in the immediate vicinity of the lamp, but a slightly increased amount midway between lamps. A comparison of the light given by the two enclosed arcs, namely, the direct current and the alternating current lamps will show that the former gives slightly more light at all points than the alternating lamp, although the alternating lamp gives more light than the open direct current lamp midway between lamps. It is claimed that "the difference in the light (at, say, 150 feet from the lamp) between the D. C. and the A. C. enclosed lamps is nearly, if not quite, compensated for on account of the more subdued light in the vicinity of the A. C. lamp increasing the relative effect of the light at a distance by reduced contrast." Whether this is so or not, the fact remains that the light given by the alternating lamp is apparently less than that given by the open D. C. lamp, and the apparent reduction in illuminating power is a very difficult point to explain satisfactorily to the municipal authorities or the public in general. It is only fair to say though that where an old style open direct current arc system has been replaced by a modern alternating enclosed system it is rare to find any serious opposition, especially so if the new system is properly handled and maintained. The possibility of such trouble need not, I think, deter anyone from installing modern equipment of this type if other conditions indicate that it is advisable to do so.

Summary of Costs.

As the factor which will determine the apparatus or system that shall be adopted, when the remodelling of an arc plant is under consideration, will most likely be the cost, it was thought that the placing of these costs in a convenient form might be useful, and this has been attempted in Table No. 5, as above:

Assumed Cost of Power.

60 Cycle Steam Power delivered on the Bus Bar—$50 for 24 hours service.

Steam Power delivered at engine—$35 for 24 hours service.

60 Cycle Water Power delivered on the Bus Bar—$15 for 24 hours service.

25 Cycle Water Power delivered at 60 cycles on the B.B.—$25 for 24 hours service.

25 Cycle Water Power delivered at 25 cycles on the B.B.—$15 for 24 hours service.

1st. We have the station costs for small arc dynamos, large arc dynamos, and constant current transformers under different operating conditions.

2nd. The line costs for open and enclosed D. C. and enclosed A. C. lamps.

3rd. The efficiency, power factor, horse-power, and apparent horse-power for the different types of apparatus. Also an assumed cost of power under different conditions.

From this table we should be able without much trouble to determine the approximate annual cost of a 500 arc lamp plant under almost any conditions. For example, let us take a 60 cycle water-power plant with steam reserve, using direct connected sets and enclosed lamps. From the table we find:

The station costs	$ 6,453 00
The line costs	5,292 00
The efficiency of direct connected sets is 81 per cent. and the actual power required 397 h.p., this at an assumed figure of $15 per h.p. for 60 cycle water-power would equal $5,955; but $15 is for 24 hours service, so it might be fairer to charge the arc plant with but one-half of this, or $7.50 per h.p., at which the cost of our power would equal	2,977 50
The total cost would, therefore, be	$14,722 50
Or a cost per arc lamp of about	29 44

Table No. 5.

Summary of Annual Costs.

STATION COSTS—INTEREST, DEPRECIATION, MAINTENANCE AND OPERATION.

Style of Station Arc Apparatus in use.	Water Power. 60 Cycles. Motors and Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	25 Cycles. Motors and Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Steam Power. 60 Cycles. Motors and Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Engine. Engine and Shafting. $	Engine and Motors Connected to Shafting. $	Water Power and Steam Reserve. 60 Cycles. Motors connected to Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Engine and Motors Connected to Shafting. $	25 Cycles. Motors Connected to Shafting. $	Direct Connected Sets. $	Constant Current Transformers $
Small Arc Dynamos	7067	....	....	7067	....	....	7067	....	....	7818	9084	7067	....	....	9084	7067	....	....
Large Arc Dynamos	....	6453	....	....	6453	....	....	6543	....	7258	8660	....	6453	....	8660	....	6453	....
Constant Current Transformers	....	....	1415	....	....	1415	....	....	1415	....	....	....	....	1415	....	....	....	1415

LINE COSTS—INTEREST, DEPRECIATION, MAINTENANCE AND OPERATION.

Open D.C. Lamps		Enclosed D.C. Lamps		Enclosed A.C. Lamps	
Total Cost	Cost per Lamp	Total Cost	Cost per Lamp	Total Cost	Cost per Lamp
$9500	$19	$5292	$10.6	$5842	$11.7

EFFICIENCY AND POWER FACTOR.

	Direct Connected Sets	Motors and Shafting		Engine and Shafting		Constant Current Transformers
		Small Dyn.	Large Dyn.	Small Dyn.	Large Dyn.	
Efficiency	81%	53.8%	76.8%	52.7%	75.25%	93%
Power Factor	.92	.92	.92	100	100	.75
H.P. required for 500 Lamps	397	598	420	614	427	347
Approximate H.P required for 500 Lamps	432	650	456	614	427	462

We might now compare this cost with the cost of constant current transformers on 25 cycle water-power. For this system we find from our table that:

The station costs	$ 1,415 00
The line costs	5,842 00
We also find that our efficiency is 93 per cent., and that the actual power required will be about 347 h.p. Our cost for power in this case will not be the same, as A. C. arc lamps will not operate on 25 cycles, so we will have to take the cost of power after it has been changed to 60 cycles; this we find is $25 per h.p.; 347 h.p. × $12.50 (half as in the other example) would be	4,337 50
The total cost for this system being	$11,594 50
Or a cost per arc lamp of	23 02

A saving in cost by the use of the A. C. system of $6.42 per lamp. When the cost of power is known to vary from those assumed in this table the change can readily be made. In most cases the cost of power would likely have to be figured on the basis of apparent horse-power rather than actual horse-power; both are found in the table.

(For discussion of this paper see page 298.)