INTERLOCKING LAWS IN THE UNITED STATES AND CANADA.

BY J. G. VAN ZANDT.*

This is the first of two articles on this subject. The second will appear in an early issue.

Since the United States has committed itself to the policy of railway regulation by commissions, it has often appeared desirable to emphasize the necessity of there being uniformity in the requirements of the different states. In no one particular is this uniformity more to be desired than in railway signaling and interlocking; and from a study of the reports of the many state commissions it appears desirable that this matter be given mention at this time.

Our present railway laws are a result of processes of evolution. The history of their making is most interesting, as it reveals the manner in which we have come to inherit laws dealing in many cases with items forgotten by the railroading profession because of their obsolescence. There are now on the statute books of several of the states laws passed years ago, possibly amended several times over to meet the changing conditions, and now either very difficult of interpretation or entirely inapplicable.

With the rapidly changing characteristics of railroading it has been found that those laws dealing in any but general principles have required continuous amendment. Thus amended they have often failed to be operative because they were difficult of interpretation. The natural conclusion to be drawn is that it is desirable that future legislation should state principles in no uncertain terms and should not specify details.

This has been one of the contentions of the railways in the past. It has long been misunderstood to be a contention against all legislation on railway subjects. The fact is, that there have been some laws passed which have received the united support of the railways. These have usually been those defining policies and establishing principles which encouraged uniformity of practice.

It is of interest to note that the first statutory provision made in the United States regarding interlocking was one which received the united support of the railways. This was the "Crossing and Drawbridge Act," passed by the legislature of the State of Illinois in 1887. The report of the Railroad Commission of the State of Iowa of the same year stated that the "railway managers were not only willing but were virtually asking for legislation." Previous to that year the only statute relative to crossings in Illinois was that of 1874, which required all trains to come to a stop before a crossing. In some other states similar statutes appeared specifying the character of the stop and the exact limits of the distance from the crossing, though not mentioning whether the engine or caboose should be within the limits stipulated. With the growing demands for increased speed, and as crossings became more frequent, it was often a question (as it is today) whether the full stop would actually be made, and, in case two trains met at the crossing, which was to have the right to cross first. These and other matters proved to be the necessity which was the "mother of invention," and the installation of interlocking was the result. The first plant was erected at East Newark, N. J., in 1875. It was a "Saxby & Farmer" machine, imported from England. Other installations were made soon after in other states, and there was no question as to their success. This settled the matter of right-of-way, but there was still the legal requirement of making the stop. One state, Minnesota, had provided that "when a flagman was stationed at the crossing" trains could proceed without stopping when receiving the proper signal. The Illinois Act of 1887 was the first to recognize the interlocking plant. The provision was made that no stop would be necessary when there had been erected a "system of signals, works, fixtures, and machinery" which, in the opinion of the Railroad and Warehouse Commission, would "render it safe for trains to pass over without stopping."

There is an element of comprehensive simplicity in this early statute. The principle is stated in unquestionable terms and there is no attempt to specify details of construction. The art of signaling was properly given a free opportunity for development, and at the same time the principle of protection was secure. The only desirable principle omitted was that which was afterward added by amendment in 1891, in which the commission was given mandatory powers in cases where the roads crossing could not agree between themselves, and in fixing the proportion of expenses. The test of time has proved that the desired results may be secured by the application of this and other very similar statutes.

Other states soon followed the example of the state of Illinois and laws were passed nearly every session regarding interlocking. Unfortunately the same principles were not always set forth, nor was it always clear just what was intended to be required. It appeared that, in some instances, the main object of the regulation—protection—was either overlooked or given secondary consideration, and the details were emphasized as all-important. The wise provision which authorized the Illinois Commission to appoint a competent engineer to examine the systems of signals to be used, and to report "for the information of the Commissioners" was an important item that was not always included in the other laws. It had evidently appeared unnecessary when the details of construction had been specified in the law, and so the inspections of the Commissioners were often necessarily perfunctory and wholly without competent counsel. The numerous sets of plans required by law were in large measure unintelligible to the eyes of the Commissioners and were carefully placed in safe-keeping without examination. In some states it has become practically necessary for the signal engineer of the railroad making an installation to give a lecture before the Commission explaining the elementary principles of common signaling devices to secure a permit for their operation. The natural result of these conditions was that many a poorly designed or inadequately equipped interlocking plant was permitted to go into operation. Thus there was a failure to secure the desired results, because, attempting to specify details, the law did not properly provide for a uniform principle of protection or competent expert engineering advice in its execution. "The success of the Interlocking Statute of Illinois," says an editorial in one of the engineering periodicals contemporary with this later legislation "is in a very large measure due to the expert advice of the consulting engineer."

There were other more radical departures in some of the new laws. For example, the Texas statute called for interlocking at all crossings, a requirement which not only works against railway development in a new country, but in many cases can hardly be justified on any grounds. Quoting from the General Laws of the Twenty-seventh Legislature (Ch. LXXXIX, Sec. 2), "That in any case where the tracks of two or more railways cross each other at a common grade in this state, it shall be the duty of such railroad company to protect such crossings by interlocking or other safety devices, under regulations to be designated by the Railroad Commission of Texas, to prevent trains colliding at such crossings." Many crossings of unimportant tracks present little need of any such equipment, and there are some at which it has never occurred that two trains have come to cross at the same time. When compared with more important crossings in other parts of the country where there is no interlocking, and where in spite of the heavy traffic con-

*Instructor in Civil Engineering, University of Illinois.

Digitized by Google
Original from UNIVERSITY OF CHICAGO
Generated for Jon R Roma (University of Illinois at Urbana-Champaign) on 2013-05-02 02:0 GMT / http://hdl.handle.net/2027/chi.103590110
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

ditions there have been no accidents, it appears that there is no occasion for such radical measures. It is the usual experience that when a crossing becomes used sufficiently to justify the investment of interlocking equipment, either on the grounds of the economics of operation or on account of the liability to accident, then the railways interested consider the matter voluntarily. Thus, as the district develops, the desired end is accomplished automatically, and without the installation of equipment unnecessary at the time of construction and possibly to be inadequate later when it might reasonably be erected. Fortunately, the Texas Commission has taken a broad view of the matter, and in commenting on their action state that "all grade crossings of railroads are required to be protected by standard interlocking devices or crossing gates, to be operated under the strict rules and regulations on the part of the railroads." This interpretation to include crossing gates as "safety devices to prevent trains colliding at such crossings" has been recently made by the Louisiana Commission also, and this Commission has given permission to the railways to run trains over crossings of logging roads without stopping "when the crossings have been provided with gates set normally against traffic on the logging roads."

It has probably been because of the broad interpretation of the laws by the various railroad commissions that the railways have been able to keep up with the requirements, and to operate without incurring unreasonable expense for interlocking at remote and unimportant crossings. This is, perhaps, one item in favor of regulation by commissions. It has often been pointed out that a Federal law would be a most satisfactory arrangement to secure the desired uniformity of protection. Certainly a Federal law attempting to specify the details of construction would be most undesirable. The numerous bills which have approached passing have so far been defeated, and, fortunately, the field is still open for reasonable legislation. There is evidence in every legislature that some kind of bill, either for the promotion of some new invention or some other financial gain, is liable to come up for consideration, and these indications prove that eternal vigilance is still a necessity. If there was to be a law of Federal origin there is no doubt but that the experience of the many states would indicate that a commission should be appointed to take care of the execution of the details. On account of the many duties now imposed upon the Interstate Commerce Commission, it is doubtful if the work could be successfully executed unless a new commission was to be appointed for the purpose. Unfortunately, the arduous duties of the present commission have caused much delay in the transaction of its business, and many details which might be of interest and value in the statistical work have necessarily been omitted. It would seem that a special commission of experts dealing with safety appliances, interlocking, and signaling only, should be considered as the most satisfactory solution. Like most of the railway commissions, the Interstate Commerce Commission was created for rate-making purposes, and in like manner, also, it is an open question whether such a commission should be required to pass on technical matters dealing with the safety of the traveling public. It might be pertinent to suggest that, judging from some of the reports of accidents, probably the indifferent attitude and the laxity of competent inspections have contributed to the frequency of railway accidents in this country.

The commission idea is comparatively a new one. It was in 1869 that Massachusetts created the first state railroad commission, and in 1871 there were several, "that of Illinois" (1) being in the lead "among the western states." In fact, there was no general railway laws of any kind until 1848. While England had been practicing a "progressive intensification of control" for several years before this, there was no commission created until 1873. In Canada the first board of railroad commissioners was appointed in 1888. The functions of all these were, in the first place, to adjust rates and to overcome the impracticabilities of the previous laws, many of which specified rates and schedules. There is no doubt that the commission has been a great improvement over the old rate-making system. For the same reason a commission is more to be desired for the administration of interlocking matters, and no form of legislation specifying details should be considered. In 1892 only 34 of the 49 states had provided railway commissions. Thirteen of these performed advisory functions only. Seventeen were regulative, and four were statistical bureaus only. Since that time there have been added powers and duties, until many are crowded with all kinds of rate-making and service-regulating functions. It may be said that no two states use exactly the same methods or have the rules of procedure. The lack of uniformity in the forms of accounting and of arrangement of statistical data has often been mentioned, and, fortunately, the conventions of commissioners are doing much to overcome these conditions. In matters pertaining to interlocking the powers and duties of the several commissions differ in the same way, though, fortunately, there are many respects in which they agree. One important power in which the law of Illinois gave the commission authority to compel interlocking where the roads could not agree has been followed in many states. The matter may be summed up as follows:

(1) The railways are given opportunity to agree between themselves regarding all points and to present the petition jointly.

(2) Either railway may petition in case they cannot agree.

(3) The commission may consider a crossing unsafe and may of its own initiative compel the railways to show cause why the crossing should not be protected.

(4) The installation of an interlocking device once decided upon, the commission has authority (a) in approval of the device, (b) in examination after completion to determine whether all reasonable precautions have been taken to insure its safe and efficient operation, and (c) in granting a permit for operation.

The report of the consulting engineer in the annual report of the Railroad and Warehouse Commission of Illinois of 1895 further states that, "One of the difficult tasks which the Commission has been called upon to perform, is the division of the expenses of the interlocking plant between the two railway companies whose lines intersect. Many different methods have been proposed for effecting an equitable division. The principal may be enumerated as follows:

"1. That the division should be effected in proportion to the number of tracks of each road.

"2. That the division should correspond to the number of trains sent over the crossing daily by each road.

"3. That the division of expense should be in proportion to the number of levers in the interlocking machine required for each road.

"4. That each road should construct the device in its own tracks and allot the expense of operation according to levers required for each road.

"5. By the force of existing contracts or agreements between the companies as to the protection of the crossing and the division of the expense.

"Consideration has been given to all these contentions in all the various decisions of the Commission according as the conditions seemed to require."

In Michigan the apportionment of the expenses was left to the Supreme Court. The law in Louisiana specified that the number of levers should determine the division of the first cost and the expense of operation should be divided equally between the roads. Ohio singularly has left the power of the determination as well as the possibility of the

(1) Henrick in "Railway Control by Commissions."

Digitized by Google
Original from UNIVERSITY OF CHICAGO
Generated for Jon R Roma (University of Illinois at Urbana-Champaign) on 2013-05-02 02:0 GMT / http://hdl.handle.net/2027/chi.103590110
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

separation of the grades to the county courts, but in most of the states the Commission has been given jurisdiction in the matter.

The many requirements of the different states would be much more difficult of comparison were it not for the fortunate custom which has become current in many of them of issuing in pamphlet form all the laws and rules on the subject. There are many duplications in the laws and rules which it appears might well be eliminated, thereby adding clearness to the requirements. Most of these pamphlets contain the rules and "recommendations" of the commissions. These will be taken up in a subsequent article.

In conclusion, let it be emphasized that simplicity is the "desideratum," and possibly the United States could do no better than to follow the Canadian Railway Law, which has been operating so successfully over the entire Dominion of Canada. Its brevity and comprehensiveness commend it, and in many ways it may be considered ideal. To quote from the annotated edition of Macmurchy and Denison: "The Board (of Railway Commissioners) may make orders and regulations with respect to the apparatus, appliances, signals, devices, etc., to be used upon the railways so as to provide means for the due protection of property, the employes of the company, and the public."

NOTES ON GROUND CONNECTIONS.

In a current issue of the "Electrical World" appears an article on ground connections by Edgar H. Holmes, from which the following points are abstracted:

Ground connections are of the greatest importance in any system for protecting apparatus from lightning discharges, and it has been the general experience of electrical engineers that imperfect earth connections have caused the majority of lightning arrester trouble. A common form of ground connection is the wrought iron ground rod or pipe which is driven into the ground, and to which the wire to be grounded is soldered. When using this class of ground connection it has been found that the blows necessary to force the rod into the ground tend to make it vibrate transversely, with the result that the earth is pushed away from the rod and a poor connection is obtained. To eliminate this trouble it is necessary to tamp the earth around such a ground rod after driving. A series of experiments made by the author to determine the effect of such tamping showed that in four average cases the resistance between driven ground rods and an adjacent water pipe system varied from 1,600 ohms to 1,950 ohms, and that the same four rods after thorough tamping showed resistances varying from 59 ohms to 90 ohms. Even the latter figures, however, are not as low as they should be for a good rod or pipe ground, as under favorable conditions it is possible to secure resistances as low as 15 to 30 ohms. Concerning the depth to which ground rods should be driven, experiments show that there is little gained by exceeding a depth of six feet. The resistance of a pipe ground does not vary inversely as the depth in a simple ratio. For the first few feet driven, the resistance decreases rapidly with each additional foot of earth, but as the depth increases the ratio is very much less. It has been found that the resistance is almost constant for depths greater than seven or eight feet.

The presence of common salt mixed with the earth surrounding a ground pipe or rod considerably decreases the resistance of the ground. In an experiment cited by the author, the addition of eight pounds of salt and enough water to keep it moist reduced the resistance from about 47 ohms to 15 ohms in a period of four days. It is, of course, evident that the amount of water present greatly affects the resistance and this was shown in the experiment referred to by the fact that after the resistance had been reduced to 15 ohms it gradually rose again, the total rise in four days being only about two ohms, however. A method of applying this salt to the soil is suggested by the writer as follows: The pipe is driven into the ground to a depth of five feet and the soil scooped out around the pipe at the surface of the ground to make a cup-shaped depression holding about four pounds of salt. In other instances a length of sewer pipe is used to hold the salt near the top of the pipe. In such cases a wooden cover is fitted in the shoulder on the sewer pipe and salt is introduced by removing this cover.

DIAGRAMS FOR THE SECTION FOREMAN.

It is the rule on some roads to make the track department responsible for the maintenance of interlocking connections to outlying main-line switches, especially in cases where the switch is pipe-connected to a side-track derail. The average section foreman is usually not familiar enough with interlocking apparatus to enable him to identify parts which need repairs or replacement from having been damaged by a wreck or derailment or from any other cause. In order to make it possible for repairs of this kind to be made quickly, and to help the section foreman to avoid misunderstanding as to the material needed to effect the necessary repairs, one road furnishes its section foremen with white prints of the standard connections used in all of the switch layouts they are expected to look after. For example, a diagram of each of the parts used in making the connections between a main-line switch and a side-track derail are shown on the print, which is standard for that type of switch connection. Each part bears its name and the dimensions and catalogue reference necessary to identify it without any chance for error. The prints also bear instructions to the foremen to telegragh the division signal foreman when repairs are needed, stating just what parts, as shown on the print, are required to repair the layout. If pipe is needed, the foreman is requested to state the number of feet that will be required, and in case of a broken derail he is expected to signify whether it is right or left-handed. The telegram to the division foreman enables him to ascertain, by reference to a print just like the one the section foreman has, what material is needed, and he can then have the same shipped by the first train. Sometimes the section foreman will mark up one of the prints so as to show what is wanted and mail it to the division foreman. This is done in cases where there is not so much need for quick repairs. Wherever this plan has been tried, the section foremen have found it very useful. It enables them to make themselves understood when they ask for signal material,—a class of material which, as a rule, they know very little about.

It is difficult to inspect bonded joints which occur in a roadway crossing the track. Thus these joints are a source of great annoyance to the maintainer and cause much trouble. As long, however, as 33 ft. rails are used (and it will be quite some time before they are all supplanted by longer rails) joints will fall in the road. So the maintainer must make the best of it. By placing the bond wires close to the angle bar and having the section men hew out the plank one and one-half inches around the joint, it will be found easier to inspect the joint without removing the plank. This scheme will in nearly every instance solve the problem, as it is the working up and down of the rail when the bond wires are held tight by the plank that causes them to break so much and so easily. Two bond wires on the inside of the rail and two on the outside will also be found a good preventative of trouble of this kind, as if the inner ones should break, the outer ones would carry the current. The inner bond wires should be copper, and the outer ones should be iron, as the copper is better protected on the inside.

Generated for Jon R Roma (University of Illinois at Urbana-Champaign) on 2013-05-02 02:0 GMT / http://hdl.handle.net/2027/chi.103590110
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CHICAGO