie, said that the proposed order apparently requires two installations, one for the Erie and one for the Chicago & Erie. His signal engineer had given estimates that 125 miles on the Chicago & Erie would cost \$243,000, or \$345 per roadway indication and \$1,600 per locomotive; for the Delaware division the cost would be \$316,000. He said he did not know what device this estimate covered, but it is impossible to get accurate estimates because the devices are not yet in a marketable condition. It is difficult for the Erie to get money for any purpose. If it had the money it would prefer to complete its double track, which would cost \$3,000,000; and there are two divisions on the main line between Chicago and New York not yet equipped with automatic signals. The company is anxious to complete this work and it would cost about the same as the train control installation contemplated by the commission's order. The company would also like to buy some steel passenger cars and complete its stone ballasting; and it is continually embarrassed by state orders for the elimination of grade crossings. It is now under orders of courts and commissions to spend \$10,000,000 for this purpose, and some of the work is under contract. He thought the burden of experimenting with train control should be borne by others. Passenger traffic of the Erie is thin with only two through passenger trains between Chicago and New York and about two local trains each way a day. The company has laid great stress on requiring obedience to signals on the part of its enginemen and every year conducts from 30,000 to 40,000 surprise tests. It is a very rare thing for an engineman to run past a signal except for a short distance. Mr. Parsons said he was not opposed to automatic stops, but the Erie has not for 20 years had a passenger train accident which would have been prevented by one. It has been experimenting with various devices. There is no question but that they stop trains, but many operating problems are involved. If a division were to be equipped now it would undoubtedly have to be changed in two or three years. He recommended that the commission arrange with the American Railway Association to pick one railroad to make a thorough test, the expense to be shared by all roads; the Erie would be glad to pay its share.

A. H. Rice, signal engineer of the Delaware & Hudson, asked that the order be not entered as to his road, on the ground that the only satisfactory type would be a continuous induction type, which he thought had not been sufficiently developed. He estimated the cost of the installation at \$927,500, including \$753,000 for engine equipment. The intermittent induction type would cost \$405,000. This covered 301 locomotives.

T. S. Stevens, signal engineer of the Atchison, Topeka & Santa Fe, filed a statement by A. G. Wells, vice-president. The Santa Fe has made no plans for installation, awaiting the commission's final order. The company is ready to stand its share of the expense of testing any device which the commission or the A. R. A. committee thinks should be tested. Commissioner Lewis said that most of the roads take the position that other work should be done before automatic train control is installed, and asked if the road would make the same plea if automatic train control devices were in a higher stage of development. Mr. Stevens said that for himself he held that the most important thing is signaling.

Charles Stephens, signal engineer of the Chesapeake & Ohio, was called to the stand and asked to comment on the report submitted by Mr. Peabody of inspections on the C. & O. He said certain defects referred to would be corrected; others are fundamental, but a way would be found to correct them. He said, however, that the report of the A. R. A. observers did not correspond with the records of the railroad; there are serious discrepancies. He filed a record which he said showed only two clear failures in two years out of 1,200,000 operations, but he admitted that there had been a great deal of difficulty with damaged shoes. This, however, was a question of clearance. The company should not be required to extend its installation at this time because it is necessary to change the location of the shoe on the engines. He believed this would eliminate the shoe trouble, but it would cost about \$30,000, which the company is not now in a position to spend.

"Is this a practicable device?" asked Commissioner Lewis.

"It has worked very satisfactorily," replied Mr. Stephens.

"Is it still in the experimental stage?" asked Mr. Lewis.

Mr. Stephens replied in the affirmative. "We are now engaged in re-designing the apparatus."

Commissioner Lewis asked if it unnecessarily slows up the traffic. Mr. Stephens replied in the affirmative, but this can be overcome by a permissive form of speed control. He said that the formation of ice on the shoe or the ramp causes no difficulty; but hard packed snow such as is found in the northwest would probably break off the shoe.

M. E. Miller, representing the Simplex Train Control Company, said that his device had been tested on the Buffalo, Rochester & Pittsburgh, and he asked that a representative of that road who was present be called to state the result of the test. E. W. Kolb, signal engineer of the Buffalo, Rochester & Pittsburgh, expressed reluctance to testify, saying he was present only to get information, but Commissioner McChord insisted that he state the result of the tests. He said the Simplex company had asked for an opportunity to make a test and the road had permitted this to be done on a branch line. Tests were made on two separate days during the last six months with an engine and one car; and the device did all that was claimed for it. It stopped the train. But there was nothing to show how it would work with a longer train. The officers of the road do not approve of the device, for it includes insulated sections of track and it would leave part of the track unprotected by the automatic block system. Mr. Miller said the objections could easily be overcome and his company was anxious to get permission from any road to make an installation over several miles.

Industrial Development in Southwest

B. A. Hamilton, vice-president in charge of operation of the St. Louis-San Francisco, asked that that road be relieved of the proposed order in view of the present ex-

penses confronting it in connection with proposed second main track and grade reduction work. In view of the commercial and industrial development now taking place throughout the southwest he would prefer to use the sum required for automatic train control for other purposes such as new cars and better highway crossing protection. To install train control over 238 miles would cost \$312,000. The territory named in the commission's order has an average of 18 trains each way daily. If the commission should not see fit to relieve his road he requested permission to make a combined installation of automatic train control and automatic block signals over the territory from Monett, Mo., to Aston, Oklahoma, a distance of 72 miles, all single track except five miles.

The representative of the Pere Marquette endorsed and adopted the report of the railroads' committee, especially the conclusion. Plans have been made to test the wireless type of train control as developed by T. E. Clark of Detroit. Ten miles of track have been set aside for this purpose near Detroit. It is planned to begin work in 30 days and to equip three or four locomotives. An installation of this apparatus over 150 miles with 65 locomotives would cost probably \$260,000. This road made the plea that, in view of this proposed test, it be omitted from any orders. A. L. Grandy, chief engineer of the road, thought that a year to a year and a half would be necessary for satisfactory experiments. A 10-mile installation is sufficient; this road needs its money for automatic signals, interlocking, grade separation, etc. When asked how long it would take to complete these improvements he replied, "at least 10 years."

Chesapeake & Ohio Costs

H. B. Wickham, vice-president and general counsel of the Chesapeake & Ohio, asked that his line be not required to make an installation throughout the entire limit designated in the commission's order, as with the completion of the installation to Staunton, Va., train control would be in service over 61 miles of road. It had been found necessary to redesign the apparatus and it was still in the experimental and development stage. With the completion of the installation through Staunton, the cost to the railroad company will have been \$372,742 with an annual charge of \$30,166. For the visual (light) signals the sum of \$74,326 was spent. The maintenance on this is estimated at \$13,604 a year, making a total installation cost of \$447,068 and total annual maintenance charge of \$43,770; and he felt that his road had complied with the spirit and intent of the commission's order.

H. F. Haag, signal engineer of the Kansas City Southern, explained the situation on that road. It does not operate trains of such a character, number, or speed as would bring it properly within the class of the other roads named in the order. It has but four through passenger trains a day, two in each direction, and these are somewhat local in character, averaging approximately 25 miles an hour gross speed. During 1921 only 8.7 freight trains a day were run on the division from Kansas City to Pittsburg, 128 miles; the average train would have about seven meeting or passing points in 122 miles. Railroads running more trains have not been included in the proposed order. The number of collisions which might have been prevented by train control apparatus on the Kansas City Southern has been very small. In the last nine years between Kansas City and Texarkana, 487 miles, there have been only 24 collisions, which show a total property damage of \$59,792, and personal injury bills amounting to \$114,015; a total cost of \$173,807, or an average per year per mile of \$39.57. These figures do not include the portion of the cost borne by other roads involved. The trains are operated by the train order sys-

tem entirely; there is no block system. From Kansas City to Pittsburg there has been only three accidents in the nine years, involving a total cost of between \$10,000 and \$11,000. The Kansas City Southern being a comparatively new railroad, much work of a permanent character remains to be done of a more elementary character than a highly specialized device such as train control. Many improvements which it deems necessary would increase safety as well as economy and efficiency in operation. For instance, there are still some timber trestles remaining in the main line, and some of the main track has not yet been ballasted. There are also still a few sags and bad curvature which should be eliminated as soon as the company is financially able to do the work. The expenditure necessary to install an automatic train control system on a full passenger division Mr. Haag estimated at \$625,000, which he said is beyond the ability of the road to furnish. The estimate is based on equipping 30 locomotives at prices from \$400 to \$3,000 per locomotive, and from \$200 to \$1,000 a mile for roadside equipment. It also includes the cost of installing automatic block signals. In reply to questions by Chairman McChord the witness said his estimates were based on figures from five train control companies, from which he had made a weighted average. He was asked to file the detail figures for the record.

Train Control Proprietors Heard

In order that representatives of two train control companies on the Pacific Coast need not stay over for the hearing on April 12, the Commission heard them on Friday. F. F. Bostwick of the National Safety Appliance Company, San Francisco, and R. L. Miller of the Otis Automatic Train Control Company, Spokane, Wash., presented brief statements and were followed by A. J. Brookins.

Mr. Bostwick emphasized the advantages of the magnetic system, not affected by weather, and said that the last four months' service on the Southern Pacific near Oakland, California, had demonstrated that maintenance cost would be low. His apparatus had been tested by Japanese engineers in Manchuria and Japan, where the weather conditions were satisfactorily met. During these tests the clearance between track element and the engine element was increased to 10 in. and the magnet of a track element had been set off the center 4 in. without harmful result. The track element was also surrounded with iron and the voltage of the track battery was lowered one-half, but the device functioned satisfactorily. The engine equipment would have to be cleaned and oiled every three months. The track element had been under water for two weeks at one time, but it worked all right. The maximum cost of the locomotive equipment would be \$350; and of the track appliances \$400 (per block). The labor of installing the locomotive device would cost \$25 and the track installation \$175. The additional cost of installing the speed control feature at each magnet location would be probably \$150. These prices Mr. Bostwick gave as maximum.

Mr. Brookins said that his device had received the approval of the Bureau of Safety as to its mechanical features. He had attempted to get a trial on the Chicago & Alton and also on the Atchison, Topeka & Santa Fe, but had been unable to make any progress.

R. L. Miller said that tests had been made of his apparatus in June, 1920, and February, 1921, on the Canadian Pacific (Spokane International) at Spokane; and since then a number of changes had been made.

At the close of the hearing on March 24 it was announced that other proprietors of train control devices would be heard on April 12.