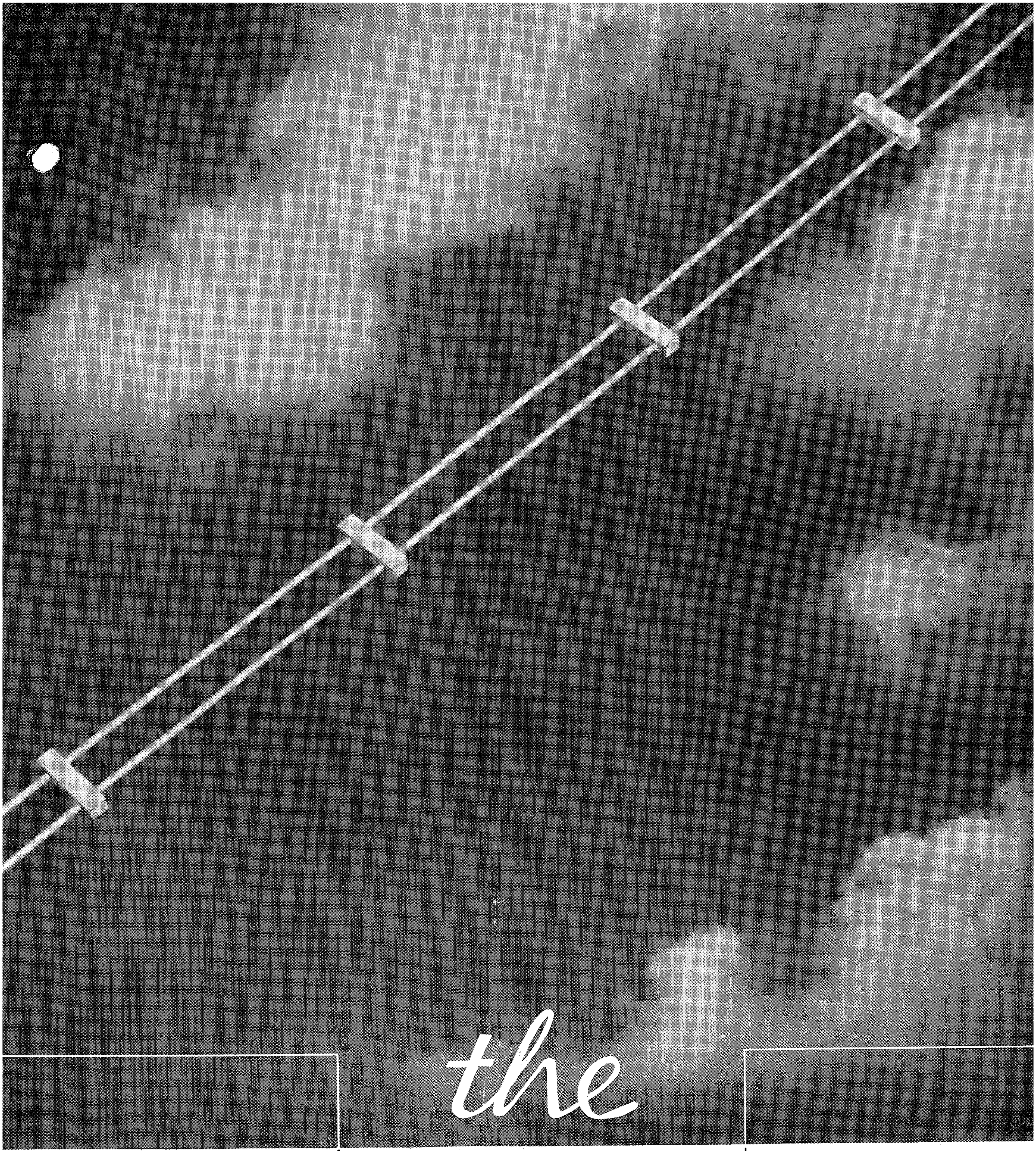

the COLLINS SIGNAL

DECEMBER, 1935

IN THIS ISSUE:

- Multiband Antenna Data
- the 600A Transmitter

We have been very much delighted with the favorable comments on the return of the SIGNAL. Indications are that the SIGNAL will have well over 10,000 readers after the mailing list is corrected by the return cards sent out with the October issue. Without doubt, our engineering department, will have to look forward to a continuation of editorial work in addition to its regular duties.

The antenna article by Mr. Craft, in this issue, should prove of general use. A second article can be written discussing the directive properties of multiband antennas. We also have some data on an L section antenna matching network which promises to replace the π section network because of its greater ease of adjustment and increased flexibility.

An attempt will be made to have this material ready in the near future.

ARTHUR A. COLLINS

★★★ DECEMBER, 1935

COLLINS SIGNAL

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Multiband Antenna for High Frequencies

Section I. Practical Data:

A HIGH FREQUENCY antenna and associated transmission line, capable of efficient operation over a wide range of frequencies, has been urgently needed. Amateurs are rarely fortunate enough to have sufficient space for erecting more than one antenna, and commercial high-frequency stations are also frequently located in restricted quarters where separate antennas for each channel cannot be used.

The ordinary high-frequency antenna consists of a doublet operated at its fundamental (the length equal to one-half wave length) or at a harmonic. Such antennas are popularly classified by the type of feeder system employed, such as "Center Fed," "End Fed or Zeppelin," "Single-wire Hertz," "Matched Impedance with Y connected feeders," etc. Only by connecting the feeders into the center of the doublet can the antenna and feeder system be kept electrically symmetrical as the frequency is varied. Unfortunately, the impedance at the center of the antenna changes with the frequency, and any ordinary arrangement for matching the transmission impedance to the antenna impedance can be effective at only one frequency. Furthermore, the effective electrical height (which may be different from the physical height above ground) has a marked effect upon the antenna resistance, and an impedance matching system which is effective at only one value of antenna impedance cannot be counted on to give correct energy transfer to the antenna unless it is adjusted for each particular installation.

The problem, then, resolves itself into the designing of a transmission line which operates efficiently over a wide range of terminating or antenna impedances. The usual two-wire line, constructed of two No. 12 wires spaced about six inches and having a characteristic impedance of about 600 ohms, is not satisfactory for this purpose. For example, such a line one-quarter wave length long connected to the center of a one-half wave length doublet will not be terminated in its characteristic impedance of 600 ohms, but in the antenna resistance of about 75 ohms, and due to the properties of such a line the input impedance at the transmitter end will be about 5,000 ohms (mathematical study will be reserved for the second section of this article and is not essential for a practical understanding of the system). An input impedance as high as 5,000 ohms is undesirable because it is difficult to transfer power to it, because a slight capacity unbalance will cause serious radiation from the line, and because line losses are high due to poor power factor, i. e., pronounced standing waves.

In practice the impedance at the center of a horizontal antenna varies between about 75 ohms and 1200 ohms as the frequency is varied. The lower values occur when the antenna length is one-half wave length, three one-half wave lengths, five one-half wave lengths, etc., and the impedance is highest for frequencies making the antenna length one or more full wave lengths long. If a transmission line with a characteristic impedance of 300 ohms (the geometric mean between 75 and 1200) is used, the standing waves will be a minimum at all frequencies, and the input impedance will remain at all times a manageable value not exceeding 1200 ohms. A 300 ohm line can be constructed of two ¼ inch tubes spaced 1½ inches by means of ceramic blocks at intervals of about 20 inches. The blocks can be located by crimping the tube slightly on either side of the block. A 50 foot copper line of this type weighs 10.9 pounds and is not difficult to support from the center of the antenna. If necessary, aluminum instead of copper tubing may be used to reduce the load on the antenna supports when the vertical part of the transmission line is greater than 50 feet. A line so constructed has surprisingly low loss. Figures 1 and 4 show the actual data, but the following excerpts indicate the minimum efficiency obtained for a line 100 feet long terminated in either 70 or 1200 ohms.

Frequency	Efficiency
3000 kc.	98.5%
7000 kc.	98 %
14000 kc.	97 %

By way of comparison it is interesting to note that a 100 foot twisted pair transmission line of popular make has the following efficiency when terminated in its characteristic impedance:

Frequency	Efficiency
3000 kc.	95%
7000 kc.	84%
14000 kc.	68%

Of course, an antenna with twisted pair feeders can only be used on one band.

A 600 ohm two-wire line 100 feet long terminated in 70 ohms has the following efficiency when **properly balanced:**

Frequency	Efficiency
3000 kc.	94%
7000 kc.	92%
14000 kc.	89%

In practice, slight unbalances in a 600 ohm line materially reduce the efficiency, whereas the 300 ohm line is not so susceptible to loss in efficiency.

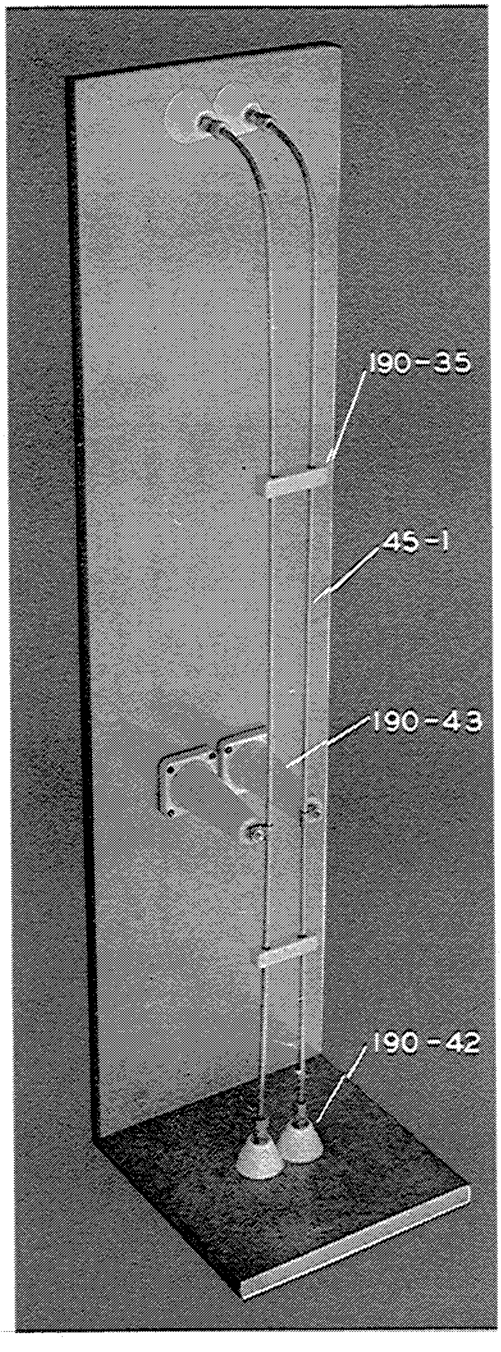
In view of the above information it is seen that an antenna can be made to work very efficiently over a wide frequency range and with any antenna im-

Multiband Antenna for High Frequencies (Continued)

pedance between 75 and 1200 ohms by the simple expedient of using a specially constructed transmission line. Several different models of such an antenna system are possible and Table I shows representative combinations designed for use on amateur bands. In each of the arrangements shown in Table I the length of the multiband transmission line is so chosen that the reactance at the transmitter end is negligible and the line can be coupled to the output tank circuit of the transmitter by a simple pickup coil. An impedance matching network need not be used provided the number of turns in the pickup coil is continuously adjustable.

In cases when it is not convenient to use a transmission line as long as is shown in Table I it is, of course, entirely practicable to reduce the length of the line to a convenient value and build out the equivalent electrical length by inserting an impedance matching network between the transmitter and the line. When such a network is used the line can be made any length, and then the only important dimension is the antenna itself. The only precaution which must be observed is that the transmission line should not be ⅛, ⅜, ⅝, etc. wave length long at any of the operating frequencies. If the line happens to be cut to a length equivalent to an odd number of ⅛ wave lengths, trouble may be encountered due to the network transmitting not only the fundamental frequency but also harmonic frequencies. This difficulty can be overcome by proper adjustment of the impedance matching network, but a discussion of this subject will be reserved for a later article. In general it is better to avoid these specific lengths.

Table I can be used directly for designing multiband antennas for amateur use. It will be noticed that the antenna lengths shown are an even number of one-quarter wave lengths long at the lowest and highest frequencies. In the case of antennas for 14,000 kc. and 4,000 kc. operation the frequencies are not harmonically related, but the lengths are chosen for the highest frequency, and they are also approximately right for the lower frequency where small variations in length do not represent very large percentages of a wave length.



The constructional model illustrated above was built to show the manner of assembly. Items and their type numbers are as follows: Spacers (190-35); Stand-off Insulators (190-43); Feed-through Insulators (190-42); Seamless Copper Tubing (45-1).

In designing similar systems for other groups of frequencies, the antenna length should be (k-.05) 492,000/f feet where f is the frequency in kilocycles and k is the number of half-wave lengths. Thus, for two or more frequencies integral values of k should be chosen to give approximately the same length and the exact length should be that for the highest frequency.

For example, consider model A antenna. At 14,300 kc. and k=4 or a two wave length antenna the length is 136 feet. This length is also correct for f=7,050 and k=2 or f=3440 and k=1. The frequency range of the amateur bands may be tolerated by this length even though the transmission line be terminated in an antenna impedance not a pure resistance.

The feeder length should be determined by the relation 234,000 m/f feet where f is the frequency in kilocycles and m is the number of quarter-wave lengths. That is, the 66 ft. feeder of model A antenna is one wave length at 14,200 kc., a half-wave length at 7,100 kc., and one-quarter wave length at 3,550 kc.

A slight variation from the above procedure is indicated in Model G. In this antenna the length of 103 feet is 1½ wave lengths at 14,100 kc. and approximately ¾ and ⅜ wave lengths on the 40 and 80 meter bands. The feeder length of 82.5 feet is 1¼ wave lengths at 14,200 kc. and approximately ⅝ and 5/16 wave lengths at the 40 and 80 meter bands. That is, on 40 and 80 meters the transmission line is terminated in an impedance largely reactive but is of such length that the impedance at the input to the transmission line is approximately a pure resistance. The loss in the transmission line is slightly larger under this condition, but this antenna may be used successfully where space is a factor.

Many amateurs are using so-called Zeppelin antennas rather than antennas fed at the center because their transmitters happen to be located nearer the end than the center of the antenna and the transmission line is shorter if it is connected to the end of the doublet. The Zeppelin antenna is an inherently unbalanced system (Zeppelin feeders balanced for equal currents are not balanced for equal phase and vice-versa) and a considerable portion of the energy is una-

Multiband Antenna for High Frequencies (Continued)

voidably radiated from the feeders, which radiation may or may not be useful for transmission. The multiband system just described should receive preference over the Zeppelin arrangement even if the transmitter is close to one end of the antenna, because the additional loss introduced by running the transmission line horizontally to a point under the center of the antenna, then vertically to the antenna itself will be entirely negligible, and probably will be considerably less than the loss in Zeppelin feeders. The multiband antenna is readily supported from suitable stand-off insulators and can be carried around corners by making bends having a minimum radius of about 10 inches. It is entirely feasible to double back the line in trombone fashion, if desired, to obtain a length which will obviate the use of an impedance matching network.

The directional properties of the multiband antenna vary as the frequency is changed. The directivity is not ordinarily considered in amateur installations where transmission is carried on in random directions. There are a large number of possible combinations giving different degrees of directivity and a review of this subject with special reference to multiband operation will be attempted in a second article.

TABLE I

MODEL	A	B	C	D	E	F	G
Antenna Length—Feet	136	136	275.5	250	67	67	103
Feeder Length—Feet	66	115	99	122	65	98	82.5
Frequency Range M.C.	3.7- 4.0 7.0- 7.3 14.0-14.4	3.7- 4.0 14.0-14.4	1.7- 2.0 3.7- 4.0 7.0- 7.3 14.0-14.4	1.7-2.0 3.7-4.0	7.0- 7.3 14.0-14.4 28.0-29.0	7.0- 7.3 14.0-14.4 28.0-29.0	3.7- 4.0 7.0- 7.3 14.0-14.4
Nominal Input Impedance	1200Ω All Bands	75Ω All Bands	1200Ω 160-80-20 m, 75Ω 40 m	1200Ω All Bands	75Ω 40 m 1200Ω 20 m 10 m	1200Ω All Bands	1200Ω All Bands

* * *

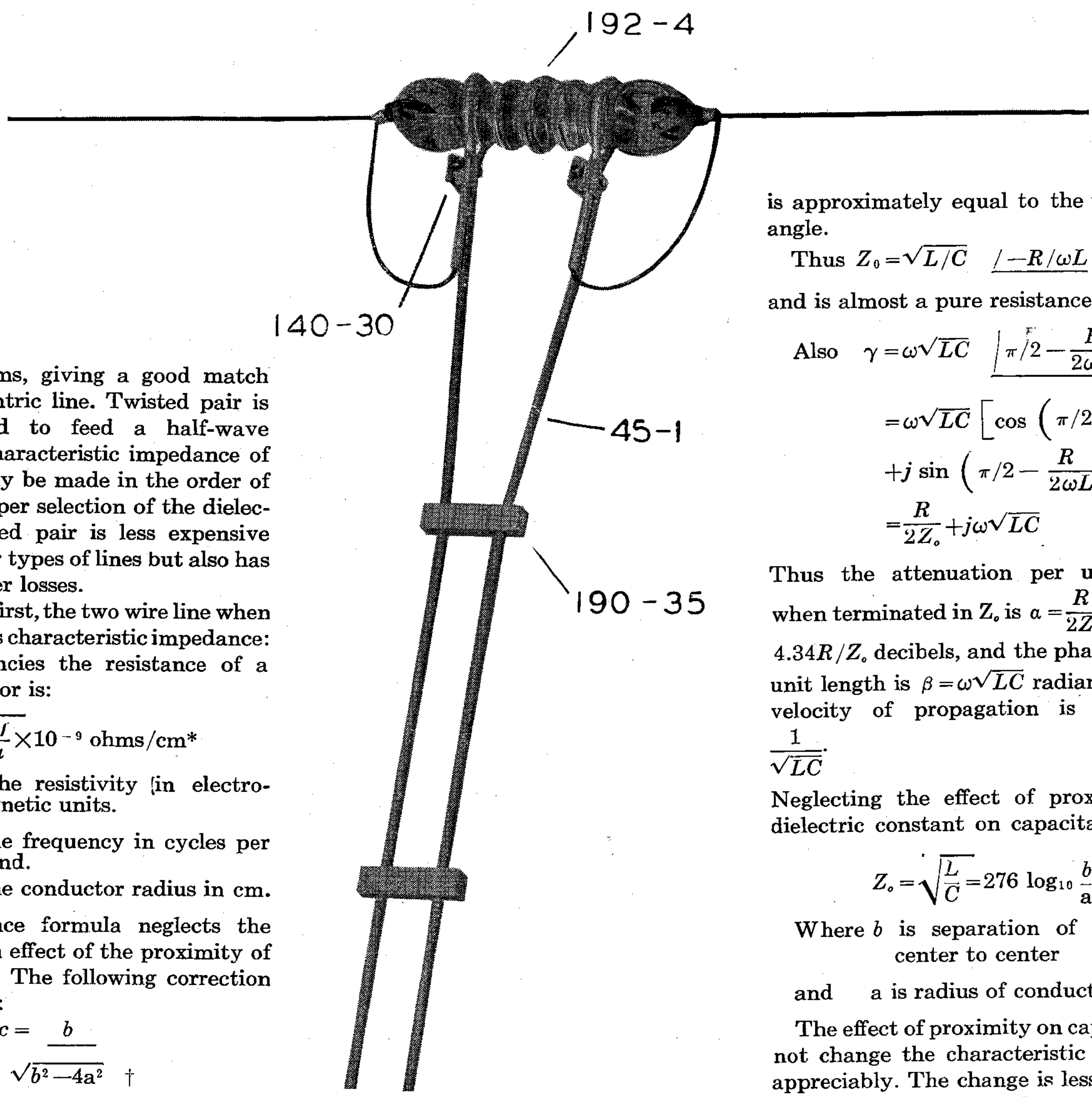
Section II

Transmission Line Loss Calculation and Measurement

It has been the purpose of this project to study the various types of radio frequency transmission lines that might be used as connecting links between a radio transmitter and the radiating system proper. In this connection it is desirable to study the losses occurring in the line when terminated in its characteristic impedance—and in some cases when terminated in a different value. This latter is the condition of operation of a section of line used as a transformer matching section between two impedances, or as a resonant feeder. It is also necessary to check the calculated characteristic impedance by experimental means and to determine experimentally the velocity of propagation of the electromagnetic waves along the line. The velocity of propagation is necessary to determine accurately the phase shift in sections of line used in directional radiation systems.

There are essentially three types of lines which are used extensively in the transmission of radio frequency power. They are, namely, two wire balanced line, coaxial transmission line and twisted pair. The two wire line may be essentially of two types. It may be constructed of solid wire with nominal spacing and having a characteristic impedance some place in the region of 600 ohms. This type of line is normally used as a properly terminated transmission line. The two wire line may, however, be made of copper or aluminum tubing of ¼ or ½ inch diameter and relatively close spacing. The characteristic impedance of this type of line may be in the region of 150 to 300 ohms. This type of line is very suitable for use as matching sections in which it is desired to get high efficiency in the presence of standing waves. The coaxial or concentric transmission line has a characteristic impedance in the region of 70 to 125 ohms and is inherently an unbalanced transmission line of quite low loss. It is usually used to transmit power from the transmitter to an unbalanced load—such as feeding an antenna against ground. It is very popular with broadcasters due to its high efficiency and to the fact that it may be run on or under the ground without further insulation or increased loss, thus giving neat appearance as well as a factor of safety where high power is involved. A concentric line may also be used to transmit power to a half-wave doublet antenna. It is well adapted for this purpose since the impedance of a half-wave doublet in free

• Transmission Line Loss Calculation and Measurement (Continued)



space is 73 ohms, giving a good match with the concentric line. Twisted pair is sometimes used to feed a half-wave doublet. The characteristic impedance of twisted pair may be made in the order of 70 ohms by proper selection of the dielectric. The twisted pair is less expensive than some other types of lines but also has somewhat higher losses.

Considering, first, the two wire line when terminated in its characteristic impedance: at high frequencies the resistance of a circular conductor is:

$$R = \sqrt{\frac{\rho f}{a}} \times 10^{-9} \text{ ohms/cm*}$$

Where ρ is the resistivity in electromagnetic units.

f is the frequency in cycles per second.

and a is the conductor radius in cm.

This resistance formula neglects the reaction on skin effect of the proximity of the conductors. The following correction may be applied:

$$c = \frac{b}{\sqrt{b^2 - 4a^2}} \dagger$$

Where a is radius of conductors

and b is separation center to center.

This correction may be neglected except for the lines constructed of tubing having close spacing.

From transmission line theory the characteristic impedance and the propagation constant are given by:

$$Z_0 = \sqrt{\frac{Z}{Y}}$$

and $\gamma = \sqrt{ZY}$

Where Z is the impedance per unit length.

and Y is the admittance per unit length.

•

FITTINGS FOR THE CENTER OF THE MULTIBAND ANTENNA

The special clamp (140-30) makes a permanent connection between the line and the antenna wire without soldering. Center insulator (192-4) is also illustrated.

•

For a given line:

$$Z = R + j\omega L$$

and $Y = j\omega C$

neglecting leakage conductance.

Using the fact that for a low loss line $\omega L \gg R$ and the angle of Z is approximately $\pi/2$ gives

$$Z = \omega L \underline{/\pi/2 - R/\omega L}$$

since for small angles the angle in radians is approximately equal to the tan. of the angle.

Thus $Z_0 = \sqrt{L/C} \quad \underline{/-R/\omega L}$

and is almost a pure resistance.

$$\text{Also} \quad \gamma = \omega\sqrt{LC} \quad \underline{\left|\pi/2 - \frac{R}{2\omega L}\right.}$$

$$= \omega\sqrt{LC}\left[\cos\left(\pi/2 - \frac{R}{2\omega L}\right) + j \sin\left(\pi/2 - \frac{R}{2\omega L}\right)\right]$$

$$= \frac{R}{2Z_o} + j\omega\sqrt{LC}$$

Thus the attenuation per unit length when terminated in Z_o is $\alpha = \frac{R}{2Z_o}$ nepers or $4.34R/Z_o$ decibels, and the phase shift per unit length is $\beta = \omega\sqrt{LC}$ radians, and the velocity of propagation is $V = \omega/\beta = \frac{1}{\sqrt{LC}}$.

Neglecting the effect of proximity and dielectric constant on capacitance:

$$Z_o = \sqrt{\frac{L}{C}} = 276 \log_{10} \frac{b}{a} \text{ ohms}$$

Where b is separation of conductors center to center

and a is radius of conductor

The effect of proximity on capacity does not change the characteristic impedance appreciably. The change is less than one-half of one percent for the case of ¼-inch tubing spaced 1 inch center to center. In air the dielectric constant may be taken as unity.

As an illustrative example of the loss occurring at radio frequencies on a transmission line terminated in its characteristic impedance, the computed loss in decibels per 100 feet has been calculated for three cases:

(1) No. 12 Hard-drawn wire spaced 6 inches with a characteristic impedance of 600 ohms.

(2) ¼ inch copper tubing spaced 1½ inches with a characteristic impedance of 300 ohms.

(3) ¼ inch aluminum tubing spaced 1½ inches.

(Continued on Page 8)

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*(A. Russell Phil. Mag. April, 1909.)

† (S. P. Mead Bell System Technical Journal, pg. 327, 1925.)

● Transmission Line Loss Calculation and Measurement (Continued)

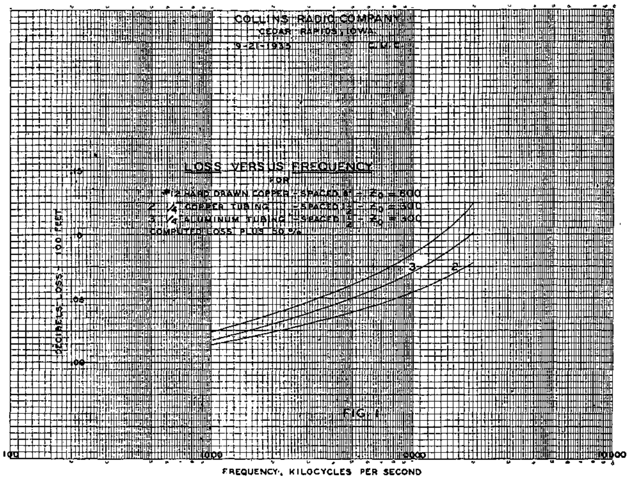
LOSS VERSUS FREQUENCY
FOR
1 #12 HARD DRAWN COPPER - SPACED 6" - Z_0 = 600
2 1/4 COPPER TUBING - SPACED 1/2 - Z_0 = 300
3 1/4 ALUMINUM TUBING - SPACED 1/2 - Z_0 = 300
COMPUTED LOSS PLUS 50 %

FIG. 1

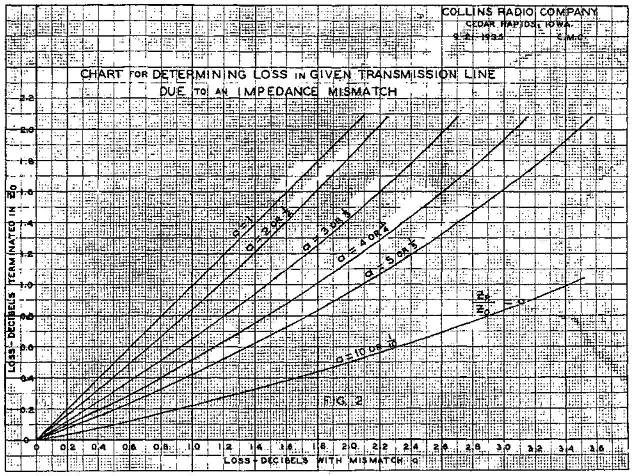
CHART FOR DETERMINING LOSS IN GIVEN TRANSMISSION LINE DUE TO AN IMPEDANCE MISMATCH

FIG. 2

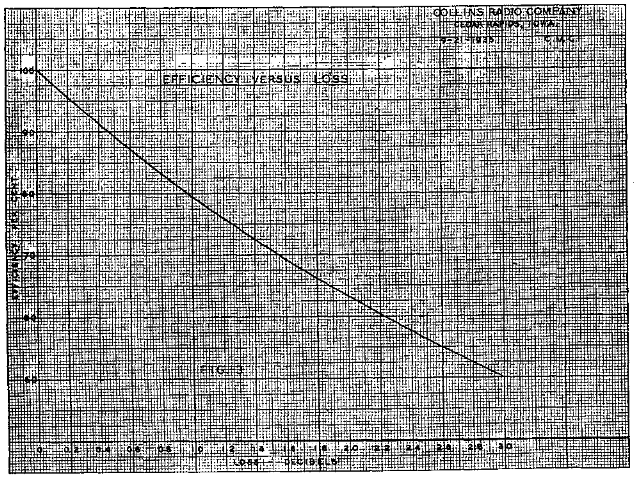
EFFICIENCY VERSUS LOSS

FIG. 3

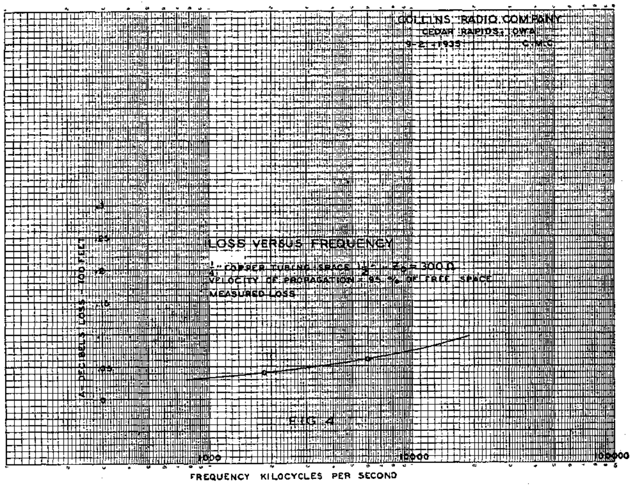
LOSS VERSUS FREQUENCY
1/4" COPPER TUBING SPACE 1/2" - Z_0 = 300 Ω
VELOCITY OF PROPAGATION = 95 % OF FREE SPACE
MEASURED LOSS

FIG. 4

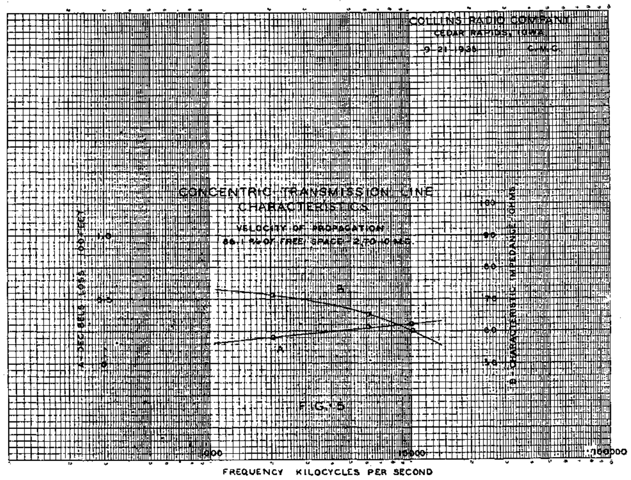
CONCENTRIC TRANSMISSION LINE CHARACTERISTICS
VELOCITY OF PROPAGATION
86.1 % OF FREE SPACE - 2 TO 10 MC.

FIG. 5

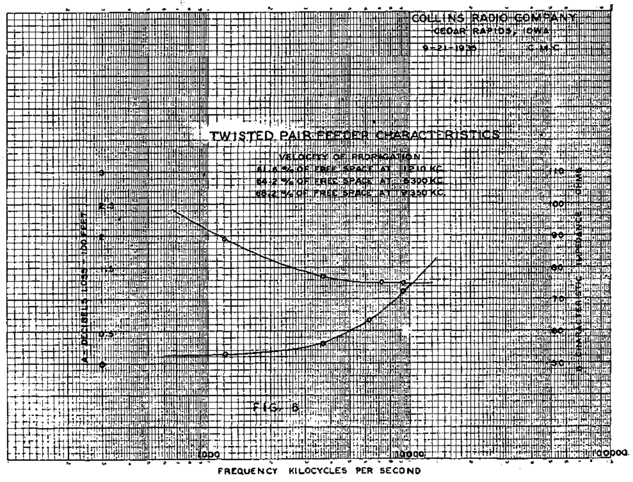
TWISTED PAIR FEEDER CHARACTERISTICS
VELOCITY OF PROPAGATION
61.6 % OF FREE SPACE AT 1210 KC.
64.2 % OF FREE SPACE AT 5300 KC.
68.2 % OF FREE SPACE AT 9350 KC.

FIG. 6

Transmission Line Loss Calculation and Measurement (Concluded)

It has been stated in previous articles on the subject that the measured loss at radio frequencies is 50% larger than computed values. This agrees quite well with tests made in our laboratories. The computed values increased by 50% have been plotted in Fig. 1 for the three cases mentioned. Actual tests on the ¼ inch tube line showed the velocity of propagation to be 5% less than that of free space.

If the two wire line is terminated in an impedance not equal to the characteristic impedance the loss is increased due to the presence of standing waves. The loss under these conditions can also be calculated from the well known transmission line equations in terms of hyperbolic functions.

$$I_S = I_R \cosh \gamma l + E_R/Z_o \sinh \gamma l$$

$$E_S = E_R \cosh \gamma l + I_R Z_o \sinh \gamma l$$

Where subscripts S and R denote sending and receiving currents and voltages respectively. Taking Z_o as a pure resistance R_o and terminating the line in a complex impedance $Z_R = E_R/I_R$

$$\text{Where } Z_R/Z_o = \frac{R_R}{R_o} + j\,\frac{X_R}{R_o} = \mathrm{a} + j\,b.$$

From these equations the input power to the line may be calculated as

$$P_i = \mathrm{a} R_o I_R^2 \left[\cosh 2\alpha l + \frac{\mathrm{a}^2 + b^2 + 1}{2\mathrm{a}} \sinh 2\alpha l\right]$$

The output power into Z_R is

$$P_o = I_R^2 R_R = \mathrm{a} I_R^2 R_o$$

The line loss in decibels is then given as $L = 10 \log_{10} P_i/P_o = 10 \log_{10}$

$$\left[\cosh 2\alpha l + \frac{\mathrm{a}^2 + b^2 + 1}{2\mathrm{a}} \sinh 2\alpha l\right]$$

If the termination is a pure resistance, then $b = o$. Also if this termination is a resistance equal to Z_o a $= 1$ and the loss is $8.68\alpha l$ in decibels. Thus if the loss is known when the line is terminated in Z_o the above relations may be used to determine the loss when the line is terminated in a value other than Z_o. In Fig. 2 there have been plotted the values of the loss in decibels for various degrees of mismatch versus the loss in decibels for the same length of line when terminated in Z_o.

In Fig. 3 there has been plotted for convenience the efficiency versus loss in decibels as calculated from the relations

$$\text{Loss } (db) = 10 \log_{10} \frac{P_i}{P_o}$$

$$\text{Eff } (\%) = 100\,\frac{P_o}{P_i}$$

This is useful in obtaining the efficiency of any length of line with any degree of mismatch. The loss of the given length of line when terminated in Z_o can be determined from Figs. 1, 4, 5 and 6 by direct ratio. For the degree of mismatch for which you desire the efficiency the loss can be found from Fig. 2 and from this loss the efficiency is read from Fig. 3. Thus, for example, 250 feet of ¼ inch copper tubing spaced 1½ inches and terminated in 60 ohms resistance has an efficiency of 90% at 14 megacycles.

Figs. 4, 5 and 6 show the results of experimental measurement of losses on three types of lines. Fig. 4 is the ¼ inch copper tubing line computed previously. Fig. 5 is a small size coaxial transmission line made up of No. 12 wire inside of ⅜ inch copper tubing and centered by Isolantite beads spaced 1¼ inches. Fig. 6 is a type of twisted pair often used for radio frequency transmission. It consists of two No. 12 wires with a spacing approximately $\frac{5}{32}$ inch. Each wire is rubber covered, and the two wires are twisted together and covered with an impregnated braid. The loss for this type of line increases more rapidly with frequency than the theoretical treatment would indicate. This is due to the addition of the dielectric loss of the insulation to the copper loss and skin effect.

The characteristic impedance of a coaxial transmission line is 138 $\log_{10} r_1/r_2$ ohms.

Where r_1 is the inner radius of the outer conductor

and r_2 is the outer radius of the inner conductor.

For the coaxial line measured $r_1 = .15$ inches and $r_2 = .0404$ inches, giving a theoretical value 78.7 ohms for the characteristic impedance. The measured value is slightly less. This can be explained by the fact that the inner conductor of No. 12 wire is slightly oversized, and the capacity is increased partly by the dielectric constant of the Isolantite beads. The velocity of propagation is 15% lower than for free space.

In the twisted pair transmission line the velocity is reduced by 35 to 40% from the value for free space due to the increased dielectric constant.

—L. M. Craft

★

The 45A Transmitter (see October Signal) has rapidly won an important place for itself. The photograph shows a group of 45A's under construction. An effort is being made to speed up production to meet the unexpected number of sales.

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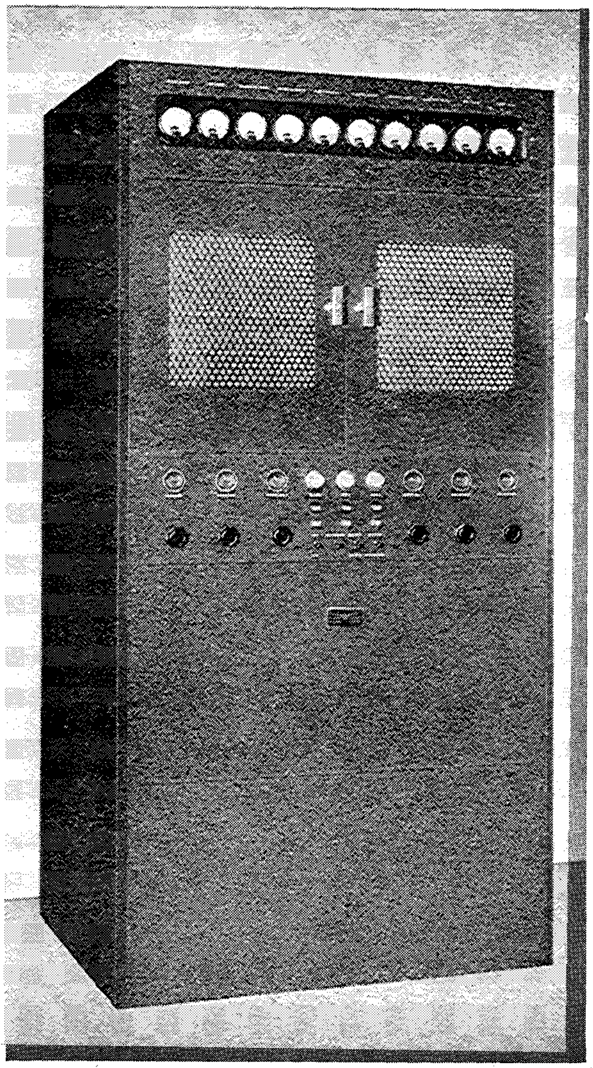
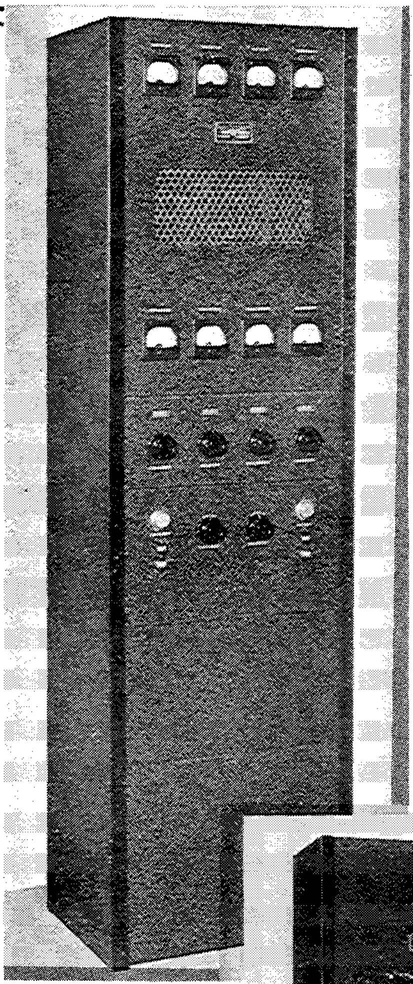
BROADCAST EQUIPMENT



20C
ONE KILOWATT Transmitter

AT RIGHT

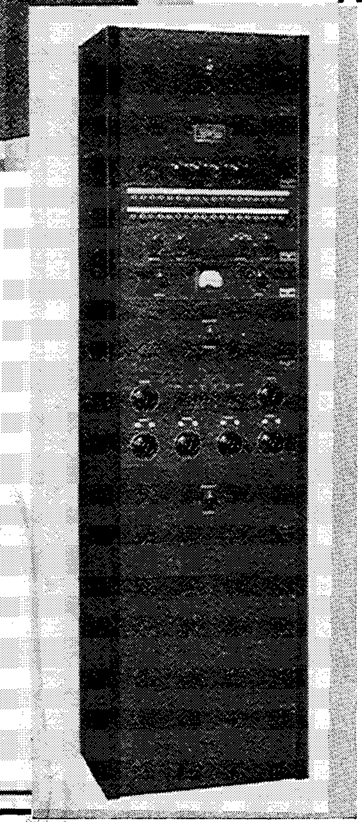
300D



BELOW

12E

Several new Collins transmitters and speech input assemblies are being manufactured for broadcast use. The 20C One Kilowatt Transmitter, the 300D One Hundred Watt Transmitter, and the 12E Speech Input Assembly are illustrated on this page. Greatest attention has been given to the fidelity, modern appearance, reliability and convenience of operation of this equipment. Complete details will be furnished on request.



600A

THE NEW COLLINS 600 WATT TRANSMITTER

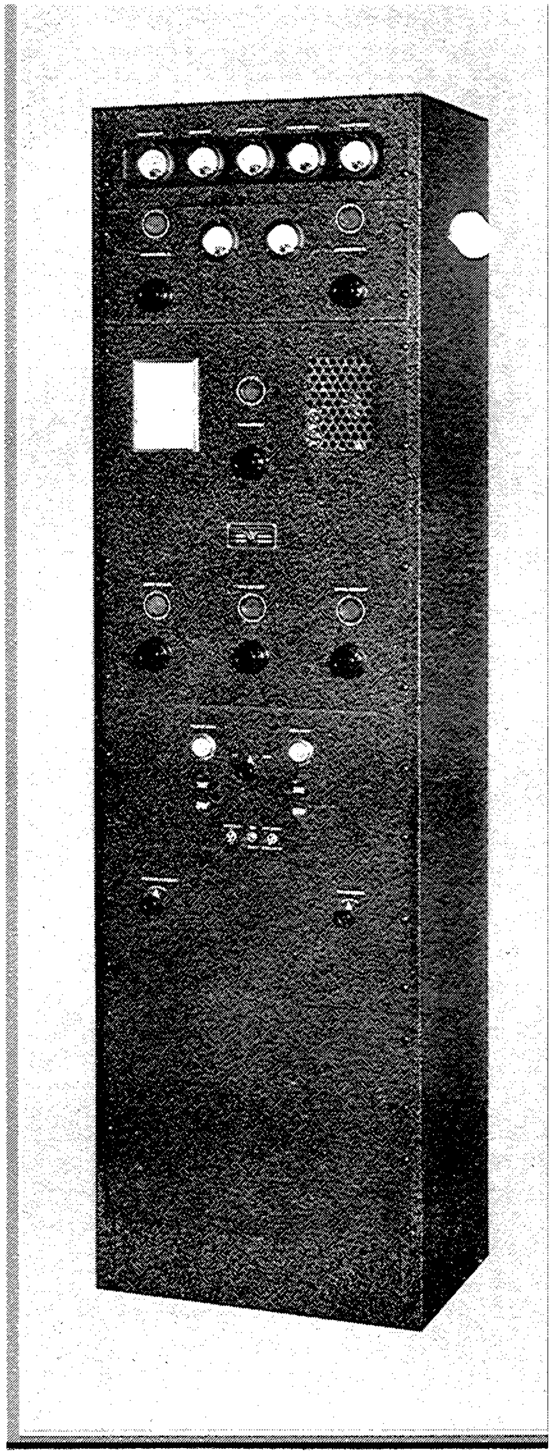
THE 600A is a high-powered telegraph and medium-powered telephone transmitter of novel design. The terms high and medium power, of course, are relative and apply to the class of transmitters employing air cooled tubes. The telegraph output rating of the 600A is 600 watts. In actual operation, an output of 800 watts is readily obtained without over-loading any component. The normal radiotelephone rating is 150 watts output, but this value is also below the measured output which ranges from 200 to 300 watts. The radiotelegraph performance of the 600A is exactly comparable to that of the new 202A Transmitter and the radiotelephone operation is equivalent to that of the older 300BA model. The cost of the 600A is somewhat less than that of the 300BA, and at the same time this new set has all of the new devices and refinements which characterize the new series of Collins transmitters. The 600A Transmitter is intended primarily for Government communication service, for high-frequency broadcast stations, and for deluxe amateur operation.

The list of tubes employed in the 600A is as follows: C-100 high-stability oscillator, 46 first doubler, RK23 first amplifier, RK20 second amplifier, two C-200 or two C-300 final amplifier, two 866 high-voltage rectifiers, one 83V low-voltage rectifier and one RK19 bias rectifier. Either the C-200s or C-300s may be used in the final amplifier without circuit changes. The C-300s have a higher plate dissipation capability and are useful when a radiophone output of 300 watts is desired. On the other hand the less expensive C-200s may be used to obtain maximum radiotelegraph output with a radiophone output of 150 to 200 watts.

The unit-type of construction is effectively employed in the 600A, and all of the components are systematically arranged in a standard rack cabinet. The lower deck carries the high-voltage plate transformers and the first section of the high-voltage filter. The second deck contains the high-voltage rectifiers, the filament transformers and the second section of filter. Above this deck is the control unit which consists of the power relays, timing relays and overload devices, the low-voltage and bias rectifiers, and the push-buttons and pilot lights. The radio frequency section of the transmitter is constructed as a single unit, although the low-level r-f stages are carefully isolated from the high-powered stages. The new type of frequency shift unit is used for interchanging the crystals and excitation tank circuits, all of which are contained in a small aluminum case. The other plug-in unit is the final amplifier coil which also carries the inductive neutralization and output coupling devices.

The antenna impedance matching unit is of a newly designed type permitting continuous adjustment of the inductances. This arrangement is especially suited for use with the Multiband Antenna, although it may be used with other types of antennas as well.

A distinctive development which has made its first appearance in the 600A is the new precision-flush dial. The dials which have previously been used by the Collins Radio Company have more or less set the fashion in transmitter construction, but it is believed that the new dials are even more attractive in appearance and more convenient for adjustment. An etched nickel-silver dial and indicator plate are located behind a circular window. A knob of generous proportions is located a little distance from the window and the control designation is engraved between the knob and the window. A vernier ratio of 6 to 1 between the knob and the dial is obtained by means of an accurately machined gear train. Another type has the knob directly connected to the shaft of the control element. The controls on the front panel of the 600A Transmitter are as follows: Oscillator Tuning, First Amplifier Tuning, Second Amplifier Tuning, Final Amplifier Tuning and the two Network Controls. In addition are the filament and bias rheostats, the phone-CW switch and the various pushbuttons. A card holder is located on the front panel with an interchangeable printed card for recording the exact dial settings for each frequency.



FRONT—600A

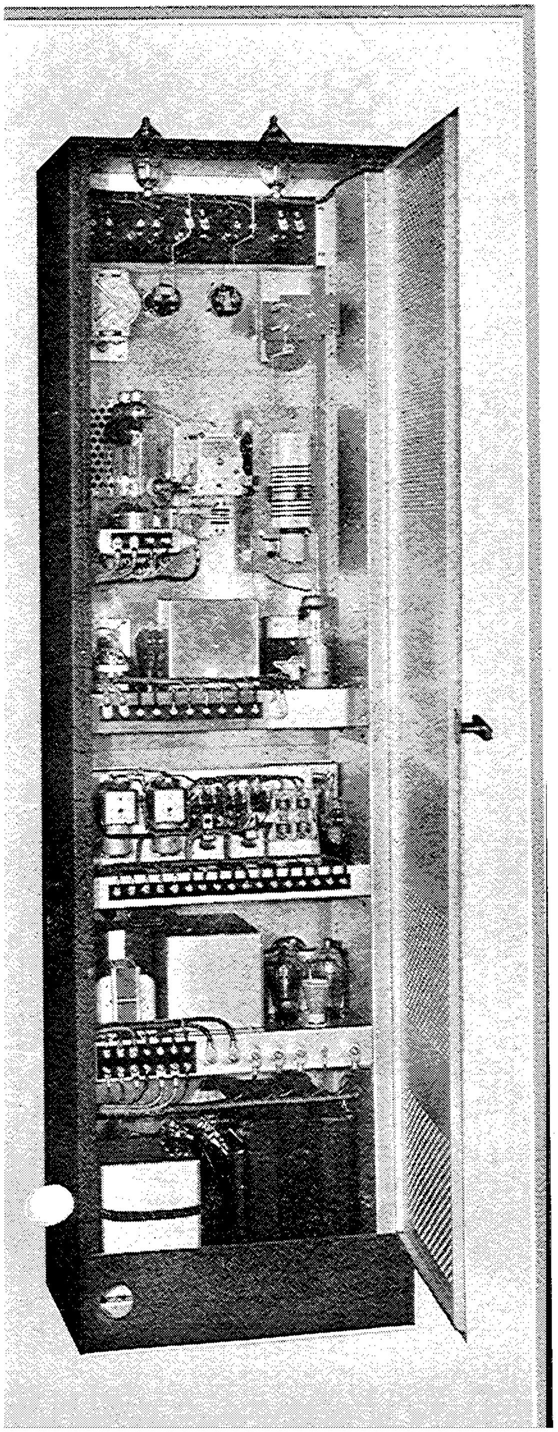
Seven flush-type, high-grade instruments are furnished for reading plate and grid currents to the various amplifier stages, as well as filament voltage and antenna currents. All except the r-f meters are mounted behind a plate glass window.

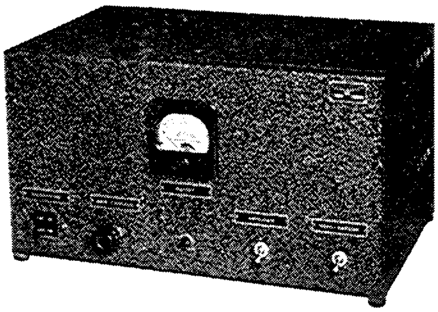
The new control-grid type of modulation, perfected by the Collins Radio Company and so successfully employed in the 45A Transmitter, is also used in the new 600A. The transmitter controls are so arranged that it is possible to change instantly from radiotelegraph to radiotelephone operation with the assur-

The 600A Transmitter (Continued)

ance of correct adjustment. Control-grid modulation as applied to the 600A results in very efficient operation with low distortion and complete (100%) modulation. The speech amplifier is not an integral part of the transmitter. The 7M Amplifier and control unit is designed for use with the 600A and 202A when these transmitters are used for two-way service. One of the standard 12 Series Speech Input Systems should be used with the 600A when the transmitter is operated for short-wave broadcast service. The 7M Amplifier, however, is extremely convenient for the usual types of installation. It is small in size and is suited for mounting on the control desk. All connections between the 7M Unit and 600A are made by a single rubber-covered cable, fitted with heavy duty connectors at each end. The 7M Amplifier has adequate gain to allow its use with either the sound-cell or diaphragm type of crystal microphones. The amplifier is mounted in a small cabinet together with a modulation level indicator and a push-to-talk key, the latter being tied in with the relay circuits in the transmitter. A jack is also provided at the rear of the amplifier cabinet for connecting the usual telegraph key.

INSIDE—600A





7M SPEECH AMPLIFIER WITH VOLUME INDICATOR

600A TRANSMITTER

SPECIFICATIONS

POWER OUTPUT: 600 watts CW, 150 watts radiotelephone, nominal rating. (Measured output is 700 to 800 watts CW, 200 to 300 watts radiotelephone.)

FREQUENCY RANGE: 1500 to 28,000 kc. Coils for operation on lower frequencies may be had on special order.

FREQUENCY CONTROL: Crystal control, with provision for temperature controlled oven type holder if desired. Isolation of the oscillator is effected by a minimum of two buffer stages. Three buffer stages are used on the higher frequencies.

RADIO FREQUENCY TUBES: C-100 high stability oscillator, 46 first doubler, RK23 first amplifier, RK20 second amplifier and two C-200 or two C-300 final amplifiers.

RECTIFIER TUBES: Two 866 high-voltage rectifiers, one 83V low-voltage rectifier, one RK19 C bias rectifier.

POWER SOURCE: 110 volts, 60 cycles, single phase standard. Provision can be made for other voltages and frequencies on special order.

DIMENSIONS: 72″ high, 19″ wide and 14″ deep.

WEIGHT: 445 lbs.

SHIPPING WEIGHT: Domestic, 585 lbs.
Export, 678 lbs.

A substantial binder, attractively printed in blue ink on a bright red stock, has been made-up for filing past and future issues of the SIGNAL.

With one of these binders, you may insure the safe-keeping and accessibility of the valuable technical data, that will be included in future issues of the SIGNAL.

In ordering, please include twenty cents, to cover mailing costs.

★

Minor price changes are being made, effective January 1, 1936 on certain Collins models, in order to adjust sales prices with present manufacturing costs.

It is suggested that we be allowed to re-quote on the particular models in which you are interested.

DECEMBER 1935

COLLINS SIGNAL

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