

NINETEENTH ANNUAL CONVENTION.

OPENING SESSION.

Discussion at Great Barrington, June 18th. Papers by F. G. Baum, M. Leblanc, H. W. Buck and Charles P. Steinmetz.

PRESIDENT STEINMETZ:—Gentlemen, Members of the INSTITUTE and Guests: I now call to order the Nineteenth Annual Convention of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Following our previous practice, we hold the Annual Convention outside of the place of our regular monthly meeting, this time in a very pleasant country village, and I hope you will enjoy the convention very much, especially as we have been so very well and cordially received, in somewhat striking contrast to some experiences in former times.

[After presentation of papers by the authors named above, the discussion proceeded as follows:]

DR. F. A. C. PERRINE:—I have some notes here for closing the discussion on Mr. Baum's paper which I think we might as well read. Mr. Baum wrote me a letter that I thought might possibly be required in answering some questions, but as I did not hear the questions, I will read the letter anyway.

“STOCKTON, CAL., Jan. 1, 1901.

DR. F. A. C. PERRINE.

DEAR SIR:—As I telegraphed you on December 28, 1900, I made a practical test of the compensator at Stockton. I was able to make arrangements with Mr. Adams to start 15, 20, 25 and 75 h.p. motors on the G. E. 100 k.w. synchronous motor, which is now being run as a generator. This generator is a bad regulator (having been built for motor work), the reactive pressure being about 20 per cent. on full load current, and the starting of the 75 h.p. Westinghouse type C, (Farmer's Union) motor is as severe a test as you will ever get in practice.

I thought the conditions here for giving the compensator a severe test were better than at Maryville, and therefore did not go up there. I am convinced that I could start this 75 h.p. motor on a 50 k.w. generator, and not cause more than a momentary dip of the lights.

The compensator was driven in synchronism by a gearing on the shaft. This gearing is satisfactory, but usually when several alternators are to be compensated, the compensator would be driven by a small synchronous motor. A synchronous motor for the purpose can be made by winding a $\frac{1}{4}$ h.p. motor frame. Since a $1\frac{1}{4}$ h.p. motor will make a compensator large enough to take care of a 2,000 k.w. generator or station, you need not go to any expense in getting out new patterns, etc., for the compensator. For smaller generators 50 to 200 or 300 k.w., a smaller machine than the $\frac{1}{4}$ h.p. motor could be used for the compensator.

Starting test of 20 h.p. G. E. (Hyatt) motor, on 100 k.w. G. E.

generator. (Speed change in engine varies the voltage from 114 to 118; railroad on same engine.)

	CONDITIONS		MOTOR
	BEFORE START	START	RUNNING.
Alternating Amperes,	6.25	15	9
“ Voltage,	116.	114	116
Exciter Amperes,	9.25	10	9.5

No change in rheostat necessary. Voltage dips to 114 but returns to 116 in less than two seconds. This dip is on account of the lag in magnetism spoken of.

Without compensator, when this motor is started, the voltage drops 10 to 20 volts, and must be brought back by turning rheostat handle. Station must be notified when motor is thrown on or off. No notice is necessary when compensator is in.

Start 75 h.p. Westinghouse type C (Farmer's Union) motor on 100 k.w. G. E. generator.

	BEFORE START.	START.	MOTOR RUNNING.
Alternating Amperes	10	Over 50 amperes.	15
“ Voltage,	116	95	116
Exciter Amperes,	9.75	12.75	11.5

Ammeter needle off scale.

No change in rheostat. Voltage dips to 95, but comes back to 116 in about two seconds. Note that the exciting current immediately jumps from 9.75 to 12.75, an increase of 32 per cent., and then gradually drops as the speed of the motor increases, to 11.5 amperes, where it remains. Rheostat was not touched. When motor is cut off, alternator voltage remains at 116.

Without compensator, the voltage drops when this motor is started to about 85, and remains down about 100 until brought up by station attendant. Station must be notified when the motor is thrown on or off. No notice is necessary when compensator is used.

Yours truly,

(Signed) F. G. BAUM.

PROF. C. A. ADAMS:—I should like to ask Dr. Perrine about the compensator.

DR. PERRINE:—The sparking is one of the things that Mr. Baum attempts to get rid of by the arrangement shown in Fig. 6, where he obtains a very small current from the compensator largely to do away with sparking, and uses that to excite an auxiliary exciter, which in turn excites the extra winding of the excited field. When he attempts to use a compensator directly, he is apt to get considerable sparking, but he gets rid of the sparking by making the current very small—a current of the maximum of an ampere is sufficient to do all the work when he uses this auxiliary exciter.

PROF. ADAMS:—My inquiry was if in this latter case he gets rid of the sparking.

DR. PERRINE:—He does not get rid of it, but he uses such a small current it does no harm.

PROF. ADAMS:—How would you get rid of sparking in using 1,500 k.w. instead of 200 k.w.?

DR. PERRINE:—The compensator in any case is a small outfit; he uses that to act on a secondary exciter, and he always keeps his current in the compensator small, even when compensating from a large generator.

MR. ADAMS:—It would be possible, then, to use a small compensator for the exciter, regardless of the size of the generator?

DR. PERRINE:—Yes, provided the winding of the secondary exciter is correct; that is, he need not change the current in the compensator at all.

Concerning Mr. Buck's paper there are a few things of which I would like information from Mr. Buck. At the time the original plant was built, we heard a great deal of the manner of carrying the heavy shaft and I would like to know whether there has been any change in the design of the thrust bearings along the shaft which carry that shaft. Also whether anything has been done to obviate the extreme wobbling of the 30-inch shaft. I was in the wheel-pit of the old power-house a short time ago with some Western engineers, and we all noticed that the 30-inch shaft seemed to be running out an inch or two, and the question was raised, even though it may be considered trivial, whether it really was not straining the material, and bringing about the effect that we commonly know as crystallization, which is not crystallization, but simply the exceeding of the elastic limit to a very small extent continuously, which ultimately overcomes the elasticity of the entire material, and it appeared to be a good thing to get rid of.

On the seventh page of the paper is given the guaranteed and test efficiencies of the old machines, and nothing is said of the efficiencies of the new machines. I do not presume from those efficiencies they can be very much greater, and may be less, but it would be interesting if we knew approximately what those efficiencies are.

I agree with Mr. Buck entirely in the question of the arrangement of his switchboard, namely, that the bench system in combination with the instruments on panels is bad. The bench system to my mind, is only practical where the station is so small that the instruments can be arranged so close together that lines drawn from the bench will come directly on the switchboard panels. What I mean by that is this: if we have a switchboard with instruments on, and divided into panels, and an operating table of smaller dimensions, then the benchboard is permissible if the switchboard is short enough to be within the eye of the attendant, and his small switches located with lines drawn showing what they represent on the instrument board; then when a man puts his hand on any particular switch, by following his lines he goes directly to the instruments he is operating. But I

agree with Mr. Buck entirely, it is poor practice to have an operating table at one point and the instruments that are operated from that table 20 or 30 feet on either side. Obviously, a man cannot tell what he is doing; and furthermore, the advantage of having all of the switches at any station under a man's immediate hand is more or less fictitious. It is rare that a man at any one time will want to handle more than two machines, and they are generally adjacent machines; the cases are 99 out of 100 where an operator has not before him all the switches he needs to have. In this Niagara station I first saw the method of putting all the recording apparatus in the superintendent's office, and it seemed to me that is really where they belong. There is only one thing to my mind worse than putting wattmeters on the switchboard, and that is lightning arresters. The operator at the station should have before him such instruments and such apparatus as he must necessarily use in handling the station, and only such apparatus. If the station operator has before him instruments that he does not need to use in operating the station, and whose indications he does not need to consider, he gradually loses his respect for all indication of instruments; and I believe that there should be before the station operator only the things he has to pay attention to and use. This idea of putting on the switchboard all kinds of phase indicators, and frequency indicators and indicators of everything under the sun, is to my mind an absolutely vicious practice. The station attendant ought to have before him such apparatus that every movement of a needle tells him something, and he should not have wattmeters, for example, any more on his switchboard than he should have lightning arresters; and with the three-phase generator he does not need three voltmeters and three ammeters; and to put apparatus there that the station attendant positively cannot control, I think is confusing to his mind. This Niagara plant is the first one where this principle was put in practice, and I am very glad to see it carried out in this latest development. The change from an external revolving field to the internal revolving field seems, in our ideas of the Niagara plant, very radical; but the speeds of those generators are not greater than the speeds that are being used in other revolving field plants and the construction I imagine is very much similar; and it seems to me the change is a distinct practical improvement in the construction.

MR. BUCK:—Replying to Dr. Perrine, the average weight of the rotating parts of the machinery in power-house No. 2 will be carried as in the old plant, upon a hydraulic step at the bottom of the shaft, and the variations in downward thrust due to variations in head of water, will be taken care of by an oil thrust bearing near the top of the shaft, which is operated by oil under pressure of several hundred pounds per square inch. The friction of this oil thrust bearing is so slight that when the machine is standing still a man can turn it around by hand.

In regard to the apparent eccentricity of the shaft, I think that

it is due to the shaft being hollow, and made of lapped boiler iron. Every time a lap goes around it looks as if the shaft were out of true, but the shaft as a whole is centered so that there is no wobble on the bearings. The test efficiency of the internal field generators was not given for the reason that these machines have not yet been tested. The guaranteed efficiency is 2/10 of 1 per cent. lower at full load, than that of the external field generators.

In the old power-house the indicating and recording wattmeters are both placed in the office of the superintendent. In the new plant the indicating meters will be transferred to the switch-board and the recording wattmeters only retained in the office of the superintendent.

MR. A. V. GARRATT:—The drawing is on so small a scale that it is difficult to tell what style of gate the turbine has. It will be interesting if Mr. Buck will advise us as to what type of turbine is being used, and also where turbines of this particular type have been installed, if at all, in this country, and what success has been obtained with them in regard to speed regulation.

MR. BUCK:—I do not think that any turbines of this exact design have yet been installed in this country, but there are a number installed in Switzerland and other European countries, and I understand that the results obtained have been very satisfactory. In this design, the water coming down the penstock enters the wheel case, which is spherical in form, and from there discharges inward through a double set of buckets which are controlled by ring gates from above. From the inside of the rotating part, the water is drawn out through double draft tubes as shown.

MR. P. H. THOMAS:—There is a little more, it seems to me, that should be said on the uses of benchboards in these large systems. Of course it is very important to have the attendant see the instruments on the panel on which he is going to throw switches, but it is also important that he should know as well the actual connections on the rest of the system. In many cases I should think the latter would be more important than seeing the indications of the instruments. A complete knowledge of the connections of the system is very easily obtained by the benchboard system. Undoubtedly, however, some plants can be more satisfactorily handled with the feeder system than with a benchboard.

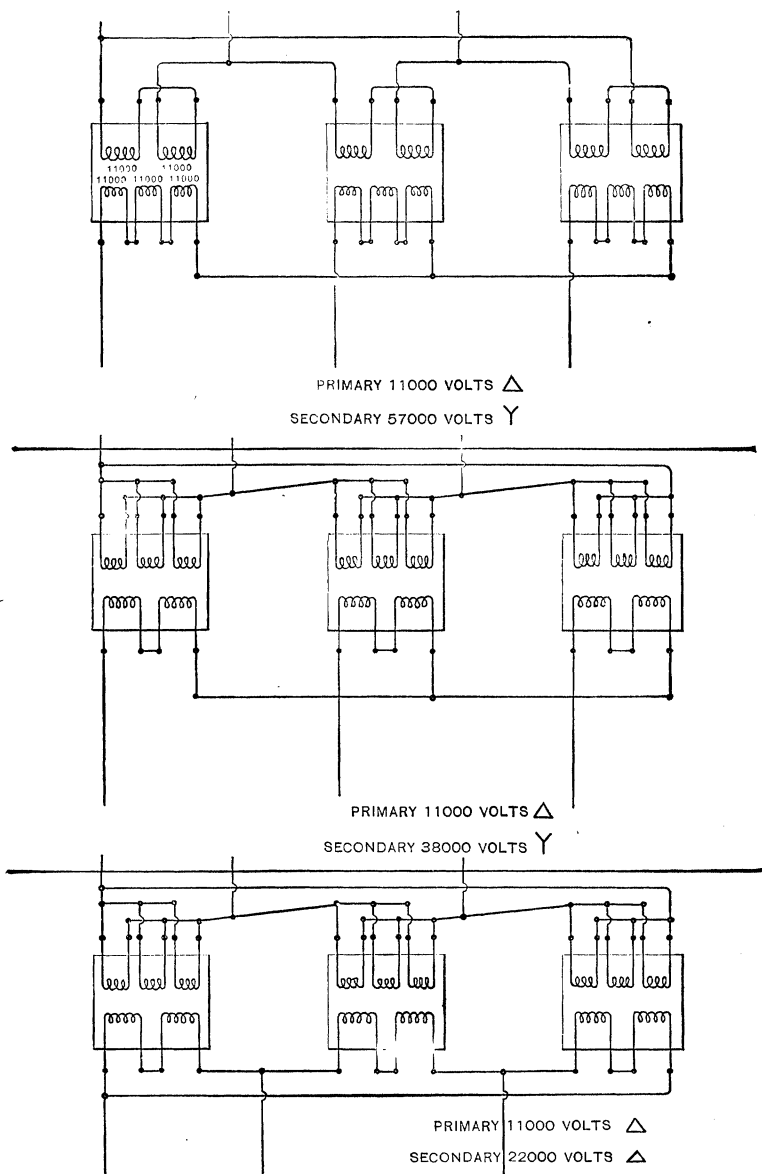
Mr. Buck, do you expect to pay duty on your power when you are transferring it from Canada to the United States?

MR. BUCK:—In regard to Mr. Thomas's first point, I quite agree with him that there might be some special case where benchboard control would be of advantage, but where you have a large number of generator panels and feeder panels it is impossible to get instruments arranged in such a way that there would be no confusion.

In regard to the duty on power, that matter was settled, I be-

lieve, by Congress and also by the Canadian Parliament, and a reciprocal arrangement arrived at.

PRESIDENT STEINMETZ:—In Mr. Buck's paper the statement



is made that the output of the Canada plant is intended for long-distance transmission to Toronto, I believe. We would all be interested to hear somewhat more of what is intended to be done

there and what work is in progress regarding the transmission. The distance is rather long, pretty well up to 100 miles, and the climate is not so lovely as in southern California, and it would be quite interesting to hear what Niagara expects to do.

MR. BUCK:—Up to the present time nothing very definite has been done upon the Toronto transmission line, but negotiations are now pending and it is likely that construction will start before long. The line is to be arranged for operation at either 40,000 or 60,000 volts. The arrangement of step-up transformers selected for this transmission may be of interest to the INSTITUTE, and I will illustrate the construction on the black-board. [See Fig. 1]. The transformers are designed with five similar coils, two of which constitute one winding and three the other winding, either of which can be used interchangeably as *primary* and *secondary*. By the various combination of coils as shown in the sketch, any of the voltages shown can be used with the full copper efficiency of the transformers.

PRESIDENT STEINMETZ:—If there is no further discussion today, then a motion to adjourn will be in order. Before we adjourn I desire to say this: We have postponed two papers which we had scheduled for this forenoon's meeting. We have a very large programme for to-morrow and the following day, therefore it will be absolutely necessary to start the meeting punctually at 9 o'clock.

Announcement regarding social features in connection with the Convention were then made by Mr. Stanley, after which the session adjourned.

In the afternoon the members with their ladies were entertained at a Lawn Tea, under the auspices of the Thursday Morning Club, at Brookside, the residence of Mr. and Mrs. William Stanley.

In the evening a Lantern Exhibition arranged by the Committee on Papers was given by the INSTITUTE at the Town Hall. Groups of slides upon various subjects were shown and described by the members named, who were introduced by the Secretary: Messrs. T. Commerford Martin, W. B. Spellmire, F. A. C. Perrine and W. J. Jenks.