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The fire which, since our last issue went to press, destroyed the laboratory of Nikola Tesla in this city and reduced to ashes all the recent devices of his ingenuity, has again aroused public interest in the work of this world-renowned inventor. By the creation of the rotary field motor, which now, some six or seven years from its birth, is a commercial success, and the brilliant investigations he subsequently made in the direction of high frequency phenomena - not yet so far advanced - Tesla has established his right to be regarded as the most promising inventor in electricity that we have today. It is, therefore, only natural that when without warning all his records and more recent apparatus are suddenly wiped out of existence, the public should be eager to know what he had in preparation for his next surprise.

The so-called “Oscillator" was near to a practical working form when the fire occurred, and as this machine, in a less finished shape, had been exhibited at the Chicago Exposition, and has received a large share of his attention since that time, he has considerately given the public some photographs and details of the more advanced forms of this engine. Tesla's researches and inventions have heretofore been confined to purely electrical problems, and electricians were naturally expecting a continuation of such work, but this inventor appears to delight in surprises, and when the Oscillator was announced for the first time, the general conelusion that Tesla had contrived some way of shaking the earth's electric charge, or had made some other ultra scientific step of a like character, was far from the truth.

Of all things yet produced by him the Oscillator is certainly the most thoroughly mechanical and possibly the most practical. The term “Oscillator," in fact, was evidently selected by him in order to distinguish it from other well-known forms of vibrator, and gives hardly any idea either of the machine itself or the functions it is designed to perform. There is, indeed, no connection between this machine and his former productions, except through the fact that its purpose is to economize the work of the steam-engine and the dynamo at the same time, and so materially to increase the output of these, two essentials of every large electric generating plant, the combined weight and cost of the two being greatly reduced.

The Oscillator, in fact, is an “engine dynamo," consisting of a novel form of steam engine combined with and operating on the same bed plate a novel form of dynamo. To understand how such a contrivance can have any practical value in electric generation it is necessary first to consider the essential features of any ordinary electric plant, their relations to each other, and where any losses of power seem unavoidably to enter. In plain terms, all such plants at the present time consist of two independent parts, the steam-engine and the dynamo. This the engine drives generally by indirect methods, as it would any other piece of machinery, as a lathe or a planer, through a system of shafting and belting. True, in modern plants, where large units are employed of five hundred horse-power or upward, the moving part of the dynamo is secured directly to the driven shaft of the engine. This plan is known as direct coupling, and though it introduces no small degree of economy in operation, it seems, according to Tesla, to be only a step in the right direction. It saves, for instance, at least one unnecessary line of shafting with its attendant friction; also, the work wasted in driving the belt or gearing of some kind between the engine and the dynamo, which is a far greater useless drain upon the steam-power.

Direct coupling is, therefore, all very well, so far as it goes, but we have not saved much, if anything, in floor space, or in weight, for we have still an ordinary engine and an ordinary dynamo as before. Are there not other losses equally easy to eradicate? Every engineer knows how really imperfect the steam-engine itself is in respect to work wasted in the friction of many parts that are purely auxiliary, yet apparently necessary to its operation; and although the dynamo, the much younger machine of the two, is a far less wasteful engine, there is still in every reliable form a large percentage of wire that does no work, the friction resistance of sending current through which has to be overcome. Consider the steam-engine first. Here we have a steam cylinder in which is produced the reciprocating motion of the piston rod, and this motion, which represents the active power of the engine, is next converted into rotary motion through a system of auxiliary parts, namely, the connecting rod, the crank, and the attached fly-wheel. These parts all consume work by friction, but by far the greatest loss lies in the change from the reciprocating, or to and fro, piston motion to the rotary motion of the crank, the actual power of the piston working, as it does, at every point of the circle at a disadvantage, owing to the varying inclination of the crank and piston rod in all positions. Rotary motion once obtained, however, we have to reconvert a portion of it back again through further auxiliary apparatus - the eccentric with its rods and valves - to the reciprocating motion of the valve in the steam chest, which latter by its great friction, due to the steam pressure, wastes no inconsiderable amount of power. Thus we see that in the steam-engine all the apparatus except the piston and steam cylinder are auxiliary to it, and all waste, or use up without doing any work on the shaft of the engine, some of the energy delivered by the expanding steam to the piston head. In fact, it is plain that our conversion of the reciprocating motion of the piston to the rotary one of the fly-wheel is wasteful, and if done away with a considerable saving of power could be effected.

Unfortunately, however, in all the machinery for which the steam-engine has been heretofore used as a motive-power or driver, the rotary motion was required in the apparatus, and was, therefore, made in the steam-engine which drove it; all machinery, in fact, with very few exceptions, being essentially rotary.

On the other hand, if we examine the dynamo we shall find that we have made the dynamo a rotary machine only because the steam-engine is, and to accommodate it to the latter. The dynamo had to be driven by a steam-engine, and in its evolution was naturally first made rotary in order to adapt it to existing forms of the steam-engine.

It is well known to electrical engineers that the simplest and most economical forms of dynamo have reciprocating parts only, and that the rotary form can only be contrived at a certain loss of efficiency. We may, therefore, state in general terms that the usual form of engine, rotary, is not adapted to the best form of dynamo, while the best type of engine for driving the simplest and most economical form of dynamo, that having a reciprocating motion only, has not yet been contrived or designed; not because of any inherent difficulty in the designing of such an engine, but simply because such a machine has heretofore had no particular sphere of usefulness.

The Tesla Oscillator is revolutionary in this respect, that it reverses the existing forms of engine and dynamo construction by making them both reciprocating in their action, thus coupling an efficient dynamo to a steam-engine, which, being also reciprocating, has no wasteful auxiliary parts, and no wasteful conversion of the original reciprocating motion to the rotary form of motion. Such, in general terms, is the Tesla Oscillator. It aims simply at a higher economic construction of the two essential parts of an electric generating plant, and in formulating this idea Tesla makes one machine of the two on one bed-plate, and thus again makes no little saving of space and weight.

While this construction, as described for sake of simplicity, might seem easy at first glance, a few engineering difficulties of a purely mechanical character soon become evident that render the solution of the problem one of extreme difficulty.

Briefly stated they are as follows. The dynamo to be economical requires an extremely high rate of to-and-fro motion motion say at least eighty to one hundred strokes a second, while the steam-engine, on the other hand, owing to its necessarily heavy parts, requires a very slow rate for a dynamo, say ten strokes a second, and these adverse requirements of the two machines must somehow be reconciled.

Again, the conversion to rotary motion in the steam-engine from the reciprocating form through the medium of the crank, serves a very useful purpose, especially in the case of heavy and powerful engines. This connection of the piston to the crank causes the piston to start up slowly under the enormous pressure of the steam, attaining its highest speed only for an instant about midway of the stroke, then slowing gradually down to the end of the stroke, where it is zero. The piston is then ready to resume its backward journey in the same manner without shock or jar to the structure. We thus see that there is at least one compensating feature in our conversion loss, for it would evidently be impossible to send the heavy piston, weighing, perhaps, a thousand pounds, at full speed from one end of the cylinder to the other, then instantly arrest its motion at the exact point and send it back again at the same rate. To do this a few times a second would be certain disaster but to do it at a high rate of speed would be as certainly impossible. In the Oscillator the piston travels its journey to and fro a hundred times a second, and can go much faster if required, but the mechanical conditions are all different. In the first place, the parts are all small and extremely light, it being claimed that an engine of a given power on this plan can be made about one-fortieth the weight of an ordinary engine of the same power; secondly, the piston stroke is very small, being in no case more than a fraction of an inch; and, finally, automatically operated air cushions, or springs, are used, that serve to check and slow down the motion of the piston gradually at the end of the stroke.

In one form of the Oscillator two pistons are used that go out and in the opposite ends of the same cylinder at the same time, thus balancing the motion and relieving the apparatus from the rapid shock of vibration. Like the engine having two pistons the dynamo is double, or rather there are two, one for each piston, each of which carries a light armature that it rapidly thrusts into and withdraws from a very intense magnetic field. The vibratory form or oscillatory form of dynamo is not essentially new. Several earlier laboratory machines having been made this way, perhaps the most remarkable of which was the Edison tuning-fork dynamo, remarkable chiefly, however, for its utter inapplicability to any use.

Perhaps the most remarkable feature about the Tesla apparatus is a novel system of steam packing introduced, which enables him to use a steam pressure of three hundred and fifty pounds without any perceptible leak. This, taken in conjunction with the very high rate of piston speed used, which, of course, only compensates for the very short stroke, should produce an engine of high economy. As for the dynamo, the type certainly admits of high economy in construction, and it is claimed that in one form there is absolutely no armature wire that is not cutting lines of force and doing work.

While it is too early to predict the eventual outcome of such revolutionary steps in both steam and electrical engineering the developments thus far seem to have been of the most encouraging sort.

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