

THE RADIO ENGINEERING HANDBOOK

PREPARED BY A STAFF OF
TWENTY-THREE SPECIALISTS

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The over-all gain must also be held within extremely close limits, as a variation of 0.1 db can be perceived by the eye and variations greater than 1 db cannot be tolerated in high-class commercial service.

Some systems are equipped with networks comprised of special circuits which have been carefully equalized and adjusted and are used only for facsimile work. These may be extended by using ordinary telephone lines to interconnect them with other locations, usually on an emergency basis, for a sudden news event. Other systems utilize ordinary telephone toll facilities and take their chances on the quality and stability of the circuit. Some connect their equipment directly to the lines through repeat coils, and others connect by inductance coils coupled to the ringing box and coil of the ordinary telephone subscriber's station. Most of these networks are set up primarily for the handling of news pictures and are therefore designed for the utmost of flexibility so as to meet any emergency of news occurrences.

TAPE-FACSIMILE SYSTEM

Tape equipment is designed solely for message communication as opposed to picture or news matter. It produces a record on a narrow tape, much as do the better known telegraph printers. The method of recording used to date is that of a rapidly rotating spiral and an axial bar moved by a loud-speaker magnet in accordance with the signal. This is exactly similar to the action shown in Fig. 17. The recording

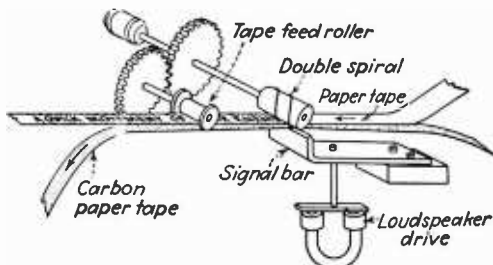


FIG. 19.—Elements of facsimile tape recorder with double spiral.

has been done either with a carbon paper tape, also similar to Fig. 17, or by applying ink to the surface of the spiral through the medium of a felt roller saturated with the ink. The scanning lines are crosswise of the tape and are made at a rate of about 60 per second. The tape is slowly advanced lengthwise so the texture of the lines are about 60 to 100 per inch.

Two distinct methods of transmission have been developed. In the United States much work has been done to develop a phototube scanner along the general principles outlined in Art. 4. This method actually transmits a facsimile copy of written or printed messages placed on a tape at the scanner. It is being developed for mobile services, such as police and aircraft.

The second method utilizes a special instrument which comprises a large number of cams, one for each character (figure, letter, or punctua-

tion mark) to be sent. The cut of the cam is such that a contact operated thereby will send out telegraphic type mark and space signals, which, when recorded as above described, will form the shape of the desired character. Two designs of this instrument have been developed. In one the message is perforated in paper tape as though it were to be sent on a standard printing telegraph circuit. The permutations of the holes in this tape consecutively select and release the proper cams, as the tape is fed through the instrument. In the other type a typewriter keyboard is manually operated and the striking of a type key will release the proper cam. This type of scanning is used extensively in Europe, and the United States rights have been acquired by one of the large companies in this country. **RCA**

The synchronizing problem is just as pertinent as in the other systems but is possibly slightly easier. This is because the scanning line is so short and the rate so high that the discontinuity between the end of one line and the commencement of the next readily provides a frequency component that may be used for automatic framing and synchronizing.

OPERATING STANDARDS

To date the only effective attempt toward standardization in the facsimile field has been in the adoption of International Standards under the aegis of the C.C.I.T. and the C.C.I.R. The former, in its Opinion 681, as amended at Warsaw in 1936, established rules for drum size, line advance, speed of operation, frequencies for synchronizing and carrier, setting up of circuits on the international telephone circuits, tariffs, refunds and rebates, etc. The C.C.I.R. is endeavoring to modify or apply these rules to the needs of the radiophoto service.

A typical proposal to the C.C.I.R. which covers the technical specifications, is cited herewith to indicate the trend:

1. Drum diameter—88.00 mm (3.464 in.).
2. Drum circumference—276.46 mm (10.88 in.).
3. Gripping (framing) loss—15.00 mm (0.59 in.).
4. Phasing loss—5.00 mm (0.196 in.).
5. Maximum skew or hunt—0.08°.
6. Drum length—310.00 mm (12.2 in.).
7. Picture size, maximum—250 × 290 mm (9.8 × 11.4 in.).
8. Drum speed—20, 60 r.p.m.
9. Line advance—4, 5 per mm (101.6, 127 L.P.I.)
10. Index of cooperation—352, 440.
11. Speed stability—0.001 per cent.
12. Screen frequencies—100, 150, 200 cycles.
13. Standard frequency—300 cycles, or multiples.

The International Index of Cooperation is defined by the formula

$$M = \frac{D}{P} = DF.$$

where D = diameter of the drum

P = pace of the scanning line or helix

F = fineness of scanning expressed in the number of lines per unit length of the drum axis.

If two machines have different dimensions but the same index, the picture sent between them will be enlarged or reduced but will not be distorted in its proportions.

APPLICATIONS OF FACSIMILE

Radio Circuits:

Short Wave—at relatively low speeds of 20 to 60 r.p.m. for long-distance transmission.

U.H.F.—at high speeds of 240 to 600 r.p.m. for point to point work.

Medium Wave—at medium speeds 75 to 120 r.p.m. for broadcasting to homes.

Marine Service—broadcast of weather maps, etc., to ships at 20 r.p.m.

Wireline:

Point to Point—for news dissemination or public service, 90 to 120 r.p.m.; for message pickup and delivery (customers' machines or "letter-box" machines) at 180 r.p.m.; for message service on trunk lines at 180 r.p.m.

Submarine Cable—at 20 r.p.m.

Photoengraving—used for preparation of printing plates, either black and white or four-color separation plates for color printing.

Military—for both Army and Navy use in handling maps and documents.

Tape Facsimile or "Hellschreiber"—used extensively throughout Continental Europe for news dissemination to agencies, by radio on 60 to 150 kc—also proposed for aircraft and police-car use.

References

Although a vast amount of work has been done in facsimile, it is fortunate that recent compilations have gathered the various references together so that the few citations given below will permit the reader to follow in detail the developments of facsimile in the radio field and will give him a working knowledge of the wire-line services.

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