in nine hours by the Wright system. If the operator makes a mistake in a message it has to be sent a second time.

Mr. Wright had almost completed another machine which was to dispense with motors and to be worked by electro-magnets. The instrument may be said to be still in a state of development, and there is not a large number in use.

The Morkrum apparatus also enables about eleven hundred to twelve hundred telegrams to be dealt with on a circuit in a day of nine hours. There is no tape used. The inventors have been nine years engaged in perfecting the machine. It has worked from Chicago to New York through repeaters quite satisfactorily. Some of the railways were using it to a limited extent. The current required is about 30 milliamperes. The instrument is stated to be hardy. Much care has been taken to provide for the speedy removal of faults by a process of elimination. Parts are made easily removable and interchangeable, and are subdivided a good deal. When trouble arises parts are removed one by one and another substituted. A special alphabet like that of the Baudot is used, but as the combinations are effected by the keys of the keyboard the typist does not need to know the alphabet. The keys combine positive and negative impulses in a certain manner according to the key struck. Any key just lightly touched is pulled down by magnetism, as a circuit is set up. Any key depressed and kept so prevents any other key from being depressed, as all are locked. The depression of a key arranges certain levers, so that they determine the order of the impulses to line by their action upon a bank of seven transmitting relays. The impulses pass through two polar relays in series. One polar relay works the home recording-apparatus as a check on what is sent. The line current picked up at the tongue of the other in response to the impulses goes to the split of a polar duplex. They balance by galvanometer, which is unusual in the States. The recording relays at each sending end are in a local circuit. There are earth line, two local-battery terminals for 110 volts, and the main-line battery, of which the voltage can be varied, and either dynamos or chemical batteries may be used. The incoming signals work a polar relay which works banks of receiving relays. The impulses from these move discs in which are holes. There are four of these discs side by side. Any movement which makes holes so fit in all four discs as to be exactly opposite each other, allows pins worked by springs to drop into the holes, and this in turn mechanically rotates the circular typeholder so that the proper letter is opposite the paper and the blow is struck. In front of the typeholder is a small ink-pad on a spring. As the typeholder comes forward it rubs on the pad, which then passes on to the top of the typeholder. As the typeholder moves forward to impress the letter on the form a small projection on its mechanism breaks the circuit, so that everything is unlocked ready for the next letter. The paper is stationary. The typeholder moves along. The polar relay is wound to 140 ohms, half on each coil. Large currents are used, because of induction from high-power circuits in places. Key and sounder can be switched over to, if necessary.

These instruments had been in use only about eight or nine months. The proprietors do not sell, but rent them for about £12 10s. a month. The Wright Company does likewise. The Postal Telegraph Company is going to use the Morkrum machine fairly extensively. Comparatively low-priced labour will be used—girls at £6 to £9 a month, instead of operators at £17 to £20. As about sixty-five messages an hour per pair of operators can be handled, this is considered to be good business.

The Morkrum Company is beginning to manufacture. The factory was visited, and it was seen that a first-class array of tools is ready.

The pole-lines of the companies carry thirty to forty wires. The conductors are mostly copper, about 170 lb. to 200 lb. to the mile. It is stated that they pick up a good deal of induction from their own circuits, owing to the length of the lines and the strong currents used. Polar relays are wound to 300 ohms and B relays to 150; sounders to 150, and some to 250.

The general finish of instruments used for telegraph purposes in the States was rougher than that seen in Britain and on the Continent.

On railway wires where there is a large number of stations, there are means by which any station can be called without disturbing the others. A bell is rung. There is mechanism at each office which will respond only to a particular combination of signals sent from the calling office. This mechanism is somewhat involved, and would not fill any need that we have.

Loop lines pass away to various offices all over the large cities. In these offices leased lines are worked through repeaters at the main office. A shutter is arranged at the main office, and if the loop office wants to obtain the attention of the main office a key is depressed, which causes the current to be so increased that the shutter opens and the testing officer cuts-in on the line. There is some variation in methods for doing this at different places.

These leased lines are a source of considerable revenue to the companies. The general rate is £4 a mile. Some lines are leased for only twelve hours. One circuit was mentioned as being leased for £3,200 for day use and £2,200 for night use per annum. When newspaper offices are extended to, operators are sent to these offices. The only charge is the rental, except when loop wires only are leased, then the operator is provided and charge is made at the message rates. The *Times* newspaper telegraph-office, New York, was visited at night, but no special features were observable. The officer in charge asked for men to be sent to him from the central office according as he saw they were needed, and he ordered them back as the work slackened. Most Press-work is done at the office of the newspapers, so that the central-office staffs are much reduced at night.

In the Western Union Telegraph Office, New York, there are four test-boards. The references already made to cables from underground, battery leads of different voltages, use of lamps as resistances, double sets of springs so as to cut into circuit more than one set of instruments by inserting wedges, way-lines for connecting from one test-board to another, all apply. There are red lamps on these boards which glow when a leased wire or an extended wire is out of order.