

arranged in tiers. Lamps are not used as resistances. These are made of wire, enamelled so as to readily dissipate heat.

Quadruplexes are worked fast. The B side is not too good, except on comparatively short lines. Gerritt Smith's relay and condenser arrangement is used for correcting the kick of the B relay. As dynamos are used up to about 385 volts, which may be tapped at points in the sets of dynamos to get intermediate voltages, strong currents are employed. Heavy currents are used on all American telegraph circuits. The Stephen Feild system of connections is employed generally for quads. Machine keys are used by the men even on the fastest circuits, but their use has to be tempered with discretion, as if the dots are too fast the signals at the distant end arrive light.

Figures or doubtful words are not repeated in telegrams. The theory, which is a correct one, is that there should not be any such. An operator should break when there is any uncertainty.

Two hundred and eighty messages are considered a day's work. For any over that number the operator receives $\frac{1}{2}$ d. each, and it is not unusual for men to earn, besides their wages, as much as from 4s. to 14s. a day. Good operators are paid from £18 10s. to £22 a month. They work nine hours a day. Others receive from £17 to as low as £13, according to capability. Women are paid the same as men for equal work. Two women are working circuits, for which they were getting £17 10s. a month. Women are mostly engaged in distributing, however. At night 170 messages are considered a day's work, and operators are paid 1d. for every message over that. An operator may go off duty when he has sent his 280 messages in the daytime, and sometimes, although not often, that is done by noon.

Many of their circuits are much affected by power lines. Near Hammond, in North Michigan, they have twenty-two wires ruined by high power, and they are fighting the power-user in the Courts. The effect of this high-power induction was seen on several circuits. All would be normal and going smoothly, when suddenly the repeater would chatter just as if a telephone generator were applied to the circuit.

Duplex was working to Montana, approaching two thousand miles away, with, of course, repeaters. The signals were good, but fast work cannot be done on circuits of this kind. A repeater in a duplex circuit, New York to San Francisco, was listened to and was working well, but at only about eighteen words a minute.

Wheatstone automatic working to New York was introduced a few weeks prior to my visit. The perforating was being done by hand. The circuit was 200 lb. copper, and there were no repeaters. The distance is about 950 miles. At the receiving end the signals are perforated on tape at about a hundred words a minute, although duplex has been worked at one hundred and fifty words a minute. The perforation at the receiving end is effected in the following way: To the tongue of the receiving relay 385 volts are applied from the dynamo, the other pole of the dynamo being earthed. The marking and spacing contacts of the relay are connected to separate electro-magnets of 150 ohms each, the other terminal of the electro-magnets being joined to a condenser, which is earthed. These electro-magnets are so set up that they control their armatures in such a manner that pins on them suitably perforate the tape. This tape is then passed through an apparatus that has two brushes, which make contact with the roller whenever a brush meets an opening in the tape, and by this means a sounder is operated. The operators typewrite from the sounders at any suitable speed. The tape can be divided amongst several operators if desired. The speed of perforation at present does not exceed a hundred words, as the electro-magnets fail if more is attempted. This is worked mainly at night, and it is intended to develop it. The transmitters are not of the magneto type—they are motor-driven.

This company was operating the Rowland system for a couple of years, but, although when in good order it did good work, it was so complicated and uncertain that its use was abandoned.

The Wright and the Morkrum systems of type-printing telegraph are now being used. The Wright printing-machine works from impulses controlled from the keyboard direct. The keyboard is like that of a typewriter, and has fifty keys. The depression of a key selects and transmits the impulses for the required character. A small motor rotates a cam shaft, which moves once round, when a key is depressed. There are four positive and four negative signals, which are combined by the keys in such a way that the impulses suitable for each character pass to line. The positive impulses turn the type-wheels and the negative impulses lift it. A slow-acting magnet comes into operation on the lengthening of a final signal, by which the type-wheel is turned back a little. The result of all this is that the type-wheel can send out the fifty characters. At the receiving end there is a relay with a double tongue. One armature lifts the wheel and the other turns it. On the reception of a signal the type-wheel moves to the position corresponding to the impulses, and the tongue of a polarized relay in the local circuit of the first relay rests at the completion of a signal on one or the other stop long enough to complete a local circuit so that a latch may be released to allow the cam shaft to revolve once. The cam shaft has several cams which bring about different movements necessary to print the letter and have all in readiness for the next impulses. The batteries used are 130 volts, earthed at the centre to work a relay which repeats the positive and negative impulses from 385-volt dynamos. At the sending end the message being transmitted is printed on a long sheet of paper so that the operator can see all, and also to provide a record. The message is recorded at the receiving end on the forms which are fed in by the attendant. The line can be duplexed and these instruments used. The speed is not high, being about thirty words a minute.

On three consecutive days from 8 a.m. to 5.30 p.m. two women dealt with 450, 451, and 239 forwarded messages, and 277, 272, and 320 received messages. This comes to thirty-eight messages an hour a pair, as there are two engaged at the distant end also. One way one pair was working at fifty messages an hour. There was not enough work to fill the wires. At New York it was found that from one thousand to one thousand one hundred messages a day could be handled