It is guided laterally between two pairs of vertical racks fastened to two pairs of latticed towers built alongside of it. Each pair of towers is connected by overhead bracing. Into the racks gear spur wheels, which are connected to a stiff overhead frame on top of the basin, and which are operated from an engine placed on the frame. The spur wheels, actuated by the engine, serve as brakes when the moving lift basin approaches one of its extreme positions, or assists in moving it.

The ends of the basin, and likewise the ends of the canal, are closed by vertical sliding doors, which are pressed tight against a caoutchouc rim by the inside water pressure as long as basin and canal are not connected. As soon as the lift basin has reached either its lowest or highest position, water is admitted into the space between its doors and that of the corresponding canal end. The water pressure is so equalized on both sides of the doors, which latter are lifted by hydraulic power. The boats are towed into the basin and out of it by means of hydraulic capstans.

A full description of this lift work, of which this is an abstract, is to be found in the *Revue Technique*.

Oil Cup for Main and Side Rods.

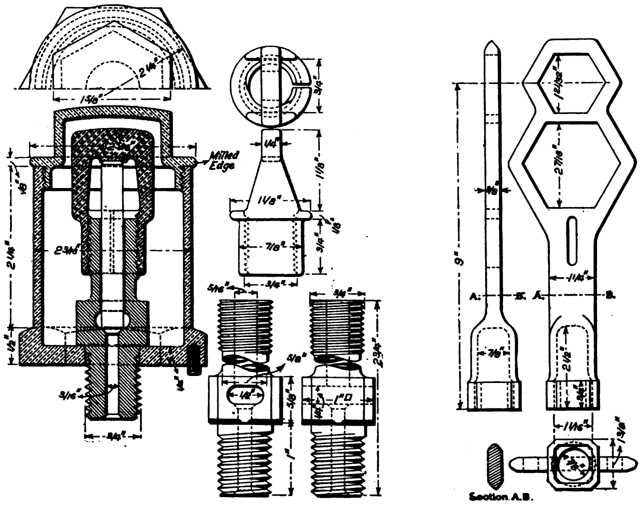
The accompanying drawings show the construction of an oil cup which embodies several improvements in the application of oil to the crank pins of locomotives or other rotating parts of machinery requiring lubrication.

The body of the box is of brass, polished outside and rough turned inside to insure lightness and freedom from sand or grit. The top is also of polished brass with a large hexagon for a wrench and so fitted as to screw tightly into the body of the cup. The cup is secured to the rod by a central stem of steel, projecting through the bottom of the box, and threaded at the upper and lower ends, the lower end screwing into the rod and the upper end carrying a cap which regulates the feed of oil. This stem has a $\frac{1}{16}$ in. hole extending from the top to a point near the base of the cup where it is intercepted by a cross feed hole. From this point downward is a $\frac{1}{16}$ in. hole. In the upper end of the stem is an iron spindle fitting loosely in the $\frac{1}{16}$ in. hole and ground to a joint at the point where the diameter of the hole is reduced. The vertical lift of the pin is limited by the cap, which is of brass and sawed open at one side so that it can be closed up so tightly that when once set its position can not be altered by the motion of the engine.

The advantages of this cup are that it cannot be broken or thrown off by the motion of the rod, as the central stem is of steel, separate from the body, nor can it be stolen by unscrewing it or breaking if off. The stem can be unscrewed only by a special socket wrench which reaches to the bottom of the cup. This wrench is also adapted to the adjustment of the feed cap and fits the cap and the base of the cup.

The cup has a positive spindle feed, automatically shutting off the supply of oil when the engine stops, and of sufficient weight to vibrate in heavy oil. It is easily adjusted; the amount of feed can be seen by removing the cap, and the feed adjustments are all within the cup.

The cup is the invention of Messrs. F. J. Cole, Mechanical Engineer, and G. B. Hazelhurst, General Superindendent of Motive Power of the Baltimore & Ohio, and is now in use on a number of railroads, several thousand having been made.



Hazlehurst & Cole's Oil Cup for Main and Side Rods.

Modern Railroad Signaling.

BY C. A. HAMMOND, M. AM. SOC. M. E.

In the Minutes of Proceedings of the Institution of Civil Engineers, Volume XXXVIII, 1873-74, may be found a paper by Richard Christopher Rapier, Associate of the Institution, "On the Fixed Signals for Railways," which has long been out of print and unpurchaseable except by accident. This is a pity, for it is one of the most valuable monographs on the history and principles of signaling that ever was written, perhaps the most valuable, and I doubt not that it has supplied many of the wise words on signaling that have appeared in sundry catalogues and in some of the contributions to the columns of the *Railroad Gazette*, for it is well-known to the closer students of signaling. It may not go amiss, however, to give to those readers who have not been special students of this art some notion of the value of this Rapier. It may whet their appetites and lead them to seek further acquaintance with him in those dim and dusty libraries where he may be found.

The first fixed signals of distinctive character appear to have been devised by Edward Woods, C. E., and indicated danger. For many years only danger signals were given by positive indications, and it is very interesting to see that the first idea of the men who originated fixed signals was the same as the first idea of the inventor who comes fresh into this field now, that is, to make the danger signal and not the clear signal the positive one. The fallacy of this idea is too well known to signal engineers and railroad men now to need emphasis, but it might not be a bad notion for the railroad men to whom a brand new system of signaling is brought to ask its inventor to carefully read Rapier as a preliminary to having his system considered at all. Such a practice would save a good deal of valuable time.

It was Mr. C. H. Gregory, past-President of the Institution of Civil Engineers, who, late in 1841, designed and erected at New Cross the first semaphore signals for railroads, and Mr. Rapier says that it was the most important step in the development of railroad signals, and it is interesting to learn that from the first counterweights were used to make the signal go to danger.

After the introduction in England of the semaphore signal, there arose the question as to how its indications should be given. With the development of the caution signal, it was at once seen that by using three positions of the semaphore arm, the three signals, danger, caution and safety, could be given; the danger position (horizontal) and the clear signal (vertical) having properly been given the extreme positions of the blade, the caution signal naturally came in midway between the other two. Thus we find that in England, as is true in this country, on some roads the three-position signal was used, and on others, the two-position: horizontal for "stop" and inclined for "go on." The latter scheme was conceived to be right, for the reason that wherever the block signal was in use, the caution signal would mean precisely the same as the clear signal, namely, "go on" to the next signal post, and if not, then no amount of caution would afford security. Another reason for abolishing the caution signal and adopting 45 or 60 deg. for the clear signal was, that when the arm is vertical the signal is practically absent, thus reverting to the wrong principle that the absence of a signal means safety; while on the other hand, the horizontal position for "stop," and the inclined position for clear, can always be seen. The arc of 60 deg. was preferred to that of 45 simply because it was found to be less unfavorably influenced by variations in the length of the signal wires, caused by changes in temperature, which would indicate that the art of compensating signal wires had not then been perfected.

It may be said that the final outcome of the discussion between the advocates of the three-position and those of the two-position signals was in favor of the two-position only, so that in English as well as in Continental practice, no difference is made at night-time between the danger signal and caution signal. This at once permitted the elimination of white for the clear signal at night, which was strongly advocated on some lines and which has now received official sanction in English practice. In this country, however, owing to the need which seems to be felt on many lines for using the block signal system permissively, the caution signal has become of far more importance in our practice; so that it is not probable that here we can ever do away with the three indications of signals.

The movement which has recently been under discussion in favor of using green for a clear signal, leaving red for danger, and using some intermediate color for caution, brings us at once to face the great difficulty of finding a satisfactory color for the caution signal by night. On one of the leading Western roads, this Gordian knot has been cut by combining red and green for the caution signal by night, on the principle that the more important color, red (signifying "stop"), being first seen, any misreading of the signal would be an error on the safe side, and the engineman, on nearer approach to the signal, would then discover the intermediate qualification of the green, and so, having slackened speed and thus prepared to stop, he would practically have acted as he should have acted if he had first recognized the signal as a caution signal. While this signal may have, and we are assured that it has, given fair satisfaction, at least to the management of the road, it can hardly be advocated on principle, for the reason that it is a weakening of the force of the danger signal, for which, in the minds of many experienced railroad managers, the color red should be sacredly reserved, free from all qualification, and never to be displayed for any other purpose whatever than to give in a clear and even startling manner the command, "Stop."

Where color alone is relied on for night signals, there has never been any serious thought of making any other color than red serve for the danger signal. It is true that on one road in this country, white has been used for the danger signal, but in this case color was disregarded, two white horizontal lights giving a "position" danger signal, and two vertical (green) lights a position "clear" signal. Recognizing the further principle, that giving to the safety indication a distinctive color, we may well believe, therefore, that no other color than red will be used to mean danger. If green be used for safety, we have the difficult task of selecting, or rather, of practically obtaining, a satisfactory color for the caution signal by night. All tones of yellow must be ruled out, since the ordinary "white" light is itself yellow or orange, as any one can see by contrasting it with the pure white of a neighboring arc light. Since we have to eliminate the ordinary white (yellow) light from our color scheme, only confusion would result by adding anything bordering on the yellow tone. Blue is out of the question, from practical considerations, for if glass of a light blue color be used, a flame shining through it will look almost like white light, especially when seen in contrast with red or green; while if a strong blue tint be used, the glass would be so opaque as to be of little value in railroad signalling. The tertiary colors being, of course, out of the question on account of the uncertainty in classifying the particular shade, we are really driven to the only remaining color, namely, violet, —that which is seen at the extreme end of the spectrum and which is not purple, for that is too near blue, while violet has a distinctly reddish tinge; and here there seems to be an objection to its use. If it is to have an important signal meaning, it is certain that in fast running under the block-signal system, there is no more important signal than the distant signal, and unless we are to adopt the European practice and make its horizontal position red, it is a question whether it would not be a dangerous thing to adopt a light violet, but a few shades removed from white, which might be termed by color-blind experts a "confusion" shade. This again brings up the important point that if the scheme of red, green and violet color only be used for night signalling, it would be of the greatest moment to eliminate from the railroad service all enginemen who are in any degree color-blind. However clearly visible, and apparently well differentiated the red and violet colors may be under the most favorable conditions, it will take a nice eye for color to always discern the difference between them when their hue is modified perhaps in a very great degree by smoke, vapor and unfavorable atmospheric conditions. Under such unfavorable conditions, perhaps during a time of storm, he would be the more likely thus to err; this would be certain in time to result in disaster.

It is a question with many practical railroad men whether there is sufficient reason for abandoning the present scheme of color, long recognized by the standard code and to which railroad men have been bred, so that their significations have been branded, as it were, into their very being; and here it is that the illuminated semaphore ought to prove an important aid in solving this perplexing question. As a recent editorial in the *Railroad Gazette* has well expressed it, there is no need to see a railroad signal, particularly a distant signal, a great distance in advance of the same. In fact, however, the illuminated semaphore can be seen much farther than any violet light will show, since it uses for its clear signal the unobstructed white rays, which have the greatest degree of penetrating power; and, since its clear signal is so distinctive and quickly recognized, its absence from the accustomed point at which it is displayed would be instantly noticed even by a careless engineman. It must be admitted, however, that much of the argument stated would lose its force if in this country we should come to adopt the foreign practice of having but two signal meanings by night, namely "all clear, go on," and "danger, stop."

Distant Signals seem to have been first introduced in Scotland in the year 1846, and were at first put about 50 yards on either side of the points-man's box; but, having to walk to and fro so many times a day in order to set the signals, the canny Scot arranged a wire, with a few rail-chairs for a back-balance weight, so that from his box he could and either signal to safety. This arrangement was found so convenient that the distant signal was afterward placed 250 yds. in advance of the points of danger, and in 1852, the Great Northern Railway was completely fitted with distant semaphore signals. Another interesting evolution in English railroad signalling was the order in which signals should be read when more than one was displayed on the same post. The first practice seemed to have been to put the main-line signal at the top, then the "main platform" line, the "goods" line, and after that, the "through crossing" or other subordinate lines in a regular order. A later plan arranged the signals so that the top blade should govern the road farthest to the left (the Englishman runs on the left-hand track as everyone knows and the signals are placed on the left of the road), and so on in regular order, the lowest blade indicating the extreme right-hand track. By the first plan it was contended that the driver of an express train has the advantage of always knowing that the top signal is for him, regardless of what station he might be approaching or what arrangement of tracks he might find there; whereas by the new plan, he had to know where he was and then pick out his own signal accordingly, which might be the first blade in one case, the second in another, and the third or fourth in others.

Another modification was to place all signals, say four or five of them, on the same bracket, giving a post to each, but even then it was soon found necessary to put the main-line signal higher than the others, and thus there was no compensating advantage in increasing the top weight of the bracket. Once having found it necessary, however, to increase the height of the main-line signal, this principle finally prevailed, having the merit of simplicity, certainty and reasonableness.

Owing to the peculiar climatic conditions of England and the unusual prevalence of foggy weather, it was soon found necessary to supplement visible signals by those which should appeal to the ear also, and it was in the year 1841, the same year that witnessed the invention of the railroad semaphore, that Mr. E. A. Cowper, also a member of the Institution of Civil Engineers, designed what was known as the detonating fog signal, which ist almost universally used on English roads, and consists of a small metallic case with two leaden ears to hold it to the head of the rail, ordinary gunpowder being used for the explosive mixture, fired by the crushing of a couple of Promethean matches, which were made with a small glass bulb of sulphuric acid, around which was wrapped in paper a little chlorate of potash and sugar; afterward, fulminating powder was used. By way of coincidence, it was Mr. Gregory, the inventor of the semaphore, who first allowed the detonating signal to be tried on the Croydon Railway, and adopted it as a standard device.

English invention in signalling was then as active as we find it here to-day, and a host of contrivances sprang up intended to give signals to the driver of an engine by bell or whistle, but nothing ever came of them. Electrical devices were also used; for instance, on the Northern Railroad of France, a metallic brush took current and opened a steam whistle on the engine to arrest the driver's attention "provided all goes well with the apparatus." The objection was made, however, that the driver, hearing no signal, would suppose that his way was clear, and that this would set up the principle that the absence of a signal implies permission to proceed, so that all plans of audible signals were dismissed as merely reverting to the old idea of giving danger signals, a system which the author pronounces as entirely inadequate to the requirements of English railroads.

Electrical devices, however, were early seen to be important in connection with interlocking work, and, in fact, the telegraph may be said to be the corner-stone of block signalling. By the absolute block system, the greatest possible number of trains can be made to travel over a single pair of rails in a given time, but the complete installation of interlocking plants was found indispensable to the success of any block signal system. With the enormous traffic that is handled at terminal stations in England, particularly in London, where, at the time of our author's writing, at Moorgate street station, over 1500 movements of engines and trains were made over four lines in 19 hours, every movement of which required to be distinctly and separately signalled, it is admitted that these remarkable results would have been absolutely impossible without electrical instruments of communication and protection.

Before concluding the writer would mention a point suggested several years ago in a discussion on an English paper regarding signal lights, in which the idea which we have recently heard advanced was brought out, that night signals should be given by powerful lamps; and a Mr. Douglas regretted that the paper in question had neglected to discuss the improved signal lamps, of which presumably he was the inventor. He advocated immense parabolic reflectors like those we use for head-lights, two of which, mounted in a great lantern, gave the proper signal indication; but as the expense was $50 or $60 apiece it may be surmised that the benefits which seemed so clear to Mr. Douglas were not equally obvious to the railroad managers; and indeed, as pointed out above, it would seem to be a false principle of signalling, anyway, to seek to make signal indications visible at great distances, since, with the necessary multiplication of signals, as traffic and the necessary terminal accomodations increase, there would be great danger of confusing the near with the farther signals. What is particularly needed for a railroad signal is distinctiveness, and too much emphasis cannot be laid upon this point. It was the writer's experience with illuminated blades, at a point where they were surrounded by street and electric lights, that has led him to the conclusion that a distinctive form of signal, even if not visible three miles or even one mile away, is much more desirable than an extraordinary increase merely in the brilliancy of the signal light, if its distinctiveness (and this can best be secured by form principally) be lost sight of.

The Johnson Boiler Tube Expander.

The engraving Fig. 1 shows a new self-feeding boiler-tube expander, made and sold by the Henry C. Ayer & Gleason Co., of Philadelphia. Fig. 2 shows the construction of this tool. It consists of a central taper-shaped roll with a capstan head surrounded by five smaller rolls, whose knobbed ends are encased in a collar. When the central taper shank is forced in and at the same time turned, it causes the smaller rolls to revolve and to expand the tube. The twist given to the capstan bar is transmitted to the tool itself, which turns the small outside rolls at an angle with the axis of the tube, as shown in Fig. 3. The counter revolution of the small rolls, produced by the direct rotation of the central shank, causes them and therefore the tool as a whole to advance into the boiler tube without forcing or driving. Being slightly tapered any advance must be attended by an expansion of the tube. When the tool is turned in the opposite direction the outside rollers straighten themselves with regard to the central pin or shank which releases the tool.

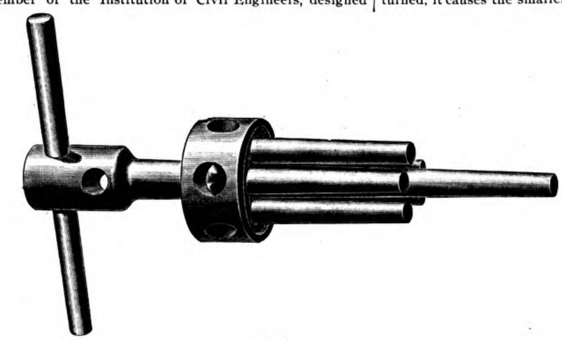


Fig. 1.

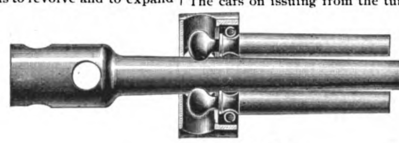


Fig. 2.

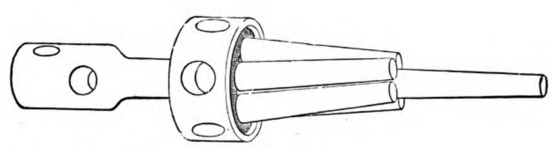


Fig. 3.

The Johnson Self-Feeding Boiler Tube Expander.

It is claimed that in the usual form of boiler tube expander the driving of the center pin not only damages the tool but injures the tubes. This tool has special advantages in scaly or old flues as it has not the tendency to produce leaks that those driven with a hammer have. The tool has been in continual service for three years in the Delaware, Lackawanna & Western Machine & Car Shops at Kingston, Pa., and is said to be in as good condition now as when first used.

The tool in the hands of an apprentice boy has a record in the Lackawanna shops of expanding one end of a full set of 220. No. 11 W. G. flues in 10 hours, without the use of a hammer, and the job was so well done that no caulking was necessary for two years, though the engine was in daily passenger service. It is made in sizes from 1½ to 7 in. inclusive.

Some Results in Garbage Cremation.

The results of the recent trials of a new system of garbage cremation in Chicago, the invention of Mr. James C. Anderson, have been favorable. Not only was the quantity burned large, but the residue, after cremation, was but a small per cent. of the original.

The crematory used was the tunnel kiln, in which the pressed bricks of the Chicago Anderson Pressed Brick Co. are burned. This kiln consists of two brick tunnels having a common wall between them, each capable of holding ten ordinary flat cars. In the sides of these tunnels, for the space of about two car lengths each way from the centre, are openings on a level with the floor of the flat cars, and through these the flames from burners using crude petroleum impinge on the contents of the cars. These cars are about the size of those used in freight service, and are built of steel and iron, the floors being covered with an insulation of firebrick to prevent injury to the cars by heat. To exclude the heat from the trucks and underframe of the cars, a sand seal is provided along each side and the cars kept fastened closely together. This has the effect of dividing the kiln into two chambers, the upper one being used for the combustion and the lower kept cool by numerous openings. With a heat of 3,000 deg. Fahr. in the combustion chamber, the underframes of the cars are only slightly warm. The tunnels are always kept full of cars when heated, and are provided at each end with sliding doors of sheetiron, which are raised only for the admission and exit of the cars. At each end is provided the necessary apparatus for moving the trains, in the present case consisting of a winding drum with a cable, which is attached to the foremost car. In kilns to be built hydraulic machinery will perhaps be employed. The necessity of having this at each end is that the two trains move in opposite directions. Also at each end is a transfer table, upon which the cars run as they are drawn out of the tunnel.

The loading and unloading apparatus was merely put up for the occasion, and consists of endless chains with scrapers attached, but this method will not be employed when a kiln is built expressly for garbage cremation. In the operation of burning the garbage each car as it enters the tunnel runs under a hopper and is loaded with garbage. On entering, the heat at first is sufficient to begin the evaporation of the moisture, and by the time the car reaches the flames in the centre of the tunnel the garbage is thoroughly dried out. To allow the flames to come into contact with all parts of the garbage the mass is stirred by means of long iron pipes, through which is forced a current of compressed air, which not only thoroughly stirs up the dry garbage, but also assists the combustion. By this method refuse consisting of a mixture of garbage proper with a large quantity of ashes and cinder, which heretofore has been burned with difficulty in crematories, is here readily disposed of, as the air effectually stirs up the ashes and prevents them caking down. The cars on issuing from the tunnel pass under an endless chain provided with scrapers, and the small residue is removed. By means of the transfer table they are shifted to the other tunnel, loaded, and run through the second tunnel in the opposite direction from which they passed through the first. The heated gases escaping from one tunnel pass through a flue partially surrounding the other tunnel, and thus assist in heating its walls. The capacity of the kiln where the tests were made is 100 tons an hour.

In this same kiln a few weeks ago was tried the experiment of coking the refuse slack from western coal mines. The trial seemed entirely successful, a good domestic coke of a bright silver tint being produced. This coking process makes it possible to utilize the by-products which under the old system go to waste.

Corrosion of Pipes and Cables from Electrolysis.

In our issue of April 6 appeared an article on the above subject which showed injuries to pipes and cables by the return currents from the trolley electric system. In a paper entitled "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," read before the eighty-sixth meeting of the American Society of Electrical Engineers on April 18, Mr. I. H. Farnham gives further data on the subject and mentions some remedies proposed.

First: It had been proposed to remove all cables from the wet bottoms and sides of manholes, but it was found difficult to place and retain cables free from the wet sides. Had this been accomplished the action at the mouth of and within the ducts would have still continued. They were, however, all removed from the bottom.

Second: Ground plates constructed from pieces of old lead cable, 6 to 10 feet in length, were embedded in wet earth at the bottom of manholes in the hope of transferring the electrolytic action to these plates. In some cases the voltage between the cables and the earth was reduced 25 per cent.; in many others no noticeable reduction was made.

Third: A plan suggested, but not tried, was placing motor generators operated by the railroad power current at different points along the line where cables and pipes were in danger, the secondary current developed to be utilized to lower the potential in the cables and pipes to zero, with respect to the surrounding earth or rails. The