



Television en Route

The "KAROLUS CELL" Better Reproduces By PAUL J. G. FISCHER

THE day of Television is rapidly approaching; it will be with us very shortly. Several important inventions, made by German scientists, have practically removed the last difficulties in the field of "phototelegraphy" and have served to open a promising field of investigation. Though the developments made are still confined to the laboratory, the experiments conducted have been entirely successful and certainly indicate the practicability of the system.

I will explain in the following paragraphs the new "phototelegraphic" apparatus worked out by the Telefunken Co. in Berlin, with which tests were carried on between Königswusterhausen, near that city, and Vienna, the capital of Austria.

THE SPEED PROBLEM IN COMMERCIAL RADIO

Present forms of automatic radio telegraph systems permit a transmission and reception speed not greater than 100 to 150 words per minute, and sometimes much less, as the actual speed depends on atmospheric conditions. Bad atmospherics partly or entirely destroy the telegraph signals, and for this reason high-speed communication is greatly hindered.

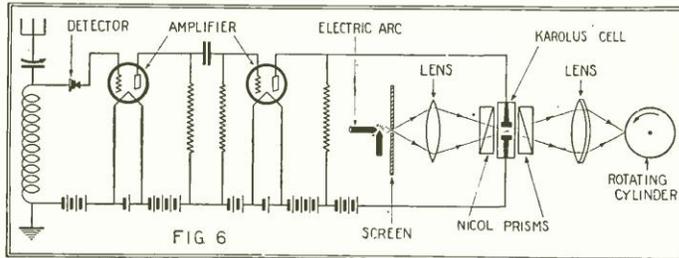
The Telefunken system of phototelegraphic transmission is far more reliable, as it is practically independent of atmospheric conditions. Static and other forms of electrical disturbances cause only small black dots and thin lines on the received photogram, which

in no way detract from the legibility. Not only is this new system more reliable, but it is far superior to present automatic systems, as it is possible to attain a transmission and reception speed of 400 to 600 words a minute.

The speed of the system can be materially increased if the transmission and reception

16 square inches are required for 200 words, and two or three times this area is reproduced in a minute, at regular commercial speeds.

So well does this system retain the formation of the original script transmitted that the received photogram can be used immediately for reproduction in newspapers or magazines, whether it be of handwriting,



The receiver circuit. Notice how the plate of the last vacuum tube is connected to the condenser of the Karolus-cell. The variations in the plate current cause a corresponding change in the transparency of the cell, by the phenomenon of polarization.

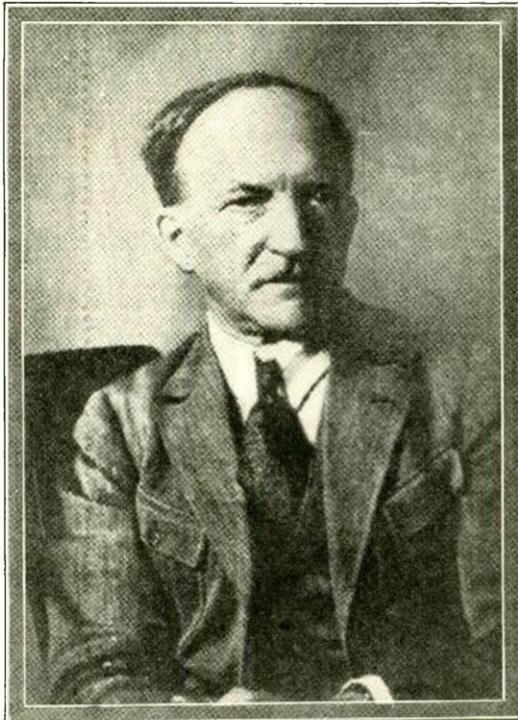
is done on a short wave-length, less time being required in such an instance for the complete transmission and reception of a photogram of a given area. In fact, it has been found possible to transmit 400 words within the space of a few seconds. About

type, a photograph or a sketch. Of course, where exactness is demanded in the transmitted material, such as scientific sketches or photos of artistic value, the weather conditions must be favorable; as it can be seen that small dots or thin lines might be ruinous to the reproduction at the receiving end.

ADVANTAGES OF THE TELEFUNKEN SYSTEM

Various systems of phototelegraphy now in use in Europe and America have reached a high point of development; but there are two distinctive advantages which go to explain the superiority of the Telefunken system. The first is the possibility of sending from the original telegraphs directly, without any form of photographic or other preparation; the second the very high sending-speed, coupled with the perfect quality of reproduction.

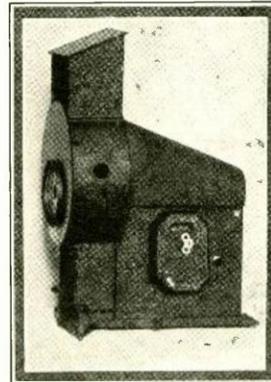
The improved operation of the transmitter is attributed to the new ring-shaped photoelectric cell developed by Dr. Schröter of the Telefunken Co. (See Fig. 1). The high speed and quality of reception is made possible by the light relay invented by Dr. Kar-



At the left is an untouched reproduction of a photogram of the German radio engineer, Count Arco, a director of the Telefunken Wireless Co. This portrait was transmitted by the process described in this article from Königswusterhausen, which is near Berlin, to Vienna.



Fig. 3A. This is the electric-arc projector of the transmitter shown in Fig. 3 (opposite page). Its intense ray is thrown upon the projecting object lens (See Fig. 4) and passes through the tiny "pupil" of the "electric eye"—the photoelectric cell of Fig. 1. It is then reflected with varying intensity (depending on whether it falls on an area black, white or grey) from the spot on the mounted telegram on which it is focused, to the coated surface of the photoelectric cell. The variation of current thus caused is used after amplification to modulate the transmission.



olus of Leipzig, called after him the "Karolus Cell." (See Fig. 2). It makes practical use of what is known as the "Kerr effect," and is entirely free from mechanical inertia in its operation.

THE TRANSMITTER'S "EYE"

The transmitter consists of a large cylinder enclosed in a light-proof box (See Figs. 3 and 4). An electric motor rotates the cylinder and at certain intervals changes its lateral position. On the cylinder is mounted the telegram or photo to be transmitted. The light from an electric arc is concentrated on the face of the cylinder by means of a system of lenses. The photo-electric cell or "optical microphone" is mounted between the arc light and the cylinder so that the concentrated light rays have free passage through the center of the ring-shaped electrode.

The spot of light thus directed on the telegram is only .008-inch square, thus covering a mere thread-line of the cylinder surface. The rays of light reflected from the cylinder strike the outside surface of the ring-shaped cathode of the photo-electric cell and affect the potassium coating, which emits electrons when exposed to light, in exact correspondence to the light and dark spots on the telegram traversed by the ray of light.

The anode of the photo-electric cell is formed by a grid of fine wires which readily allow the reflected rays of light to pass through to the cathode, but take up the electrons emitted by the potassium. The variations of current thus created in the circuit of the cell are passed through suitable audio-frequency amplifiers and in turn modulate the radio-frequency currents generated by the transmitting tubes.

THE KAROLUS CELL

The same arrangement of cylinder, driving motor and electric arc is used at the receiving end. (See Figs. 5 and 6). The rotation of the receiving and transmitting cyl-



An unretouched reproduction of a photogram, which was sent by the process described in the accompanying text.

inders is brought into synchronism in a very simple and ingenious manner; no transmission of separate synchronising signals is required.

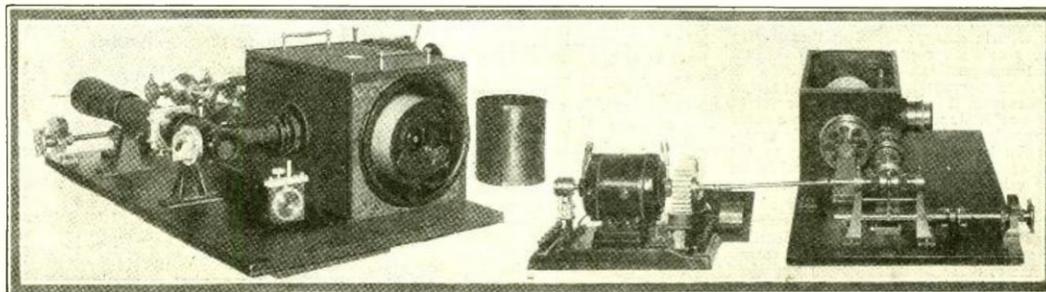
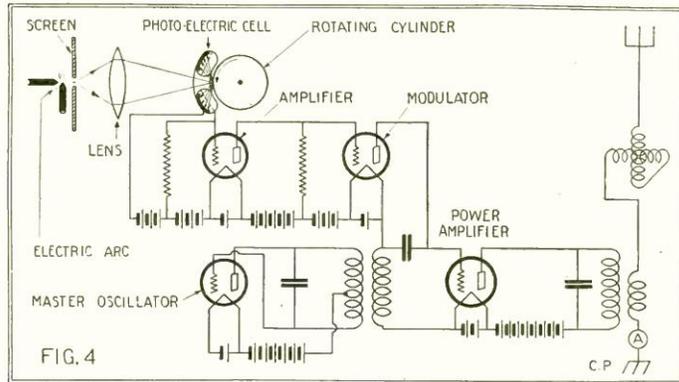


Fig. 5. The Telefunken-Karolus receiver system showing at the right a cylinder on which the unexposed negative film is mounted. One Karolus-cell may be seen in position in the center of the optical device and one standing in front of the receiving cylinder case.

Fig. 3. The Telefunken-Karolus transmitter system. From left to right: the electro-motor for driving the cylinder; the synchronising device; the transmitting cylinder showing a mounted telegram (a part of the photoelectric cell may also be seen), and a system of lenses concentrating light from the electric arc upon the cell.



Above is shown the circuit employed in the transmission of pictures by radio. Notice the peculiar construction of the photoelectric cell and its connections.

Again several lenses concentrate the rays of the electric arc towards the surface of the enclosed light-proof cylinder, on which a negative film is mounted. With the system

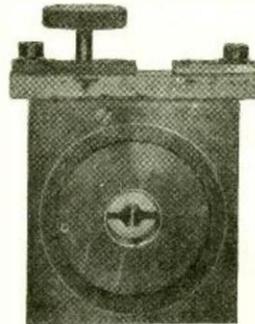


Fig. 2. The Karolus-cell. Note the two condenser-electrodes inside the glass cell and the terminals for connection to the receiver. The handle allows adjustment of the electrodes.

of lenses is incorporated the sensitive light-relay, the Karolus cell, which is connected to the output of an audio amplifier, following the radio receiver. The modulations of the transmitter's carrier wave thus cause amplified potential changes across the two electrodes or condenser plates in the Karolus cell. The cell itself is formed of glass and filled with carbon disulphide. The

rays of light which have to pass the cell, that is to say, the small space between the condenser plates, are previously polarized by suitable Nicol prisms. Due to the already-mentioned "Kerr effect," the polarization plane of the light rays is rotated or twisted in accordance with the potential change across the condenser plates. This varies the intensity of the light leaving a second pair of Nicol prisms following the Karolus cell.

The rays controlled by the cell are now directed, point by point and in thread-lines of exactly the same dimensions as in the transmitter, upon the reception film, forming a negative from which any desired number of positive prints may be made.

As the Karolus cell is entirely free from mechanical inertia it can handle a nearly unlimited frequency of applied-potential

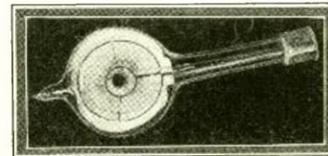


Fig. 1. The photoelectric cell invented by Dr. Schröter. Note the potassium cathode on the inner glass surface, the grid-anode and the hole in the center of the ring.

changes. The cell will also handle an enormous intensity of light without overheating, because of its small size, so that it is especially suited to television work.