and secured as to prevent the lower end being pulled open sufficiently for a person to insert his hand and arm and remove small packages.

The President announced the following subjects and and committees for the next meeting:

Management of Steam Heat on Passenger Cars; Is the Use of a Trap Necessary and Advisable? E. D. Bronner, Robert Gunn, John S. Lentz.

Average Life of Flues in Locomotives Working under a Steam Pressure of from 125 to 140 pounds and boilers under from 160 to 200 pounds. A. E. Mitchell, E. A. Miller, P. E. Garrison

Oil for Locomotive Fuel in Southern California.

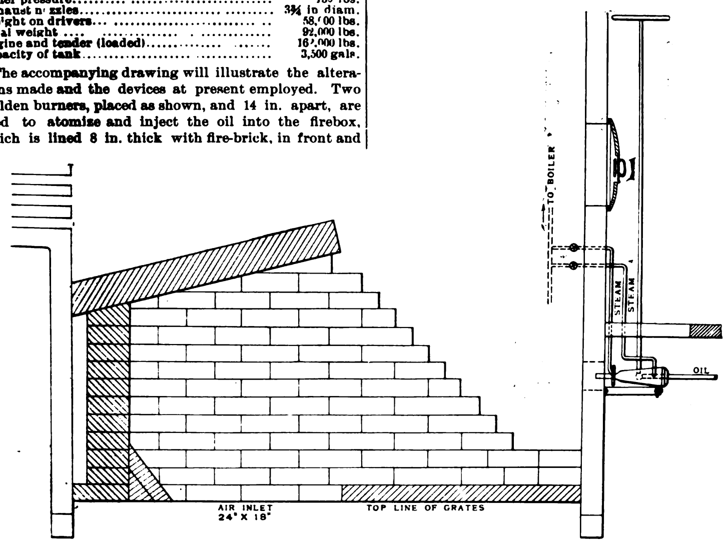
BY MR. GEORGE B. LEIGHTON,
President Los Angeles Terminal Railway.

In localities in which the relative prices of coal and oil are such as to possibly justify a change from coal to oil burning on locomotives, the following highly satisfactory results, obtained from recent experience on the Los Angeles Terminal Railway, may be found of interest. Oil is now found within the city limits of Los Angeles.

A Baldwin eight-wheel passenger engine, of which some of the more pertinent dimensions follow, has been changed from coal to oil burning, with the Holden burner, as used on the Great Eastern Railway of England.

Cylinders	18 in. × 21 in
Driving wheels	60 in.
Fire-box (at grates)	72 in. × 34 in.
Grate surface	17 sq. ft.
Heating surface	1,149 sq. ft.
Number of flues	211
Length of flues	10 ft. 11 in.
Diameter of flues	2 in.
Boiler pressure	150 lbs.
Exhaust nozzles	3¾ in diam.
Weight on drivers	58,000 lbs.
Total weight	92,000 lbs.
Engine and tender (loaded)	162,000 lbs.
Capacity of tank	3,500 gals.

The accompanying drawing will illustrate the alterations made and the devices at present employed. Two Holden burners, placed as shown, and 14 in. apart, are used to atomize and inject the oil into the firebox, which is lined 8 in. thick with fire-brick, in front and partially on sides, an air space of 2 in. being left between the brake and the sheets to prevent overheating.



Firebox of Oil-Burning Locomotive—Los Angeles Terminal Railway.

A description and detail drawings of this burner will be found in the *Railroad Gazette* of Feb. 26, 1892, page 152. Roughly speaking, it consists of three concentric tubes, the oil passing through the annular space between the outer and middle tubes, and steam from the boiler passing through the like space between the inner and middle tubes (the inner tube carrying air) the steam and oil pass into and through one combining tube, from which they are discharged through two small holes in the end forming two jets for each burner one straight ahead, and one at such an angle with the axis of the burner that it meets the corresponding jet from the other burner about the center of the firebox, the four jets there flaring out and forming a sheet of flame which fills the box horizontally, and impinging against the front brick wall, follows back under the brick arch, and then up over it into the flues. A more intense heat is obtained than with coal, but is so evenly distributed that no objectionable local heating takes place. The bricks in the box become white hot, and retain their heat so that the engine will stand all night (10 to 12 hours) with dampers and smoke stack closed, and retain a pressure of 20 to 30 lbs. of steam in the morning. The oil feed is regulated separately in each burner. One is arranged so that a quarter turn of the wheel shuts off the oil, and the other requires several turns. Thus one burner may be shut off simultaneously with the closing of the throttle, and the other which is left burning during stops, as well as when running, is used, by virtue of its gradual feed, to nicely adjust the supply of oil to the demand, as indicated by the smokestack and steam gage.

The grate surface is floored over with brick, except a rectangular space 24 in. long by 18 in. wide, through which air is admitted. The brick arch is longer than in ordinary practice, and by the proper adjustment of this arch and the grate opening, preventing the incoming cold air from striking against the exposed parts of the sheets, no trouble need be had with leaks, resulting from undue contraction when the oil is temporarily shut off, or turned down, and there is no indication that boiler repairs will be materially increased.

The oil tank is built to fit in the coal space of the tender, and holds a supply of 23¼ barrels of oil (equivalent to about seven tons of coal), the oil being heated by a coil of steam pipes in the bottom of the tank, as more satisfactory working is obtained when the oil is thinly fluid. An air pressure of five to seven pounds per square inch is carried in the tank—this and the heating device being especially necessary in the use of heavy oils—the wire netting and baffle plate are removed from the front end and the nozzles reduced to 3 in.

Following is the cost of making the changes, though these figures may be materially reduced where labor and material are cheaper, and facilities for such work are better:

Material for oil tank	$71.24
Two Holden burners	150.00
Lining brick for firebox	15.25
Miscellaneous pipes and fittings	10.97
Labor and superintendence	107.72
Total	$358.18

An additional expense of $63.50 for 50 barrels of oil, and $35.00 for minor experimental alterations, was incurred in running the engine, in trial service, before putting it on to revenue trains. The engine has been heretofore running in light passenger service between Los Angeles and San Pedro (27 miles) burning Wellington coal (Vancouver Island) costing $7.50 per ton on the coaling track. During experiments extending over a period of two weeks prior to the change, a precisely similar engine, in essentially the same condition and the same service, evaporated 6.2 lbs. of water per pound of coal, from feed water at 60 degs. F., to steam at 150 lbs. pressure (366 degs. F.). Since the change we have burned two different oils; the first, a Santa Paula oil of 24 degs. to 28 degs. Beaumé (7.5 lbs. per gallon) gave an evaporation of from 11.73 lbs. to 12.40 of water per pound of oil, these being the extreme limits. The least favorable of these limits makes 3.3 barrels of oil, costing $4.19, equivalent to a ton of coal, costing $7.50—a saving of 44.1 per cent., while the most favorable gives a saving of 47.2 per. cent. The above is figured at $1.27 per barrel for oil, which it has cost us in small quantites (27 cents being freight charges).

The other oil is a Los Angeles product of from 13.8 degs. to 16 degs. Beaumé (8 lbs. per gal.) which we get for 75 cents per bbl., and which has given an evaporation of 10.31 lbs. of water per pound of oil, which, figured as before, gives a saving of 64.2 per cent.

The approximate accuracy of the above is checked as follows: During runs covering a total of 1,094 miles with Los Angeles oil the cost per mile for fuel has been 11.1 cents, as against an average for the previous year of 28.3 cents for coal. This shows a saving of 60.8 per cent. The difference between these two results may be accounted for by the fact that in the coal-burning service the engine was allowed a slight switching mileage, and in the oil service none has been allowed, and also in oil burning a small percentage of the steam generated is used in the burner and in the steam pipes for heating the oil, this making a slight increase in cost per mile for fuel that the evaporation comparison would not show. Where an engine is worked hard, with heavy trains, or at high speeds, and the waste of coal correspondingly enormous, a still greater saving may of course be had, as combustion of oil is virtually complete, howoever hard the engine may be forced.

Our experience has indicated that the best results are obtained when thin, grey smoke is allowed to issue from the stack, as when the stack is entirely cleared it is accomplished by admitting an excess of air over the amount required for combustion, involving danger of chilling the boiler; while, on the other hand, if too little air is used, and black smoke issues from the stack, carbon and the heavier constituents of the oil will deposit unburned in the flues. While standing over night the oil is turned on once, or perhaps twice, in order to keep up sufficient steam to run the burners, and when firing up a cold boiler (which may be done in much less time than is required for coal), the steampipe leading to the burner is connected to a stationary boiler in the round house, which provides the burners with steam. Foremen become proficient with very little experience, the main requisite being extreme care in preventing the firebox from being cooled by using too much air or too little oil. One important fact is that with this plan a heavier oil is being used than has been used elsewhere, and therefore oil is used from oil wells that have no other customers.

We have also two engines fitted with the Baldwin burner, which seems to give equally good service. The working tests are for a less period, the engines having been more recently converted and so similar to the work of the Holden burner that it does not seem necessary to describe the work further. The reader is referred to the *Railroad Gazette* of Feb. 8, 1895, page 82, for a description of this burner, the chief difference between it and the Holden being that the Baldwin burner is inserted under the mud-ring, requiring no cutting of the water leg. It is much cheaper in first cost and cost of application. The Holden burner, however, has given rather better results upon our large 10-wheel engines.

Great credit is due to our Master mechanic, T. R. Shanks, for his efficient work in coverting the engines to enable them to use the heavy Los Angeles oil, and to his watchfulness when first put in service in adapting the lining of fire brick to give the best results. No superheating of flues or sheets has at any time occurred. To his assistant, Mr. H. S. McKee, is due the credit of the office work and the careful watch on all measurements to give the accurate figures here given.

Railroad Legislation in Maine.

The Legislature of Maine, which has recently adjourned, passed a number of laws affecting railroads. We copy from the *Lewiston Journal*, which issued a special edition giving all the laws in full, the following paragraphs epitomizing these statutes, including also two or three which have only a local application.

An act to enable Washington County to loan its credit to the Washington County Railroad was passed, and the charter of the Shore Line Railroad was allowed to die. The Washington County Railroad charter has been extended four years.

All horse railroads are to be known as street railroads for the purposes of taxation, which shall be upon all at the same rate as heretofore upon horse railroads.

An addition has been made to the Revised Statutes relating to malicious mischief so that whoever breaks and enters any railroad car, destroys, injures, defiles or defaces any railroad car, or mischieviously or maliciously releases the brakes upon, moves or sets in motion any railroad car, etc., shall be imprisoned for a time not exceeding two years or be punished by a fine not exceeding $500.

All railroads have been authorized to operate their lines by electricity.

The railroad commissioners have been given power to determine the manner and conditions of one railroad crossing another. The commissioners shall determine how bridges erected by any municipality, over which a railroad passes, shall be constructed and maintained as to safety.

The county of Aroostook has been empowered to invest in the Bangor & Aroostook Railroad to an amount not exceeding $228,000, and the second mortgage made by the company has been ratified and confirmed.

The railroad commissioners are given the power of approval on the location of street railroads.

A person whose building or property is injured by fire communicated from a locomotive cannot now collect damages from the railroad company and also receive insurance on the same.

Interlocking for an Electric Crossing.

The drawings given herewith show the manner in which the National Switch & Signal Co. has equipped a crossing of the Chesapeake & Ohio at Catlettsburg, Ky., to protect the C. & O. trains from the danger of running into electric street cars, and to protect the latter from the steam locomotive.

The main idea in designing this interlocking was to provide complete safety at the least expense, and the arrangement is such that a regular attendant need not be employed. The conductor of the street car is to leave his car before it enters upon the crossing, and go into the cabin and set the signals on the Chesapeake & Ohio at danger. After proceeding thus far he finds himself locked into the cabin. He then sets the signal for his own car to cross; and he must replace this at danger and set the Chesapeake & Ohio signals at all-clear before he can open the door to go out.

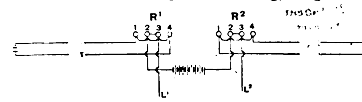


Fig. 2.—Track Circuits.

The arrangement of tracks is shown in Fig. 4, the letters r^1 and r^2 indicating the electrical connection with the relays. The home signals, 2 and 7, are located about 300 ft. from the crossing, and the distant signals, 1 and 8, about 1,500 ft. from the home signals. There are derailing switches 5, 5, in the street track, but none in the tracks of the standard railroad. The street signals 3, 3, are dwarfs, though they may be placed on high posts where desired. These, as well as the derailing switches and all the other signals, are connected with the levers in the tower in the usual manner. Ordinarily the railroad signals 1, 2, 7 and 8 are left at all-clear, and the others at danger, with the derailing switches open.

A section of the interlocking is shown in fig. 1. To provide against carelessness on the part of the conductor of the electric car the levers are so in-

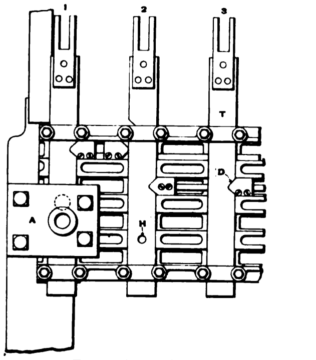


Fig. 1.—Interlocking.

terlocked that he cannot clear No. 1 until he has cleared 2, 7 and 8; and he cannot open the door to go out until he has cleared No. 1. Besides this the home signals are locked at clear and the street signals at danger by a track circuit when an approching train passes the distant signal. The arrangement of the track circuits is shown in fig. 2, in which R^1 and R^2 represent the relay points, and L^1 and L^2 lead to the lock magnet. It will be seen that both tracks must be clear of trains (from the distant signal to and beyond the crossing), in order to close the circuit through the lock magnet, so as to unlock lever 2 and permit the street signals to be cleared. The arrangement of the lock magnet is shown in fig. 3. When, in consequence of the presence of a train inside the distant signal, on either track, either one of the relays is open, the lock magnet is open and the counterweight, *C*, attached to the armature, falls, thrusting the plunger into the hole in the tappet of the interlocking machine. This hole is shown at *H* on tappet No. 2 in fig. 1. The similar hole at *A*, fig. 1, is for a plunger operated by a lever connected with the door of the cabin, this being the method of locking lever No. 1, referred to above.

In the operation of the signals for the passage of a street car the operator puts levers 1, 2, 7 and 8 to danger. The movement of lever 1, which must be made first, shifts the hole *A* so that the plunger cannot enter it, and this keeps the cabin door closed. When the four levers have been put to the danger position 3 and 5 are unlocked so that the man can close the derailing switches and clear the signals for his own car. After the car has passed over he replaces 3 and 5 and clears 1, 2, 7 and 8. As before stated the home and distant signals 1, 2, 7 and 8 are so interlocked that all of them must be cleared in proper sequence, 1 being cleared last; and with lever 1 thus reversed the hole *A* registers with the plunger operated by the door and the operator is free to leave the tower.

If the conductor attempts to set signal 2 or 7 at danger when a train is approaching it he finds it locked

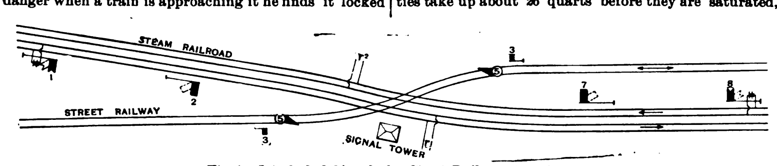


Fig. 4.—Interlocked Signals for Street Railway Crossing.

by the electric lock, lever 7 in the clear position being locked by lever 2 in the clear position.

The apparatus for locking the lever by means of the door has been patented and a patent has been applied for on the electric lock.

A plant of this kind has also been ordered by the Toledo, St Louis & Kansas City road for Alhambra, Ill.

Preservation of Ties in France.*

In a recent issue of the Revue Générale des Chemins de Fer, Mr. Euverte, an officer of the Paris, Lyons & Mediterranean system, gives a pretty comprehensive study of the methods of treating cross ties which are greatly used in France. The subject is presented with that elegance of arrangement that we expect in French scientific writing, but in the abstract which follows we shall cut it down a great deal and depart somewhat from the author's arrangement.

These primary conditions are laid down as necessary to the utility of an antiseptic employed. It must be liquid at the moment of injection, and it must be cheap enough for practical use. Sulphate of copper, chloride of zinc and creosote fill these conditions and are all used. Sulphate of copper, however, has to-day but little use, although it is cheap enough. The P., L. & M. Co. used it until 1875, and there it cost 11.4 cents † per tie. Of this 6.2 cents was for the sulphate itself. Each tie received from 52.8 to 70.4 lbs. of a solution, which solution contained 33 lbs. of sulphate of copper to every 260 gals. of water; that is, each tie was treated with 1.03 lbs. of sulphate of copper. The antiseptic dose was feeble, the sulphate was partially washed out by humidity, and it caused rapid corrosion of the rail fastenings.

Chloride of zinc is much used in Germany, Austria and Russia. It is used in a solution of 2 to 3 per cent. For oak ties, 9.51 quarts of the solution, that is, .4 lbs. of the salt, are used per tie. For pine about 1.10 to 1.65 lbs. of chloride of zinc is used per tie in Denmark. This treatment is still cheaper than that by sulphate of copper, but it has the same drawback with regard to solubility in water.

Creosote has long been used in England, France, Belgium, Austria and Portugal. It is relatively cheap when its antiseptic qualities are taken into account and its naphthaline is insoluble. On the French state railroads, an antiseptic mixture of creosote and chloride of zinc is employed, being 8 gallons of chloride and 10.4 gallons of creosote to every 260 gallons of water. The wood is treated to saturation.

With this brief examination of the various methods, Mr. Euverte proceeds with his particular account of creosote and its uses. The general name of creosote applies to one of the products of distillation of coal tar containing a certain proportion of antiseptic products. Of course, other tars yield creosote, and wood tar would be particularly useful for preservation if the price was not too high, for it is rich in antiseptic phenols. The chief source of coal tar is from illuminating gas works and from coke works, but the first source is very much the more important as the coke works are not often arranged to save the tar. It is believed that by a change in this matter in the French coke works all the creosote necessary could be produced in that country without importation. In the French experience about 5 per cent. of the coal is returned in tar in the manufacture of gas and about 2 per cent. in making coke. After distillation at the gas works, the heavy oils are delivered directly to the railroad companies for creosoting. This heavy oil or creosote, as it is called when used as a wood preservative, should have a minimum of 10 per cent. and a maximum of 30 per cent. of naphthaline and as much as possible of phenols, say up to 10 per cent. It is well to be sure that your creosote contains these proportions of these elements, for there is considerable temptation to extract the phenols which are now useful, in France at any rate, in making nitric acid explosives and naphthaline, which has various industrial uses.

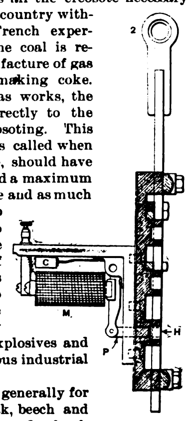


Fig. 3.—Lock Magnet.

The French companies use generally for ties three different woods—oak, beech and pine. Exceptionally they use fir, larch and chestnut. Heart oak may be used without treatment, but when it has much sapwood it soon rots and should be injected.

Ties of heart oak will absorb but small quantities of creosote. Oak ties with more or less sapwood absorb from 5.2 to 7.39 quarts of creosote. The beech and pine ties take up about 26 quarts before they are saturated, but the process is usually stopped before that point is reached. The quantities of creosote as adopted by the different demonstrations are, as below, in pounds per tie:

Oak	11 to 15.4 lbs.
Beech, Northern System	28.6 "
Western	33 to 35.2 "
P., L. & M.	35 2 "
Eastern	52.8 "
Pine, Southern System	26 4 "
Orleans	30.8 "
P., L. & M.	26.4 "

The Eastern, Southern and Orleans companies buy their ties creosoted or have them creosoted by contractors. The Lyons Co. and the Northern buy a part of their ties creosoted and treat the rest in their own works, of which the P., L. & M. has two and the Northern one. The P., L. & M. Co. can treat 600,000 ties a year, and, if need be, 800,000. The Northern generally treats from 250,000 to 300,000. The Eastern Co. treats all of its own ties in two works, one of which alone turns out about 400,000 ties a year, and may turn out 500,000.

The Northern Co. employs at its works at Villers-Cotterets a special process, a modification of the old Blythe system. The timber is first steamed in a reservoir containing creosote, then the products of condensation are drawn off and the heavy oil is collected for use again. The cylinder is then filled with creosote and subjected to pressure by steam, and a dose of about 6.6 lbs. per tie forced into the beechwood. At these works there are 9 cylinders, each of which will take in about 25 ties and about 1,000 ties are turned out per day.

The companies generally use stationary cylinders, while the contractors more generally employ portable cylinders. In the first the ties are run in on trucks, the trucks being handled either by hand or by capstans. In the second system the cylinders open at the middle and each of the two halves can be rolled to the place where the ties are piled. The system using stationary cylinders has the advantage of economy of time in loading, while the movable cylinders admit of less costly plant. The cylinders used vary in length. They are generally from two to four times the length of a tie; that is, from 19.7 to 39.4 ft. Their diameter is generally from 5.2 ft. to 5.9 ft. The operation of filling the cylinders with ties, carrying out the process of injection, and then taking the ties out, is found to take 75 minutes, on the average, for stationary cylinders. For the portable cylinders, the average time at the different works varies from 105 to 125 minutes.

In the early days of treatment the aim was to treat the wood near the forest where it was cut, and small and portable plants were common. Generally it is found more advantageous to build larger and permanent plants. These are placed near the forest regions. Thus, the Northern Co. has established its works at Villers-Cotterets, the Lyons at Collognes and the Eastern at Amagne. The additional transportation of the ties necessitated by taking them to the works is estimated to cost about six cents per tie. In order to minimize this the P., L. & M. Co. has established two works, one for its Northern and one for the Central portion of its system, not counting the works of the contractors.

Much attention is paid in France to the seasoning of the ties before treatment. The time that they are left piled, to season varies from six months to a year, according to the climate, the prevailing winds, etc. Therefore, the treating plant should have land available for piling a good many ties. Various methods of piling are adopted, but generally the aim is to pile the ties so loosely that the air can circulate freely and to arrange the piles with regard to the prevailing direction of the winds. In some cases ties are kiln dried. For instance, at the Amagne works of the Eastern Co., all ties are kiln dried, probably for the reason that the climate of the region is comparatively damp and cold. It is estimated that oak ties lose about 15 per cent. of their weight after 18 months' seasoning in the open air, and then about 1.6 per cent. in kiln drying for a period of 144 hours. For beech the average figures are rather different. After three months' seasoning in the open air these ties will have lost about 7 per cent. of their weight. They are then kiln dried for 72 hours and lose 4 per cent. more. Kiln drying is used more or less by the Northern Co. at its Collognes establishment. The author estimates the cost of kiln drying at from 0.6 to 1.0 cent. per tie.

It is customary at the French works to face the ties for the reception of the rail or chair by machines devised for that purpose, which is a great saving over the old method of doing this by hand.

The cost of treatment of oak ties is put down at 8 cents per tie for creosote and 4.4 cents for other expenses at the Collognes works. For beech or pine the creosote cost is considerably more, namely, 22.4 cents on the P., L. & M., and 34 cents on the Eastern, which company uses a great deal more creosote. We may say, then, that the oak ties will cost for treatment 12.4 cents and the beech or pine ties from 26.8 to 38 cents, although the author thinks that 4 cents should be subtracted from these figures. The extra cost for transportation is of course quite variable.

Of course the gain in life of ties is the most important of the questions to be considered. The P., L. & M. Co. substituted creosoting for the treatment of sulphate of copper in 1876, for beech ties or oak sapwood ties, which represented about one-fifth of the ties used. The average life of those taken out of the track in the years 1881, '82 and '83 had been 9.8 years. From the latter date the life of the ties grew steadily, and in 1893 it had reached 13.4 years; but this life is still growing as the old ties disappear and as the percentage of treated ties increases, and it may be expected to grow much higher.

A non-treated oak tie costs 90 cents near the point where it is cut. After treatment it costs $1.06, an increase of 20 per cent. The beech tie, not injected, costs 60 cents; creosoted it costs 92 cents. On the P., L. & M. the life is seen to have increased 37 per cent., while 4 per cent. of the ties were creosoted. Observations were made on trial sections on the Eastern system, which indicated an increase of 65 per cent. in the life of treated ties, and on two trial sections on the P., L. & M. the observations led to the belief that the ties would live from 21 to 24 years, where the life of ties treated by sulphate of copper was only 13.7 years.

At present about half the creosote used on the French roads is imported. France exports annually about 850,000 ties, most of which are creosoted before shipping and are imported from Bordeaux to Spanish and Portuguese ports.

The Mozier Three-Position Semaphore.

The Mozier Safety Signal Co., of Cleveland, is issuing a new catalogue, from which we take the accompanying engraving of the latest design of the company's three-position semaphore with a hollow post.

The company makes these signals, with solid posts,

*For an excellent account of the method of preservative treatment of timber on the Southern Pacific, see the *Railroad Gazette* of Feb. 8, 1895.

† In transforming from the French systems, a franc has been taken as 20 cents.