at long intervals. For this particular purpose, as compared with electro-magnetic feeds, the advantages all appear to be with the thermal feed. Such lamps strike their arc quietly and slowly without being necessarily retarded in their action by dash-pots, their feed is positive, and slight frictions in the moving parts introduce no noticeable error; they may be operated at will on direct currents, or on alternating currents of either of the standard frequencies. On alternating currents the power factor of a load of these lamps would be high as compared with a load of lamps having large magnet coils and cores, and in the matter of maintenance there appears to be nothing about such a lamp to suggest repairs, although the replacing of an occasional regulating strip would be much cheaper than the renewing of magnets.

Aside from the economies of enclosed lamps resulting from the increased life of the carbons they possess other advantages peculiar to themselves. As a result of the absolute enclosure they burn quietly, being free from hissing or flaming even though not accurately adjusted, and, as it is impossible for sparks to make their exit, all possible fire risk is eliminated, a feature which meets with the unanimous endorsation of the boards of Fire Underwriters generally. By virtue of the long arc which is maintained more perfect distribution of the light over large areas is obtained than is possible with open arc lamps Direct current lamps of the latter type exert their greatest illuminating effect at an angle of about 45 degrees from the vertical so that a very intense light is noticeable within a radius slightly exceeding the height of the lamps from the ground, while beyond this the illumination rapidly falls away. Enclosed lamps on the other hand spread their rays more horizontally, their angle of maximum intensity being about 75 degrees, and as a result the light is more regularly diffused over a large area and does not assume the form of concentric zones of rapidly diminishing intensity. The economy in maintenance however, affords the most striking example of the advantages of enclosed lamps over the open and the gain will be clearly noted by a comparison of the two systems. As an example we may compare the maintenance costs of 450 watt open and enclosed alternating current lamps operating 10 hours per day per year of 365 days, assuming for the former a life of 14 hours per trim of carbons costing $36 per 1,000, while for the latter a life of 80 hours per trim of carbons costing $30 per 1,000. In this comparison the matter of interest and depreciation allowance may be dismissed on the assumption that it will be similar in each case and thus there remains to be calculated the cost of carbons and trimming.

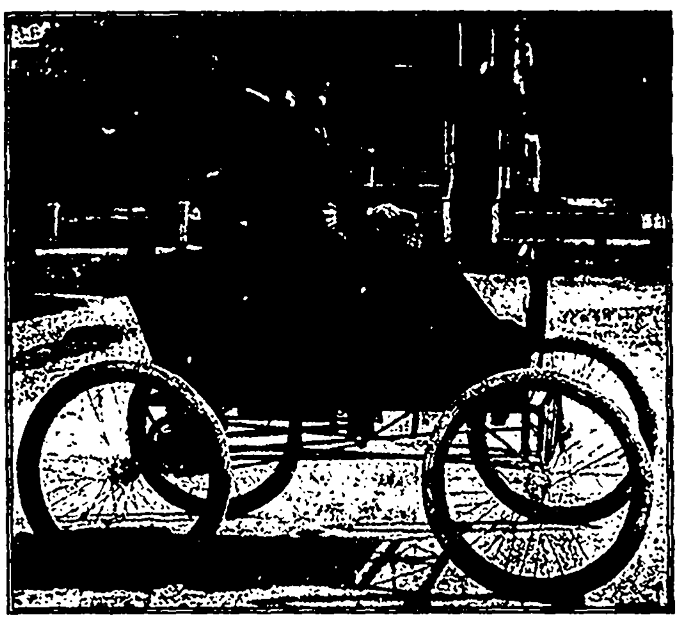
As the open lamp requires two new carbons per trim it will in a year therefore, on the above basis of 10-hour runs per day, require some 261 pairs of carbons, costing $18.80; on the other hand the enclosed lamp requires but one new carbon per trim and in a year will consume but 46 carbons, costing $1.38, so that an annual saving of $17.42 per lamp is effected by the use of the enclosed lamps. The cost of trimming will depend largely upon local conditions, but we may assume that one man at $2 per day can trim one hundred open lamps, or one-half as many enclosed lamps, which will make the cost per trim, therefore, 2 cents and 4 cents respectively. On the 10-hour basis the trimming, therefore, will cost approximately $5.62 per open lamp per year, as against $1.84 per enclosed lamp per year, resulting in a further annual saving in favor of the enclosed lamp of $3.78, making the total saving $21.17. With direct current lamps the saving will be in like ratio, allowances for differences in the life and cost of carbons being necessarily taken into consideration, but whether direct or alternating the advantages of the enclosed lamp are so apparent that before a great period elapses not only will they largely supplant the open arcs, but they will further enter the arena in competition with large incandescent lamps and regenerative gas lamps.

STEAM POWER FOR AUTOMOBILES.

For some years Sir David Salomons and other experimenters and engineers in Britain have been vaunting the praises of steam as a motive power for autocars, arguing for it as the ideal power on account of its expansiveness or range, and hence being superior to the gasolene engines, whose limits are but too well known, and resembling electricity minus the difficulty of re-charging batteries. The Serpollet boiler gave Sir David and his friends good ground for argument, and as a matter of fact steam is being pushed to the front in Britain, especially for heavy traction. The Americans have done much better with steam automobiles than either British or French inventors—the latter having given chief attention to gasolene, or "upetrol," as it is called. Some rather sudden and surprising developments in steam autocars have been made in New England. It is to be noted that the Western and Middle States of the Union have as yet produced no steam autocar. The reason stated by experts is that nowhere in the United States except in New England can the extremely fine work be had that is required on steam vehicles. Every engineer will understand that a 4-wheel two-passenger carriage, whose total weight empty does not exceed 400 lbs., the boiler shell being only 14 inches diameter by 13 inches high, and yet containing 306 tubes, requires exact adjustment and minute mechanism that would drive the ordinary machine shop foreman crazy. Yet the Stanley brothers had no difficulty in getting such work done in a rush, so that their first carriage was completed within six months. New England now boasts three prominent steam carriage makers—Whitney of East Boston, Stanley Brothers, the famous dry-plate makers of Newton, Mass., and the Overman Wheel Co. of Chicopee Falls, Mass.

At the motor vehicle contest in Boston in November last, the performance of the steam carriages astonished the crowd of 2,000 persons, for steam power done up in such compact form was decidedly novel. On a 3-lap cycle track the Whitney wagon, weighing 1,000 lbs., made a 2-mile run in 5.40 2-5, while the Stanley wagon, weighing 400 lbs., finished the mile in 2.11. Whitney says he has often made a straight-away mile inside of 2 minutes.

The hill climbing contest gave the hardest test. A plank track 85 feet long was laid level for the first 10 feet, and the balance in sections of 10 feet, each section raised 5 degrees higher than the preceding, the final angle being 35 degrees. This made a constantly increasing up-hill angle of track, which is



STANLEY STEAM CARRIAGE.

vastly difficult. Some seemingly powerful cycle riders tried it with a flying start, but could not go much above half way up. Whitney with 125 lbs. of steam ran up the grade beyond his brake control, and had to be caught by men standing on the incline, and steadied down to where his carriage could take care of itself. Stanley took the hill, running up to the top, and bumping the cross-bar at the end, from a standing start at the bottom of the incline, no headway run on the level being made. Stanley had probably 150 lbs. boiler pressure for this hill effort. It looked as though Stanley was going to come down with a rush, but after some hurried scrambling the wagon was seen to be under control. The Stanley engines were not made to reverse, but the reversing feature has been added since this test.

The following particulars in regard to the power and gear of the Stanley steam wagon, given by Hugh Dolmar in The Cycle Age, will be of interest to steam engineers: "Boiler shell,