number of cars owned by each road to the total number of cars.

This seems to be a theoretically correct way of finding the just charge, so that the total amount paid by owners may equal the total cost to the users, although users with economical equipment for repairs would be gainers and those less economically equipped would be losers. An "average" is rarely true when applied to any specific case.

Having arrived at a basic labor charge, the fixing of the specific charges for certain common repairs becomes largely a matter of observation of the time necessary to do the work in each case. There is little to choose between the two systems of making out bills, on the fixed charge or on the charge per rivet removed and replaced. In those shops where the piece rate system is in use, it is usually based on a fixed price for each kind of repairs made. Rendering bills for repairs to other roads in the same basis would probably simplify the shop cost records. The other method, however, of arriving at the cost of repairs on the basis of number of rivets removed and replaced is perhaps a more equitable one since it allows to some extent for differences in the construction of cars and depends on a unit charge which can be determined with reasonable accuracy by observation; it also permits of the ready calculation of cost of repairs for any combination of damage which might not be specifically stated in a set of rules.

One important point which the committee has not touched in its circular of inquiry is the credit for scrap and the charge for second-hand material applied. This is of more moment in the case of repairs to steel cars than for wooden cars inasmuch as bent and broken parts can be straightened and spliced or patched and put in serviceable condition in almost every case. Practice differs widely in different shops and there is left open a fine field for contention over improper repairs unless some definite rule is adopted covering the replacement of parts with second-hand material. Take the case of a road which does not approve of cutting off and splicing bent or broken center sills, but insists on cutting out the damaged members entire and replacing them with new sills. One of its cars is damaged in collision and goes for repairs to a shop where it is the usual practice to splice center sills. Repairs are made and the car routed home with spliced sills, being in perfect condition in the opinion of the user. The owner's claim of improper repairs is not allowed by the user and contention ensues. Again, where a shop repairs a large number of steel cars it is not practicable to wait on the furnace men to straighten bent parts removed and then replace these identical parts on the car. Instead, a large stock of repaired second-hand parts is kept on hand to draw from. A slightly damaged piece may be removed and replaced with a patched or spliced piece. Are such repairs improper ones? These are only instances of the many such misunderstandings which may occur and which should be covered by some agreement.

Uneconomical Use of Block Signals.

In his opening address at the annual meeting of the Railway Signal Association, Mr. Hope, the retiring President of the Association, proposed as the chief subject for discussion the "Protection of trains at stations without delaying the approach of other trains." This is significant, and indicates a growing appreciation of the benefits to be derived from the block system. On most single track roads the time interval and flagging system was at first done away with to prevent collisions on the open road; but those who took this action soon found by experience that the remedy for that evil was equally applicable to the prevention of collisions at stations, and everywhere; also that it may bring in a far more tangible benefit, an increase in the capacity of the road.

Mr. Hope's road, the Chicago, St. Paul, Minneapolis & Omaha, is for most of its length a typical trunk single-track line, not enjoying the highest single-track earnings, yet carrying an important passenger traffic. Its officers, therefore, rightly aim to follow high standards of safety, although they do not feel able to put in as many signals as they want and need. In such a situation the result is a compromise, the "telegraph block system" in its simplest —or rather its most incomplete—form. There is a like condition now on many hundreds of miles of single-track railroads. The switches are not interlocked, the block signals are not in the most suitable location, and provisions for high speed in thick weather are generally lacking. Nevertheless, it is a block system, and, in the circumstances, the establishment of such an improvement is commendable, for it is an improvement and leads to further progress.

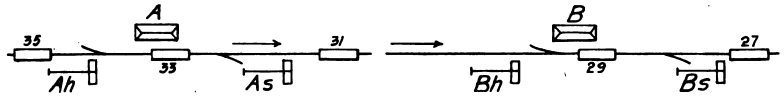

Fig. 2.—Home and Starting Signals at Each Station.

The problem is to get from the arrangement shown in the accompanying sketch, Fig. 1, the same results as are to be had from that in Fig. 2, without going to the expense of providing the additional signals shown in Fig. 2. It cannot be done. The arrangement shown in Fig. 1 will provide only for the easiest traffic. With stations 5 miles apart and trains 10 miles apart; and none of them having work to do at stations, the arrangement is practicable, provided switches are never left wrong. But if trains are close together there is a temptation to let the second train pass a little beyond the signal at A before the first has passed completely beyond the signal at B. This is done, no doubt, many times every day; but it is defective block signaling. It involves partial dependence on hand motions or oral signals, and these introduce an element of uncertainty. If an eastbound freight train (A to B) thus breaks the rule at A, to enter the side track at P E, (to avoid delaying a following passenger train), it will probably break it again by going out of the side track at O E on an oral or hand motion signal. If a train is doing switching at either switch, P or P E (station B) and the operator at B allows a following train to come on from A, that is not block signaling, but is more properly described as movement by written or unwritten telegraphic orders; for his own signal is not in the right location to fully protect the switching train. If any train, at either station, should move off and leave a switch wrong, the signal would only partly protect trains against the wrong switch; it would warn trains from but one direction; but this warning, as we have just seen, is weakened by the regularly permitted practice of running the front ends of trains some distance past a signal before obeying its indication to stop.

By providing two signals at each station, as in Fig. 2, those objectionable conditions are eliminated. If the practice has been of the kind just described, the additional signal adds greatly to the safety; while if the practice has been strict (keeping trains farther apart), the improvement doubles the capacity of the road; for each short section (as for example Ah to As) is as useful, measuring by the time it is occupied, as one of the long ones (from A to B). That is to say, a stopping-train spends as much time between Ah and As, as between As and Bh, although section Ah-As is very short as compared with As-Bh.

If, with the signals fixed as in Fig. 2, the levers working them are suitably interlocked with the levers working the switches, full safety is provided; and if, in addition to this, distant signals are provided in both directions, we have all needed provision for both safety and speed.

The only reason that we know for not using the arrangement in Fig. 2 universally is its cost. With careful and experienced trainmen and station men, the cheaper arrangement may work for years with satisfactory results. With an irregular traffic, or freight congestions, or scarcity of good men, necessitating the employment in responsible positions of inexperienced trainmen or enginemen, there is a constant risk. So we have the problem of balancing a known expense of $100 to $500 per station for signals, against a risk which can be measured only vaguely; and the resultant, if it could be determined, would be modified by the probable effect on the feelings of the superintendent, and the effect on the reputation of the company, of killing a passenger now and then.

The original question, therefore, comes pretty nearly being answered by a reply which has been made several times, in Signal Club discussions, to other questions on the relation of signals to safety. If a railroad will pay the money the signal engineer can quickly provide the needed signals; and signal engineers are now measurably well agreed as to how much money is required for any specified protection of trains. To signal a road in the way indicated in Fig 1, when many trains are to make station-stops of considerable length, either for passenger business or for switching, contemplates an uneconomical use of the track, for it violates the fundamental principle that block sections should be of uniform length, measured by the time that trains occupy them.

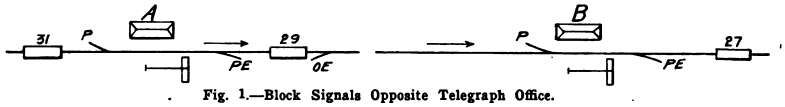

Fig. 1.—Block Signals Opposite Telegraph Office.

January Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of January, printed in another column, contains accounts of 31 collisions, 16 derailments and 3 other accidents. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances, occurred as follows:

	Killed.	Injured.
†1st—Newville, Pa.	2	9
†3d—Edgemont, Md.	2	38
4th—Clancy, Mont.	0	1
†6th—Willard, Kan.	10	40
†25th—Seeburger, Mo.	4	6
*†26th—Diaz, Ark.	1	3
27th—Ann Arbor, Mich.	0	0
†31st—Miller, Kan.	1	13

* Fire. † Passenger killed.

The butting collision at Willard, due to carelessness in identifying a freight train on the side track, was the eighth of a series of accidents occurring since October 15 which killed ten or more persons each, the deaths in the other seven aggregating 165. All of these seven (Lambertville, N. J.; Indianapolis, Ind.; Kentwood, La.; Tremont, Ill.; Godfrey, Kan.; Laurel Run, Pa.; and East Paris, Mich.) were collisions, except Laurel Run. At a more quiet time the Willard case would have served as a striking object lesson in single-track train-running methods. It shows once more the futility of depending on a conductor to correct an engineman's error, and incidentally serves as a reminder that a third man in the cab would be likely to be of little value. It confirms the view that a man's interest in the safety of his own life may often have no effect whatever in keeping him vigilant and careful. It is high time that railroad officers —if no other class—abandon the notion that such interest does have a definite value as a promoter of safety. To keep a competent block-signal attendant at every meeting point every night would cost five or six hundred dollars yearly. That sum, multiplied by the number of night offices lacking, is a rough measure of the price of a fair degree of protection from butting collisions on many single-track lines. The block system is the only remedy for these collisions that is worth attention; and the lack of the necessary money appropriation or of the courage to introduce the block system appears as the main element in any analysis that is made to discover the reason why such disastrous collisions continue to occur.

The Clancy accident is mentioned in our table because of its peculiarity, not its magnitude. The Ann Arbor derailment illustrates the value of the principle embodied in the rigid rule of the Emperor William I. of Germany, who never allowed himself or his officers to appear in military circles with a single coat-button unbuttoned. An officer of the road says of this accident:

"This bridge is about 500 ft. long and the part of the structure upon which the accident occurred is a steel trestle with alternate 30 ft. and 42 ft. spans. In the train were 35 cars. They were being hauled by an 85-ton engine assisted by a lighter engine pushing. The sixth or seventh car was the first one derailed, and it derailed the following cars by going to the outside of the curve. Ten of these derailed cars got across the bridge all right, when the guard rail gave way and the ties were bunched until an opening was made large enough to let a truck through. The trucks in falling ripped out the bracing, and two girders on the outside of curve, one 30 ft. and one 42 ft., were knocked down, taking with them one trestle post. Six or eight inches of the bottom of the post was imbedded in concrete inside of the cylinder pier, and it broke off 15 or 18 inches above the foot. Ten cars went down." It appears to be the conclusion of the officers of the road that if the bridge floor had been perfect the derailed cars might all have crossed safely. The guard rail was lacking for 150 ft., and the guard stringer was not bolted, but only spiked. The ties were of oak and new, but the rails were spiked only to every other one. It seems that some repair work had been done and had been left as finished, when in fact it lacked completeness in the particulars mentioned.

The number of electric car accidents reported in January was 17, in which 7 persons were killed and 162 were injured.