THE COLLINS SYSTEM OF LONG-DISTANCE WIRELESS TELEPHONY.

The longest distance wireless telephone tests yet made on this side of the Atlantic have just been completed between Newark, N. J., and Philadelphia, Pa., a distance of eighty-one miles, as wireless waves travel.

The system by which this has been accomplished is due to A. Frederick Collins, a pioneer in the wireless telephone field. The first of his series of tests took place between his laboratory in Newark, where he has a high-power sending station, and the Singer Building in New York city, about twelve miles away, on the night of July 9, when spoken words were clearly and loudly transmitted across the intervening space. The following day the distance was increased to thirty-five miles, when the receiving station was located at Mr. Collins's country home at Congers, N. Y., and then, amplifying the power of the sending station and bringing the instruments into sharp resonance, the Newark-Philadelphia tests were made the following Tuesday at midnight, from the top of the Land Title Building.

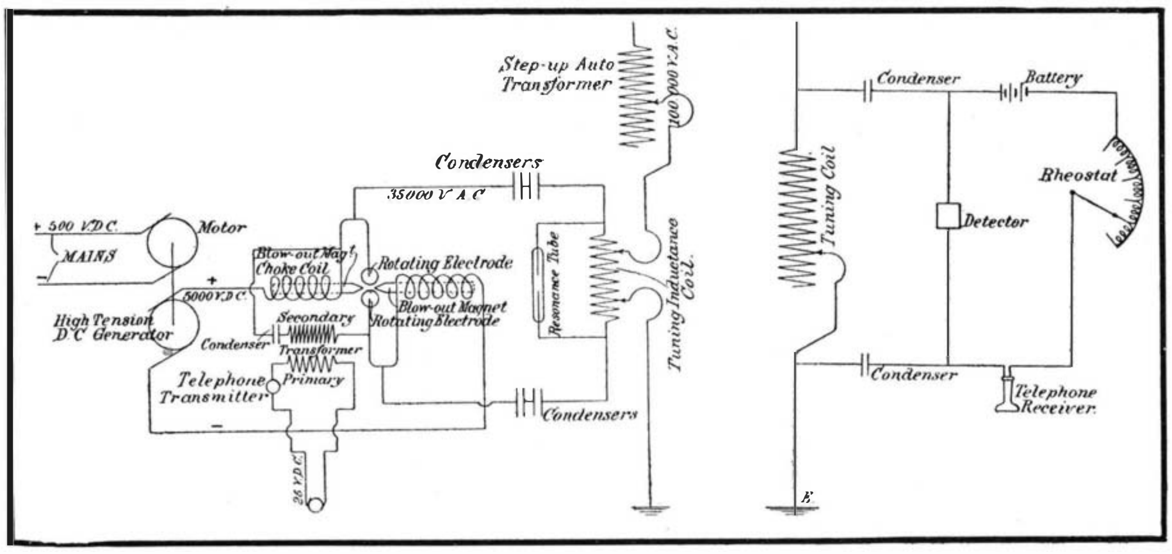
This system of wireless telephony is the culmination of work begun by the inventor in 1899, and in its modified and present form it consists of an apparatus for generating continuous oscillations and an instrument for reconverting the received oscillations into audible, articulate speech. For the overland tests the initial energy employed was a direct current at 500 volts furnished by the Newark Public Service Corporation. This was increased to 5,000 volts by a direct-connected motor-generator set, the dynamo of which was especially designed by Mr. Collins to stand high-potential strains.

The latter current was used to energize a self-regulating arc lamp having revolving electrodes instead of the usual induction coil employed in spark telegraphy. A blow-out magnet was adjusted at right angles to the oscillation arc, and one of the ends of the magnet was placed in series with the positive wire, and the other coil in circuit with the negative wire. This magnet fixes the arc in the best position; besides the coils serve to choke back the oscillations from the high-tension generator. Across the 500-volt direct-current circuit, the terminals of a small transformer coil are shunted, but a condenser is interposed to check the high-voltage direct current from flowing through it. The primary of the transformer is connected in series with a source of current developing 25 volts direct current and a telephone transmitter.

From the opposite sides of the arc the oscillation circuit leads off, and is completed by a battery of glass plate condensers on either side of the tuning induction coil. The choking effect of the induction coil causes the potential difference of the oscillations to be greatest on either side of the coil. Hence the aerial and ground wires are placed on opposite sides of the coil at the point where resonance is a maximum. An auto-transformer in the aerial serves further to step-up the potential to 100,000 volts or more of the oscil-

The Thermo-Electric Detector Taken Apart.

lations surging through it. Not the least important, though a subsidiary piece of apparatus, is the resonance tube devised by Mr. Collins for the instant visual determination of the proper values of induction and capacity of the closed circuit, as well as when this latter circuit is in tune with the aerial wire system. The device consists of an exhausted glass tube 13



The Elements of the Collins Wireless Telephone System and Their Electrical Relation to One Another.

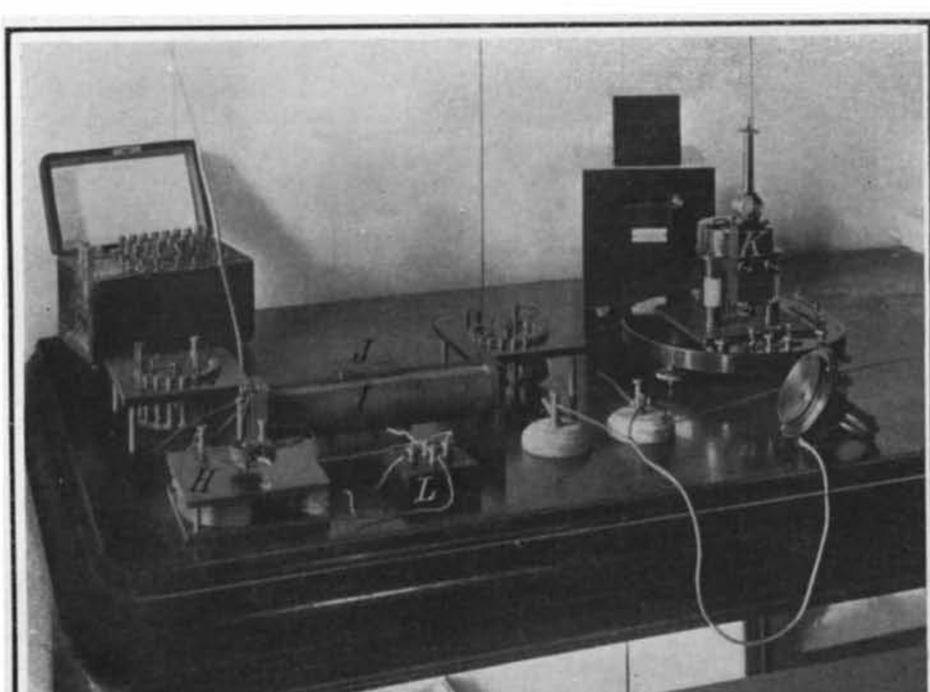
inches in length and 1¾ inches in diameter. Sealed in the ends are platinum wires 1/16 inch in diameter, and these extend longitudinally through the center of the tube until the ends almost touch each other. The outside terminals are connected in shunt with the induction coil. Now, when the first feeble oscillations begin to surge in the closed circuit, one or the other will glow, or both of the free ends of the inclosed wires will glow, depending on the oscillatory nature of the current. As the current strength of the oscillations increases the glow-light extends farther and farther toward the ends of the tube, but always keeping close to the oppositely-disposed wires.

The length of the glow on the wires is proportional to the current strength, and thus the tube may also be used as a measuring apparatus instead of the milammeter usually employed. The characteristics of the oscillations can also be easily observed; for if they are positive the light will appear almost wholly on the end of one of the wires, and if the current is reversed, on the opposite end; while if the current is oscillating with equal electro-motive forces, the light will have the same degree of intensity on both wires. By means of a revolving mirror the oscillations may be segregated, and it is then easy to see whether they are periodic or continuous, and if the latter, to analyze the wave form of the spoken words.

The receptor comprises a thermo-electric detector of Mr. Collins's invention, the fuller details of which it is inadvisable to give out at the present time. It may be said, however, that the principles upon which it is based are entirely different from the numerous other detectors that have made their appearance since the original form of the Branly coherer. Roughly, the detector in question consists of two exceedingly fine wires of different metals crossed at right angles and forming a couple, somewhat on the order of a Boys radio-micrometer, the conduction losses, however, exceeding the radiation losses. Under the junction of these wires is placed a resistance wire, which is heated by the currents surging in the aerial wire system. The detector is sensitive to oscillations of 1/5000 of an erg, and is especially well adapted to the reception of articulate speech. A variable electrolytic resistance is used to modify the current, while the tuning inductance and condensers are very much the same as in other wireless systems.

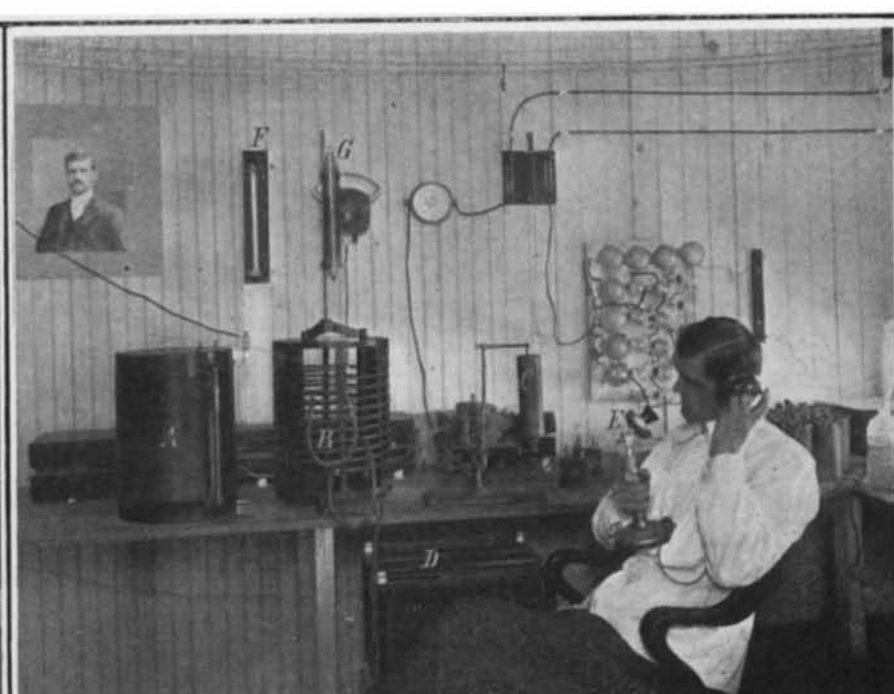
The highest degree of tuning is obtained by means of a thermo-galvanometer. This instrument comprises a single loop of silver wire suspended between the poles of a permanent magnet. The lower ends of the loop are connected with a bismuth-antimony thermo-couple, which is heated by a fine filament of high specific resistance, through which filament the oscillating current passes, very much as in the detector just described. One end of the heater is connected with the frame of the instrument, in order to avoid electrostatic stress. The heat generated by the passage of the oscillations through the resistance falls on the thermo-junction, and the resulting electromotive force applied to the ends of the silver loop causes it to turn in the magnet field.

In the Newark-New York tests the aerial wire at the sending station had a length of 250 feet, and was formed of four radiating phosphor-bronze wires, making a total of 1,000 feet of wire. At the Singer Build-



H. Adjustable Condenser. I. Tuning Coil. J. Battery. L. Thermo-Electric Detector.

Long-Distance Telephone Receiver With Thermo-Galvanometer for Fine Adjustment.



A. Auto-Transformer. B. Tuning Inductance Coil. C. Arc. D. Condenser. E. Transmitter. F and G. Resonance Tubes.

Mr. A. Frederick Collins in His Laboratory, Showing Part of His Wireless Telephone Apparatus.

THE COLLINS SYSTEM OF LONG-DISTANCE WIRELESS TELEPHONY.

ing the receiving station was located on the twenty-fifth floor, and from the receptor an aluminium wire passed through a window and followed the perpendicular wall to the forty-first story, where it passed through a porcelain bushing, which was suspended at the end of an arm projecting five feet from the cornice of the building. The upper end of the antenna was likewise swung away from the top of the flagstaff, 612 feet above the street level, by means of a highly insulated arm, and the wire was thus kept free from the building.

The receptor was grounded to the water pipe. In the Newark-Congers experiments the aerial consisted of 1,000 feet of aluminium wire held in the air by three kites which were connected in tandem. The same aerial was elevated from the top of the Land Title Building in Philadelphia. Hence in every case there was practically a clear visual line between the sending and the receiving instruments.

PUBLIC SERVICE CAR FENDER AND WHEEL GUARD TESTS.

The Public Service Commission for the first district of the State of New York will hold a car-fender and wheel-guard test on October 20, 1908, at Wilmerding, Pittsburg, Pa. Generally, the tests will consist in picking up or removing from the track three sizes and weights of dummies placed in various positions in front of the car, approaching them at two different speeds. The fenders will be attached to both double and single-truck cars. To conform with the street conditions within New York city, two different kinds of pavement will be imitated on the track roadbed. The three dummies will represent, respectively, a man, a youth, and a child. The first will be about 5 feet 9 inches in height, and weigh 170 pounds; the second about 5 feet 3 inches in height, and weigh 120 pounds; and the third about 4 feet 6 inches in height, and weigh 50 pounds. The dummies will be placed on each type of pavement, not more than 30 feet from the end of such pavement nearest the approaching car. The two speeds at which the test will be made will be six and fifteen miles per hour. The speed at which the car moves will be determined by a speedometer.

The portion of the track prepared for the test will be about 200 feet long, consisting of 100 feet to represent asphalt or macadam surface; and 100 feet of cobble pavement.

The positions in which the dummies will be placed for the test are as follows:

Test No. 1. Dummy placed in an upright position on the track, with its back toward the car.

Test No. 2. Dummy placed in an upright position on the track, facing the car.

Test No. 3. Dummy placed in an upright position on the track, with its side toward the car.

Test No. 4. Dummy lying on the track, with its side toward the car (transversely).

Test No. 5. Dummy lying on its side, with arms extended toward the car.

Test No. 6. Dummy lying somewhat diagonally on the track, with its feet toward the car.

Test No. 7. Dummy lying on its back with its head toward the car.

Test No. 8. Dummy lying on its back with its feet toward the car.

Test No. 9. Dummy lying along the rail, with its head and one arm extended toward the car.

Test No. 10. After the fender or wheel-guard has passed satisfactorily all the tests made for the purpose of determining its life-saving qualities, it will then be subjected to a test to determine its ability to pass over obstacles or obstructions in the roadbed, by running it against boards or blocks spiked down in position.

Each projecting fender will be submitted to Tests No. 1, 2, 3, 5, 7, and 8, with all three dummies, over each type of roadbed and at both speeds, provided the tests are not discontinued as hereinafter prescribed.

Each underneath fender or wheel-guard will be submitted to Tests No. 4, 5, 6, 7, 8 and 9, with all three dummies, over each type of roadbed, and at both speeds, provided also the tests are not discontinued as hereinafter prescribed. The following rules will govern the tests:

1. The entire conduct of the test will be under the direction of a sub-committee of the Public Service Commission for the First District, and only such directions as may be issued by the sub-committee will be recognized.

2. The testing ground will be roped off, and all disinterested parties will be excluded therefrom.

3. Each fender or wheel-guard submitted for test may be represented by not more than two accredited representatives, who must be named before the tests are begun.

4. The order in which devices will be tested will be determined by the sub-committee. Its decisions will be announced as far in advance as possible. A failure on the part of a competitor to be ready in his proper order may result in his being dropped from the competition.

5. A sufficient number of competitors will be notified to occupy the first three days of the test, directing such competitors to be on hand on the morning of the first day the tests begin. Other competitors will be notified by telegram a day in advance of the date upon which they will be called.

6. Fenders must be shipped by the manufacturers or inventors to themselves, care of "Westinghouse Machine Company, Pittsburg, Pa.," with the boxes or crates clearly marked "For fender tests." The commission will not be responsible for the receipt or for the care of any device.

7. For convenience, the tests on both fenders and wheel-guards will be divided into series. A complete set of four tests at one speed on each of the two types of pavement, with one size dummy (12 tests in all), will constitute a series.

8. If fifty per cent of the tests in any series on any fender or wheel-guard are not of Grade "A" as hereinafter defined, the tests on such fender or wheel-guard will immediately be discontinued.

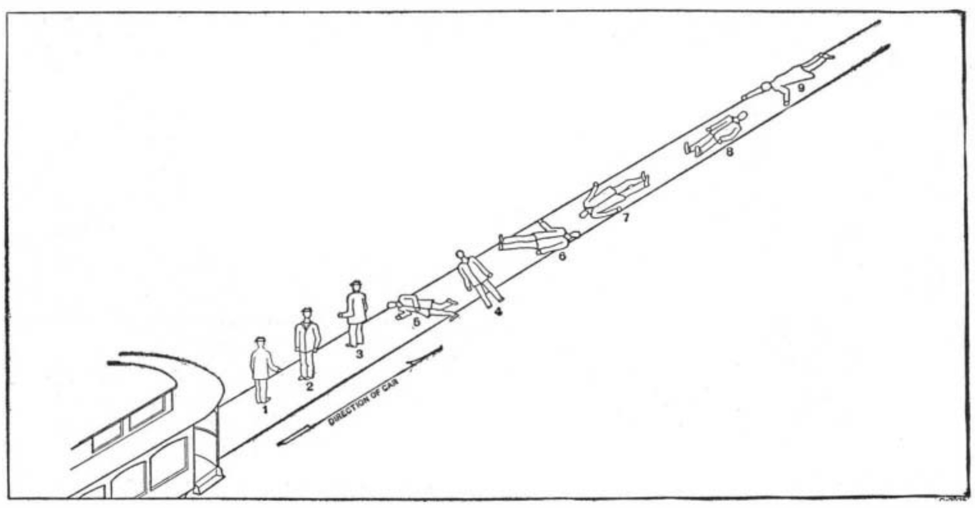
9. The tests will be conducted in the following order:

First Series. 50-pound dummy at 15 miles per hour.

Second Series. 50-pound dummy at 6 miles per hour.

Third Series. 120-pound dummy at 15 miles per hour.

Fourth Series. 120-pound dummy at 6 miles per hour.



POSITIONS OF DUMMIES IN PUBLIC SERVICE CAR FENDER AND WHEEL GUARD TESTS.

Fifth Series. 170-pound dummy at 15 miles per hour.

Sixth Series. 170-pound dummy at 6 miles per hour.

The first series of tests will be made with the devices attached to a double-truck car. A separate series will be conducted with a single-truck car, provided the former set is passed satisfactorily.

10. Only the predetermined number of tests will be permitted, except as provided in these rules. If a device does not pass satisfactorily a sufficient number of tests in any series, a protest may be filed and considered as provided in Rule 9.

11. If the ruling of the sub-committee is disputed at any point in a test, notice of a formal protest shall be given immediately; a formal protest shall be filed on the date of the test, setting forth all particulars, and a hearing shall be held and final ruling rendered in time to permit other tests to be made, if allowed by the sub-committee.

12. In an underneath fender or wheel-guard test, if the dummy is struck by the car and knocked entirely from the roadbed (out of reach of the fender or wheel-guard), this will not be considered as a test, and the trial will be immediately repeated. The same ruling will apply in the case of a fender, if a similar occurrence takes place.

13. When the car comes to a standstill, the results of the test will be graded and recorded as follows:

A complete pick-up or removal from the track by either the fender or wheel-guard, a test of Grade "A," counting 4 points.

If any part of dummy remains under the fender or wheel-guard, but is partially picked up or removed from the track, a test of Grade "B," counting 3 points.

If the dummy is for the most part under the fender or wheel-guard, but still is partially picked up or removed from the track, a test of Grade "C," counting 2 points.

If the dummy is entirely under the fender or wheel-guard, but dragged sufficiently to prevent its going under the car or wheels, a test of Grade "D," counting 1 point.

If the dummy passes under the car or wheels, the test is a complete failure, Grade "E," counting 0.

A Railway to Mecca.

On Tuesday, September 1, was celebrated with great rejoicing the completion as far as Medina of the Hedjaz Railway, which, according to the original plans, is to be continued to Mecca, the starting point being Beirut, on the coast of Palestine. The most remarkable feature of the railway is the manner in which the money was obtained for its construction. It is neither a government nor a commercial undertaking, but has been designed solely to meet the convenience of the thousands of pilgrims who yearly undertake the journey to Mecca to pay their devotions at the shrine of the Prophet Mahomet, and the cost has been defrayed by public subscription—the first time, it is believed, that a railway has been built in this manner. A certain proportion of the money raised was, indeed, compulsorily extracted from the donors, for every official in the employment of the Turkish government and every officer and man in the naval and military forces was levied to the extent of ten per cent on one month's salary. The Sultan himself gave $250,000 in one donation, and has made several smaller contributions in addition. All over the world the Moslem press has published appeals for funds, and these have been answered in the most whole-hearted way, the gifts including, besides money, jewels, silks, ivory, cloths, and merchandise of all descriptions. The only source that appears to have remained untapped is the bazaar and lottery. Altogether some fifteen million dollars have been raised, of which voluntary subscriptions account for more than a half, another million dollars coming from the salary tax.

The work of constructing the railway was commenced in 1904, the line being already laid between Beirut and Damascus. By the end of 1906 the way was completed to a length of 452 miles, to a point 18¾ miles beyond Tebouk. During 1907 another 217 miles were laid, so that by the end of that year trains were running to Bir-Jehid, 669 miles from Damascus, while the same period saw also the completion of the greater portion of the earthworks between Bir-Jehid and Medina, a stretch of 156 miles.

Most of the work of construction is being done by soldiers, of whom about six thousand have been employed in making earthworks and cuttings, and in leveling, laying down and transporting rails, etc. The technical part of the work has been in the hands chiefly of Italians. On reaching Medain-Salih, however, a rearrangement was found to be necessary, for this spot, 612½ miles from Damascus, is considered the boundary of the Holy Land of Hedjaz, into which none but the followers of the true Prophet were allowed to pass. From here to Medina, therefore, a distance of 212½ miles, the work has been entirely in the hands of Moslems, who will also be responsible, unaided, for the remaining 240 miles to Mecca. A branch line 100 miles long has been built from Dareiya, just below Damascus, to Haifa, by Mount Carmel, so that the total length of the line is 1,009 miles, of which 769 miles have been completed. The aggregate expenditure so far is thirteen and three quarter millions of dollars, which works out to $17,800 per mile and leaves a balance in hand of a million and a quarter dollars. It is anticipated that the line will be completed to Mecca within two years. Throughout its whole length it will run parallel with the Derb-el-Haj, the pilgrims' route to Mecca.

A New Life-Saving Appliance.

Capt. G. K. Gandy, R.N.R., is responsible for a useful adjunct to the accepted life-saving appliances required by the English Board of Trade. He has utilized the ordinary canvas cover of a ship's boat so as to form a buoyant raft by the introduction of cork and bamboo cane. This additional element of buoyancy occupies no more room and adds very little weight to the customary equipment of a ship's boat, and possesses the material advantage of being in the most natural and convenient place on a vessel for use when occasion arises. To lower a boat its cover must be removed for the operation, and in the case of the buoyant cover it can be either laid aside or thrown overboard, and, being attached by a line, is there afloat ready for any emergency. The idea has evidently been well considered. The Admiralty have recognized its advantages, the makers having just completed an extensive order for the dockyards.