total interest of a little more than $3,300,000, and the refunding now arranged for will give about half a million a year, or something over one per cent. on the capital stock.

Hearings have lately been held by the city authorities of New York and Brooklyn on the matter of the proposed tunnel of the Long Island Railroad Company under Atlantic avenue, Brooklyn, and under the East River to some point beneath Maiden Lane and Cortlandt street. The reader is aware that this project is designed to give a passenger entrance for the Long Island system into the city of New York, and that it is the purpose of the President and Directors to put on a very frequent and fast electric service. The proposal is to put the tunnel down so far that it cannot possibly interfere with buildings or any other construction, and so far as we can judge, it would be a great public improvement and will do no harm to anyone, unless it may be to some competing trolley and ferry companies. The project seems to be as thoroughly commendable and as entirely unobjectionable as it well could be, and it is greatly to the public interest that it should be facilitated Indeed, no city officer can afford to hold it up without making his reasons absolutely clear to the public.

NEW PUBLICATIONS.

Texas & Pacific Quarterly.—The October issue is the first number of a publication issued by the General Passenger Department of the Texas & Pacific Railway at Dallas called the Texas & Pacific Quarterly. This is the first effort of this kind that has been made, so far as we know, by any of the Southwestern railroads. The little journal contains a good deal of interesting information, both local and general, and shows the marks of intelligent editing.

TRADE CATALOGUES.

Crosby Steam Gage & Valve Co.—The Crosby catalogue for 1897 is a solid, 6 × 9 in., 170 page book, in which are carefully described and fully illustrated the numerous gages, valves, indicators, regulators and other specialties made by this company. The catalogue will be valued by engineers particularly because of its completeness and accuracy. Special mention should be made of the Crosby mine and draught recorder, which is designed for making a continuous record of the pressure of fluids either above or below the atmosphere, as ordinarily measured in inches of water. It is also useful for special purposes, as for determining and recording chimney draughts. The Crosby indicator, the spring seat valve and the various types of well-known recorders are described at some length. The planimeters and recording instruments, together with instructions for their use, are discussed in the latter part of the book. The closing pages are occupied with letters from well-known engineers and useful tables and a complex index. This last-named feature is sometimes overlooked or disregarded in catalogues of this nature, much to their detriment.

Coal Screens and Washers.—The Link Belt Machinery Co., of Chicago, sends a small special pamphlet showing and describing the link belt, shaking screen and weigh boxes, and the Luhrig patent picking table and patent coal-washing machinery, as made and sold by this company.

American Society of Mechanical Engineers.

(*Continued from page* 849.)

conditions was computed, from which the efficiency of the entire plant, including both engine and pump, was calculated. The paper was accompanied by tables showing the results of various tests and computations when the water was discharged under different conditions.

Mr. William Wallace Christie, of Paterson, N. J., presented a paper on *Boiler Tests: Classification of Data and Plotted Results*, in which he gave by numerous diagrams the results of boiler tests, which have been recorded and by classifying them and plotting these results, determined both the average values and the mean values such as shown in Figs. 3 and 4 The average results are plotted in Diagrams I., II. and III. It is interesting to note that in each of these three diagrams the vertical boiler occupies the lowest and highest place as far as evaporative efficiency is concerned, while horizontal boilers occupy the middle positions. Diagrams IV. and V. give the results showing the areas of most economical performance for horizontal and vertical boilers using bituminous and anthracite coal.

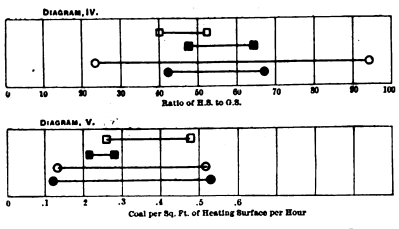


Fig. 4.—Diagrams Showing Most Economical Performance of Boiler.

In the paper, *A Staybolt Threading Device*, Mr. Hartness describes a means for threading staybolts, which consists of placing two screw dies, described above, in tandem and threading both ends of the bolt at the same time. This insures accurate correspondence in lead. Both dies should be of the opening type, but the rear die may be a non-opening one.

The Stevens Valve Gear for Marine Engines, by Mr. Andrew Fletcher, is an account of the origin and introduction of the Stevens valve gear for the beam type of marine engines, as contained in two letters of recent date from the inventor, Mr. Francis B. Stevens. The Stevens valve gear, wherein the cut-off is fixed and the speed is controlled by the steam pressure, was first used in 1840 on the steamboat Albany. The patents expired in 1862. Since the expiration of the patents the gear has been used almost exclusively on all beam-engine paddle-wheel steamboats in the United States. Of late years the substitution of the screw, with quick moving engines and slide valves, has in great part superseded the paddle wheel.

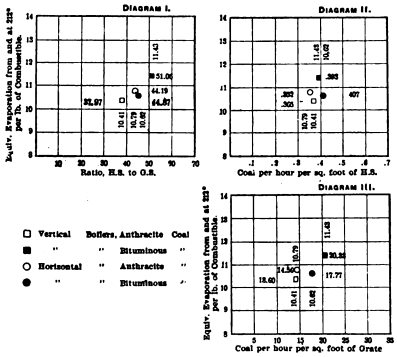


Fig. 3.—Diagrams of Average Results of Boiler Tests.

Mr. David Guelbaum read a paper on *The Law of Hydraulic Obstruction in Closed Streams*, in which he arrives at a formula which, expressed in words, says: "If an obstruction placed within a stream enclosed in a casing with an upset is changing its position from the limit distance h_0 to the distance h toward the upset, causing thereby a certain variation in the quantity of motions of the contracted stream around the obstruction, then the difference between the full pressure upon the obstruction and the direct pressure upon it due to loss of height only, equals twice the part of the variation in the quantity of motion that reacts upon the area of the obstruction, plus a certain constant; pressures and loss of height mentioned being those due to presence of obstruction only."

Mr. Arthur L. Rice described *A Wire-Testing Machine*. This consists simply of a frame made of two uprights supporting a spring balance on a top crosspiece. At the base of the frame is a pulling gear made with gear wheels and a screw, all operated by a hand wheel. The apparatus is also supplied with an air dash-pot to prevent the sudden rebound of the spring balance when the specimen breaks. The machine works satisfactorily up to its full capacity of 200 lbs. and costs about $32.

Mr. Charles T. Main presented a paper on the *Valuation of Textile Manufacturing Property*, in which he at considerable length sets forth the various conditions to consider in the valuation of manufacturing property, whether it be for the purpose of sale, bonding, insurance, condemnation, adjustment of losses by fire, etc.

Brief mention should also be made of the paper by Prof. Wm. S. Aldrich, of Morgantown, W. Va., on *Notes on Rating Electric Power Plants Upon the Heat Unit Standard*, the first paper of which was presented at the Hartford meeting and reported with discussion in our issue of June 4, page 383. The present paper goes a little into the details of the subject, and the author draws from his investigations some practical conclusions. Among other items he states that anything which tends to increase the economy of electric power plants along the lines which have been clearly marked out in the development of high duty pumping engine plants, merits considerable attention, and it is believed that the heat unit standard specifications and the subsequent contract trials of pumping plants upon the heat unit basis have combined to develop electric railroad plants in a large degree. Should there be an extensive discussion on this paper we will speak later more in detail in reference to the heat unit standard.

Mr. John B. Mayo, of Brooklyn, N. Y., submitted a paper on *A Strength of Gear Chart* which showed graphically the horse powers for cast-iron gears, cut or machine dressed, for given velocities, from formulæ by Wilfred Lewis, originally appearing in the *American Machinist*. The publication of this chart would hardly be of value to our readers, and those interested will find the subject well discussed in the paper.

Mr. George Richmond, of New York, presented a paper on *Thermodynamics Without the Calculus*. This subject should prove of considerable interest to engineers, and the paper will be published at some length in a future issue, with notes on the discussion at the meeting.

Dr. Thurston's paper on *Multiple Cylinder Steam Engines* we also hold until the call on our space shall be less, in order that we may print it nearly in full. Mr. Geo. W. Dickie's paper on *Auxiliary Engines* and *Transmission of Power on Naval Vessels* is also held over.

The Union Electric Semaphore Signal.

The Union Switch and Signal Company, of Swissvale, Pa., has lately designed a semaphore signal to be operated by an electric motor, the motor to be placed in a suitable box at the base of the post. One of these signals is in use on the Michigan Central at Detroit and we give herewith illustrations showing its general appearance and some of the details of construction. Its more prominent peculiarities are the metallic post and arm, the disposal of the rods inside the post and the placing the battery-well beneath the post. From Mr. J. P. Coleman, Assistant Engineer of the Union Company, we have the following account of the different stages in the evolution of this signal.

Until quite recently semaphore signals operated entirely by electricity have been of doubtful value because there was no suitable battery or motor; but small motors of high efficiency and primary batteries of low internal resistance, free from the wasteful effects of polarization, have been developed in the past few years, making the problem commercially possible. The best types of these batteries, however, are capable of but two or three amperes discharge without a serious fall in their electromotive force. It is, therefore, undesirable that more than this amount of current should be drawn from the cells under any condition of service, and to avoid this the motor of the signal should have such a resistance as to prevent a greater discharge through it. A motor which uses as a maximum three amperes of current will require a battery of many cells in order to develop the necessary energy to operate a signal of the usual type, counterweighted in the usual way, and the cost of installation and of maintenance becomes high in consequence. Semaphore signals, while fairly well suited to be worked manually, are far from well designed to work automatically, when gravity constitutes the only power by which they are moved to danger.

The first and most important requirement of a signal is that it shall invariably show danger when the force operating to clear it ceases to act upon it. In the Union pneumatic signals a failure in the supply of either the compressed air or of the electric current controlling it will cause the signal to move by gravity to the danger position. Signals thus operated were, until quite recently, of the same construction as those worked manually. The friction of the parts was objectionable, but notwithstanding this and other drawbacks, fully 2,000 signals of this type are in successful operation to-day. But each operation of a pneumatic signal represents about ¼ H. P. of energy, the larger part of which is required to operate the heavy counterweight, and although one compressor supplies the energy for many signals and it is found economical to thus operate them, a lighter signal is desirable.

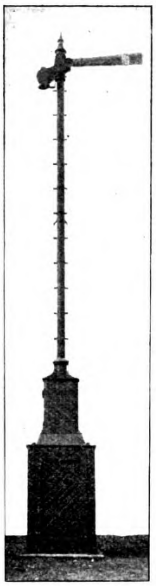
By designing a semaphore signal with connections inside the post, and by eliminating the surfaces which are liable to suffer from snow, sleet, ice and wind pressure, we were enabled to materially reduce the counterweight required to insure the signal's return to danger, and therefore to reduce the power necessary to move the signal. This change in design produced a post which is light and graceful in appearance, and left only the semaphore arm and its bearing subject to weather influences. Notwithstanding these improvements the signal was yet too cumbersome to work by electric power alone, and the problem of still further lightening it was taken up and solved.

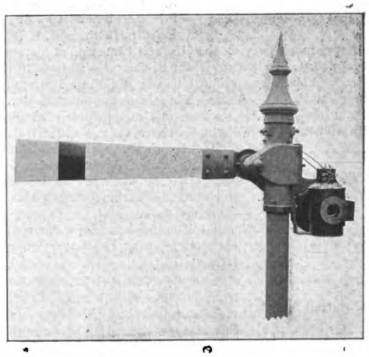
The chief obstacle to the reduction of the counterweight was the length and area of the blade, and the consequent liability of a heavy accumulation of sleet or ice upon its surface. To reduce this we designed a blade more in harmony with the slender post supporting it. A further step in this direction was to extend the spectacle casting, and to so design it as to present as much surface as possible to the weather, thereby permitting snow and sleet to accumulate upon it with the effect of balancing to some extent a like accumulation upon the blade. These modifications, coupled with the pivoting of the blade to the right of the post's center, produced a blade which, while somewhat smaller than those ordinarily used, bears a strong resemblance to them. Yet it is much less liable to be retarded in its operation by snow, ice or wind.

Experience with all classes of signals for about 20 years had impressed upon us the dangers resulting from the free and frequent use of paint upon them. Numerous instances of improper operations were trace-

able to this cause. An ordinary semaphore signal balanced when new to rest at danger may be and actually has been repainted enough in four years to completely overbalance its spectacle and back light, so that it would show safety when disconnected from its balance lever. Wooden blades sometimes break off in service and by heavy winds. To meet these faults we have made the blade of our new signal of aluminum, as being the lightest and most durable metal suitable to this purpose, and we have used colored enamel, carefully applied, as a substitute for paint. When dulled by service the original brilliancy of the colors may be restored by simple washing.

Furthermore, snow and sleet are less likely to adhere to the hard smooth surface of the enamel than to that presented by wooden blades. The flat elliptical section was adopted so that there should be no horizontal surface presented by the upper edge of the blade.





The Union Electrically-Operated Semaphore Signal.

Another step of importance was to remove the surface presented by the extension of the semaphore shaft through its bearing at the rear for supporting the back light. In the new signal the back light is carried by the semaphore spectacle on an arm projecting from it to the rear of the post; and the semaphore shaft does not project through the bearing in the rear of the post at all.

Having constructed a signal capable of reliable operation with a moderate counterweight, we obtained the conditions to operate economically a semaphore signal from a reasonable number of cells of primary battery. The next problem was to construct a mechanism which would work such a signal under all conditions. Motors operating on low electro-motive force and using small currents are necessarily of high speed, from 1,500 to 2,000 revolutions a minute. To transmit this energy to the shaft of a semaphore signal so as to turn it through 60 deg. (to move the signal from danger to safety), could be accomplished by directly connecting the shaft of the motor with that of the signal by means of one or more sets of gear wheels, as in ordinary clock work. Assuming that the average time consumed in moving the signal from danger to clear should be about six seconds, and that the speed of motors best suited to this work is 1,800 revolutions a minute, it follows that the motor will make 180 revolutions in clearing the signal. This, however, involves only one-sixth of a revolution of the signal shaft. A whole revolution would, therefore, involve 1,080 revolutions of the motor, from which fact it is evident that the semaphore shaft revolves with a power 1,080 times greater than that of the motors.

A motor of small size is therefore well suited to this purpose, and has ample power to operate a signal in the time specified and to overcome unusual resistances in its bearings, etc. But on returning to danger, the signal, if thus directly connected, must drive backward the gearing and the motor, and to do this must have a large excess of counterweight over what would be used were the gears and motor not operated by it, just as the power to overcome resistance is increased in each successive shaft when driven by the motor in clearing the signal; so is that power decreased in each successive shaft when driven backward.

Therefore, we have avoided the direct gearing of the motor to the signal. Instead, the motor is geared, in a similar manner, to a main shaft in the mechanism, which is suitably equipped to give a vertical upward movement to the signal-operating rod. This rod is formed of two parts, one attached to the signal and one to the driving mechanism, and they are enaged or disengaged by means of an electro-magnet, the device forming what is commonly termed an electric slot. By this means of operation the mechanism, including the motor, is never turned backward, the signal being totally disconnected from the gearing and moving to danger entirely independently of it, while the motor and gearing never operate except to clear the signal. The signal moves instantly to danger when the current holding it at clear is interrupted. This method of operation also enables us to operate two or more blades on one post by a single motor and set of gearing; that one of the signals only being operated whose slot is energized. In the case of a home and a distant signal on one post, the home signal is first cleared, and the distant signal as soon thereafter as the conditions permit. Both may be thrown to danger together, or the distant signal independently of the home, as is customary and desirable in common practice.

The magnets of the slots are of very high resistance and hold the signal at clear with a current much less than that used in any other form of signal, while the motor, having no weight to raise other than that actually required to insure the signal's return to danger, operates from a 10-volt battery on a current of less than two amperes.

The motor upon clearing the signal becomes idle and remains upon an open circuit (the slot holding the signal at clear), until the signal is again put to danger by action of the slot magnet.

This mechanism has been found very simple and reliable in operation.

It will be evident that every step taken in the development of this signal was with a view of reducing the cost of its maintenance. Heretofore the aim has been more to produce a cheap signal than one cheaply operated. We have, as a result, a signal long desired for automatic block work that not only far excels the disk signal, but one which can be operated at an expense very much less than has ever been attained with disk signals.

We recognize that this signal, though acceptable to many as having a blade sufficient in size for the ordinary requirements of block work, will not meet with universal approval in this particular; and though we are encouraged by the favorable comments of those who have seen it, we are prepared to furnish a signal of this design provided with one or two blades of any size and style desired. In the design here shown the blade is about 8 in. shorter than that of our standard manually operated semaphore; but its bearing is at the right of the center of the post, so that for all practical purposes it is only 3 in. shorter than the older form.

While the signal is shown as mounted on a pedestal which forms a compartment over its foundation, into which the batteries are drawn up for inspection or renewals from a well formed in the masonry, it is manifestly possible to mount it otherwise if desired. But any resistance in the motor circuit, external to the motor itself, is a source of loss, and the batteries should be as close to the motor as practicable. Batteries work best in a moderate and uniform temperature, hence the desire to place them below ground. A receptacle is formed in the signal base into which the lamp of the signal may be placed by day, and where oil, track wires, drills and other repair material may be housed and all secured with the batteries by one lock.

It is manifestly possible to operate this signal either normally-clear or normally-danger, but we must adhere to our advocacy of the normally-clear plan as being the simplest in construction, the most reliable in operation, the one most readily adapted to traffic conditions and to unusual track situations, and the only one by which inspectors can see the conditions of the signals of adjacent tracks from the rear of trains. From the method by which they operate, normally-danger signals cannot be made to conform to the rule that every failure should put the signal in the danger position: and the inability to determine whether a signal's movement to clear is due to the approach of a train or to a failure of the apparatus is as undesirable as it is unavoidable.

Additions to the Niagara Falls-Buffalo Transmission Plant.

The power transmission line from the Niagara Falls power house to Buffalo is being increased, the demand for power from Buffalo having extended beyond the capacity of the wires already in use. An order for three new cables to be strung on the present poles, as well as for additional transformers, has been placed with the General Electric Company. The cable will be insulated to stand the ultimate pressure of the line, of 22,000 volts, and is tested under a considerably higher pressure before leaving the works. Twenty-four thousand feet of this cable will be used at first for that part of the transmission line within the city of Buffalo. The order for increasing transformers covers seven of similar size and design to the three already installed in the transformer house of the Niagara Falls Power Co. Each of these 10 transformers has a capacity of 1,250 H. P., making a total step-up transformer capacity of 10,000 H. P. They are of the air-blast type, and will stand in rows of four upon the air-tight chamber, whence the air is forced through the ventilating spaces in the transformers. It will be remembered that the two-phase current at 2,200 volts passes from the 5,000 H. P. generators in the power house to the transformers. In these it is not only increased in pressure but changed in phase, the current issuing from the transformers three-phase current at 11,000 volts. This pressure will be adopted until it becomes necessary to increase it, when it will be doubled and be delivered to the transmission lines at 22,000 volts. On its arrival in Buffalo it will be delivered to the step-down transformers of the Cataract Power Conduit Co., which controls its distribution there. The electricity will be transformed down to different pressures for distribution over a city network to different points for a variety of purposes, being used directly in induction motors.

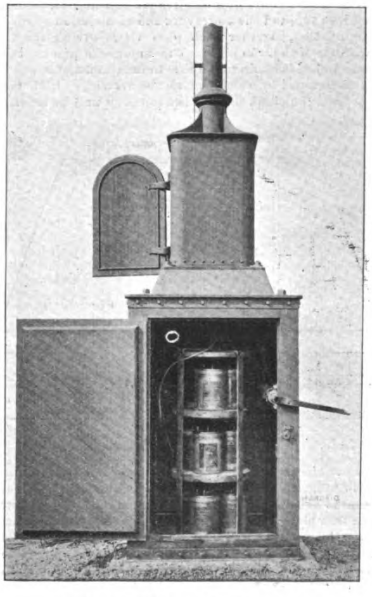
Several step-down transformers will also be placed in the station of the Buffalo General Electric Co., and from these, three-phase current, converted into direct current in rotary converters, will be utilized for lighting purposes and for small power.

The Buffalo Railway Co. is also increasing its step-down transformer and rotary converter capacity in its Niagara street power house. In addition to the two 500 H. P. converters already in operation, two others of similar capacity and construction are to be installed. These will bring the total converter capacity in the station up to 2,000 H. P. To supply these necessitates the installation of three additional step down transformers, and in the transformer house between the station and the canal. These will be of about the same capacity as the three already there—each of 275 KW., reducing three-phase current from about 10,500 volts to 375 volts for delivery to the alternating current side of the rotary converters, in order that it may issue direct current at 550 volts, at which pressure it is delivered to the bus bars of the station switchboard.

Foreign Railroad Notes.

Aug. 24 last contracts were let for 400 new locomotives for the Prussian State Railroads. The contracts were awarded to eight different works, three of which have enough to keep them busy till the end of next year. The average cost appears to be about $12,000 per engine.

A "north and south" express train is to run this coming season between Berlin and Naples, passing by Leipsic, Munich and Inspruck. It will have only first-class cars and the fare will be more than the ordinary first-class fare.



Union Electric Semaphore—Base of Post.

The Hungarian government contemplates giving out contracts for 370 locomotives, 1,130 passenger and conductors' cars and 7,000 freight cars, to be delivered at intervals within the next five years.