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Electric Power for Operating Bridges

An Article Illustrating the Dependability of Electricity for the Operation of a Group of Five Trunk-Line Railway Bridges, All Using Central-Station Service—Decriptions of Electrical Installations and Methods of Operation

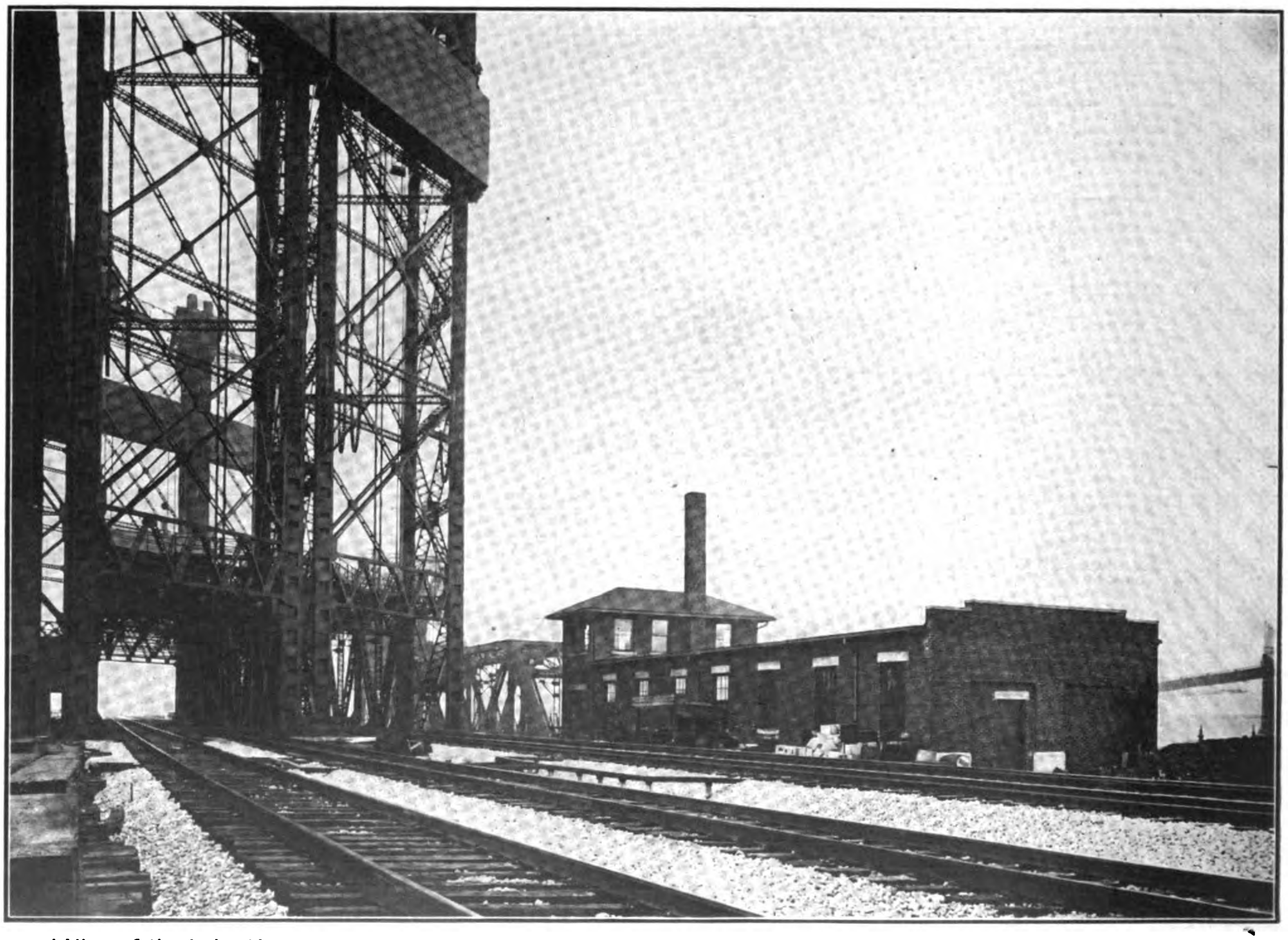
Industrial Power Series—Article No. 195

ONE of the chief advantages of the use of electricity that recommends it to power consumers is its dependability from an operation standpoint. Working to this end is the fact that a number of sources can be created for the supply of electrical energy to the point of operation, thus assuring continuity of service, which, in some instances, is not only desirable, but absolutely essential.

This dependability of service is one of the best arguments the electric power salesman has—one that makes a direct and tangible appeal to anyone contemplating the use of electricity for power. Interruptions due to lack of power have often been the experience of manufacturers and other operators and power service that will prevent such occurrences is appreciated and finds ready recommendation. That many central stations can point, with justifiable pride, to records showing long periods of uninterrupted service on their lines is one of the important reasons for the rapid increase in the use of electricity for power purposes.

A very good illustration of this point is given in the operation of a group of five railway bridges over the Calumet River in South Chicago, Ill. These bridges are installed on lines of the Lake Shore & Michigan Southern Railroad, Pennsylvania Lines and Baltimore & Ohio Railroad, and are a part of the trunk lines of these railroads between Chicago and eastern points. Because of the large amount of traffic that passes over these structures it is imperative, to assure safety and to prevent delays, that the methods of operation be the most satisfactory obtainable and that they be subject to a minimum number of interruptions.

Electric power was chosen by each of the railway companies for the operation of the bridges, and all are operated on central-station service, supplied by the Commonwealth Edison Company, of Chicago. It is interesting to note the attitude taken by the different companies regarding the dependability of central-station service. Two of the bridges have only one method of operation, dependence being placed on a storage-battery station charged by central-station power. One of the bridges is operated directly from the central-station company's lines, with a gasoline engine for emergency use. The remaining two bridges can be operated directly from central-station service through a motor-generator set; from a generator driven by a gas engine, and from a storage battery which can be charged from either source. Energy for the operation of all the bridges is supplied from the Commonwealth Edison Company's substation in South Chicago, about three blocks distant from the bridges. A pole line carrying 4,400-volt, three-phase, 60-cycle circuits runs from the sub-

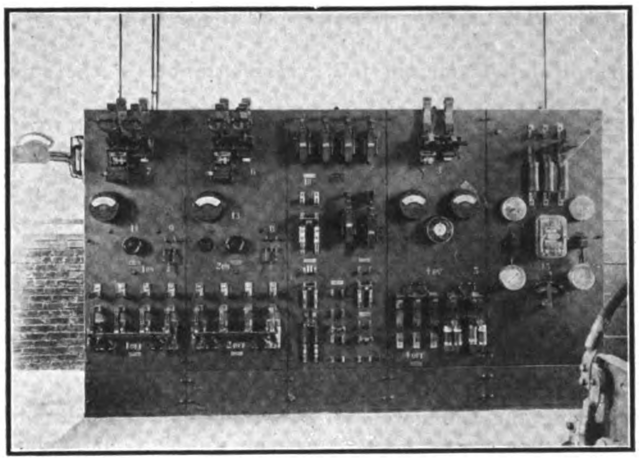


General View of the Lake Shore & Michigan Southern Lift Bridges and Power House in South Chicago—Part of the Baltimore & Ohio Bascule Bridge Can Be Seen in the Center of the Illustration—The Pennsylvania Bridges (Not Shown) Are to the Left of the Lake Shore Bridges.

station to the west bank of the river. The substation is fed from the company's main distribution system by means of three different underground feeder circuits, which is an important factor in making the service dependable.

Baltimore & Ohio Bascule Bridge.

The Baltimore & Ohio bridge is a Strauss bascule bridge of the cantilever type. The span is 246 feet, making it the largest one-span bridge of this type in the world. The power service lines run to a transformer vault on the west bank of the river, from which side the bridge is operated. Three transformers, each of 100-kilowatt capacity, step the voltage down to 440 volts, which is the operating voltage. In order to raise the cantilever span an exact order of closing switches must be followed, an interlocking system preventing the supply of energy to the motors and guarding against carelessness and lack of operation knowledge. After the switches controlling the front and tail rail-locks have been closed, a bridge-lock switch is closed, releasing the structure for raising, and operating an automatic circuit-closer which connects the two bridge motors to the line. These are wound-rotor induction motors, both of 140-horsepower capacity, the speed being governed by drum-type controllers. The general practice is to use both of the motors in operating the bridge, so as not to throw a large load on either when starting. Each motor, however, has sufficient capacity to operate the bridge alone, assuring satisfactory operation if one of the motors should be placed out of commission. If both motors are disabled or if the electric power service fails, a 35-horsepower gasoline engine, provided for emergencies, is used for bridge operation. It is connected with the chain of drive gears by means of a sliding gear, and when this is shifted to connect the gasoline engine the motors are automatically disconnected.



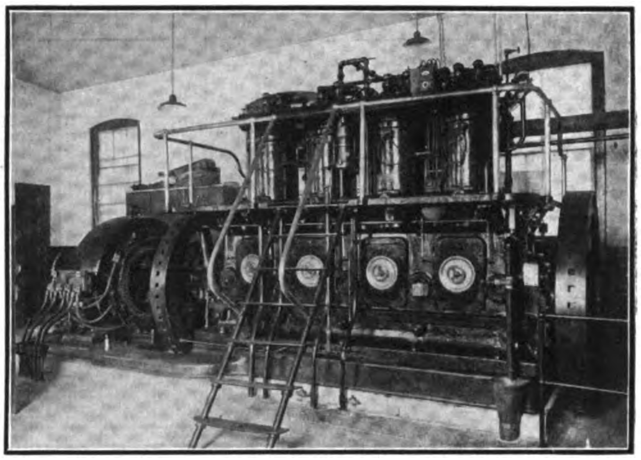
Switchboard in Lake Shore & Michigan Southern Substation and Power Plant.

During the summer months, when navigation is at its height, the bridge is raised and lowered on an average of about 30 times daily, while during the navigable winter months this average is reduced to four or five. It takes about 1.5 minutes to raise and lower the bridge.

Lake Shore & Michigan Southern Bridges.

A short distance south of the Baltimore & Ohio bridge are two bridges belonging to the Lake Shore & Michigan Southern Railway. There are both two-track structures of the Waddell & Harrington vertical-lift type. The span of each lift is 206 feet and the weight of each lift-span is about 900 tons.

The electrical installation for the operation of these bridges is more elaborate than that installed by either of the other railway companies on their bridges. Three sources for the supply of electric power are available.



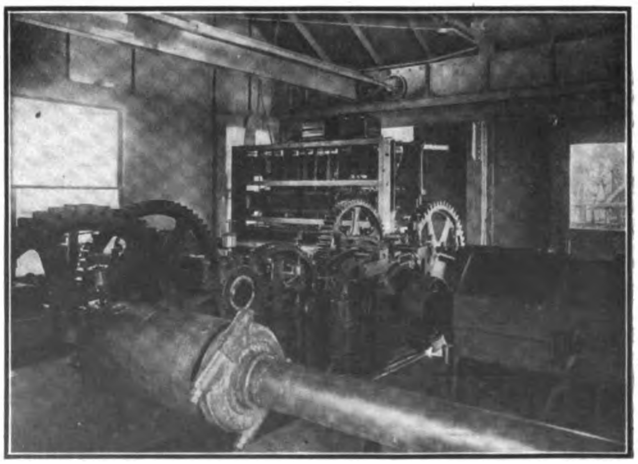
Gasoline Engine Driven Generating Unit in Lake Shore & Michigan Southern Power Plant.

These consist of central-station service connected to a motor-generator set, from which the bridge may be operated directly; a gasoline engine direct-connected to a generator, which will supply energy for bridge operation, and a storage-battery system, which may be charged from either generator, and which is generally used for supplying the energy for operating the bridge. These interconnected systems are independent of each other except in the extreme case when the batteries are discharged, and they furnish nearly perfect protection against failure of energy supply.

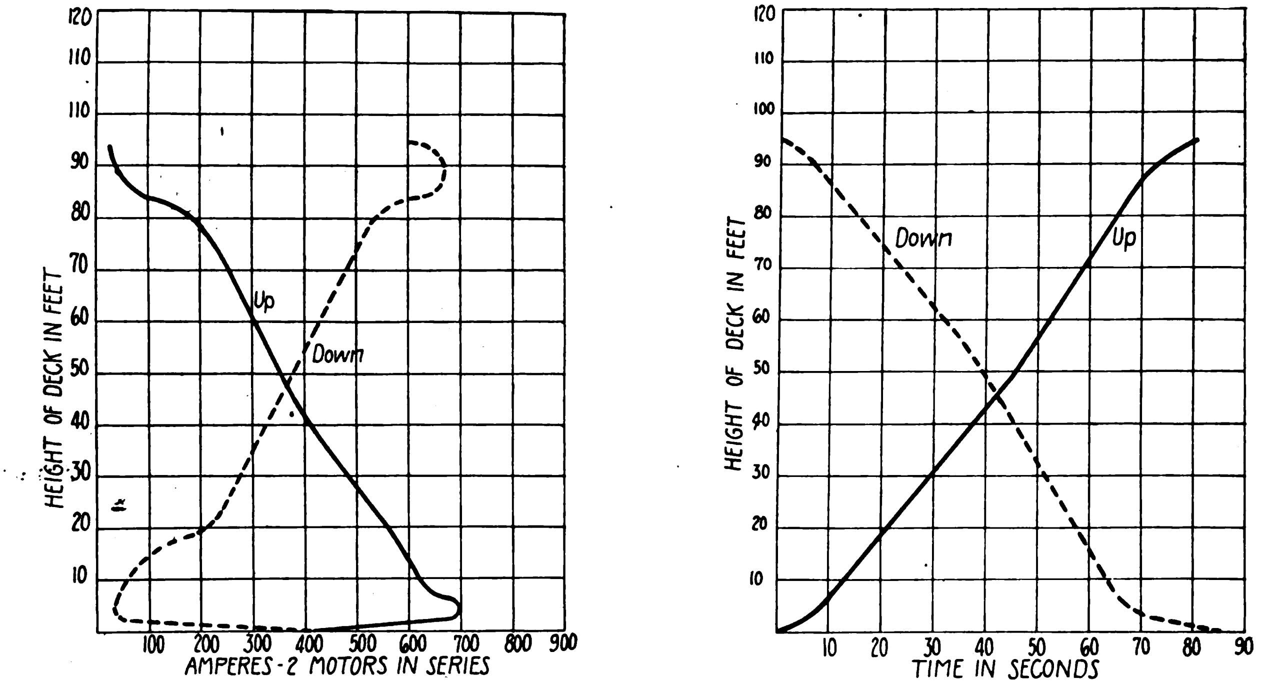
Taps are made from the central-station company's 4,400-volt, three-phase, 60-cycle lines on the west bank of the river and a circuit run through a three-inch iron pipe in a tunnel underneath the river to the transformer vault on the east bank, where the power plant is also located. From the transformers the 440-volt secondary circuit goes to the main switchboard connecting to the meters and to the control switch of a 175-horsepower induction motor direct-connected to a 220-volt direct-current generator. Switchboard equipment is provided for supplying the output of this generator to charge the storage batteries or directly to the bridge motors.

The gasoline-engine unit consists of a 200-horsepower four-cylinder Bruce-Macbeth engine direct-connected to a 175-horsepower generator similar to the one forming part of the motor-generator set, and which also has switchboard equipment for supplying power to the batteries or to the bridge motors direct. Apparatus is also provided for running the generator as a motor from the storage-battery for starting the engine.

The motor-generator set is used the most frequently for charging the storage-battery system, consisting of 117 cells, which have a total capacity of 2,600 ampere-hours. Most



Hoisting Equipment Tower on Lake Shore Lift Bridge, Showing Motors and Controller Resistance Units.



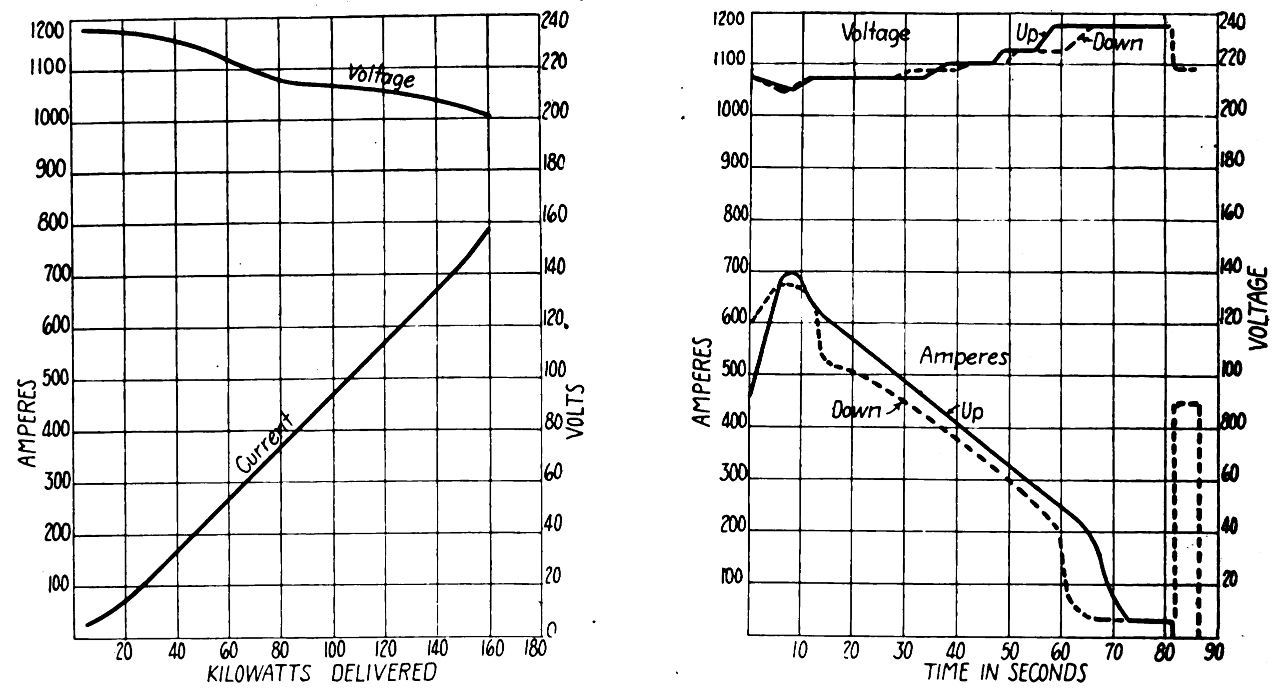
Curves Showing Current Consumption and Time for Raising and Lowering of Span of Lift Bridge.

of these cells are used for bridge operation, though some eight or ten of them are switched off to provide energy for signaling equipment.

Each bridge is operated by two 100-horsepower, mill-type series motors which drive gear trains connected to drums for winding or unwinding the cables which hoist and lower the lift span. On lowering, the motors drive through a load brake in a manner similar to that on the hoist of an electric crane. The lift span is supported on the four corners by cables and sheaves suspended from the end towers and the weight of the span is kept uniform by means of heavy equalizer chains (shown in an accompanying illustration) attached to the towers and the lift span. The motors of both bridges are operated by control apparatus located in a stationary tower between the two bridges. The control is semi-automatic, consisting of two three-point hand controllers with relay-operated switches for cutting in and out the grid resistances in the supply circuit.

The most efficient precautionary methods are provided for the safe operation of the bridges, and they could not be operated or non-operated so as to plunge a train into the river. Bridge and rail-lock switches must first be operated before energy can be supplied to the motors. To further guard against accidents, the electrical system is arranged so that a bridge cannot be unlocked for raising until the signals are operated to show the engineer of an approaching train that the bridge is up. Derails are also placed in service to provide against failure to act on signals.

During the summer months each bridge is operated 20 to 25 times a day. They may be raised a maximum of 98 feet in about 45 seconds, with a power consumption of about five kilowatt-hours. When navigation is open the



Curves Showing Power Relations and Current and Voltage for Raising and Lowering of Span of Lift Bridge.

total energy used per sonth for charging the batteries for bridge and signal operation approximates 7,000 kilowatt-hours, with a maximum demand of 140 kilowatts. The storage-battery system permits the use of service during off-peak periods, making the load desirable from a central-station standpoint and at a price attractive to the consumer.

Pennsylvania Bridges.

Situated adjacent to the Lake Shore bridges are two belonging to the Pennsylvania Lines, and they are both two-track structures of the same type as the former bridges. Each lift span is 210 feet from center to center of end pins, and the total weight of each is about 950 tons. The method of operation of the lift spans is also similar, except that the operator's tower and control equipment is a part of each lift span and travels with it.

Central-station service is supplied to two motor-generator sets, each consisting of a 35-horsepower induction motor connected to a 220-volt direct-current generator. Ordinarily one of these sets is used for charging a storage-battery system, the other set being provided for emergencies. This equipment, together with switchboard, etc., is installed in a concrete cellar underneath the company's tracks on the west bank of the river. The storage-battery equipment is depended upon entirely for the operation of the bridges, and has given satisfactory and uninterrupted service. The power consumption, which is off-peak, is about 5,000 kilowatt-hours a month for 20 to 25 lifts a day.

The accompanying diagrams show the operation characteristics of the electrical equipment of a lift bridge of the type described.

Large Power Project Planned by Connecticut Companies.

By the terms of a bill that is now before the Connecticut Assembly, the Housatonic Power Company, one of the subsidiaries of the New Haven Railroad Company, is empowered to sell its rights and properties to the Rocky River Power Company, whereupon a new corporation, the Connecticut Light & Power Company, will develop and operate the same.

The Housatonic Power Company operates a hydroelectric plant on that river and a large steam plant at Waterbury. The company now generates and sells electricity to the Connecticut Company, a traction system, and to the public in New Britain, Waterbury and other places, through the local electric light companies.

The Rocky River Company owns five valuable water powers on the Housatonic and its tributaries.

One of the advantages of the merger will be the coordinated use of the river flowage as between the several stations. More energy will be obtainable than heretofore by harmonious working. The ultimate developed horsepower will be about 50,000, and an auxiliary steam plant is likely to be built to provide for the seasons when the flowage is inadequate. It is said that negotiations have been entered to furnish the New Haven railroad with its entire electrical supply.

Indiana Tornado Damages Electric Plant.

Electric-lighting service in New Albany, Ind., was disorganized on March 23 by the tornado which damaged a portion of the city. Wires were blown down by the high winds which affected the whole city, and for safety's sake there was no attempt made to provide service even to those parts of the city where the system was comparatively intact. Crews of the United Gas & Electric Company, with assistance from Louisville, put in the following day restoring service and cutting wires at the entrance of the devastated area so as to obviate chance of damage from grounded wires.

Maine Bills Seek Public Control of Water Powers.

Two bills are before the Maine Legislature which aim to conserve the water powers of the state. One bill, introduced by Representative Dutton of Bingham, creates a commission of three which, on authorization of the governor and council, may take over by purchase or eminent domain, all lands, works, dams, buildings, flowage rights, plants, machinery, transmission and distributing lines. This commission would have authority to develop the power and sell to municipalities, who would distribute the energy. The commission is given sole right to regulate all charges and rates.

The other, or Baxter bill, creates a commission to study the state's topography, and report to the next Legislature, if possible, a plan for the improvement and creation of storage reservoirs, reporting on rights remaining in the state to be developed and the best methods for development. The commission would have supervision over the construction of dams by private companies.

At a session last week P. B. Yates, formerly of the Hydroelectric Power Commission of the Province of Ontario, told of the accomplishments of that commission, and the beneficent results accruing to the province.

It appeared that the Dutton bill is a copy of the legislative act under which the Ontario Commission was created.

Edward F. Merrill, of Skowhegan, argued that the Ontario Parliament, unhindered by a written constitution, had conferred absolute powers on the Commission. The State of Maine could not do this, any commission's power being sharply limited by the state and federal constitutions.

Mr. Yates said the Commission charged $18 per horsepower for all power exported and $12 for that used in the province or Dominion. Recently the policy has been to restrict the sale of power outside the Dominion. He said the Commission paid adequately for all property taken. Sales of municipalities are at the average price of 3.9 cents, ranging from 11.5 to 2.4 cents per kilowatt-hour.

Opponents of the Dutton bill pointed out that the courts of Maine have ruled that private property cannot be taken by right of eminent domain except for public uses, and that the sale of electricity for power is not for public purposes. The constitution would prevent confiscation.

Safety Rules for Electrical Installations in Mines Issued.

The Bureau of Mines, Department of the Interior, has just published Technical Paper 138, "Suggested Safety Rules for Installing and Using Electrical Equipment in Bituminous Coal Mines," by H. H. Clark and C. M. Means. The preparation of this code of rules, which has been going on for nearly three years, was undertaken to encourage the standardization of safety measures for the prevention of electrical accidents underground.

The code is the result of many conferences held by the authors with mining engineers, mine operators, the engineers of public service companies, and the manufacturers of electrical mining equipment. The rules have been revised many times at the suggestion of the conferees, and, as published, are said to meet with their approbation in almost every detail.

Mr. Clark, in discussing the paper, says: "The code is unique in some respects. The first step in its development was to establish five basic measures that would insure the use of electricity with safety and to use these as a basis upon which to formulate the rules. Each rule is proposed as necessary or helpful to the accomplishment of one or more of these measures. Their general enforcement will work toward preventing many casualties."