Tools and other loose objects must be placed so they cannot fall off; track jacks must be carried on the rear of car. Track cars must not be loaded so heavily or operated in such manner that they cannot be set off the track in advance of approaching trains.

(10) Employees must not get on or off moving track cars from the front or side. Starting or pushing motor cars from the side is forbidden, except in case of specially constructed inspection cars.

(11) Car must not be started before those on a car are seated and no one is permitted to stand on a car while it is in motion. Each man should be assigned a regular place on the car and must not be permitted to ride on the water keg or anything loose, or sit on the car with feet hanging over the edge. There should be an understanding as to each man's duty when taking car off track account approaching train. One man should be assigned as lookout for trains approaching from the rear and a lookout should be kept ahead.

(12) Except in case of necessity track cars shall not be operated at night or during storms or foggy weather, when the view is not good for one-half mile. When necessary to operate track cars at night or under obscure conditions, red and white lights must be displayed to front and rear. Headlights must not be depended upon as a warning of approaching trains.

(13) Motor, hand and velocipede cars must not be operated at a speed in excess of 15 miles an hour. Inspection cars protected by train order, or under special instructions from superintendent, may be operated at a speed not in excess of 25 miles an hour and may exceed 15 miles per hour only where track is straight and view unobstructed.

(14) Run slow over switches, turnouts, railroad crossings, highway crossings and curves. Positions of switches and derails must be carefully observed approaching them. Care must be exercised at interlockers to avoid injury on account of towermen shifting points, detector bars, etc.

(15) Approaching highway crossings, persons on or near the track, cars on adjoining track, buildings and other places where the view is obscured, be prepared to stop should any persons or vehicles move onto the track. Do not assume that others see the motor car or that they will stop or get out of the way.

(16) Live stock found on right of way must be driven off and fences closed.

(17) Track cars must be operated with care when passing trains receiving or discharging passengers and must not be run between such trains and stations.

(18) Main track switches must not be shifted to run track cars to and from main tracks, except heavy inspection cars running under protection of train orders or special instructions of superintendent, or cars loaded heavily with material; the wheels must be lifted over switch points.

(19) Extreme care must be exercised moving over trestles or bridges, through cuts, high fills, etc., where no places are provided for setting off cars, and curves and other places where view is obscured, by sending a flagman ahead when necessary, to protect against trains or other motor cars approaching, at the same time protecting against trains from the rear when necessary.

(20) On double track each track must be considered as single track. When train approaches car must be brought to stop immediately until it is determined which track the train is on, and if view is not clear for a sufficient distance to move safely, must remain standing until all of the train has passed, protecting against approach of a train from either direction on the track occupied by the motor car.

(21) Track cars must be removed from the track when not in use and must be placed not less than six feet from the nearest rail and securly blocked so that they cannot foul the track. They must not be left standing within the traveled limits of highway or private road, except in cases of emergency. They must be kept locked when not in sight of the men in charge, and should be kept under cover at night and at other times when not in use.

(22) Track cars must not be attached to trains or locomotives or run closer than 500 ft. behind moving trains or locomotives.

(23) The space between hand cars, when running, should be not less than 300 ft., that between motor cars or between hand cars and motor cars should not be less than 600 ft. A car in advance must not be stopped until the following car has been signaled.

(24) Insulated cars only shall be used where there are track circuits.

(25) Track cars must not be overloaded; brakes should be applied gradually, except in cases of emergency when warning should first be given.

(26) Hand cars must not be run with motor cars. If necessary to run push cars with motor cars, they must be coupled behind.

(27) Motor cars must not be shipped by passenger trains unless specially authorized. When shipped, fuel tanks must be carefully drained and all tank caps screwed down tight.

(28) Employees in charge of motor cars must make inspection at end of each day or trip to see that bolts are kept tight and unsafe conditions corrected. When repairs cannot be made by employees in charge, report must be made and steps taken to have such unsafe conditions repaired. Cars must be kept clean. Grease cups should be screwed down as required to keep bearings properly lubricated.

(29) In filling car, oil and fuel must be mixed in proportions as directed.

(30) If necessary to carry an extra supply of gasoline, it must be in properly constructed containers, painted red, with tops screwed down.

(31) Firearms must not be carried on cars.

(32) Side drive motor cars must not be run backward unless designed or adjusted, to make such movement safe.

Denison, Tex. J. A. JOHNSON.
Signal Engineer, Missouri-Kansas-Texas.

Remembering Always the Need of Being Careful Is the Most Effective Way to Eliminate Motor Car Accidents

REGULATIONS governing the use of motor cars on the Grand Trunk Western Lines include the following: No motor car is to be operated on the railway without permission from the proper authority and, when so operated, one man must be in charge and responsible for the observance of all rules. Brakes must be tested on each journey and cars must not be run over grade crossings until the full protection provided at such crossings for railroad traffic is given. Except in cases of actual necessity, cars shall not be run after sunset or during foggy or stormy weather. A distance of not less than 500 ft. must be maintained between cars running in the same direction. All motor cars used in the signal department of the Grand Trunk Western Lines are equipped with hand rails and gongs.

A bulletin, covering the operation of motor cars, is issued and all concerned are expected to familiarize themselves with the rules. I am of the opinion, however, that the most effective way to eliminate motor car accidents is to induce every man responsible for the operation of a car to carry in his mind always the simple but golden rule, *"BE CAREFUL."*

Detroit, Mich. W. L. DAYTON.
Superintendent of Signals, Grand Trunk Western.

Semaphore or Light Signals?

"For new installations of automatic signals, do you prefer semaphore or light signals? On single track? On double track?"

Unbiased Comparison Urged

SEMAPHORE signals have and are giving excellent service where ever used. That fact warrants the continued use of them where already installed. However, signal engineering has advanced rapidly. The development of the light signal is an advance in signaling, and we will be obliged to admit it, if we

make a study of them. Signal engineering does not jump at conclusions. Hence, where light signals are adopted, it behooves one to look into the reasons for such a change.

Increased traffic is nearly always the cause for an installation of signals. More and longer trains must be run on a shorter schedule with a greater degree of safety. If signals are to be used for the above reasons, then the best signal known should be used.

The one man most interested must be the engineman, who receives an indication by which he is governed. That signal giving the best indication is certainly the one for him to be guided by.

Experience shows that the light signal is superior to the semaphore signal. Place both types of signals at a given location in bright sunlight and trees or buildings for a background. The light may be seen twice as far as the semaphore. Look at the two signals at twilight and the light signal indication is still brighter.

Compare the two signals through a fog at night or daytime and the light signal wins again. This should be given serious consideration where fogs are frequent, at such times semaphore indication will be poor. Look at both signals after a wet drifting snow. Only those in the direct path of the wind will be dimmed. If the snow turns to sleet, the result to semaphore signals is disastrous to traffic. We have all had our troubles with sleet on the blades.

So far as mechanisms are concerned, we have all had difficulties with them. Electric lamps having the proper voltage fail so seldom that it need not enter this discussion. The whole question is one of reliability of the system and the certainty with which the engineman receives the indication at the proper distance from the signal.

The principal reason for installing semaphore signals seems to be that those operating motor cars may see the indication from both directions. Weigh this against the advantages gained by the use of the light signal and if it is a sufficient reason, semaphores should be installed by all means.

Henderson, N. C. P. G. BODWELL,
Signal Supervisor, Seaboard Air Line.

Adjusting Track Circuits for Maximum Battery Life

"How do you adjust track circuits to obtain maximum life from primary batteries?"

Several Methods of Adjustment Are Acceptable—Procedure Outlined for Both Wet and Dry Weather Conditions

SINCE there are almost as many different methods of adjusting track circuits as there are individuals making the adjustments it is naturally impossible for any one person to outline all the many acceptable methods which ultimately reach the same general objective, namely, the putting of enough current through the relay to pick it up sufficiently to close all of its points, under the most adverse ballast conditions, with the battery voltage at its minimum.

Many conservative signal men make it their objective to put enough current through the relay to pick the armature up *to the stop pins*, under the most adverse ballast condition, with the battery voltage at its minimum. Whether the objective be to put just barely enough current through the relay to close its points under the worst condition or to pick the relay up to stop under this same condition the same general method of procedure may obviously be used to adjust the track circuit limiting resistance unit.

Before proceeding with the actual adjustment of the unit, however it is obviously necessary to determine the values in voltage or current at which the track relay just barely picks up, or at which it picks up to stop, as the case may be.

Having determined this, it can readily be seen that the best, though not always the most convenient time, to adjust track circuits is during a spell of wet weather when the ballast resistance is at its minimum. If at this time the voltage of the track battery also happens to be at its minimum it is then only necessary to increase or decrease the resistance of the track circuit limiting resistance unit until the proper value is found which will put the required voltage and current at the track relay.

Since track batteries are not normally at their minimum voltages it is not quite as simple to adjust track circuits as it would seem even when the variation of the ballast resistance is eliminated, by making the actual adjustments in wet weather. When track battery voltages are above their minimum it is necessary to make allowances for this fact when adjusting the unit. To do this in a manner which will avoid any mathematics, certain signal men temporarily insert a rheostat in series with the track circuit between the battery and the conventional track circuit limiting resistance unit and so adjust this rheostat that the voltage on the track side of it will be *equivalent to the minimum voltage of the track battery*. After cutting the voltage on the track side of the rheostat to the equivalent of the minimum voltage of the battery the track circuit limiting resistance unit is adjusted in the usual manner until the proper voltage and current are in effect at the relay. After adjusting properly the unit the rheostat is removed from the circuit and the job is completed. When this method of reducing the effective voltage of the track battery is followed, great care must be used to readjust the rheostat, after each change is made in the resistance of the regular unit, as increasing or decreasing the current through the rheostat will obviously alter the effective voltage on its track side. (Unless this voltage is constantly kept at the equivalent of the minimum voltage of the battery the method is ineffective.)

Another method used to reduce temporarily the effective voltage of the track battery while the unit is being adjusted, is to put a variable low resistance shunt directly across the battery terminals, thus actually short circuiting the battery to a point where its terminal voltage will fall to its minimum effective operating voltage, after which the track circuit limiting resistance unit is adjusted in the usual manner. Though this method is followed quite extensively, unless considerable ingenuity is used it unnecessarily wastes the battery, and if the short circuit is left on too long causes permanent injury. Under the circumstances the use of the former method which does not waste any current and accomplishes the same net result is to be preferred.

To work either of the above methods effectively without the aid of mathematics requires either two men, one at each end of the circuit, using some code of signals, or several trips back and forth over the circuit by one man, in order to observe the operation of the relay as adjustments are made in the limiting resistance unit. A very few simple calculations in arithmetic make it possible for one man to do the work alone, with usually but one trip over the circuit. These calculations are based