letin boards to which he had access. Having seen neither of these bulletins, the only instructions he had, therefore, were those contained in the book of rules, and he stated that, as it had been customary to pass red blocks, he had inquired and was told that there was authority for the practice. Under the book of rules trains in single-track territory are required to stop five minutes at a red block and then proceed under flag protection. This rule, No. 971, reads as follows:

Trains on single track finding signal in stop position will stop before entering block, and immediately send flagman in advance, wait full 5 minutes, and then follow flag through the block under control.

Conductor Hargett, of extra 1736, stated that he saw the flagman of the work extra at Adamsville, but did not talk to him or know why he was there, neither did he make any inquiry concerning him. He did not notice the indications of the automatic signals as he was busy figuring on where to meet an opposing passenger train. He had not seen either Bulletin No. 310 or No. 191 before the accident, but said a copy of the former bulletin was mailed to him afterwards. He had been on engines which passed red blocks on flagmen's verbal instructions. He had no authority for doing so except custom, and he said that in this case he would not have sent a flag ahead had he known he was passing a stop signal.

Flagman Allen, of extra 1736, stated that he had on previous occasions been on trains which had passed red blocks on verbal instructions.

Fireman Garner, of extra 1736, saw the signal at the north switch at Adamsville displaying a stop indication, and said that his train passed it at a speed of 6 or 8 miles an hour.

This accident was caused by the failure of Engineman Parker and Conductor Hargett, of extra 1736, properly to obey automatic block signal indications.

Operating Rule No. 971, as well as Bulletins Nos. 191 and 310, is involved in this case, but these employees stated that previous to the accident they had not seen either of these bulletins, and there is some evidence indicating that they were not properly posted. Not knowing of the existence of these two bulletins, rule No. 971 was the controlling rule and its requirements should have been rigidly observed. Had extra 1736 stopped five minutes at signal 721.4 and sent a flagman ahead, as required by this rule, the accident would have been prevented. On the other hand, his statements indicate that he would not have stopped his train even if he had known it was passing a red signal. Under these circumstances he is equally at fault with Engineman Parker.

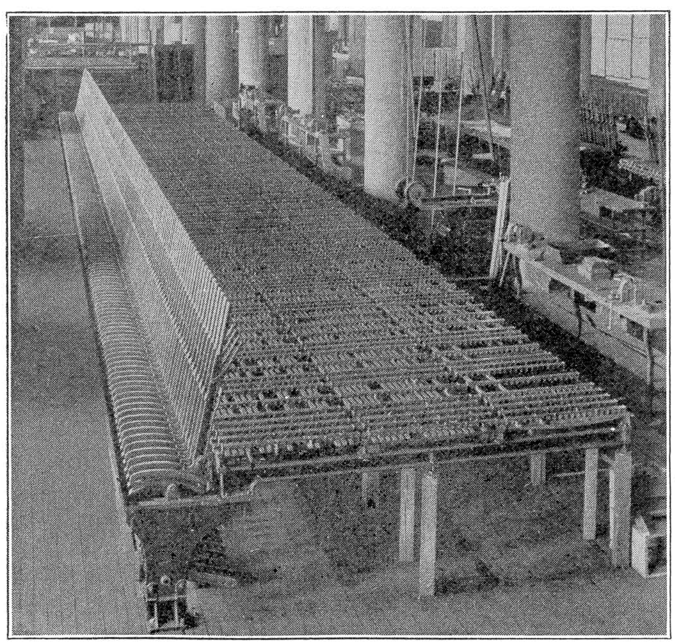
The crew of the work extra knew about Bulletin No. 191, while the crew of extra 1736 said they had not seen it. Neither of these crews knew of the existance of Bulletin No. 310. These bulletins do not authorize trains to pass red blocks unless flagmen are stationed at such blocks. This was not the case in this instance; consequently the provisions of these bulletins did not apply. But this does not alter the dangerous condition resulting from bulletins being in effect without the knowledge of employees. There can be no excuse for the existence of such a condition on any railroad, and the responsible operating officials of this railroad should take immediate steps to see that all bulletins are properly posted and that all employees are fully acquainted with their contents.

The flagman at Adamsville had oral instructions to notify all except passenger trains that the work extra was between those two points and to look out for the work extra at any point. The flagman at Coal Creek had written instructions to hold all freight trains, and to have them call the work train in by means of whistle signals. The conductor of the work extra should have given written instructions to both of his flagmen. Failure to do this, which is required by the bulletins referred to, has often resulted in accidents due to misunderstanding of flagging instructions, and Conductor Bazemore is to be censured accordingly. His failure to obey this requirement, however, did not have any bearing on this accident, as the statements of the engineman of extra 1736, as well as of the flagman of the work extra, indicate that the flagging instructions were properly and correctly communicated.

While under the circumstances as they existed in this case the crew of extra 1736 is responsible for this accident, attention is called to the fact that had the flagman at Adamsville been stationed at signel 721.4 instead of at Adamsville station, the crew of extra 1736 would have had the right, under Bulletin No. 310, to pass this red block and proceed until either the work extra or another red block was encountered. Had this been the case, the accident undoubtedly would have occurred, without any violation of rules on the part of either of the two crews involved, and the responsibility therefor would have rested upon the officials who authorized the issuance of Bulletin No. 310, for such an arrangement would have resulted in both trains having right to the track between signal 721.4 and the succeeding northbound automatic signal. Bulletins or rules authorizing trains to pass red blocks on single-track line, under any circumstances without full flag protection, are a serious detriment to safety in train operation. Immediate steps should be taken by the operating officials of the St. Louis-San Francisco to correct the dangerous situation created by the terms of Bulletin No. 310.

LARGEST SAXBY & FARMER MACHINE IN THE UNITED STATES

In connection with the reconstruction of the mechanical interlocking plant on the Pennsylvania at Dalton,



The 172-Lever Saxby and Farmer Machine Set Up in Factory for Testing Locking

Ill., a new interlocking machine was required. Some time ago an order was placed with the Union Switch & Signal Company for a Saxby & Farmer mechanical interlocking machine with 172 levers, of which 162 were to be working levers.

Recently this interlocking machine was completed in the plant of the Union Switch & Signal Company at Swissvale, Pa. The illustration shows the completed machine set up in the factory for testing out the locking, and the photograph was taken just prior to dismantling and preparing the machine for shipment to Dalton.

This is the largest interlocking machine of the Saxby & Farmer type in the United States. In addition to the new interlocking machine, the Union Switch & Signal Company supplied complete new lead out material, which will also be used in connection with the reconstruction at the Dalton plant.

A Study of the Soda Cell in Plain Language

The Electrolyte and Action of Copper and Zinc in Solution, Causes of Exhaustion, Crystallization and Local Action

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IT is with due appreciation of certain definite natural laws that manufacturers of soda cells take extraordinary care in the proportioning of active materials and are enabled to anticipate and make provision for an almost endless number of varying service conditions. Similarly it is with a knowledge of the effects of variations of one kind or another that recommendations can be made for the proper care of soda cells in service. In order to better appreciate the vital points of successful primary battery operation, it is essential to clearly understand the source of energy and something of the mechanism by which that energy is made available to do work.

The Electrolyte and Action of Copper and Zinc in Solution

The standard caustic soda cell consists of a solution of caustic soda in water, in which is suspended an element made up of a series of zinc and copper oxide plates. In electro chemistry, caustic soda (NaOH) is regarded as consisting of two parts, the sodium (Na) and the basic portion (CH) called hydroxyl. Ordinarily these two component parts are held in firm chemical combination, but, if the soda is dissolvved in water, the bonds holding the two parts are broken down and the two portions come to exist separately and are know as ions. The sodium ion, or Na, carries one positive electrical charge while the hydroxyl ion, or OH, carries an equal negative charge. This breaking up of a chemical compound such as caustic soda into ions, when dissolved in water, is known as electrolytic dissociation or ionization and the resulting soda solution, by virtue of its ions becomes a conductor of electricity or is said to be an electrolyte.

If zinc and copper plates are immersed in caustic soda electrolyte a very interesting and complicated cycle is set up. Both metals have a certain tendency to dissolve or throw off positive ions into the solution by reason of their solution pressure or, more simply, their solubility. As each plate gives off its positive ions, the adjacent solution acquires a corresponding excess positive charge while the plates themselves become negatively charged. This action is instantaneous and of sufficient extent to establish a definite equilibrium between each plate and its adjacent solution. Thus each plate with its negative charge is at a potential with respect to its adjacent solution carrying a positive charge. It so happens, however, copper is at a lower potential than zinc, because copper is less soluble, or has a lower solution pressure, and in consequence throws fewer ions into solution. This difference in potential between zinc and its adjacent solution as compared to copper and its adjacent solution is the true potential difference or voltage of the cell and, since both plates are in the same solution, there is, in effect, a difference in potential or a voltage between the plates themselves. Thus if we have a soda electrolyte with an element in place, an almost immeasurably small amount of zinc and copper will pass into solution as ions until the system comes into equilibrium. When this action, which is probably instantaneous, is complete there will be a voltage between the plates and the cell will exhibit the usual characteristics of any soda cell on open circuit and no further change will take place so long as the external circuit remains open.

Nevertheless, if the circuit is closed across the poles of the cell, the equilibrium which formerly prevailed is entirely upset. On open circuit, there were the two metals with its own potential solution with respect to its adjacent solution, now, on closed circuit, the two metals cannot retain different changes (since they are connected) and therefore neutralize themselves through the closed circuit. The result is, that the entire metallic system acquires a uniform charge equal to the average of the two separate charges formerly on the separate plates. Thus the zinc becomes less negative and the copper more negative than was required for equilibrium and the forces within the cell are again out of balance. In an attempt to re-establish equilibrium, the zinc plate sends off more positive ions that it may, thereby, become more negative and similarly the copper plate offers an attraction for positive ions that it may, accordingly, become less negative. This action within the cell to again establish balance tends to again set up the separate potentials, which continually neutralize themselves through the external circuit, or, as is more commonly said, a continuous current of electricity flows. Since this cycle results from positive charges continually being given off at the zinc plate in the form of ions, to be conducted through the solution to the copper plate, and, from there, led away as current, the zinc plate or, more properly, the junction of the zinc plate and the solution must be regarded as the source of current and zinc is therefore said to be electropositive and copper electronegative. Outside the cell, however, the copper pole is the apparent source of energy, it is considered as the positive pole and zinc as the negative pole.

With this description of the action within a soda cell as viewed in a very broad way, it might be of interest to come to a little greater detail as to the exact mechanism whereby positive charges travel through the solution and find their way to the oxide plate, there to be conducted away as current. If we assume a standard soda cell with circuit just closed, the solution would

*Abstract of paper presented at the St. Paul Sectional Committee meeting in March.