

The Wireless Storm Detector*

Its Influence Upon the Operation of Lighting Central Stations

By W. H. Lawrence¹

SUCH public utilities as those supplying gas and water are fortunate in that the commodities they distribute are physical materials. During those parts of the day when the demand for their product is small, the excess delivered from the station can be economically stored in a reservoir for use at later periods in the day when the demand is greater than the capacity of the station.

The public utility that distributes electricity, however, cannot be modeled profitably after this plan on account of the properties of the commodity that it handles.

Electricity, like light and sound, is not a physical material and therefore can exist only as long as the influence of its generating source continues. This property renders it impossible to directly store or preserve electricity for future use. Although such an end may be indirectly accomplished by the use of storage cells, which convert the kinetic energy carried by the current into potential chemical energy and later carry out the reconversion, the efficiency of this method is very low. For this reason, the use of storage batteries in supplementing the generation of electricity has been restricted to such purposes as involve the furnishing of a reserve to safeguard the service against interruption when some accident temporarily affects the generating, transmission or transforming systems.

Electrical stations, being unable to economically avail themselves of the use of a reservoir which may be charged with the excess energy of the station at light load periods and discharged to assist the station at the heavy load periods, have to be designed with a capacity equal to no less than the maximum demand upon them. This factor of an installed station capacity at least equal to the maximum peak load is the greatest financial handicap to which an electrical station is subjected. That this condition is unavoidable has long been recognized and accepted by our business men and engineers.

Since it is only during the peak load of the day that the whole equipment of the station is working, it is evident that the return on the entire investment during the remainder of the day must be earned by that portion of the equipment that is then operating.

This is a condition that makes it highly imperative that an electrical station be operated with maximum economy throughout the entire day. Given a certain station equipment, this is mainly accomplished by a strict adherence to a regular daily routine. Thus, at any period of the day only that number of machines is operated which is sufficient to economically carry the load then existing. At times of light load or average load, a steam-driven station will have a large share of its boilers "banked" and a number of its generating units idle. When under such a condition a large unexpected demand for an increased output may be made so suddenly that the number of machines which are operating will be insufficient to carry the abnormal demand, and it is probable that the standard of service will be lowered until such time as reserve boilers and generating units can be brought into service. For this reason it is imperative that the station receive preparatory warning of any abnormal demand.

The rapidly moving clouds which accompany a storm constitute the principal cause for the sudden and unexpected increases in the demand for current from a lighting station.

Any device, therefore, that will provide a warning of the approach of a storm, at a time sufficiently far in advance to enable the station attendants to prepare for the exception to their daily routine in a deliberate and orderly manner, would be most welcome.

The storm detector is such a device.

All summer storms, or practically all of them, are accompanied by electrical disturbances in the ether. These cover a field far greater than that over which the storm clouds themselves are visible. By use of antennae, some of these radiations may be intercepted and by a suitable apparatus be made to give an indication of not only the presence but also the relative proximity of the storm.

The storms that occur during the winter months are usually snowstorms and are of but a weak electrical nature. For this reason, they may perhaps not affect the device. At this season, that is a matter of but small moment. In winter, the load upon the stations during the daylight hours is uniformly greater than during the summer and the demand regardless of the severity of the storm will always be from 20 to 25 per cent less than

the demand which occurs daily between 5 and 5:30 p. m., for which the station is always prepared.

This is evident when it is considered that winter storms have no effect on street lighting and other outside lighting, sign lighting, residence and apartment-house lighting, etc., all of which are on at the time of the daily peak at 5:00 p. m. For this reason, winter storms are of such minor importance that the service of the storm detector is dispensed with during that season.

The various parts making up the detector are an aerial, a short-circuiting switch, a spark gap, a coherer, a relay and battery, a bell (which also acts as a decoherer) and a condenser, and a ground connection. Figure 1 shows the diagram of connection of these parts.

Aerial.—Antennae, similar to the more simple ones used in connection with wireless telegraph outfits, have been found to serve the purpose admirably. It is this part of the equipment that receives the ether radiations resulting from the storm.

The oscillating current thus set up travels to and from the ground through the spark gap, coherer, and condenser.

Short-Circuiting Switch.—This switch and its connections are shown in Figure 1. Nominally, it is kept in the "open" position. After the alarm bell has begun to ring continuously, it is closed to protect the apparatus from heavy surges and to silence the bell.

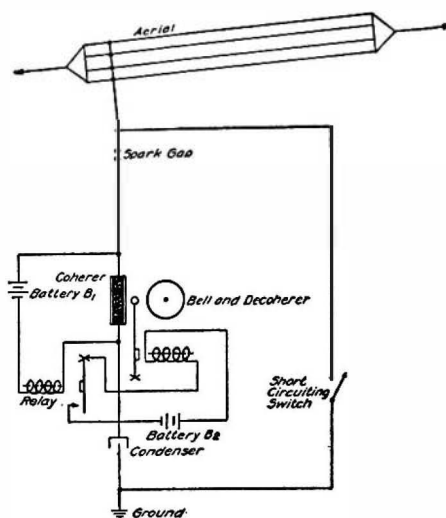


Fig. 1.

Spark Gap.—This consists of a simple gap with spherical terminals placed approximately $\frac{1}{8}$ inch apart. The purpose of this gap is to prevent those surges that are induced in the antennae by the radiations emanating from wireless telegraph stations, but which are very weak as compared to the lighting disturbances, from flowing through the remainder of the apparatus and thus causing a false alarm.

Coherer.—This is also patterned after the type of the simple ones used in the early days of wireless telegraphy. In brief, it consists of a short section of glass tube of small bore loosely filled with nickel-silver filings. These are connected at each end of the outside circuit by German-silver plugs. The action of such a type of coherer is well known and needs no further explanation than to say that it acts as a high resistance to the low-voltage battery current impressed upon it until a high-frequency discharge current, between aerial and ground, has passed through it. This high-frequency current effectively lowers the coherer's resistance to the battery current, which consequently allows a greatly increased battery current to flow through the tube. The resistance of the tube then remains unchanged until it is violently jarred, at which time the high-resistance property returns.

Relay and Battery.—The most effective type of alarm is an audible one, of which the simplest form is a bell. However, as a bell requires a greater amount of current for its operation than that increased amount of battery current which is caused to flow in the coherer by a high-frequency discharge, some magnifying or relay device must be used. The relay employed is one of the ordinary telegraph type and the battery, B₁, Figure 1, is of dry cells. The connections are given in Figure 1.

Bell and Battery.—The bell is one employing single-stroke connections and is of a size sufficient to be easily heard throughout the system operator's office. (The coherer, relay, condenser and bell are located in this

office.) The bell has its own supply battery of dry cells, B₂, and is controlled by the secondary contacts of the relay, as shown in Figure 1.

As the low-resistance condition into which the coherer is thrown by a high-frequency discharge is permanent until the tube is severely jarred, the bell is mounted so that its clapper will strike the tube and thus perform the two-fold function of bell and decoherer. (It is evident that the tube must be decohered, otherwise it would not show the effect of a later high-frequency discharge.)

Condenser.—The condenser is an ordinary one and is inserted in the ground wire to prevent stray direct current from flowing in the apparatus.

Ground Connection.—This connection completes the high-frequency circuit from aerial to ground.

The operation of the apparatus comprising the storm detector leaves practically nothing to be desired. The manner in which it enters into the activities of a steam station will be described, as it is perhaps to such a station that it is of the most benefit.

It will be remembered that the bell or decoherer, together with the coherer and relay, are located in the system operator's office.

It is the duty of the system operator that he keep continuously posted on the demands that are or may be made upon the station for power and to so direct the disposal of all the generating machinery that the station will afford the highest quality of service and will operate with the maximum degree of economy. In detail, the latter function he performs by orders to the boiler room specifying how many boilers shall be maintained under load and how many shall be carried "banked," by instructions to the generating room as to which machines shall carry the load and which other units and auxiliaries shall be held idle or in readiness, and by orders to the various switchboard operators as to which feeders shall be used in the disposition of the output.

Under the usual daily conditions of operation the demand which will be made upon the station from hour to hour is accurately known, for the variations of the load curve constitute a daily cycle. These regular changes of load, being anticipated and taken care of by orders from the system operator, become a matter of station routine.

In order to secure smoothness of plant operation, the system operator is informed of the unusual departures from the regular load curve that are to be expected, e. g., exhibition lighting, etc., and also of the weather forecasts. All such is of great assistance in aiding good management. Those unusual irregularities of whose coming he is reliably warned present no difficulties. It has been found by operating experience, however, that the weather forecasts come far from providing a reliable and early warning. Further, the reports are not couched in such terms as furnish the system operator with the information that is of paramount importance to him, viz., the rapidity, in hours, of the approach of the storm.

It is true that the number of severe storms which come over a city with extreme rapidity is much less than that of the slower moving storms, but, on account of their tremendous capacity for suddenly deranging the orderly routine of the lighting station and perhaps even affecting the standard of its service, the fast moving storms make it requisite that all are to be guarded against.

Assume, for instance, such a storm to be approaching a city in which is located a lighting station that possesses a storm detector.

At a time varying from two hours to seven hours before the actual storm clouds reach the city (depending upon whether the path of the storm is a direct or a round-about one), the alarm bell will begin to strike at intervals of from five to fifteen minutes. The system operator regards this merely as the warning of the possible approach of a storm but gives it no further attention, for the storm may change its direction and pass off without molesting the quiet weather conditions of the city.

The disturbing conditions by their further approach cause the bell to ring oftener. With the storm but about two hours' travel away, the bell will strike about once every half-minute or every minute. When this occurs the system operator orders the reserve boilers into service, the auxiliaries of such generating units as he deems may be required started, and the generating units themselves run at low speed.

These conditions prevail until that later time when the bell gives an insistent warning by uniting its periodic strokes into a continuous ringing. This will ordinarily occur at about one-half hour to one hour before the storm

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reaches the city. It has been found quite often that even at this time the sky will remain clear and unclouded to the eye, which shows how much superior are the services of a storm detector to those of a watchman stationed upon the roof to observe the conditions prevailing in the sky. (This latter practice was the best one available prior to the development of the storm detector.) The switch short-circuiting the detector is closed when the bell begins to ring continuously to protect the receiving apparatus, for the storm will now be comparatively close, and to silence the bell for its warnings are no longer needed, since it is positively known by this time that the coming of the storm is a certainty. Simultaneous with this action goes the order to synchronize the incoming generating units with the bus. Everything is now in readiness to supply the increased load which will be demanded in but a matter of minutes.

The following are actual records of the frequency of the bell warnings and the loads existing at various times preceding two storms last year:

July 28th.

1.45 p. m., 1 bell.

2.15-3.30 p. m., 1 bell every $\frac{1}{2}$ to 1 minute.

3.30 p. m., bell began ringing continuously, load 96,000 k. w.

4.15 p. m., (very dark, heavy rainstorm), load 142,600 k. w.

August 1st.

8.25 a. m.-2.00 p. m., 1 bell every three to five minutes.

2.02 p. m.-2.15 p. m., 1 bell every $\frac{1}{2}$ minute, load at 2.00 p. m., 100,000 k. w. (cloudy).

2.15 p. m.-3.20 p. m., bell ringing continuously.

3.45 p. m., load 150,000 k. w.

The storm detector as described is in service and located in the office of the system operator in the Waterside stations of the New York Edison Company. These

stations so far as it is known are the only one possessing a device of the same nature.

The field for such a device among steam-driven lighting stations would seem to be in the larger cities, particularly in those which possess crowded office districts as it is the load derived from such a source that is most sensitive to changes in daylight.

A field in which it would also seem that the device would furnish valuable service is that of keeping the isolated hydro-electric station informed as to the weather conditions existing in the distant cities which it is supplying with lighting current. The places of generation and consumption being so far separated, a visual observance of the weather conditions at the power plant would be of no use. By means of storm detectors located in a few of the widely separated towns, which receive lighting current from the station, the attendants may keep forewarned by a bell in their station as to the irregular demands which may be made on them by storm clouds passing over those distant towns.

Some Birds of the Yellowstone^{*}

Unusual Specimens Seldom Observed by Travelers

By M. P. Skinner

WE often gain a wrong impression as to the number of birds within Yellowstone Park, thinking them few. Heavy timber is seldom found to be very bird-populous anywhere; and, besides, in the parks the heavy timber is where the stage roads are, and the constant travel frightens the birds away. For these are shy birds, not the half-domesticated ones of the farms and villages. Another reason for the conclusion that birds are few, lies in the fact that the tourist travels during the heat of the day when the birds are resting. Scarcity, however, is more seeming than real; the birds are there—in large numbers. At present 197 species have been recorded. Let the bird-lover go out early and walk along the brush-lined brooks and through the meadows, and he will find birds in plenty. To be sure, there will not be as many as in a cultivated section; there never are. The cultivated area has too many attractions in the way of grains, fruits, and insects.

Usually the first bird noticed in the Yellowstone is one that is small and almost black, flying along close to the surface of a stream. He tries to alight on a slippery rock, slides off into the water, unconcernedly paddles ashore, and climbs out. A close scrutiny shows this oddity to resemble a wren, except that he is darker, and has feet of ordinary passerine construction and not webbed. He is the dainty little "dipper," or "water ouzel," of the mountain streams. If you watch him, he does still more curious stunts. He sits on a stone for a few moments, only his white eyelid moving; then comes to life, bows first toward you, then turns and repeats his curtsy in the opposite direction, walks down the rock into the water, under the water, and across the pool bottom, stopping here and there for a moment, and finally comes shooting up to the surface as buoyant as a cork. No misanthropic hermit is the dipper. True, he lives alone with his family on his own section of stream, which he is always ready to clear of poachers by force of bill and wing, but he picks out the true scenic parts. A waterfall is a favorite dwelling place, and I have never found the nest anywhere but near rapid water. Usually a rock in midstream is selected and the nest placed so that it is directly above the water, the opening downstream. Both birds work hard at building the nest—a ball eight inches in diameter, made of a peculiar kind of moss and fastened in a crevice or notch in the rock with a cement of mud. The ball is lined with mud, and the inner nest constructed of fine, waterproof grass that will not become sodden. The spray from the rushing water keeps the moss green, and during the summer grass seeds are sure to lodge on the ball and sprout there, so that the nest soon resembles a small clod of earth supporting a tuft of luxuriant grasses. The entrance to the nest is usually arched over, or bottle-necked with opening downward, to shed the spray. The brainy little architect waits until after the June freshets before building a nest—which might be inundated earlier. He really seems to wait, for he mates early, after having sung his dainty little song since Christmas. One of the strangest facts in nature is that this tiny bird is a winter songster. He is not just a mere chirper, his notes are varied and unusually sweet. Often he is heard in the depths of a wintry world, when

his song rings out above the noise of such rapid waters as are open in January.

Barely has one crossed the norther boundary of Yellowstone Park, before the driver points out Eagle Nest Rock, and the "eagle's" nest on it, but the birds nesting there are actually ospreys. Eagles, both golden and bald, are resident in Yellowstone, build their nests and raise their young there. They are so scarce, however, as to be rarely seen, whereas the ospreys are conspicuous along every large stream. They are found by hundreds about Yellowstone Lake and Cañon. One who has watched and studied the osprey, finds him a far nobler bird than either of the eagles. The golden eagle is a fine bird and usually captures his own prey, but the osprey will touch nothing but fresh fish of his own catching. The bald eagle, unfortunately chosen our national bird, is a robber and a carrion-feeder. He watches the more expert osprey, and when the trout has been secured, he torments the smaller bird until it drops the fish. Then with an exultant scream, the eagle swoops down and catches up his unlawful prey. Often the bald eagle is ignobly caught in a coyote trap set near a dead elk. The osprey is a far different bird, cleanly in his habits—and his young are the models of deportment among birds.

The original nesting site of ospreys in Yellowstone was the tip of a pine or fir, where a great mass of sticks six feet or more in diameter was deposited, at times a stick as large as a man's wrist being used. About Yellowstone Lake there are literally hundreds of these nests. In various other parts of the park, however, notably in the Yellowstone and Gardiner cañons, the osprey has found the pinnacles of out-jutting rock adapted to his purpose, and builds his nest and raises his young there, to the delight of thousands of visitors who can look down upon the family. I cannot confirm other writers in their reports that the ospreys repair their nests in the fall; they may do so. I have repeatedly seen them rebuilding and repairing in April and May, however, when they first return from the south. As a rule the same birds return to a given nest year after year. After the eggs are laid, the mother broods them for four weeks. I do not believe that the male makes it a rule to relieve her, but he does do the hunting and is very conscientious in seeing that she gets her share. Occasionally when the sun is warm, the female gets away from the nest for a short time. The two or three young are hatched so tender that the mother remains on the nest to shield them from the sun with her half-opened wings. When the father brings in a fish, from which he has first removed the head and entrails, there is none of that hurly-burly so characteristic of other birds. The youngsters sit in an orderly row, without any attempt to get the fish, perhaps within three inches of them. The father stands on the trout, tears off half-inch bits which he gives to the mother, she "chews" them a few seconds and then gives some to each nestling in turn. Sometimes the male turns the catch over to the female, letting her do all the tearing and feeding; and he occasionally feeds a bit directly to a youngster. Not only at feeding time do the young ospreys show their training. Let an enemy appear, a warning note is sounded by a parent, usually the mother, and the young instantly throw themselves flat on the floor of the nest

and remain there motionless. Should one be picked up, he is like a lump of putty and can be placed in any posture. Nothing but the parent's cry of "All's well," perhaps not given until an hour or more after the warning, will bring him back to the semblance of a living bird.

The mountain bluebird is of a beautiful blue, indeed; even the breast is blue instead of the chestnut of the eastern bird. This bird is not quite so domesticated as the better known species, but otherwise is much the same. About the few buildings in the Yellowstone the bluebird nests as fearlessly as about an eastern farm; but buildings are scarce, and many bluebirds still follow their old-time plan of building a nest in the trunk of a quaking asp. It is a pretty sight to see a pair hunting a nesting place in early May. The husband is the scout: he goes ahead and locates a likely tree with an old woodpecker hole in it. Then he brings his wife, no doubt telling her how superior the tree is to all other trees, and the neighborhood to all other neighborhoods, and perhaps calling attention to the running water in the near brook. She hovers for a few minutes in front, looking the opening, the tree, and the neighborhood all over, and when she makes up her mind it is final. Should it be "No," the husband does not sulk but immediately hunts another tree over which he is just as enthusiastic. Should the answer be "Yes," they both set to work to collect materials; but I believe that she places most of it while he cheers her on with his gentle love song. When the bairns arrive, all is hustle and bustle. For a time, I do believe that they are the busiest parents alive. Vast, indeed, is the number of grasshoppers and caterpillars caught to satisfy that hungry nestful.

At the other extreme is the nutcracker, or Clark's crow; nothing soft, nor gentle, nor musical about him! But perhaps our ears are not properly attuned to appreciate the rolling "c-crack-k-k-k" with which he announces his presence. His uniform of gray with flashes of black and white is neat and attractive, and his ready adaptability to conditions should win our respect. This species seems more abundant about Mammoth Hot Springs than anywhere else; presumably the large supply of pine cones, as well as the kitchen scraps, draws the birds there. Sometimes the nutcracker, by a swift, sudden swoop, robs a squirrel of his cone. The squirrel may be knocked from his perch, but even if he keeps his footing he is almost sure to drop the cone. A sudden dive and the nutcracker has it, perhaps before it touches the ground. Now the pine squirrel, himself, is an impudent fellow, a noted thief and robber; but well he knows that the bird can best him. He sneaks back to some protecting cranny and then proceeds to enliven the woods by the vituperation he hurls at his enemy; and that enemy is not slow to give back his unfavorable opinion of squirrels in general, and of that squirrel in particular. I am sure that I should not dare to attempt a translation of these vitriolic remarks.

Impudent rascal and freebooter that he is, the nutcracker is never quite so happy as when a fight is going on. I even suspect him of engineering difficulties for other birds. One day two little mountain bluebirds got into an altercation. They were hard at it, when the nutcrackers began to arrive, screaming. One became so excited that he flew into a wire fence and partially

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