many a line of that article, although there was nothing of the sort there. The writer still believes that the method of treatment in the article of Jan. 12 is more simple than one involving the use of formulas at every step. He cannot object to the use of any formula for train resistance or any formula for traction which any engineer may find to represent the facts. All such considerations can have effect given them in fixing the rate of grade which shall represent the ability of the engine at about the average speed, and this grade may be made to lie as far on the conservative side as seems best to each engineer, and if desirable may easily and intelligently be made more conservative in some cases than in others. In this way the method allows greater elasticity than a rigid formula.

C. FRANK ALLEN.

Signaling As It Is and As It Might Be.

THE EVOLUTION OF THE SIGNAL DEPARTMENT.

BY A. H. RUDD.

(*Continued from page 50.*)

It will be noted from the preceding article that the preliminary and experimental work was largely done before 1888, and that the last 12 years comprises the period of actual development.

In the early stages of railroad operation, the division superintendent was supreme, having under his immediate personal control all the operating branches of the business. He was superintendent of transportation and of motive power, traffic manager, car accountant, chief engineer, road master and superintendent of buildings. As business increased, and the roads developed, it soon became evident that no man could carry this burden in detail and improve the service as the public and the stockholders demanded.

One after another the different great departments were organized, and specialists were sought and established as the responsible heads. The telegraph revolutionized the work of the transportation department, the chief dispatcher becoming an important man. Lastly, not over a dozen years ago, the signal department, the baby of the family, had its birth. By reason of its late advent it is still in short trousers, and, in many cases, not yet out of its swaddling clothes. But is it not almost time now that it be given a voice in the councils of the family? Although young in years, it has demonstrated itself to be a very precocious youth, and has developed fast.

For many years fixed signals were regarded entirely in the light of luxuries. At present they are looked upon in many quarters as a necessary evil, and not even the most liberal managements regard them as an entirely unalloyed blessing. In most cases the signal department "was not born, it growed." The exceptions to this are few. There have been some lines on which the signal engineer was appointed, and the work installed under his direction, largely by contract and covering whole divisions at a time; but the usual development has been the installation of isolated plants, and, after the number of them had for some time warranted it, the establishment of a department. This is about the way matters stand to-day.

Referring now to interlocking, how familiar to contractors is the plan of tracks submitted for signaling. No consideration has been given by the engineering department, in its arrangement, with a view to making simple and perfect signaling easy, and a "forest of masts" arises (on paper) as one signal after another is added, absolutely necessary for proper working, but which might have been easily dispensed with by a slight rearrangement of the tracks. The additions made, the transportation department steps in. "This will cost too much money; there are too many signals; this move is rarely made; cut out that signal; this move will never be made except in emergency" (when signals are most needed); "we will give hand signals at such times. Now cut off 10 per cent. and we will talk with you." The revised plan goes through, and the work is installed, usually without supervision, or at best under that of some official entirely unfamiliar with the work. The signal companies, let it be said to their credit, usually give good return for the money expended, but either the ten per cent. deducted must be made up in some way, or their profits are nil.

After being put in service, the plant, if an isolated one, is cared for by the road department, whose man oils it semi-occasionally and sweeps out the sand when it gets working too hard; or by the motive power department, whose shop mechanic, a good man in his own line, makes repairs when absolutely necessary, or more frequently after a break down has caused a tie up; or by the carpenters of the bridge or building force, who perhaps built the tower, and consequently must understand all about its contents! The person in charge, not understanding the first principles of safe signaling, sometimes proceeds, if a wire breaks, to tie the arm in a clear position until repairs are made, because "we must get our trains over the road."

Then the impossible occurs, and movements are foud necessary that "never will be made." Hand signals are resorted to, with the inevitable result; a switch run through trailing perhaps, a case of rattles, or attempt to shift responsibility, a back up move over the broken switch, something on the ground, and—more repairs. The signal company's agent, always on the alert, then appears upon the scene. "Let us complete the signaling for you at this point, and these troubles will be avoided in future." The reader can guess the reply: "We want no more of your apparatus; it is always out of order."

We buy magnificent locomotives. Are they inspected by competent men before being accepted? Are they allowed to run without further inspection until they break down? Are they repaired by track or bridge men? When purchased, are they required to be complete, or do we leave off the head lights because the engines will be used only on day runs? Do we dispense with whistles because city ordinances prohibit their use, while in the country they are seldom needed, and in emergencies the bell can be sounded or the engineman may yell? Some dollars could be saved in this way, but the method is not employed. Signal plants are, however, installed incomplete for similar reasons. Hand signals are given where none should ever be resorted to except in the rarest emergencies, which have their parallel in the breaking of the headlight or the whistle.

Does anyone consider two bolts to an angle bar and one of them broken the proper thing in good track? Why are tracks inspected daily and trestle bridges patrolled frequently? Because, although it all costs money, it is the safest way and the cheapest in the end.

Why, then, in the name of common sense, should signal plants be installed without inspection and turned over to the tender mercies of men skilled in their own lines, but absolutely incompetent to perform work for which they have received no training?

This condition has existed, and it exists to day, in many places. The remedy lies with the managing officials, and no one else.

At the next stage in signaling development we find a signal fitter from the contracting company detailed as repairman. He fills the bill, but if he is disabled or leaves the service, no one is qualified to take his place. If additions are required they must be made by contract, for how many fitters can apply the proper locking until the plans have been provided for their guidance? How many shop men can build even a part of a locomotive off-hand?

The reason for this state of things is, as already intimated, that the intricacies of the work are not realized by the higher officials because the development has taken place since they were graduated from the school period of their railroad careers. And this does not imply any failure to keep abreast of the times either. Details of other departments are left to their heads; but with no department and no head, signals are in a sorry plight.

A case is known to the writer where a Pennsylvania Steel Co.'s machine was used to operate derails with lock and switch movements at the crossing of two double track trunk lines. As a wheel was revolved the derails were closed and locked and a further revolution cleared the home and distant signals in both directions on one line simultaneously. The detector bars were removed in the fall to avoid cleaning during the winter. In the same tower with this machine was a four-lever old-style Johnson, in no way interlocked with the other, but controlling a crossover and switch within the limits of the derails, said crossover being protected (?) by dwarf signals normally clear when levers were home. Enginemen received both high signals and the dwarf for one move, and the high signals only for another, running against the dwarf.

This is a fair sample of signaling under the conditions just described. Fortunately such work is now largely a thing of the past, though there are some cases as bad still to be found in actual practice.

With electric signals, if of simple form, the problem was less difficult. These, as soon as installed, were usually placed under the supervision of the Superintendent of Telegraph. His line men, being familiar with the care of batteries, relays and wires, easily learned in a few weeks to take ordinary care of the signal apparatus, and they did it if nothing more important was on hand.

This was a good organization and is carried out in several instances to-day. The natural increase of the work in time outgrew this arrangement entirely, necessitating the appointment of a separate official, or at least modifying it so as to have a foreman in direct charge reporting to the Telegraph Superintendent. But the latter, when called upon, in addition to his other duties, to supervise the erection and care of interlocking plants, is sure to be overburdened, and at all events is usually beyond his depth. In short, the whole business resolves itself into the old saw of the shoemaker and his last.

Let us now consider the third stage of the game; when the shoes to be repaired are so numerous that the shoemaker must be found, and some division superintendent "wearied and ill at ease" decides to appoint a signal foreman to take the load off his shoulders.

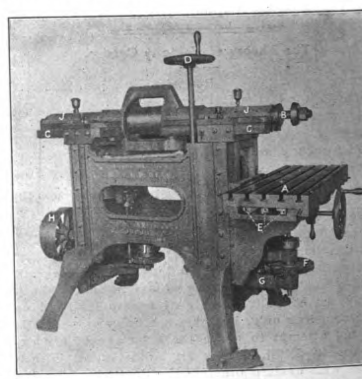
Where is the man to come from? Is he to be one of "our own men" or an "outsider"? The preference is usually given to the former, in which case the appointee must learn the business through actual experiences, and meet troubles as they appear. Not being acquainted with the work, he is liable to make costly, and at times dangerous mistakes. If an experienced signalman is desired, he is usually found with the manufacturers, and as the railroads generally pay lower wages than the latter, the only inducement for him to change is the promise of a "steady job" and the hope that he may not have to continually "live under his hat." While he has perhaps made a record on construction, he may fall by the wayside when maintenance problems confront him, and then he either loses his "steady job" or the company suffers. Only in exceptional cases will the signal companies part with their best men. The demand for good men is large, the number of them few, and so in many cases the policy obtains of employing mediocre talent, because it can be obtained at a lower price; and this in the face of the fact, that most of the roads—at least those which memory of actual examples now calls to mind—can amply afford to pay high wages, and their managements well know that the best is the cheapest in the end.

[TO BE CONTINUED.]

The Newman Emery Planer.

The Tanite Co., of Stroudsburg, Pa., recently built for the Pennsylvania Railroad shops at Altoona a Newman emery planer, larger, heavier and more substantial than those which have been for some years in use. The increased size of locomotives has called for this bigger machine, which is used for grinding parallel rod straps, slide valves, links, shoes and wedges for driving boxes, etc. It is especially useful in repair work.

A peculiarity of this machine is that while the bed A moves slowly, like the bed of an ordinary planer, the emery wheel, which is mounted on the sliding frame C and on the revolving spindle B, has a traverse motion at right angle to the motion of the bed. The table has three feeds, giving motions of $3\frac{11}{16}$ in., $5\frac{5}{32}$ in. and $8\frac{1}{32}$ in., each in two minutes. The piece to be ground is held in a chuck on the table and has a slow backward and forward motion while the emery wheel spindle revolves at such a rate as to give a speed of 5,500 ft. per minute to the circumference of the wheel whatever the diameter may be. While the planer bed is thus moving slowly backward and forward and the wheel revolving at over a mile a minute, the frame C, with the emery wheel spindle, makes 31½ throws per minute each way across the table. This variety of motion results in a kind of shear undercut, and it is claimed that the wheel will cut deeper and with less heat and friction than by any other method of application. An emery wheel thus mounted and run has made a throw of eight inches, cutting a depth of one-quarter inch. This, however, is an extreme case. The proper use of the Newman planer is to take light cuts and do approximately correct work on case-hardened or other very hard metal.



The Newman Emery Planer.

The machine, including the chuck, weighs about 3,029 lbs. and the weight of the overhead work is 526 lbs. The table is 15 x 42 in. and intended to grind 14 x 40 in. The spindle has a 15-in. throw and is 2½ in. diameter in the boxes. The table has through the hand wheel D a vertical adjustment of 13 in. The racks E are of steel with cut teeth. The large gear F, which controls the table motion, is of iron with cut teeth and the small cut gears G are of steel. The cone pulley H at the left of the machine makes 145 revolutions a minute. The pulleys of this cone are respectively 12½ and 13¾ in. diameter and are driven by a cone on the countershaft. By running this cone shaft at 550 revolutions a minute an emery wheel 10 in. in diameter will be driven at about 5,500 ft. per minute and the various motions described above will be secured through the cone pulley H.