

*A System of Train Signaling, by which also disabled Trains may telegraph for assistance without the aid of portable apparatus.** By CHARLES V. WALKER, Esq., F.R.S.

When, in the early days of telegraphy, messages were sent and trains were signaled on the same wires, no facilities existed for reducing the apparatus employed for the latter purpose to a simple form. The case is now becoming different, special wires being largely devoted to train signals; hence the present system.

The *instrument* employed is a large electro-magnet, with a movable armature, carrying a stem and a hammer, which latter strikes on a bell by the direct force of magnetism. It is provided with a contact-maker, a spring, the depression which causes a current to circulate. The bobbins are of 4 in. \times 3 in.; and are filled with ten pounds of covered copper wire, No. 16 or No. 18. The core is of five-eighth inch iron. The armature and appendages weigh $2\frac{1}{4}$ ounces. Bells of this kind have been in action for five years without cleaning or repairing. The battery is zinc-graphite, and a solution of 1 sulph. ac. + 8 or 10 water. The plates, $7\frac{1}{2}$ in. \times 3 in., are placed in stone pots that contain about a quart, the zinc standing in a gutta percha slipper containing mercury. Batteries of this kind will do their work untended for half a year and longer.

The *language* consists of blows on the bell; the number of blows varies according to the train-signal to be given. The distinctions required for ordinary purposes being few, the bell-language is very appropriate, from its addressing the ear, from its simplicity, and from the facility with which the signals are given and taken. *One* blow is for the starting of an ordinary train; *two*, for an express; *three*, for the arrival of a train; *five*, for stopping all trains; *six*, for testing. This is a general code; other forms of code are used for protecting level crossings and junctions; but the fundamental signals of the general code are of universal application. This system was introduced five years ago on the South Eastern Railway, and at the present time consists of about one hundred bells, to which additions are in progress.

The bells are connected in pairs, both bells being in a circuit that terminates in the earth in the usual way, at each station. The signal is made by depressing the spring from its earth-contact, upon the zinc end of the battery, the graphite end being in permanent connexion with the earth. The battery being thus introduced between the bell and the earth, a current circulates along the wire and produces one blow upon the bell. The home bell may be excluded or not from the circuit, when a signal is sent.

By the above arrangement signals are sent from station to station. But the extreme simplicity of the battery, the bell, and the language allows the arrangements to be so modified that signals may be made on a pair of bells from any joint, intermediate between two bell-stations, without the necessity of providing the signaler with any telegraph or battery, or

* From the London Repertory of Patent Inventions, No. 767.

any electrical apparatus whatever. The addition of this property to the bells does not in any way interfere with their being in perfect action and constant use for the ordinary work of train-signaling, and therefore if the guards of trains and the plate-players of the permanent way are provided with a signal for expressing their wants, a great advance is made in telegraphy, and a large element of safety is gained for the traveling public.

It is well known to electricians that, if two equal and opposed currents are presented to the respective ends of a wire, no evidence is manifested of the circulation of electric force; the wire is in a null state, as much so as if no current was presented to it. Taking advantage of this law, in connexion with the simple bell-system above described, the circuit is made to contain the two batteries, one at each station, as well as the pair of bells; the same pole, the graphite, for instance, of each battery being connected with the earth.

When the home-station signaler desires to make a signal, he depresses the spring as before; but the connexions are such, that by this act he excludes his *own* battery from the circuit. The circuit then contains but one battery,—namely, that at the pass station; the current of which is now able to circulate from end to end, being no longer counterbalanced by an equal and opposite current; and consequently the bells are sounded. This, then, is the process for ordinary train-signaling, under this arrangement.

By altering the contact-maker so that it inverts the battery in the circuit, instead of putting it out of circuit, both batteries are made available for each signal; and consequently the power and with it the cost of each may be reduced.

But the null state of the wire is equally well and very readily destroyed, by connecting it with the earth at any point intermediate between the two stations; for by this process a complete circuit is made or channel opened for the discharge of both ends of both batteries, each independently of the other, except that the attached wire between the earth and the telegraph wire is common to both circuits, and thus the bells at the respective stations are actuated by the batteries of the respective stations. If ten blows with the pause of a minute, and then ten more, is the signal that the engine is disabled; ten blows, and a minute of contact, that an accident has happened; a ringing continued beyond ten, that the permanent way is obstructed, the stations at either side are advised, and can take the measures necessary to meet the case.

These contacts may be made by hooking a wire or rod on to the line wire and making the necessary contacts with the rail; or, which is better, by establishing contact-makers, properly secured, at frequent intervals on the telegraph posts.

This system gives to those in charge of disabled trains, a certain means of asking for assistance from any point of the open railway, without any training beyond that of *counting ten* slowly and correctly. In practice, as between Red-hill and Reigate, no inconvenience or loss of electricity has been suffered from counterbalancing the two currents.—*Philosophical Magazine*.