Experimental 1000-Line TV

Abstracted from the French*: By JOSEPHA E. ZENTNER, Ph.D., Digest Editor, Tele-Tech

To prove their hypothesis, French engineers design and construct an experimental transmitter and receiver operating at a frequency of 145 mc

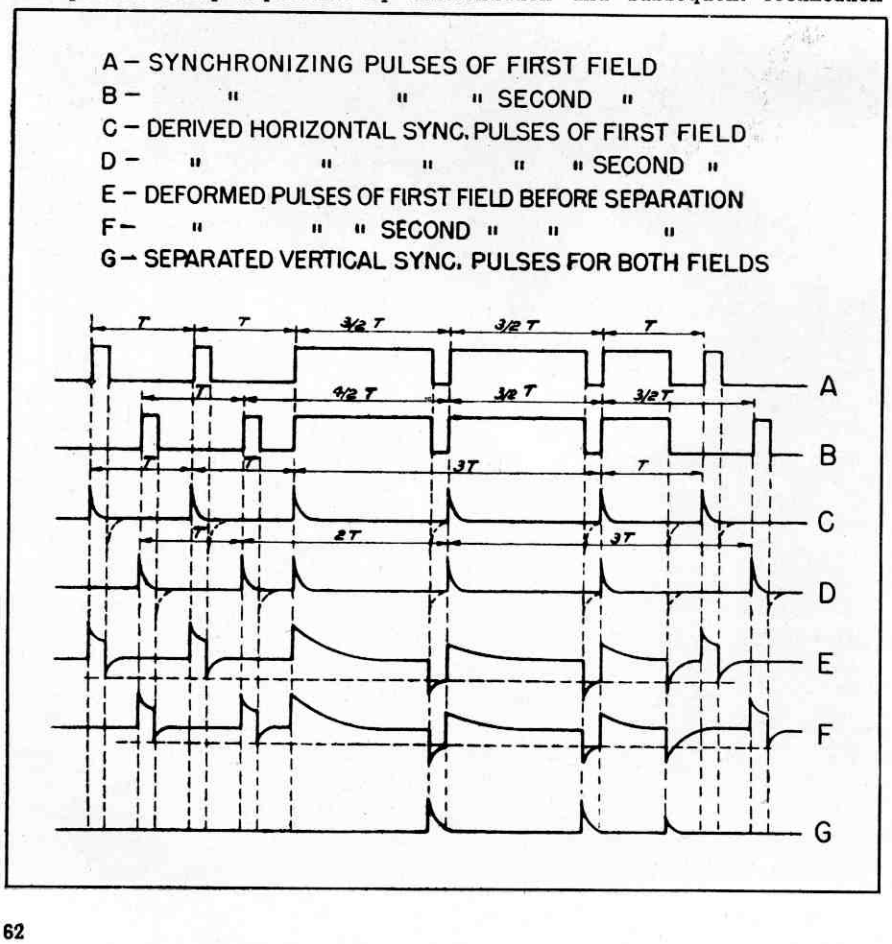
• An experimental television station was built in Montrouge, France, primarily to investigate the minimum number of lines required to completely satisfy the eye of an observer. Optimum viewing conditions obtain if the finest picture detail is of the size of the smallest unit discernible by the eye from the closest distance permitting a view of the complete picture area. Further improvement of picture detail will not be appreciated by the observer.

We may simultaneously view a picture extending 40° (or 2400 minutes) in a horizontal direction, while we can discern a detail exceeding two minutes. The ratio of the finest detail to the width of the picture is then equal to 1200. Assuming an aspect ratio of 4 : 3, the minimum number of lines required is equal to $1200 \times \frac{3}{4} = 900$. Thus a 1000-line picture appeared to meet all requirements.

To prove this hypothesis, experiments were carried out where the lines per field varied between 441 and 1575 and the frames contained either non-interlaced, or two or three interlaced fields, as desired. The experimental station incorporated a time base with a four-stage frequency divider using relaxation oscillators, which permitted rapid changes of both the number of lines and the number of interlaced fields. The field repetition frequency was always 50 times per second and the average light intensity of the 25 x 30 cm screen was 75 lux (7 foot-candles).

A 1015-line, twice interlaced picture, repeated 25 times per second, was finally adopted as presenting the least technical difficulty while still meeting the requirements of an exacting viewer. A carrier frequency of 145 mc was selected. It is stated that the direct propagation characteristics of a 145-mc carrier are not considerably different from those of a 46-mc carrier currently used. Also sufficient power is available at 145 mc.

Schematic of horizontal and vertical synchronizing pulses having opposite polarity. This permits ready separation by differentiation and subsequent rectification



Circuit Details

The time constant of the transmitter output stage is given by twice the product of the value of the charging resistor times the shunt capacitance, indicating that the output resistor should be less than 1000 ohms for a 1015 line picture, even though the circuit capacitance does not exceed the centimeter range. Absorption modulation (Parker, *Proc. I.R.E.* 1938, p. 8) was used since it permits a wide

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frequency band and the time constant of the last stage is not limited by the modulation process.

To reduce the internal resistance of the modulating triodes, they were connected as diodes with regard to the carrier frequency by the insertion of suitable inductances in the grid circuit, internal capacitive coupling making plate and grid potentials identical for the carrier frequency. The maximum power, corresponding to white areas, was of the order of 200 watts, the modulation 70%, and the residual carrier was modulated with the synchronizing signal.

The low frequency amplifier was capable of delivering 300 volts peak-to-peak signal to the modulating triodes. It had uniform gain and negligible phase distortion over the transmission range. Constant impedance circuits presenting a constant, purely resistive impedance independent of frequency were used in this amplifier.

Special Features

Vestigial sideband transmission was used. The filter for shaping the transmission curve was connected to the line feeding the antenna. It was therefore necessary that the input impedance of the filter be constant and a pure resistance in the transmitted as well as in the suppressed frequency range. A coaxial line filter consisting of two k-type networks connected in parallel and terminated by the same resistance was used as filter.

No figure for the transmitted band-width was given. (By usual rules a band of 28 mc is indicated for a 1015 line structure.) The test receiver's sensitivity was of the order of 1 millivolt with the usual superheterodyne circuit. A parabolic reflector was used with the receiving antenna to reduce multipath interference.

Conventional synchronizing methods (where the interval separating the last horizontal synchronizing pulse from the vertical synchronizing pulse is less than the duration of half a line) were not taken into consideration because of the complexity of circuits designed for the separation of the two pulses only 25 microseconds apart. The synchronizing signal was therefore modified as in the figure to make this interval considerably longer than one-half line while maintaining identical repetition for each field.

It will be seen from lines A and B that the field and the line synchronizing pulses have opposite polarity and that the field synchronizing pulses are periodic for all interlaced fields. The figure further illustrates the differentiation of the pulses which results in a shift of the pulse levels permitting separation of horizontal and vertical synchronizing pulses by rectifiers. Inspection of lines C and D will reveal that, during the vertical deflection of the beam, the synchronization of the horizontal sweep generator is partially maintained. This assures undisturbed operation of the two sweep generators in the receiver and correct interlacing of the fields.

The construction of this receiver permitted the estimation that the price of a 1000-line receiver operating in the 100-mc range would not exceed the price of a 450-line receiver by more than 25%. Comparison of a directly projected film and a televised picture proved that the only difference between the two pictures was in contrast due to the characeristics of cathode-ray oscilloscopes.

Light-Beam Communication System

The concentrated-arc lamps described previously in ELECTRONIC INDUSTRIES (July, 1946, pg. 79), which produce a high intensity, narrow-beam .003 in. diameter light spot from an incandescent zirconium oxide cathode, have recently been adapted for use as a source of modulated radiation in light-beam communication systems operating in the spectral region between 3000 and 9000 amp. The small source produces an intense beam with a spread of less than one minute of arc with the 2-watt lamp with a possible range up to the horizon. Good modulation ability has been achieved at frequencies up to 10 kc, where the loss is about 12 db, using the infrared range.

An experimental light-beam telegraph circuit using concentrated-arc lamps has been in operation for some time in lower Manhattan between the main Western Union Office at 60 Hudson St. and a branch office in the New York Post Building at 65 Washington St., an airline distance of about ¾ mile. A teleprinter-telegraph circuit operating at 65 words per minute is carried by two light-beam systems, each operating in one direction. The transmitter, consisting of a 10-watt arc lamp produces a light beam focused by a parabolic mirror on an 18 in. Fresnel lens of the receiver. The ten-watt lamp, installed over 9 months ago, is still operating. The equipment has been operating since its installation unattended for 96.7% of the time of its actual use. Of the lost time only ½% was due to interruptions of the light beam caused by fog, snowstorms, and smoke.

Radio Observations in Meteor Shower

Interpretation of results of meteor observations by radio methods obtained during the Geminid shower, December 11 to 13, is in progress at the U. S. Bureau of Standards, Washington. It is clear from the observations that meteor trails are more effective in giving reflections if the trail is parallel to the electric vector in the radio wave. These conclusions were reached by study of reflections obtained in alternate 10-minute intervals with east-west and north-south polarization of the transmitting and receiving antennas. During the early part of the evening when the meteor radiant was in an azimuth forming an appreciable angle with both antennas, approximately equal counts of meteors were obtained with both antenna systems, but as the azimuth approached due east, significantly higher counts were obtained with the east-west antenna system.

The majority of the meteors observed by radio methods could be identified with visually observed meteors, although there were several occurrences of radio reflections unaccompanied by reports of visual observations. The visual counting rate was about three times as great as the rate for radio observations.