necessary at the distributing lines to take care of the maximum demands as shown on the curve of total power. The power factor is assumed to be 100% for the class of load considered, loss in transformers 4%, in line 10%, which is not too high for the peak of the load, as this is what the line is designed for.

Electrical H.P. required at end of transmission line..	11,946
Voltage of transmission at end of transmission line....	15,000
Periodicity or complete cycles per second..........	60
Distance transmitted in miles..........................	10
Power factor assumed p. c............................	100
Loss in transformers p. c...............................	4
Loss in line p. c...	10
System of transmission—Three phase..................	

Figuring the transmission on the above assumptions the actual electrical horse-power at the generator terminals is 13,623, while the apparent horse-power as read by volts and amperes is 13,862. In other words, while the real loss in the transmission is 14% of the power required at the end of the line, the apparent loss is 16% This shows a high power factor for the whole system, and is obtained by a non-inductive load on a line well sub-divided, and with the wires properly placed.

To illustrate the effect of an inductive load upon the amount of apparatus necessary, another line with a load power factor of 90% has been figured, the other conditions remaining the same as before. This, while having the same losses as in the first case, requires 1[illegible]32 apparent horse-power at the generator, necessitating an increase of generating apparatus of 25%, or, in case the plant were installed, it would cut down its capacity 20%, and would decrease that of the distributing apparatus 10%. Were it not for these induction effects the problem would be as simple as in the case of direct current work, but as it is, they affect the matter to a very great degree, and require the most careful consideration to arrive at even a fair approximation to actual results.

Considering the fact that this power is laid down from the wheels with such simple machinery with but at most one revolving part, and therefore requiring no attention when once started, it is not surprising that electricity should have monopolized the field. The efforts at the present time to transmit to longer distances will be successful in proportion as the knowledge of insulating methods increases, and from the rapidity with which present voltages have been attained from lower formerly prevailing, it is not difficult to foresee the time when this country which is so rich in water-power, will be literally covered with power lines for all purposes The possibilities in the way of covering an increased territory by raising the voltage may be illustrated by the plant considered above, where, with 15,000 volt and 14% loss, the power covers a radius of ten miles in all directions. If the voltage were doubled, and the same loss allowed, the radius would be 40 miles, and the territory covered would be sixteen times as great. In other words the area served will vary as the fourth power of the ratio of increase of voltage. The question of the advisability of transmitting from a distance the natural power available in preference to generation at the centre of distribution by steam-power requires the most careful attention. The cost of the power laid down on the consumer's premises is made up of two items, namely, fixed charges and operating expenses. The first includes interest and depreciation on the plant, the second coal and supplies, attendance, etc. The saving by adoption of water-power is in coal and supplies, and perhaps a small part of the labor, provided the plant cost the same. Should, however, the cost of the transmission scheme be enough larger than that of the steam to eat up the saving in interest and depreciation on the increased cost of plant there is nothing to be said in favor of the transmission. If there is no cheapening of cost, the steam plant has the advantage of the greater reliability in lines and apparatus, as no high voltages need be used, and there is no risk of troubles with the water-power during the winter such as always exists to a greater or less extent in this climate.

In many cases, however, where the water-power improvement can be made with small outlay per horse-power rendered available, the gain may be large. It is not so large, however, as seems to be the idea of the public, which considers a water-power as capable of producing power for nothing, entirely ignoring the capitalization necessary for development. The transmission and utilization of electric power has got beyond the experimental stage, and is now surrounded with that mystery which used to obscure the financial facts, and the more it is considered as a commercial article depending upon the laws of supply and demand for its existence the more will its usefulness become apparent to the consumer and its financial security appeal to the capitalist.

MECHANICAL DRAFT FOR STEAM BOILERS.*

BY WALTER B. SNOW.

(Concluded from last issue).

We may now consider the influence, from a commercial standpoint, which the application of mechanical draft exerts upon the aggregate first cost of a steam-boiler plant. For this purpose there has been selected a plant of reasonable size of which the detailed cost is known. This plant consists of eight modern water-tube boilers, each of 200 horse-power nominal rating. A chimney is provided, 8 feet in internal diameter, by 180 feet high, of sufficient capacity to overcome the resistance of the two feed-water economizers and produce the draft necessary for any probable forcing of the boilers. The detailed cost of that portion of the plant which concerns the present discussion is in round numbers, as shown:

Eight water-tube boilers, of 200 horse power each	$25,000
Two feed-water economizers	7,000
Boiler and economizer setting and by pass ..	6,000
Automatic damper regulator and dampers	300
Chimney, complete	9,000
Building, complete	11,000
	$58,300

We may then consider the simplified arrangement which is possible when an induced mechanical draft apparatus is substituted for the chimney. There are two fans supported by the economizers, each driven by a separate engine. Each fan is capable of independently producing the draft for the entire plant, and thus serves as a relay is desired. Such an apparatus, with the short stack, can be installed, complete, under ordinary conditions, for about $3,500, making a saving of $5,800.

The omission of one boiler would bring the rated capacity down to 1,400 horse-power, and would call upon the fans to only increase the steaming capacity of the other boilers by about 14 per cent. above the normal, which could be readily done. This would show an additional saving in first cost which may be thus presented:

1,600 NOMINAL HORSE-POWER PLANT.

Cost of 8 boilers	$25,000
Cost of settings, etc.	6,000
Cost of building	11,000
	$42,000

1,400 NOMINAL HORSE-POWER PLANT.

Cost of 7 boilers..................................	$21,875
Cost of settings, etc., about.....................	5,500
Cost of building, about...........................	10,500
Saving by use of mechanical draft...............	4,125
	$42,000

This shows a possible supplementary saving on the entire plant of $4,125, which makes a total reduction of $9,925 to be credited to the account of the mechanical method.

In any properly arranged plant the exhaust steam from the fan engine would be utilized so that the actual cost of the steam used in producing draft would be reduced to practically nothing. The value of the land may be an important factor in first cost. If figured at $2 per square foot, for instance, the omission of the chimney would in this case save $990, and the reduction in the number of boilers, $960 on the cost of the land required for the plant. The total net saving in first cost of a single plant, under the given conditions, may be thus summarized:

By omission of chimney and damper regulator..	$ 5,800
By reduction in number of boilers..............	4,125
By saving in space occupied by chimney	990
By saving in space occupied by boiler omitted..	960
	$11,875

*Abstract of a lecture delivered before Sibley College, Cornell University