THE HELLSCHEIBER SYSTEM

The last few years have seen the revival in European amateur circles of the Hellschreiber printing telegraph, a unique system which flourished in the 'thirties and then gave way to the page-printing teleprinter for everyday commercial use. The Hellschreiber, or to give it its full name the Siemens-Hell-Schreiber, was devised by Dr. Rudolf Hell in the early 'thirties and developed by the Siemens-Halske company in Germany. The German word "Hellschreiber", which embodies the inventor's name, also means "clear writer". Hellschreiber is probably the simplest method of transmitting the printed word and it was used extensively by commercial companies for transmitting news and information worldwide by radio. The system has been described as facsimile, but this is not quite an accurate description since the transmitting mechanism does not scan an original copy. Each letter transmitted by Hellschreiber is synthesized. In reception it is formed by the scanning action of a revolving helix, which writes the letters as a mosaic of black and white picture elements in a succession of parallel lines on a moving paper strip.

The intrinsic advantage of the Hellschreiber system is its relative immunity to interference and propagation disturbances, effects which often constitute a hazard to digitally encoded systems. This is because the system does not rely on accurately timed "start" and "stop" pulses to maintain complete synchronism of the transmitter and receiver but instead permits up to a 5 per cent difference in speed (Fig 11.1). Although its relatively slow speed of 25wpm does not match the speed of the teleprinter, on the score of accuracy it is probably without equal. For example a single incorrectly received element in the case of a "start-start" signal will alter a transmitted character completely or transpose a shift signal to the opposite case. On the other hand an incorrectly received Hellschreiber letter element will only result in a slightly blurred outline—never the wrong letter. The Hellschreiber equipment used for amateur communication is the second world war German army "felderfenschreiber", a transmit/receive pack set designed to work from 12V dc (see photo). The keyboard of this machine consists of a revolving drum or commutator on which insulated metal segments corresponding to the letter pulse trains are moulded. Depressing a key on the keyboard causes a contact to drop onto the drum for one revolution and thus to release the appropriate pulse train.

The receiving mechanism seen at the bottom left-hand corner of the photograph and sketched in Fig 11.2 consists of

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Fig 11.1. (a) Hellschreiber transmitter and receiver running at same speed. (b) Receiver running slow. (c) Receiver running fast. (d) Heavy interference but text almost readable. "The overall speed is also . . .". (e) Hellschreiber signal generated by Apple II computer at PA9KLS. (f) Hellifax copy from Peking on 14,000Hz. Recorded on tape at 21IBAD and processed by GJX8. This is not strictly Hellifax but an interesting adaptation of the system which is still in use.

Fig 11.2. Working parts of Hellschreiber receiver.
a revolving helix inked by a felt idling roller and a signal-operated writing edge. A system of knurled wheels pulls the paper tape between the helix and writing edge.

The rotating mechanism of the Feldfernschreiber is powered by a 12V motor generator driving the sending drum or commutator, the receiving helix and the tape transport wheels. A second winding on the armature of the generator produces 165–180V dc for the electronic terminal unit. The terminal unit comprises a 900Hz sine-wave oscillator, a single-stage input amplifier, a copper-oxide signal rectifier and a dc amplifier to drive the printing mechanism. A fourth valve is used to control the speed of the motor generator.

This is effected by passing the regulator valve's anode current through a second field winding designed to act as a brake in response to a centrifugal governor opening the grid circuit of the valve. The speed regulation is better than plus or minus 5 per cent. The terminal unit shown in the right-hand upper corner of the photograph has a tone input for 800Ω line, another at 4,000Ω for receiver input and a high-level output "listen" jack. A simplified circuit diagram of the tu is shown in Fig 11.3.

Fig 11.4 illustrates how the Hellschreiber letter synthesis is produced. Each letter or character is formed as a mosaic on a matrix or frame of seven vertical lines, each having 14 picture elements. The first and seventh lines are left blank to give letter spacing and the 1st, 2nd, 13th and 14th elements in each line are normally left blank to give line spacing. Exceptions to the element blanking rule occur with numerals such as 3, 5, 6 and 8 as shown in Fig 11.4. This is done to avoid misreading a "3" with its tail below the normal line of lettering for a "5" with its "hat" above the line. Although there are 14 picture elements to each line they are never transmitted singly. This is done to provide maximum resolution, at the same time restricting the system bandwidth (as with all telegraph keying, bandwidth is inversely proportional to the time duration of the shortest code element).

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**Fig 11.3.** Feldfernschreiber terminal unit.

**Fig 11.4.** Method of character synthesis. (a) Matrix diagram of typical letters and numerals. (b) Element train necessary for their formation. (c) Hellschreiber character font.
THE HELLSCREIBER SYSTEM

"seven-line Hollscheriber"—-the active elements of each line are produced within a five-by-five area. Note that in the drawing the lines are numbered from left to right, the normal progression of writing or printing, while the picture elements are numbered from bottom to top since this is the way the letters are formed by the scanning action in the printing process. The helix has a two-start thread, runs at 525 rpm and prints 2-5 characters per second.

The main features of the receiving mechanism are shown in Fig 11.2.

As might be expected, on-off keyed Hellscricher radio signals occupy a slightly greater bandwidth than five-unit coded teleprinter, although with pulse shaping and filtering the actual bandwidth compares very favourably with unshaped and Unfiltered rty. Amateur Hellscricher transmissions have a baud speed of 122-5 (7 by 7 by 2-5 characters per second). Converted to frequency this is equal to 61-25 Hz, and, if this figure is multiplied by three in recognition of the rule that a square wave and its third harmonic is perfectly acceptable for normal communication, the keying bandwidth is 183.75 Hz. However when this waveform is applied to a carrier wave a further factor of two is introduced because, like any other form of modulation, two sidebands are produced. Thus the If bandwidth is twice the keying bandwidth or 365 Hz. The bandwidth necessary for a 45.5 baud 170 Hz frequency-shift keyed rty transmission, computed according to CCIR Radio Regulations, is 245 Hz.

A recent development in the Hellscricher field is the “paper-less” system in which the pulse trains are generated by a microcomputer and displayed by the same device and a visual display unit. See Fig 11.1.

Further reading

"The Hellscricher—a recovery", by Hans Evers, PA0CX, Ham Radio December 1979.

"Hellscricher—what it is and how it works", by S. A. G. Cook, G5XB, Radio Communication April 1981.