the erratic action of the load with the twin belts acting as they must have done, further complicated by the water wheel, the wheel having the greater gate opening being attached to the shaft driven by the 24-inch belt, would account for the acceleration of the speed noticed in mills Nos. 7 and 8. Whether this acceleration was sufficient to have started a rupture in the rim of the engine wheel by centrifugal force, or whether the initial rupture occurred at the jack shaft, it is, however, impossible at this stage of the investigation positively to conclude.

The construction of the wheel itself will be evident from the remnants shown in the engravings. It had a single central set of 12 arms bolted into the hub in the manner shown, and to the ends of which the segments of the rim were bolted.

Of the twelve arms, two broke across the center line of the bolts in the hub, two were complete, three full length but broken at the outer end, and the rest broken across. The fragments of the rim were scattered from the river on one side to the mills across the yard at the other, and two pieces, one of which weighed 575 pounds, were thrown over upon the roof of No. 8 mill, which is at least 80 feet in height, with sufficient force to break through the heavy planking of which it is composed. The height to which a body would be projected vertically at the normal rim speed of the engine is over 140 feet. The only complete segment found was in the basement near the eastern jack shaft.—*Power.*

Rubber Foot Balls.

The game of foot ball is now of such widespread interest that much pains are taken with the ball for college use. It has an oval form, is made of the best rubber, with a pipe attachment for inflation, and is in turn incased in a stout cover, and laced. Such a ball is termed the "Rugby," and is made in one size, nine inches in diameter, and usually retails for about $4. As it is the *piece de resistance* in the contest, it is usually treasured with care when idle, although its usage is not by any means of a tender character on the field.

The ordinary foot ball comes in six sizes, respectively six, seven, eight, nine, ten and eleven inches in diameter, selling for $15 to $30 per dozen, so says *The India Rubber World.* This ball is carefully made of Para rubber and is nearly round, with a slight depression "at the poles," so to speak. The ball is made up in segments, usually six of them on the inside, there being a cloth surface, and cemented together. At the poles is a circular cap of the same material, on which the maker if so disposed can inscribe his name, or as in the case of the Hodgman Company, a handsome monogram. There is not a single stitch in these balls, and the workmanship is of such a character that when one of them is returned as defective, a black mark is made on the annual calendar of the general office of the factory. In all the years the number returned has been three in a product of thousands upon thousands of dozens.

The ball is inflated by means of a small hollow tube called a key, which fits into a cylindrical valve in the inside of the sphere. For transportation the deflated balls are packed closely in nests, taking but little room. A chief point is to get strength with light weight, great objection being made by teams to a heavy ball, which rolls sluggishly over the ground. The color of the undercase of the Rugby ball is white; the ordinary is black.

The great impetus given to the game bids fair to make this industry even more prominent than it has been in the past, and another season probably will see a much larger output than ever before.

Petroleum as Fuel in Lowell.

Accounts from Lowell state that the Tremont and Suffolk mills, Lowell, Mass., have made a practical success in using petroleum as fuel, and the estimate is made that a pound of the petroleum is equal to 1·8 pounds of coal. The mill uses the petroleum in the form of gas. The plant includes two tanks, which are buried in the ground about 30 feet from the furnaces, thus insuring safety from fire. A smaller tank is located above the larger ones and the contents of the latter are pumped into it. This small tank contains the supply for immediate consumption. A series of pipes run from here to the boilers, which are situated on a lower level.

The arrangement of the oil reservoir in relation to the boilers is perfectly safe. The level of the two large tanks is below that of the boilers, so in case the regulators fail to act and cause the tanks to burst, no serious results will follow, so far as fire is concerned. The upper tank is so small that its contents would soak into the ground before they reached the boilers, therefore no danger lurks here, even though the level of this tank is above the fires.

The oil flows from this reservoir through the pipes to the burners, under the boilers. These devices consume the oil in the form of spray mixed with steam. Perfect combustion is produced and no soot or smoke is caused, yet volumes of black smoke pour out of the chimneys surrounding the Tremont and Suffolk mills, while not the slightest trace of smoke can be seen issuing from its own. The fire is regulated by simply turning a valve. Thus it is under the immediate control of the firemen, and it is an easy matter to keep the steam at a uniform point. The mills used eight boilers before they introduced petroleum. To-day they are using but six, and yet the speed of the two powerful engines is the same and they have as much work to do as before. The neatness of the fireroom in consequence of there being no coal or ashes is an important point. The experiment has not been under way long enough to permit an estimation of the difference between the cost of oil and coal as fuel, but it is supposed that the difference is small. The oil is brought to the mills in tank cars containing from 3,500 to 6,000 gallons each.

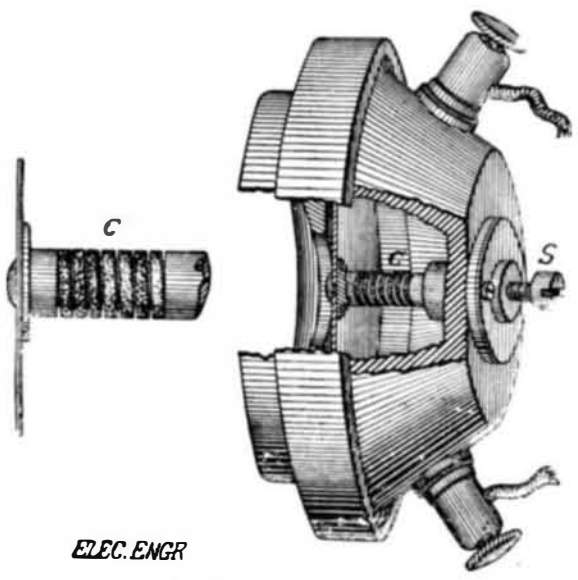
A TELEPHONE TRANSMITTER WITHOUT ELECTRODES.

BY CHAS. CUTTRISS.

While it would appear that the field of telephone transmitters had been pretty thoroughly gleaned, still among the stubble there has remained one that promises to be of considerable importance both for long and short distance transmission.

After trying numerous devices without success, it occurred to me that a helical carbon spring, if such a thing could be made, would offer the best solution.

After a few days' practice, little trouble was experienced in turning out about anything I desired. I now have the carbon helices of such resistances that when closed in their natural condition they have a resistance of about 10 ohms; but when fully distended the resistance is upward of 500 ohms, and a movement of 0·01 of an inch, tending to open the convolutions, makes a variation of from one to two hundred ohms. Their action on the instrument for which they were designed was perfect, and no sparking could be observed between the convolutions until the battery was increased to



Figs. 1 and 2.—CUTTRISS' TELEPHONE TRANSMITTER, WITHOUT ELECTRODES.

such an extent that the whole helix was heated to some 300 or 400 degrees Fahrenheit.

This absence of sparking under heavy battery at once struck me as a valuable feature in a telephone transmitter, and as the battery circuit could never, under any circumstances, be interrupted, there should be an absence of those ear-breaking kicks which are so often experienced when impatience is expressed at the distant end.

As a result I devised the simple arrangement shown in the accompanying engravings. As will be noted in Fig. 1, the helical carbon spring, C, is permanently cemented to the diaphragm and presses against the end of a screw, S, to which it is also permanently connected and by which its tension can be regulated and the convolutions of the helix brought nearer together, or separated, as desired. The carbon helix is shown enlarged in Fig. 2.

Experiments proved the correctness of my theory, and not only does the instrument transmit speech loudly, but the enunciation is so remarkably clear that I have been led to look for some particular reason why this should be so. I think it will be found to be owing to the extreme lightness of the helix (generally less than one grain); to the absolute continuity of the circuit—that is to say, the elimination of electrodes; and also to the fact as each part of the spiral is tending to open itself it absolutely precludes any tendency for the surfaces to jam or lock together.—*Electrical Engineer.*

IT is a well known fact that birds enjoy much longer terms of life than do mammals. Hesiod and Pliny both tell us of rooks that lived to the patriarchal age of 700 years, and that the average life of a raven was 240 years. How far this was correct we cannot determine. It is well known that they outlive man; while swans have been known to live 200 years, chaffinches and nightingales have been kept in confinement for 40 years. Girardin tells us that he had a heron for 52 years, and that he knew of two storks that built their nests in the same place for forty years.

Phonograph Improvements.

Mr. George H. Herrington, of Wichita, Kan., has recently patented a method of recording sound vibrations, in which the recording medium is first rendered plastic, then passed under the vibrating point or needle of the recording instrument while in such plastic condition, and finally allowed to harden, to set the impression and produce a permanent record.

He says: I employ as a recording medium to receive the needle indentations a material capable of being softened or made plastic and of afterward becoming hardened. I cause such surface to receive the indentations while in its softened or plastic condition, and it retains them when it becomes hard again. I prefer to employ a substance such as boiled tar, pitch, resin, asphalt, dental wax, or similar hard substances or compounds which become plastic when heated; and by the employment of heat I soften to the desired degree this surface as it passes under the point of the diaphragm needle, and then by cooling harden the surface to give the record permanency. The heat-affected medium is preferably applied as a coating to a suitable supporting thread, strip, or sheet of metal, fabric, paper, or rubber, and this supporting body is also preferably flexible, so as to be readily wound upon spools and passed around wheels or drums. The recording surface may also be covered with an extremely thin metallic foil or be powdered to prevent sticking to the needle or to the wheels or rollers while in a plastic condition. The heat may be applied in any suitable way, and air, water, or steam may be used, the recording medium passing through a heating chamber or over or around heating drums or rolls just before reaching the diaphragm needle. The cooling may be effected by an air or water chamber, or by drums, or by other suitable means.

The phonograph may have a motor to move the recording medium under the point of the diaphragm needle, and the same machine may, by the removal of the heating and cooling devices, be used to reproduce sound from such a record as has been described.

The same method and essentially the same apparatus can be employed for recording the movements of telephonic or telegraphic apparatus, so as to register messages sent by such instruments.

Insanity and Genius.

A good deal of comment has been excited by the publication in English of Professor Lombroso's work on "Insanity and Genius." It is a work in which the author claims that genius is the evidence of a degenerative taint, and is, in fact, an "epileptoid degenerative psychosis." We trust that our readers will not be made to feel a sense of apprehension concerning their own mental soundness by Professor Lombroso's thesis. It is one that has been worked at before by Morcau de Tours and a good many others, and neither the world in general nor the medical profession in particular has been seriously impressed by it. Men of genius have not, as a rule, been mad, except with an insanity of a scientific and scholastic kind, such as the world really needs more of. The eccentricities, monomanias, and emotional exaltations of genius have been incidental, and were not the basis of their character and temperament. Insanity is essentially a non-productive condition. No insane man has ever made a great discovery and originated great thoughts, or, by his own laborious efforts, changed the tide of human events. Insanity is a condition in which the power of adjusting one's self and one's conduct to the environment is lost. Surely there is no loss of this kind shown in the work or conduct of men of genius. Contemporaneous science has dealt somewhat kindly with Lombroso for the valuable work he has done and the new fields of study he has opened. But the *Medical Record* thinks that when he makes out Newton and Luther insane, and Christ a paranoiac, one must think that the professor himself has neither sanity nor genius.

New Use for the Telephone.

"The telephone is about to have a new application, namely, that of foretelling storms. A new discovery has been made as to one of the properties of this means of transmitting sound. By placing two iron bars at seven or eight meters distance from each other and then putting them in communication on one side by a copper wire covered with rubber and on the other side with a telephone, a storm can, it is said, be predicted at least twelve hours ahead through a dead sound heard in the receiver. According as the storm advances the sound resembles the beating of hailstones against the windows. Every flash of lightning, and of course every clap of thunder that accompanies a storm, produces a shock similar to that of a stone cast between the diaphragm and the instrument."

This paragraph, which we extract from a contemporary, is going the rounds of the papers as a fresh item of information. It is pleasing to note that the "discovery" was made as long ago as 1878, and that the SCIENTIFIC AMERICAN of that year and the following year contains several accounts of experiments in the same direction.