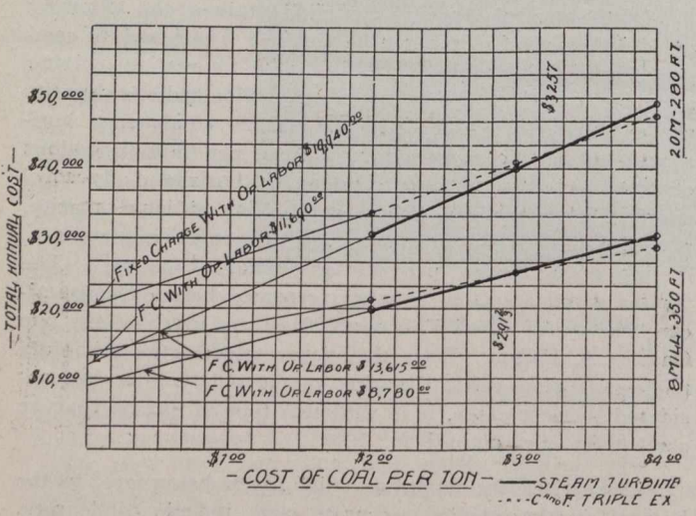
In a new station the turbine should be credited with any saving in floor space, buildings, etc., which it may effect, as compared with the reciprocating engine, and the reciprocating engine credited with the saving effected in the boiler rooms.

In a comparison of this kind certain assumptions must necessarily be made. We have tried to eliminate as far as possible arbitrary assumptions, and all figures of first cost of apparatus have been taken from, or estimated from, recent bids on the two types of machinery under consideration. The first cost per boiler horse-power we have taken to be $30, complete with piping, chimney, stokers, etc. (The use of a lower figure would favor the turbine-driven pump as compared with the high-duty engine, but we believe, with everything taken into consideration, this will prove to be an average figure.) We have assumed the following annual charges against pumping machinery:

Interest	5%
Depreciation	3%
Repairs and supplies	2%
Total	10%

We have also assumed the following annual charges against the boiler equipment.

Interest	5%
Depreciation	5%
Repairs and supplies	5%
Labor on maintenance	2%
Total	17%



Comparisons of Operation Cost of Steam Turbine and Triple Expansion Engines, Small Plants.

It will be noted in the above that an annual depreciation of 3 per cent. has been taken on the first cost of both the crank and flywheel and turbine-driven unit, equivalent to a life of 33⅓ years. We have chosen this method rather than one in which the capital charges are figured on a constantly decreasing book value for the pumping machinery and boilers, in order to avoid a complicated method of accounting.

For the reason that less data are available on the life of turbine-driven units than on crank and flywheel units, it is possible more objection may be made to this assumption of a life of 33⅓ years for each machine. However, as in neither case the question of obsolescence has been taken into account, we believe the assumption a fair one. Viewed in the light of possible future development, it would seem that a longer life should be accorded to the turbine-driven unit than to the crank and flywheel unit, as a very thorough canvass of the whole field of pumping equipment does not bring to light any mechanical apparatus which is being developed to compete with the turbine-driven machinery to the same extent as the turbine-driven machinery is being developed to compete with the crank and flywheel machinery.

It further appears that the steam turbine has reached a stage of development, such that improvements will appear only as refinements of type; and steam economies can only possibly be reduced sufficiently to render obsolete the present good designs by better theoretical design and by better steam conditions. The use of high steam pressures and superheat may be expected to gradually obtain further favor in this country as in European practice, where 250 degrees Fahr. superheat and 200 pounds steam pressure are not unusual. This, however, entails practically no change in turbines as constructed for present steam conditions.

Fuel costs are based on a boiler efficiency of 65 per cent., heat content of 13,000 B.t.u. per pound of coal and 24-hour per day operation.

The duties given are on a basis of 150 pounds steam pressure, with no superheat.

Three examples are taken, based on coal at $2, $3 and $4 per ton. Where coal can be obtained cheaper than $2 per ton, the advantages of the turbine-driven pump are more clearly marked.

It will be noted that the point at which the total annual costs are equal for the eight-million-gallon crank and flywheel vertical unit and the eight-million-gallon turbine centrifugal unit is when coal costs $2.91 per ton. Also for the twenty-million-gallon vertical crank and flywheel unit and the twenty-million-gallon turbine centrifugal unit, the total annual costs will be equal when coal costs $3.25 per ton. Above these points the reciprocating unit has the advantage, and below these points the rotatory unit has the advantage, on the basis of these calculations.

Tabulation "A."

8,000,000 Gallons per Day, 350-ft. Head, 491 w.h.p.

Item.	Vertical C. & F. W. Triple Expansion, 150,000,000 Duty. 3 125-h.p. Boilers.	Steam Turbine Centrifugal, 105,000,000 Duty. 3 175-h.p. Boilers.
Cost, pumping unit	$72,000	$16,000
Interest, depreciation, etc., 10%	7,200	1,600
Cost, boilers	11,250	15,750
Interest, depreciation, etc., 17%	1,915	2,680
Labor, three shifts—		
Engines	2,700	2,700
Boilers	1,800	1,800
Total int., depreciation, etc., and labor	13,615	8,780
Fuel cost, $2 per ton	7,467	10,700
Fuel cost, $3 per ton	11,129	16,100
Fuel cost, $4 per ton	14,934	21,400
Total annual cost, $2 coal	21,082	19,480
Total annual cost, $3 coal	24,744	24,880
Total annual cost, $4 coal	28,549	30,180