Reuter's Wireless Services

An account is given of the principal developments connected with Reuter's distribution of news from Post Office radio transmitters. A brief description of the Hell-schreiber system of telegraphy is included.

Historical Outline.

In November, 1923, Reuter's Ltd., commenced a broadcast service of news distribution in Morse to European countries, renting radio transmitting facilities from the Post Office for the purpose. The example was soon followed on a small scale by other senders of news. The progressive policy which Reuter's have adopted towards this service has led not only to very healthy growth and expansion of the service, but also to some interesting developments in telecommunications technique, some account of which will, it is thought, be of interest to readers of this Journal.

An outline view of the manner of growth of the service may perhaps best be seen from a brief review of the principal features since its inception. In July, 1928, the emissions were transferred from Northolt to Rugby radio station for a "World" broadcast service of news, sent in code, from the powerful radio-telegraph transmitter on 16 kc/s (GBR). The keying centre was transferred from the Central Telegraph Office to Reuter's offices in November, 1929, though the operating was still carried on by Post Office staff. The service was remodelled for sending unencoded messages and extended by the addition of two high frequency transmitters, with omni-directional aerials, at Leafield radio station, keyed simultaneously with the Rugby long wave transmitter GBR; following a short experimental period this new "World" service was introduced on March 23rd, 1931. A supplementary service to European countries was started on an experimental basis on July 22nd, 1933, Hell-schreiber signals being emitted from a low-frequency radio-telegraph transmitter at Leafield (GIX, 43.2 kc/s). A brief description of the Hell-schreiber system is given later; the system provides a facility similar to that obtained by receiving on teleprinter instead of by Morse. To improve reception of Hell-schreiber signals at the more remote European centres, a high-frequency transmitter at Leafield was added, and a visit was made in June, 1938, during the experimental period of these emissions, to test reception at Budapest, Prague, Belgrade and Bucharest. The years immediately preceding the war were of grave difficulty for Reuter's wireless services, on account of severe competition from foreign services subsidised for propaganda reasons. The war brought controls by the Ministry of Information; it also necessitated many and frequent rearrangements of transmitters and frequencies used for Reuter's services, arising from military requirements and from the needs from time to time for various emergency services from Post Office radio transmitters. During the first half of 1941 replacement of the one very-low frequency plus two omni-directional high-frequency emissions for Reuter's "World" service by four or five beamed high-frequency emissions was com-

pleted, and testing with a view to the introduction of Hell-schreiber signals on these emissions has now commenced. In January, 1944, special aerials designed for the high-frequency emissions to Europe (and parts of N. Africa and Asia Minor) were brought into use.

A fairly definite pattern can be traced in these developments: a service is started for Europe only, on a low frequency transmitter, then extended by means of high frequencies. For purposes of presentation, discussion will be continued under the two broad headings, "World" and "European" service, with an extra section on the Hell-schreiber system. It will be appreciated that the type of service supplied for Reuter's by the Post Office is essentially multi-destination (i.e. it is a broadcast service intended for reception at more than one point) as distinct from point-to-point, so that advantage of close technical liaison with the recipient is not available; at the same time the number of recipients in any one high frequency beam may be relatively small, and attention to individual needs, e.g. in selection of frequencies, can sometimes be given. The recipients are news distributors, not wireless engineers, and their reports on reception of the signals are generally of a broad qualitative nature (essentially if an important message has been badly mutilated in transmission or not received at all); too often it is not even possible to interpret from the report whether poor reception was due to abnormally low field strength or to interference or other local trouble at the receiving end.

"World" Service.

A powerful low-frequency radio transmitter gives good and reliable signals over a very wide area, but the equipment and the aerial are expensive and the signals are subject to atmospheric interference, especially when electrical storms are prevalent. A high-frequency transmitter with much lower power and less costly aerial system can give as good, though somewhat less reliable, signals at even greater distances, provided that the frequency is right for propagation at the time and to the place concerned. A single omni-directional emission at high frequency is quite inadequate for world coverage; several emissions at different frequencies give a better chance of reception at any point. If there are to be several simultaneous emissions it is better for each transmitter to radiate from a directional aerial to cover a particular receiving area, so that the best frequency at any time for propagation to that area can be used. For Reuter's service, such an arrangement has also the advantage of permitting specialisation in editing and timing messages for different parts of the world.

After consultation with Reuter as to their probable
future requirements an aerial system for radiating six beams was planned and erected at Leafield radio station. The aerials are arrays, with reflectors, suspended from triatics between 180-foot steel towers; there are about four for each direction (or beam), each tuned to a separate, preselected, frequency. Most of the arrays are horizontal, but some for the longer wavelengths are vertical; they have generally a nominal beam width ±10°, i.e. at 10° away from the axis, the field strength in free space has fallen 6 db from the maximum. The map, Fig. 1, shows the great-circle paths of these six beams changing propagation conditions—as can be done in point-to-point working—and it is necessary to arrange a schedule of frequency changing for each beam, based on calculations from radio propagation data and theory. Forecasts, of which Fig. 2 is an example, are regularly prepared by the Post Office to show which of the frequencies available for the service is likely to be best to use at any time for a period some months ahead. These forecasts vary, in a not very regular manner, not only with time of day and season of year, but also with the phase in the sun-spot cycle. In addition, of course, reports

![Diagram showing the arrangement of high-frequency beams for Reuters' services.](image)

and the principal regions which they were designed to cover. The beams are shown 32° wide, but in practice the cut-off at the edges is not as sharp as is indicated by this simple method of illustration; any of the beams can fairly easily be doubled in width by alteration of the arrays, if required. New transmitter construction enabled most of the beams to be operated from Leafield, in addition to the European service, in 1941, but during the course of the war some rearrangements of these services have from time to time been necessary and not all of the beams are in use.

With a multi-destination service it is not possible to make frequency changes at short notice to follow of reception are taken into account in arranging the frequencies to be used.

From the start of the war the time available on the big Rugby transmitter GBR for Reuters' services became less and less, so these had to depend more and more, and soon entirely, on the Leafield low-frequency transmitter GIX for serving the nearest centres and on high-frequency emissions for the more distant centres. GIX compares with GBR roughly as follows:—frequency ratio 11 to 4; output power ratio 1 to 6; aerial height ratio 3 to 8; it gives reasonably adequate coverage of Europe on morse. The use of the aerials of both these transmitters was temporarily lost due to ice loading in
January, 1940; the damage to GIX was the more quickly repairable.

**Hell-schreiber System and Apparatus**

The Post Office were approached by Reuters (in July, 1933) to co-operate in investigating the possibilities of application to their wireless service of a new type of telegraph printing system ("Dr. Hell's System"), being developed by Siemens & Halske, of Berlin. The system was given the name of Hell-schreiber, commonly abbreviated to Hell. Equipment was obtained from Germany and tests were made at Dollis Hill and over radio paths from Leafield (GIX) to Baldock, Dollis Hill and Berlin in June, 1934. The system then used came to be known as the 12-line system, to distinguish it from a later development, the 7-line system which is now in general use. The great advantage of the 7-line over the 12-line system lies in the use of fewer elements per letter, hence a narrower frequency band of radio emissions and a reduced liability to cause or suffer interference.

The Hell system is essentially facsimile, i.e. the characters are not printed from type face, but are built up by a series of marks. In the 7-line system each letter frame is divided into seven vertical strips (of which two are left blank to form spaces between letters) and seven horizontal strips (of which two are left blank to form marginal spaces above and below the words formed on the tape). The frame for the letter proper thus comprises $5 \times 5$ (i.e. 25) elements, in any one of which a mark can be made by the received signals as the tape passes the printing head. The marks forming a letter are so close together that, when viewed at normal reading distance, they appear as a letter rather than as separate marks.

In the Hell-printer each mark is made by pressure on the tape between the inked face of a helical tooth on the printing wheel and a straight edge which is parallel to the axis of the wheel. The straight edge is attached to the armature of an electromagnet, which is energised by the incoming signals, in accordance with which the straight edge is moved towards the wheel to mark the tape. The obliquity between the tooth and straight edge is such that the area of contact between the tape and the inked tooth is small. The duration of the shortest signal is such that the corresponding mark occupies one of the 25 frame elements. A complete vertical line, as in the letter I, is formed by a signal duration of five times the shortest; the speed of the tape is slow relative to the peripheral speed of the helical tooth, so that the line so formed is nearly, though not quite, perpendicular to the edge of the tape. The width of tape is sufficient to accommodate two letter frames and the spacing between the helical teeth is such that each operation of the straight edge makes two similar marks (one by each of two adjacent teeth) at corresponding positions in each frame; thus two parallel lines of printing are produced, to avoid need for exact synchronism with the Hell sender. If synchronism is not exact, the lines of print do not run parallel to the tape, but one or other can always be read.

Before the war Hell-printers and senders were obtained from Germany, and when this source of supply failed the Post Office undertook to arrange for production in this country. Stocks of Hell-printers were then quite inadequate for supplying new subscribers to Reuters' service, which could not therefore be expanded until supplies of these items became available. As there then were requirements for both 7-line and 12-line printers, design of a printer which could accept either was produced by the Post Office. Fig. 3 is a photograph of an early model; the printing wheel with the helical teeth is just above the printing point on the tape, above it is the inking roller and below it the box containing the electro-magnet and the straight edge. To change from 7- to 12-line, or vice versa, the printing wheel only has to be changed.

At the normal speed of operation, five characters per sec., the signalling speed is 245 bauds for 7-line or 500 bauds for 12-line working. Such speeds are too great for transmission over standard Post Office voice-frequency telegraph channels with only 120 c/s spacing. For passing the signals from the Hell sender in Reuters' office to the radio transmitter at Leafield, terminal equipments have therefore been installed at these two points to provide three one-way high-speed channels, each 600 c/s wide, and one two-way order wire within the frequency band occupied by the 18-channel V.F. system. The three 600 c/s channels are centred at 900, 1,500 and 2,100 c/s and the two 120 c/s channels for the order wire at 420 and 540 c/s, i.e. they are the two lowest frequency channels of the standard system.

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One other feature of the Hell system deserves mention: the motor of the printer is started and stopped automatically by signals from the sender, of approximately \( \frac{1}{2} \) sec. and 10 sec. respectively, which are inserted at the beginning and end of Hell emissions. Attended operation at the receiving point is therefore unnecessary, at any rate under reasonably steady conditions of radio reception.

"European" Service

Difficulties with reception of Hell emissions from the low-frequency transmitter GIX were, at the start, reported by many of Reuters' agencies on the Continent. A visit was therefore made, in July and August, 1936, to Oslo, Stockholm and Copenhagen to carry out investigations at these receiving points. Before the introduction of the Hell system it had been the practice to receive Reuters' news service in morse at points outside a city and to relay the messages to the agency offices in the city. In taking advantage of the unskilled operation offered by the Hell system the news agencies were anxious to effect further economies by locating the radio receivers in their own offices in the heart of the city, and generally the services were being handled by non-technical staff, with technical assistance obtained locally as and when required. The difficulties with the Hell receptions arose primarily from the inadequacy of the technical assistance in relation to the problem of radio reception of the Hell signals with the limitation of aerial efficiency and in the presence of heavy local interference due to the location of the receiving point in a city office. By careful attention to technical details the visiting officers demonstrated that even under these conditions satisfactory reception was quite practicable at all three centres; samples of the slip, taken at Oslo before and after modifications were made to the receiving equipment, are shown in Fig. 4. Following this investigation, reports in the form of answers to a questionnaire were obtained from other agencies.

Although satisfactory service with the Hell system was then given by the low-frequency transmitter GIX to the nearer European reception centres, the field strength was too low for proper reception at the more remote centres. A programme of test emissions from a high-frequency transmitter at Leafield was therefore arranged in conjunction with a visit to study reception at Budapest, Prague, Belgrade and Bucharest in June, 1938. Satisfactory results were obtained at the agency offices in all four cities, using a frequency of about 11 Mc/s during daytime, and an enlarged service was introduced by Reuters, with simultaneous Hell emissions from GIX and one high-frequency transmitter, during the political crisis in September, 1938.

Close study was at about that time being given to the relative merits of the 12-line and the 7-line Hell systems. From all the evidence which was available it was concluded that the substantial advantages accruing from the lower signalling speed of the 7-line system outweighed all other considerations, and Reuters' service was therefore changed from 12-line to 7-line on August 20th, 1939.

Perhaps the greatest effect of the war on engineering technique in connection with Reuters' Hell service resulted from the threat of loss of use for this service of the low-frequency transmitter GIX. Apart from the strain to which the radio transmitting facilities of the Post Office were being subjected and the possibility of damage to this rather large and powerful (and therefore not readily replaceable) equipment, the emissions were of the kind which could assist navigation of enemy aircraft and were liable to be shut down at short notice. Accordingly arrangements were made in November, 1939, to reinforce the 11 Mc/s Hell emissions by another high-frequency transmitter, using a frequency about 7 Mc/s. On occasions when the low frequency trans-
mitter was not in use, trouble was encountered by the nearer reception centres (who were relying on this transmitter) in getting good results from the high-frequency signals. The difficulty was aggravated by the absence at that time of any high-frequency radio receiver really suitable for a service of this kind in commercial production in this country—a deficiency which has since been rectified. A visit was paid to the Scandinavian and Low Countries in February, 1940, to help in overcoming difficulties in high-frequency reception, not least of which arose from variations in radio path conditions. A certain amount of semi-skilled attention (of a kind not normally required for receiving a low frequency) to controls on the receiving equipment produced a considerable improvement in the grade of service. This visit, in common with the earlier ones, by technical personnel to the agencies abroad was useful, not only in direct results, but also in stimulating interest in the various technical matters discussed.

The course of the war reduced the number and altered the geographical distribution of subscribers to Reuters' Hell service, but it did not thereby ease the problem of supplying the service; on the contrary, it raised the question of radiating high frequencies efficiently to points so scattered as Stockholm, Moscow, Berne, Ankara, Tangier, Madrid and Lisbon. To improve the service on high frequencies, therefore, aerials were designed to distribute radiation fairly uniformly within a wide horizontal angle (of about 220°) at vertical angles ranging from about 15 to 45° to the horizontal, to the exclusion, as far as possible, of radiation in other directions. The design takes the form of two horizontal radiating elements at right angles to each other, each a half-wavelength long with a reflecting element behind. Aerials to this design were brought into use at Leafield on Reuters' service in January, 1944.

Conclusion.

These few notes on the technical developments are necessarily incomplete; if the plans mature for applying Hell-schreiber signals on all of Reuters' services, a chapter of development will have been closed, but it can confidently be predicted that further chapters dealing with extensions or improvements of the services will follow sooner or later in the future.

Temperature Indicating Materials

In many cases where heat is applied to or generated in materials either in manufacture or in use, it is necessary in the original design to be able to measure the temperatures reached under test conditions and in certain cases the use of the standard temperature indicators, such as liquid thermometers, thermocouples, etc., is either impracticable or unsatisfactory. A typical example is the design of a process sequence for the sealing of wire-supported quartz crystal elements into valve type envelopes. In such a process the weak spot is the low melting point solder (180°C.) used to connect the support wires to the burnt-on silver spot on the crystal and it is necessary to adjust the temperature gradients occurring in the sealing process to ensure that the solder-joint shall never reach softening temperature.

In solving this problem, use has been made of the properties possessed by various organic and inorganic compounds by virtue of which certain observable physical changes occur at well defined temperatures. A whole range of such substances has been developed and these are vended in various forms, the chief ones being:

(a) Paints which may have one or more mainly irreversible colour changes with increase of temperature. The transition temperatures may vary according to the rate of temperature change, but if this is determined the transition temperature does not vary by more than a few per cent. It is possible to determine in this way some scores of spot temperatures in the range 180°F. to 1,800°F.

(b) Lacquers which change from matt to glossy surface at 25°F. intervals in the range 125°F. to 350°F., and at 50°F. intervals in the range 350°F. to 1,600°F. with a quoted accuracy of ±1 per cent.

(c) Pellets which melt or sublime at the same sharply defined temperatures as in the case of the lacquers.

(d) Crayons, in stick form for marking surfaces, which are otherwise similar to pellets.

Paints are marketed in this country by I.C.I., Ltd. (Thermic Colours) and by J. M. Steele, Ltd., London (Thermindex Colours), and the latter firm also supplies lacquers, pellets and crayons under the trade names "Tempilag," "Tempil Pellets," and "Tempilsticks."

There is a fairly wide literature on the subject, but it is probable that the information is not generally known to telecommunications engineers, who may nevertheless find the materials useful in many applications.

Some further information may be obtained from British Standards No. 1041.

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