what would happen if we have to start both motors together under full load?

In the case of a motor without counter E. M. F., it may be so proportioned as to carry 100 amperes from the generator all day, even when at rest.

I have seen a motor without counter E. M. F. at work. Yes, and I will say I am personally identified with it, but I am not at liberty to say more about it just now. Perhaps the author of that editorial will be able to clear my mind a little on these points, if so, I should be glad to have him do so.

[Mr. W.'s first calculation of a supposed case of two series dynamos, founded on Jacobi's law, is only partially correct. He forgets to account for the other 2,500 watts delivered by the generator. The 50 volts counter E. M. F. × 50 amperes = 2,500 watts, which is the Ce part of the total, and is that which is converted into useful work, while the C^2R part = $50^2 \times 1$ = 2,500 watts, is that part which is irrecoverably lost in heat, exactly as if that current of 50 amperes were sent through a wire of one ohm resistance in a rheostat, or in the form of an air line wire. All this is converted into heat, and, therefore, cannot possibly perform any other work. This accounts for all the 5,000 watts delivered by the generator.

The second calculation is entirely wrong. The current of 100 amperes at 100 volts passing through one ohm resistance will, in accordance with the most elementary fundamental laws of electricity, be converted entirely into heat, no matter whether that wire forms the coils of a motor or of a rheostat, or any other conductor. There will therefore be nothing left of his 10,000 watts to be converted into useful work. If that motor runs at all, he will find that there does exist a counter E. M. F.; it may be a very small one, but it exists, and when multiplied by the current the product will be proportional to the horse power delivered by the motor, neglecting the minor losses. With such powerful currents the counter E. M. F. may be small, as the useful work is proportional to their product. At low speeds a motor may be doing very little work, even if the torque appears to be very great. To find this counter E. M. F. let him run his motor loaded (the greater the speed and load the better), and measure the current and voltage at its terminals. By clamping the shaft so it cannot move, and passing the same current through it, measuring the voltage again, the difference between these two voltages will be the counter E. M. F., provided there is not much sparking. This, multiplied by the current and divided into the brake horse power, reduced to watts, will give him his efficiency. (Care must be taken with the decimal point, so as not to obtain 90 when it should be 9 or perhaps .9. With strong currents, slow speeds and small powers, it may require a good voltmeter and ammeter to make the test properly.

The quotation from "our best authorities," though not exactly wrong, is one of those unfortunate, misleading statements that do so much mischief among beginners. A series motor does develop counter E. M. F. as soon as it revolves; furthermore, it does not do any work until it does revolve. As soon as it delivers any useful work at all it will be found to develop a counter E. M. F.

Mr. W. asks what would happen if his 100 ampere motors, having no counter E. M. F., were started under full load. The answer is: The result will be that the motors will soon "look very sick and will begin to smell badly."

Crediting the innocent generator with the counter E. M. F. is novel, ingenious and amusing, but the makers of the generators, or any educated electrical engineer, could readily show the deception and fallacy of this. Let Mr. W. put a meter in circuit between the generator and motor, and he will find it out for himself. To dispel the cloud which he infers rests on his mind, let him study a few good elementary books on the first principles of electricity, motors and dynamos.–Ed.].

The Ewing High Frequency Alternator and Parsons Steam Turbine.*

BY NIKOLA TESLA.

In your issue of Nov. 18† I find a description of Professor Ewing's high-frequency alternator, which has pleased me, chiefly because it conveyed to me the knowledge that he, and with him, no doubt, other scientific men, is to investigate the properties of high frequency currents. With apparatus such as you describe, shortly a number of experimenters, more competent than myself, will be enabled to go over the ground, as yet but imperfectly explored, which will undoubtedly result in the observation of novel facts and elimination of eventual errors.

I hope it will not be interpreted as my wishing to detract anything from Professor Ewing's merit if I state the fact that for a considerable time past I have likewise thought of combining the identical steam turbine with a high frequency alternator. Anch' io sono pittore. I had a number of designs with such turbines, and would have certainly carried them out had the turbines been here easily and cheaply obtainable, and had my attention not been drawn in a different direction. As to the combination, to which you give a rather complicated name, I consider it an excellent one. The advantages of using a high-speed turbine are especially great in connection with such alternators. When a belt is used to drive, one must resort to extraordinarily large diameters in order to obtain the necessary speed, and this increases the difficulties and cost of construction in an entirely unreasonable proportion. In the machine used in my recent experiments the weight of the active parts is less than 50 pounds, but there is an additional weight of over 100 pounds in the supporting frame, which a very careful constructor would have probably made much heavier. When running at its maximum speed, and with a proper capacity in the armature circuit, 2½ h. p. can be performed. The large diameter (30 inches), of course, has the advantage of affording better facility for radiation; but, on the other hand, it is impossible to work with a very small clearance.

I have observed with interest that Professor Ewing has used a magnet with alternating poles. In my first trials I expected to obtain the best results with a machine of the Mordey type—that is, with one having pole projections of the same polarity. My idea was to energize the field up to the point of the maximum permeability of the iron and vary the induction around that point. But I found that with a very great number of pole projections such a machine would not give good results, although, with few projections, and with an armature without iron, as used by Mordey, the results obtained were excellent. Many experiments of similar nature, made in the course of my study, demonstrate that the ordinary rules for the magnetic circuit do not hold good with high frequency currents. In ponderable matter magnetic permeability, and also specific inductive capacity, must undergo considerable change when the frequency is varied within wide limits. This would render very difficult the exact determination of the energy dissipated in iron cores by very rapid cycles of magnetization, and of that in conductors and condensers by very quick reversals of current. Much valuable work remains to be done in these fields, in which it is so easy to observe novel phenomena, but so difficult to make quantitative determinations. The results of Professor Ewing's systematical research will be awaited with great interest.

It is gratifying to note from his tests* that the turbines are being rapidly improved. Though I am aware that the majority of engineers do not favor their adoption, I do not hesitate to say that I believe in their success. I think their principal uses, in no distant future, will be in connection with alternate current motors, by means of which it is easy to obtain a constant, and in any desired ratio, reduced speed. There are objections to their employment for driving direct current generators, as the commutators must be a source of some loss and trouble, on account of the very great speed; but with an alternator there is no objectionable feature whatever. No matter how much one may be opposed to the introduction of the turbine, he must have watched with surprise the development of this curious branch of industry, in which Mr. Parsons has been a pioneer, and every one must wish him the success which his skill has deserved.

*From *The Electrician* (London).

†See THE ELECTRICAL WORLD, Dec. 17, 1892, p. 391.

*See THE ELECTRICAL WORLD, Dec. 10, 1892, p. 375.

Report of the Sub-Committee on Provisional Programme for the International Electrical Congress.

The accompanying report, prepared by the special sub-committee of the American Institute of Electrical Engineers, was received by the General Congress Committee at its meeting, held Dec. 28, 1892, and ordered to be printed for presentation to the Advisory Council of the World's Congress of Electricians, for consideration at its meeting, to be held Jan. 17, 1893. This arrangement is approved by Dr. Elisha Gray, chairman of the Committee on Electrical Congress, of the World's Congress Auxiliary.

To the General Congress Committee of the American Institute of Electrical Engineering:

The sub-committee understands its duties to be as fully submits to you the following report:

The sub-committee understands its duties to be as follows:

To suggest what work it is desirable to have done at the coming International Electrical Congress, to be held in Chicago in 1893.

To suggest a programme for carrying out this work in the most satisfactory manner to all parties, and with the least loss of time.

Regarding the work to be done, your committee's recommendations are as follows:

(1.) Ratification of the adoption of units, terms, symbols and definitions by previous International Electrical Congresses.

This is a mere matter of form, and an act of courtesy to the preceding congresses. Your committee understands that this was done at both the Paris congress of 1889 and the Frankfort congress of 1891.

(2.) Defining and adopting practical units for measuring and designating the measurements of the following quantities: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; electric conductivity; illumination.

It will be noticed that this refers only to the question of what the magnitude of the units shall be, or, in other words, what multiples or sub-multiples of the absolute units they are to be.

Your committee is aware that objections are raised by some to the establishment of units not already in universal use. Past experience, however, has shown that the proper time to establish units is before their need is universally felt, in order to avoid the introduction by different persons or nations of units of different values, a contingency which will be very likely to arise, if not anticipated by concerted action.

Your committee recommends the following:

The value of the practical unit of magneto-motive force to be one-tenth of the absolute unit, that is, equal to $\frac{1}{4\pi}$ ampere turn.

The value of the practical unit of magnetic flux to be 10^8 absolute units or lines.

The value of the practical unit of magnetic intensity to be 10^8 absolute units, that is, 10^8 lines per square centimetre.

The value of the practical unit of reluctance to be 10^{-9} absolute units.

The value of the practical unit of electrical conductivity to be 10^{-9} absolute units, that is, to the reciprocal of the ohm. This makes it equal to the unit proposed some time ago, and known to some extent by the name of "mho." It should be given this value in order that it correspond with the already adopted units.

The value of the practical unit of illumination to be a bougie-decimale at the distance of one metre. The bougie-decimale is the unit of light or candle power already established, and is practically equal to one English standard candle; by making the distance a metre, the practical unit will be approximately equal to one-tenth of a carcel-metre, one-tenth of a foot-candle (or "lux") or to one metre-candle or metre-kerze, all three of which units are already in use to some extent.

It has been announced that a proposition will be made at this congress to change the values of some of the practical units, which have been adopted by previous congresses and are already in universal use. Among these are the ampere and the farad. It is urgently recommended by your committee that such changes should not be favored, since they would necessarily be followed by great confusion and would of necessity have to be accompanied by some change in these well established names in order to distinguish these new units from those now existing.

(3.) Adopting names for the following practical units: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; inductance; electrical conductivity; illumination.

The following names are suggested for these units:

For the practical unit of magneto-motive force the name "gilbert."

For the practical unit of magnetic flux, the name "weber." This term was formerly applied to a unit of current, but its use in this sense was so limited, and it has been abandoned for so long a time, that no confusion would be likely to arise; the context alone would always be sufficient to prevent any possibility of misunderstanding. The name "weber" is preferred on account of the intimate relation between this unit and that of magnetic intensity, for which the name "gauss" is suggested.

For the practical unit of magnetic intensity, the name "gauss." This name has already come into use to such an extent that objections to it will not be likely to arise.

For the practical unit of magnetic reluctance, the name "oersted."

For the practical unit of inductance, the name "henry." This name has already come into use quite extensively, and it would, therefore, be very undesirable to change it. The value of this unit has already been fixed as equal to 10^9 absolute units or nearly to the length of an earth's quadrant. The definition "quadrant" is sometimes employed as the name itself, but its use as a name is evidently objectionable, as it already has several other meanings, which might readily lead to confusion.

For the practical unit of electrical conductivity, equal to the reciprocal of the ohm, the name "mho." This name has been in use for some time and is already well known. It is thought better to recommend it than to select and introduce a new name.

For the practical unit of illumination defined above, the name "bougie-metre."

It has been suggested to name the units "kilowatt-hour" and "ampere-hour." Your committee, however, recommends that inasmuch as these terms explain themselves, and are not longer than some others in use, to give them special names would burden a system of no-