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OF THE

TWENTIETH ANNUAL CONVENTION

OF THE

American Railway Engineering Association

HELD AT THE

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REPORT OF COMMITTEE XVIII—ON ELECTRICITY.

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A. H. ARMSTRONG,
H. M. BASSETT,
Z. M. BRIGGS,
D. J. BRUMLEY,
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R. D. COOMBS,
WALT DENNIS,
R. H. FORD,
W. F. GRAVES,

A. G. SHAVER, *Vice-Chairman*;
G. W. KITTREDGE,
C. E. LINDSAY,
H. K. LOWRY,
W. L. MORSE,
W. S. MURRAY,
FRANK RHEA,
J. R. SAVAGE,
M. SCHREIBER,
H. U. WALLACE,

Committee.

To the American Railway Engineering Association:

Your Committee presents herewith its Annual Report for the year 1918.

The following outline of work was assigned to the Committee on Electricity by the Board of Direction:

SUBJECTS ASSIGNED.

1. Make critical examination of the subject-matter in the Manual and submit definite recommendations for changes.

2. Report on the study of electrolysis and insulation and its effects upon reinforced concrete; report upon methods of insulating or guarding against electrolysis.

3. Report on the study of maintenance organization and on relation to track structures.

4. Report on utilization of water power for electrical railway operation in collaboration with Committee on Conservation of Natural Resources.

5. Report recommended practice for eliminating, as far as practicable, the interference with telephone and telegraph lines caused by the use of propulsion circuits.

6. Continue co-operation with National Joint Committee on Electrolysis and the National Joint Committee on Overhead and Underground Line Construction.

COMMITTEE MEETINGS.

Three meetings were held in Room No. 5048, Grand Central Terminal, New York City, as follows:

First meeting was held on August 7, and the following were present:

E. B. Katte, Chairman,	C. S. Churchill,
H. M. Bassett,	W. L. Morse,
Z. M. Briggs,	L. S. Wells, representing Mr.
D. J. Brumley,	J. R. Savage.

At this meeting Sub-Committees were appointed and the work for the year outlined.

The second meeting was held on November 20, and the following were present:

E. B. Katte, Chairman,	W. S. Murray,
A. H. Armstrong,	M. Schreiber,
C. S. Churchill,	L. S. Wells, representing Mr.
W. L. Morse,	J. R. Savage.

At this meeting preliminary reports of Sub-Committees were read, revised, and the work of rounding out the reports detailed.

The third meeting was held on December 30, and the following were present:

E. B. Katte, Chairman,	W. L. Morse,
A. H. Armstrong,	M. Schreiber,
Z. M. Briggs,	L. S. Wells, representing Mr.
R. H. Ford,	J. R. Savage.

At this meeting the reports of the Sub-Committees were received and the report to the Association compiled as follows:

(ITEM 1) REVISION OF MANUAL.

SUB-COMMITTEE No. 1.

R. H. FORD, Chairman;	W. F. GRAVES,
A. H. ARMSTRONG,	G. W. KITTREDGE,
C. S. CHURCHILL,	C. E. LINDSAY.
R. D. COOMBS,	

The Committee last year submitted to the Association a list of technical definitions and the Association tentatively adopted and published them in the Proceedings with the understanding that the membership would have an opportunity to consider and offer suggestions to the Committee. The following list of definitions has been revised and is now submitted for adoption and printing in the Manual. These definitions, so far as possible, conform with those in use by the U. S. Bureau of Standards and printed in the National Electrical Code and those of the American Institute of Electrical Engineers. It will be noted that the definitions are arranged in alphabetical order rather than in logical sequence. This has been done with the view of conforming to common usage in the Manual. Words in parentheses after each definition indicate new definitions by the word "proposed" or the source of existing definitions.

ELECTRICAL DEFINITIONS.

BOND.—A metallic means for connecting conductors to permit passage of electric current. (Proposed.)

BONDER.—An employee assigned to install or maintain bonds and their appurtenances. (Proposed.)

BRACKET SUPPORT.—An arm supporting the trolley wire or catenary. (Proposed.)

- BRIDGE SUPPORT.**—A rigid overhead structure supporting the trolley wire or catenary. (Proposed.)
- CABLE CONDUCTOR.**—Wires bound together acting as a conductor. (Proposed.)
- CATENARY SUSPENSION.**—Any form of trolley construction supported by a longitudinal wire or cable. (Proposed.)
- CLEARANCE LINE (Equipment).**—The line beyond which no part of the equipment shall project. (Proposed.)
- CLEARANCE LINE (Third Rail).**—The line beyond which no part of the third rail structure shall project. (A. R. E. A. Manual.)
- CONDUCTOR.**—A metallic path for the flow of electricity. (Proposed.)
- CONTACT CONDUCTOR.**—That part of the distribution system other than the traffic rails which is in immediate electrical contact with the circuits of the cars or locomotives. (A. I. E. E. 706.)
- CONTACT RAIL.**—A rigid contact conductor. (A. I. E. E. 767.)
- CONTACT RAIL (Overhead).**—A rigid contact conductor above the elevation of the maximum equipment line. (A. I. E. E. 768.)
- CROSS-SPAN SUPPORT.**—Overhead wire or cable supporting the trolley wire or catenary. (Proposed.)
- DIRECT SUSPENSION.**—Any form of overhead trolley construction in which the trolley wires are attached by insulating devices directly to the main supporting system. (A. I. E. E. 780.)
- DISTRIBUTING SYSTEM.**—That portion of the conductor system which carries current of the kind and voltage received by the cars or locomotives. (Proposed.)
- DUCT LINE.**—A structure consisting of one or more tubes and chambers for the housing of wires or cables. (Proposed.)
- JUMPER.**—A cable used to connect the ends of two contact conductors. (A. R. E. A., Vol. 18, page 145.)
- PATROLMEN.**—Employees assigned to inspect track and third rail structures, cables and wires. (Proposed.)
- PULLING CHAMBER.**—A chamber in a duct line provided for pulling cables and wires into ducts. (Proposed.)
- SPLICING CHAMBER.**—A chamber in a duct line, in which cables are spliced and inspected. (A. R. E. A., Vol. 18, page 144.)
- SUBSTATION.**—A structure and its contained group of apparatus or machinery which receives current from a transmission system, changes its kind or voltage and delivers it to a distribution system. (A. I. E. E. 762.)
- THIRD RAIL.**—A contact conductor placed at either side of the track, the contact surface of which is located a few inches above the level of the top of the track rails. (A. I. E. E. 769.)
- THIRD RAIL GAGE.**—Distance measured parallel to plane of top of both running rails between gage of nearest running rail and inside gage line of third rail. (A. R. E. A. Manual.)

TRACTION LINEMEN.—Employees assigned to install or maintain wires and cables and their appurtenances for all railroad voltages. (A. R. E. A. Manual.)

LINEMAN (New).—Employees assigned to install or maintain wires and cables and their appurtenances. (Proposed.)

TRANSMISSION SYSTEM.—That portion of the conductor system carrying current of a kind or voltage different from that received by the cars or locomotives. (Proposed.)

TRANSMISSION LINE.—A system of towers or poles and cables or wires carrying current from the source of power to the substations. (Proposed.)

TROLLEY WIRE.—A flexible contact conductor customarily supported above the cars. (A. I. E. E. 777.)

CLEARANCES—THIRD RAIL AND OVERHEAD.

SUB-COMMITTEE No. 2.

H. M. Bassett, Chairman;	H. K. Lowry,
Z. M. Briggs,	A. G. Shaver.
W. F. Graves,	

This Sub-Committee makes no report this year, but has kept its organization intact with a view of revising and bringing up to date the statistical tables contained in the report of last year, and will present them to the Association in March, 1920.

TRANSMISSION LINES AND CROSSINGS.

SUB-COMMITTEE No. 3.

R. D. Coombs, Chairman;	Frank Rhea,
H. M. Bassett, Vice-Chairman;	J. R. Savage,
D. J. Brumley,	A. G. Shaver.
H. K. Lowry,	

This Sub-Committee has kept itself advised in relation to the transmission line crossing requirements of the proposed National Electrical Safety Code and is prepared to confer with the representatives of the American Railroad Association and American Electric Railway Engineering Association with a view of revising the joint transmission line crossing specifications, as soon as the representatives of the other associations are appointed.

(ITEM 2) ELECTROLYSIS AND INSULATION.

SUB-COMMITTEE No. 4.

E. B. Katte, Chairman;	C. S. Churchill,
D. J. Brumley,	W. S. Murray,
R. D. Coombs,	M. Schreiber.
H. M. Church,	

This Sub-Committee has no report to offer on Electrolysis and there has been no meeting of the American Committee on Electrolysis during

the past year. The Sub-Committee has kept in touch with the subject of electrolysis in reinforced concrete in salt water, but nothing new has developed which can be reported at this time.

(ITEM 3) MAINTENANCE ORGANIZATION AND RELATION TO TRACK STRUCTURES.

SUB-COMMITTEE No. 5.

Walt Dennis, Chairman; C. E. Lindsay,
Z. M. Briggs, Vice-Chairman; W. L. Morse,
H. M. Church, J. R. Savage.
R. H. Ford,

This Sub-Committee has kept in touch with current developments, but defers reporting until next year.

(ITEM 4) WATER POWER.

SUB-COMMITTEE No. 6.

C. S. Churchill, Chairman; R. H. Ford,
Z. M. Briggs, Vice-Chairman; W. S. Murray,
A. H. Armstrong, Frank Rhea,
H. M. Church, M. Schreiber.
D. J. Brumley,

This Sub-Committee has to some extent investigated the utilization of Water Power for electric railway operation and has collected some data to indicate to what extent water power is now used to generate electricity for the operation of steam railroads. In the table below are shown the principal steam roads which have been partially electrified, the source of power, and the approximate annual current consumption. In the case of those roads using current generated by steam, the reason why water power was not used is given so far as obtainable.

ELECTRIFIED STEAM RAILROADS—1917.

Line	1917, Miles Electric Track	Trolley Voltage	Kind of Service, Passgr. and Freight	Power From	KWH 1917 at Power House for Trains	Reasons for not Using Water Power
Penn. R. R., N. Y....	97	650 DC	P	Coal	64,290,840	None available.
L. I. R. R., N. Y....	208	650 DC	P	"	97,382,970	None available.
P. R. R., Philadelphia.	95	11000 AC	P	"	23,100,360	None available.
W. J. & Seashore....	150	650 DC	P	"	32,825,600	None available.
Grand Trunk Ry....	12	3300 AC	P&F	"	3,913,300	None available.
Nor. & Western Ry..	90	11000 AC	F	"	56,651,700	Coal cheaper.
New York Central....	253	650 DC	P	"	102,585,000	None available.
N. Y., N. H. & H. R. R.	530	11000 AC	P&F	"	90,500,000	Some water pr.
M. C. R. R., Detroit..	25	650 DC	P	"	7,431,000	None available.
Hoosac Tunnel.....	21	11000 AC	P&F	Both	7,727,000	
B. & O., Baltimore...	8	650 DC	P&F	Water	6,200,230	
C. M. & St. P. R. R.	600	3000 DC	P&F	"	124,600,000	
B. A. & Pacific.....	90	2400 DC	F	"	23,408,270	
Erie (Roch. Div.)....	38	11000 AC	P	"	1,894,860	
Great Northern.....	10	6600 AC	P&F	"	4,080,000	
Southern Pacific.....	114	1200 DC	P	Coal	30,082,000	
Total	2341				677,000,000	

GENERAL.—The development of any water power for a certain kilowattage should require that the combination of stream flow and reservoir capacity is capable of developing the same kilowattage throughout the year.

In the Middle Atlantic and New England States, within a reasonable distance—not to exceed 200 miles of any railroad having a dense traffic and excluding Niagara Falls—the streams where an appreciable head is available are erratic as to stream flow. A small amount of power can be developed economically, but to develop an amount reasonably to be expected from a central station requires either a reservoir or an auxiliary steam station. The result of this is usually a plant in which the capitalization is so excessive that, in spite of the low operating cost, electrical energy cannot be produced at a price to compete with that generated in an all-steam station of like capacity, and economy.

PENNSYLVANIA RAILROAD.—Of all the streams in the territory, the Susquehanna River is most favorable for water power development along the Pennsylvania Railroad, not only because the horsepower available for development is the highest, but because the river basin has the greatest drainage area and is the least settled, and places can be found for the power development site where the necessary land and rights can probably be obtained more cheaply than on any other river.

Examination of the records of the United States Geological Survey for the period from January 1, 1891, to December 31, 1908, shows that for the neighborhood of McCalls Ferry power plant, the minimum stream flow for the years 1901 and 1903 could have developed in one plant 28,000 K.W. In 1905 it could have developed approximately 40,000 K.W.; and in all other years only a little better than 10,000 K.W. This minimum stream flow occurred consistently in September and October. The maximum stream flow each year, during this period, could have developed in one plant an average of approximately 90,000 K.W. over any reasonable period.

At the McCalls Ferry plant it was proposed in 1916 to install 100,000 H.P. or 74,600 K.W. at an estimated cost, including transmission lines, of \$12,600,000, or approximately \$169 per K.W. of maximum utility. As the average utility, with reasonable pondage development, and without an auxiliary steam station would be much below the 74,600 K.W., the capital investment per K.W. useful throughout the year would have greatly exceeded \$169. As the plant went into the hands of a receiver for lack of funds when only 60 per cent. of the project was completed, it is reasonable to assume that the company found the cost of the development of the property considerably in excess of the amount that they had estimated.

NORFOLK & WESTERN RAILWAY.—Water power was available from the Appalachian Power Company at a price of 0.83 cents per K.W.H. for an estimated annual consumption of 66,000,000 K.W.H. It was estimated that power could be produced in a steam station, with coal at \$1.00 per

ton, and a power house near the mine, at 0.52 cents, including fixed charges. The engineers report as follows:

"Our estimates for the cost of power generated in the railway company's plant have shown by actual experience to have been very conservative. In 1916, when cheap coal was still obtainable, we generated power at 0.242 cents per K.W.H., or at 0.463 cents including fixed charges; these figures were obtained, moreover, on a yearly output of only 50,410,000 K.W.H. instead of 66,000,000. In 1918 (first three months), with coal at \$2.50 per ton, we generated power at 0.418 cents per K.W.H., or including fixed charges at 0.596 cents. In this case our yearly output is at the rate of about 90,000,000 K.W.H. It is important to note that with the price of coal even doubled, our Bluestone plant is producing power at a very much lower cost than we would have paid had we tied ourselves up to a contract with the Appalachian Company."

It should be noted in this connection that the Appalachian Company have during the year 1918 increased all their power rates 25 per cent. The Norfolk & Western has a connection between its power transmission lines and those of the Appalachian Power Company, but so far it has aided the Power Company with current to greater extent than it has received aid.

THE BALTIMORE & OHIO RAILROAD at Baltimore secures its power for operating 8 miles of its tracks under contract from the Consolidated Gas & Electric Company. The consumption of current therefrom in 1917 amounted to 6,200,230 K.W. hours. The Power Company during that year furnished this current from their Susquehanna River water power plant at 0.85 cents per K.W.H. In 1918 the Government required this power, and that furnished the B. & O. was taken from the steam power plant of the Consolidated Gas & Electric Company, located at Baltimore (Westport), and owing to increased cost of fuel the cost of current furnished in 1918 has been 1.2 cents per K.W.H.

THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD secures all its current for electric operation from steam power plants. The Committee is informed that in 1916 power from the Housatonic River, in the amount of 50,000,000 K.W.H. per year, was offered to the railroad, to be delivered at the contact wires at 0.68 cents per K.W.H., which figure is from 50 per cent. to 100 per cent. less than the corresponding amount of current being secured from steam plants during 1918. The limitations upon this current and of the value of the guarantee of the Power Company are not given. Evidently there was a mutual value in emergency situations secured by establishing a connection between the two transmission lines.

A former member of this Committee has contributed the following data as to an investigation for a suggested railroad electrification, based upon prices prevailing directly before the war:

"General Proposition.—Power was required for 100 miles division of a railroad which had better than the average density of passenger and freight traffic in the eastern section of the country. The proposition was to compare the cost of steam-generated electric versus hydro-electric power. In the case of the steam power, it was assumed that the railroad

company would build and operate the plant; for hydro-electric, that it would purchase the power delivered at a central point on the road, the power company building and maintaining a duplicate transmission line about 60 miles long.

"Power Requirements.—It was assumed that the maximum load at point of delivery would be 50,000 K.W. and that the load factor would be guaranteed at 35 per cent. of the maximum demand, requiring a dense traffic and care in regulating the train dispatching.

"First Cost.—The first cost of a steam power plant built by the railroad worked out at \$3,300,000. This cost would produce a suitable, modern and economical turbo-generator plant having sufficient reserve capacity to carry the 50,000 K.W. at peak load and with spare plant for emergencies.

"In the case of the hydro-electric development there would be no cost to the railroad company for the power plant; but the fixed charges on the cost of a suitable plant, plus profit, is reflected in the charge made for power.

"Power Costs.—(a) Steam Plant. Good steam coal, having at least 13,000 B.T.U. value, would cost, delivered at the plant, \$2.60 per gross ton. Fixed charges were as follows:

"Interest 5%, insurance 2%, depreciation 4%, total 11% on the cost of the plant.

"On the above basis, the cost of power delivered in substations worked out to be 0.683 cents per K.W. hour.

"(b) Hydro-electric power. The price named by the hydro-electric company for power delivered at the railway company's substation was 0.675 cents per K.W. hour. This price was on the basis of a certain guaranteed load factor and other conditions regarding growth of power requirements, as is usual in purchased power agreements.

"On the basis of the estimated yearly consumption of power (172,000,000 K.W. hours) the two propositions worked out as follows:

For steam-generated power	\$1,174,000 per year
For hydro-electric power	1,161,500 per year

"Factors of the Problem.—Aside from the relative cost of these propositions, there are, of course, other factors to be considered, as follows:

"1. *Reliability.*—In the case of the hydro-electric proposition, the traction project is dependent upon continuity of service over a long transmission line, whereas the steam-generating station would be located on the line of the road. Assuming equal reliability of generation, the steam power plant has advantage over the hydro-electric as regards reliability.

"2. *Location.*—As regards traction requirements. As the hydro-electric proposition is tied up to an inflexible location of plant, any change in the center of distribution would affect the length of the transmission line, and therefore may affect unfavorably the future development of the traction plan. In case of the steam power plant, this can be located with reference to future extensions of the traction scheme.

"3. *Output.*—Hydro-electric plants have a well-defined maximum output, depending upon the water supply; moreover, to make such a development pay, it is necessary to provide for the immediate sale of the entire peak output. This fact often prevents the Railroad Company from calling for more power as business increases.

"4. The flow of all streams is affected by great seasonal variations in volume. This means that the actual power that can be developed by

the flow varies greatly by seasons of a year, and again by years, some being dry and others rainy. To provide against the consequence of this variation, the scheme of emponding water can be adopted to a limited extent. Therefore it is customary to empond as much water as possible, and supply any deficiency in power during the dry season from an auxiliary steam power plant. When this steam power is drawn on, the cost of producing power will be increased."

The Committee calls attention to the following facts and statements of record:

DIRECT SAVING OF FUEL BY ELECTRIC OPERATION.—A concrete example of fuel saving by the substitution of electric for steam operation where comparable statistics are available is the electrification of the Chicago, Milwaukee & St. Paul Railroad between Avery, Idaho, and Harlowton, Montana, a distance of 440 miles and comprising an electrification of 600 miles of track. During 1917, 124,000,000 K.W.H. (equivalent to approximately 3,900,000,000 ton miles) were generated by water power for the operation of trains. Based upon actual records taken prior to electrification, 220,000 tons of coal and 453,000 barrels of oil (equivalent to a total of 350,000 tons of coal) were burned under locomotives for an equivalent steam service. In 1917 there were 2365 miles of steam railroad under electric operation in the United States and it has been reported to the Committee that during the year there were 675,000,000 K.W.H. generated for the operation of trains over these electrified tracks. Applying the figures obtained from steam and electric operation of the Chicago, Milwaukee & St. Paul Railroad to all of the roads electrified, would result in a saving of 1,890,000 tons of coal per annum, had it been possible to produce all of this electrical energy by water power.

A concrete example of fuel saving, where coal is used to generate electric power, is furnished by the Norfolk & Western electrification of about 90 miles of track between Bluefield and Vivian. During the year 1917 there was generated 56,652,000 K.W.H. for the operation of trains, using 87,160 tons of coal at the power house. Based upon records of coal consumption on steam locomotives on the Norfolk & Western, 147,600 tons of coal would be required for an equivalent steam service. Applying a similar saving to the 2365 miles of electrified steam railroads would show a saving of 720,000 tons of coal per annum if all electric energy had been generated by steam power plants.

AMOUNT OF WATER POWER AVAILABLE.—The total developed water power of the United States is reported by the Secretary of Agriculture in 1916 as 6,500,000 H.P. The undeveloped water power is reported in Senate Document 316, dated 1916, as 53,900,000 H.P., of which 39,200,000 H.P. is within the limits of the Rocky Mountains and Pacific Coast States.

Calvert Townley in a statement to a committee of the United States Chamber of Commerce, January 14, 1918, made in behalf of the Engineering Council (see Proc. A. S. C. E. and Sci. Amer. Suppl., April 27, 1918), calls attention to the fact that the federal government still

retains as proprietor more than two-thirds of the total area of the 13 Western States in which the bulk of the undeveloped water power is located. If any parts of the public lands are needed for reservoirs, dams, transmission lines, etc., a permit of the Secretary of the Interior is required, which is revocable at any time, without cause. Other water powers are on navigable streams, and require an Act of Congress for their development. A revision of these laws is under consideration. Outside of the western water power states and the territory tributary to Niagara, water power generally should be developed with auxiliary steam power.

H. S. Putnam presented a paper on Economical Combination of Water Power and Steam Plants at the American Institute of Electrical Engineers, June 28, 1917. The conclusions reached were that practically all water power plants should be developed beyond the minimum power available, and hence in combination with a steam plant. The economic limit depends on the value of money, fuel and labor, the increasing size and efficiency of steam turbines, and location of the enterprise.

C. P. Steinmetz, in an article on America's Energy Supply in Proc. Amer. Inst. Electrical Engineers, June, 1918, says that the economical utilization of the country's energy supply requires generating electric power wherever hydraulic or fuel energy is available and collecting the power electrically, just as we distribute it electrically.

CONCLUSIONS OF THE COMMITTEE ON WATER POWER.

(1) It is important to reduce the use of coal where possible by the development of water power.

(2) Water power will show the greatest economy in the West on account of the higher cost of coal and minimum cost of water power development, but may show economy in other districts at present or future coal prices.

(3) In general, auxiliary steam plants should be built, to develop the water power beyond its minimum capacity, and to secure reliability of service.

(4) Laws should be modified to permit the development of water power on public lands and on navigable streams, under reasonable restrictions.

(5) In their studies and investigations of this subject the Committee have been impressed with the failure of some of the carriers to so keep their records as to permit the proper segregation of data which is necessary to calculate the tons of coal consumed in steam locomotives separated from coal consumed for other purposes on sections or divisions where electricity has been substituted for steam.

(ITEM 5) ELECTRICAL INTERFERENCE.

SUB-COMMITTEE No. 7.

A. H. Armstrong, Chairman;	W. S. Murray,
Z. M. Briggs,	J. R. Savage,
R. H. Ford,	M. Schreiber,
H. K. Lowry,	A. G. Shaver.

This Sub-Committee was charged to report "recommended practice for eliminating, so far as practicable, interference with telephone and telegraph lines caused by the use of propulsion circuits." Owing to the fact that other engineering associations and several manufacturing companies have the matter of electrical interference under very careful consideration, it is thought best to limit the report at this time to a brief statement of some of the factors involved in electrical interference, as general information for this Association.

The interference with adjacent telephone and telegraph lines by railway propulsion and signal currents may be divided into two broad classes as follows:

(1) *Interference by Direct Currents.*—The oscillograph has shown that direct currents, produced by commutating machines, are made up of a series of minute waves or ripples, which under certain conditions on long parallel lines of higher voltages may produce a high frequency disturbance in neighboring telephone circuits of sufficient magnitude to constitute an interference. It is known that these "ripples" may be minimized by machine design and it is suggested that manufacturers of commutating machines should exercise care in this direction and agree upon some standard test for the higher voltage machines, which must be passed in order to be accepted for railway service. It is also suggested that the telephone and telegraph companies define some maximum degree of noise interference expressed in terms which will permit accurate duplication in test under different conditions.

It is admitted that such interference with telephone lines caused by direct railway currents from commutating machines already in service can be practically eliminated at a small expense by the installation of resonant shunts in the power house or sub-station.

Direct currents carried over railway circuits having rail and grounded return may in some cases interfere with the operation of single wire telegraph and signal circuits using grounded return. Such troubles may be minimized by adequate bonding of the rail circuit and periodic inspection to eliminate faulty bonds.

(2) *Interference by Alternating Currents.*—The interference by alternating railway propulsion and signal currents with adjacent telephone and telegraph circuits is more serious than from direct current and the correction thereof is more difficult.

The Committee is of the opinion that practice in this matter is not yet sufficiently standardized to justify a report to the Association at this time. Reference is made to the very instructive paper by H. S. Warren, read before the Franklin Institute in Philadelphia.

PROPOSED NATIONAL ELECTRICAL SAFETY CODE.

In accordance with the action of the Association at its meeting held in March, 1918, under date of August 13, a copy of last year's report containing the Committee's criticisms of the National Electrical Safety Code was sent to Dr. E. B. Rosa, Chief Physicist, Bureau of Standards, Department of Commerce, Washington, D. C., and advising him that should he desire a conference with the representatives of this Committee, that delegates would be sent at his convenience. The Director of the Bureau of Standards under date of August 14th wrote: "We do not feel that it is necessary for your Committee to send delegates to the Bureau at the present time, but we shall be glad to send to the members of your Committee copies of the tentative revised draft of part 2 for your consideration and criticism and to yourself revised drafts of all other parts of the Code. We should be glad to have individual criticisms of this draft and also any additional suggestions which they might care to make. After considering the revised draft if your Committee feels that a personal conference would be desirable, or if we find that such a discussion seems desirable on our part, we shall be glad to arrange for a conference with the delegates of your Committee." The revision of part 2 has not yet been issued. A tentative draft of part 3 of the Code has been received and comments thereon were submitted to the Bureau of Standards under date of October 22, 1918. Representatives of the Committee, at the invitation of the Director of the Bureau of Standards, attended a conference in Washington on January 16, 1919, and a proposed revision of part 2 was discussed at some length, but no action had been taken on the previous suggestions made by the Committee. Dr. Rosa informed the delegates that copies of the revised part 2 would shortly be issued and criticisms invited. Further effort on the part of your Committee must, therefore, be deferred. The following are the delegates representing the Association in this matter: E. B. Katte, H. M. Bassett, R. D. Coombs, J. R. Savage.

(ITEM 6) AMERICAN COMMITTEE ON ELECTROLYSIS.

No meeting of the American Committee on Electrolysis has been held since the beginning of the war, and there are no indications of a meeting being held in the near future. The following have been designated to represent the Association on this Committee: E. B. Katte, D. J. Brumley, C. S. Churchill.