

HIGH FREQUENCY TRANSMITTER



A COMMERCIAL 100 WATT
BROADCAST TRANSMITTER
FOR HIGH FREQUENCY USE



WHAT ARE **"HIGH"** FREQUENCIES ?

Many years ago, radio transmission was carried on at wave lengths several thousand meters long. These bands were found best suited to the equipment used at that time for long distance communication. Shorter wave lengths were of little use and it was not until the advent of broadcasting that wave lengths between 200 and 500 meters were found to have practical application. However, the shorter

wave lengths were still thought to be impractical for commercial service and it was not until much later that it was discovered that short waves between 15 and 60 meters were capable of carrying over very long distances.

In this way, the usefulness of the shorter wave lengths has been discovered gradually and the useful range of frequencies has been continually increased. In 1929, studies were first made of the possibilities of transmission between 5 and 10 meters and it was found that these frequencies were extremely valu-

able for short range broadcasting service and for other uses. Transmissions of higher frequency than about 33 megacycles (33,000 kc.) do not usually reflect back to the earth from the ionosphere and hence there is seldom any sky wave, fading or interference with other stations at a distance. Service is limited to a local range and as the Federal Communications Commission says in its annual report for 1935—

"Due to this characteristic of the very high frequencies, it has been considered that they offer a means of supplying strictly local service to any number of centers of population with frequency assignments duplicated at relatively low mileage separations."

The absence of beat note interference with other stations is a very different state of affairs from that which exists on present local broadcasting channels.

There are other differences also. A half wave antenna for 8 meters is about 13 feet long as contrasted with a half wave antenna of 410 feet for a station on 1200 kc. Hence, it is possible to erect a very efficient antenna at low cost or, in fact, to install special high efficiency antennas without great expense; but in order to utilize the direct ray transmission, the antenna must be located at a high point above the ground such as on a tall building or hill. Otherwise, shadow effects will be caused by intervening objects.

Because of the greater band width at the high frequencies, transmission of side bands up to 15,000 cycles becomes entirely practical and broadcast transmission of great fidelity is a simple matter.

To summarize, "high" frequencies do not usually travel by "sky waves" over long distances, hence there is ordinarily no interference or fading. Summer static is not heard on these frequencies. The antenna system is relatively small and should be placed high above the ground. High fidelity transmission is practical. For these and many other reasons, "high" frequency broadcasting seems to hold great promise for service in the future.

RCA TYPE 100-F TRANSMITTER
for high frequency broadcasting



FREQUENCY RANGE 30-41 MC
POWER OUTPUT - 100 WATTS

When you buy...

1. You want a transmitter designed for the purpose

The Type 100-F Transmitter has been designed from crystal to antenna for a single specific application—that of high-quality broadcasting at high frequencies.

2. You want a transmitter providing high fidelity

The Type 100-F Transmitter guarantees transmission quality far exceeding present standards, and equalling in every way the most exacting of probable future standards.

3. You want a transmitter of advanced design

The Type 100-F Transmitter, because of its advanced design, is several years ahead of technical requirements and hence insured against rapid depreciation.

4. You want a transmitter which is convenient

The Type 100-F Transmitter, self-contained, operating from a single 110 volt line, and requiring no auxiliary equipment, is almost as easily installed as a receiver.

5. You want a transmitter which is economical

The Type 100-F Transmitter consumes a relatively small amount of power, uses inexpensive long-life tubes, and requires almost no replacement or servicing.

6. You want a transmitter which you can depend upon

The Type 100-F Transmitter carries all standard RCA guarantees—the assurance of technical excellence and reliability which the broadcasting leaders depend upon.

TYPE 100-F HIGH FREQUENCY TRANSMITTER

An RCA high fidelity transmitter for HF Broadcast Stations

The RCA Type 100-F Transmitter is designed to provide high frequency broadcast stations with an advanced transmitter of efficiency and reliability equal to the highly perfected transmitters which have been developed for the regular broadcast band. It is an entirely new transmitter, carefully developed and designed from crystal to antenna for this special use—a use which engineers recognize as having the most exacting requirements of any type of radio transmission. It is simply designed, so that it is stable in operation; low in first cost and operating cost, so that it is extremely economical; advanced in design so that it will not rapidly become obsolete; equal in convenience and reliability to standard transmitters and, finally, capable of providing performance surpassing anything on the air today.

**SPECIALLY
DESIGNED FOR
A HIGHLY
SPECIALIZED
APPLICATION**

Programs reproduced in the home with quality essentially equal to that of the original is the standing goal of broadcast engineering. Unfortunately, the close spacing of stations in the broadcast band places a definite limit on the results that can be obtained in regular broadcast band transmission. But this limitation is not present in high frequency broadcasting—and for this reason most forward-looking engineers believe that the HF band will be reserved in the future for high quality broadcasting. Thus the desirability, even the necessity, of performance characteristics meeting the most exacting of high fidelity standards is definitely indicated. Response must be uniform at all frequencies, distortion must be practically eliminated and background noise must be exceedingly low.

**HIGH FIDELITY
AT HIGH
FREQUENCIES**

The frequency characteristic of the Type 100-F Transmitter is flat within 2 db. from 30 to 14,000 cycles. This wide audio range means that the transmitter is capable of faithfully reproducing all of the frequencies which can be heard by the best human ears. The close tolerance throughout this range means that other units of the broadcast station equipment, such as the microphone and pre-amplifiers, can be allowed somewhat larger deviations from uniformity without causing the overall response to exceed noticeable limits.

**EXTENDED, UNI-
FORM AUDIO
FREQUENCY
RESPONSE**

Distortion in the Type 100-F Transmitter is so low that for most practical purposes it is negligible. Specifically, the audio harmonic content at 100% modulation is less than 5% with all harmonics arithmetically added. At lower percentages of modulation those at which a transmitter actually operates a great proportion of the time—the distortion is even less. And statement of the distortion in terms of the arithmetical sum of the components is the most critical method of rating a transmitter—the distortion in terms of the RMS sum of the components, for instance, is even less.

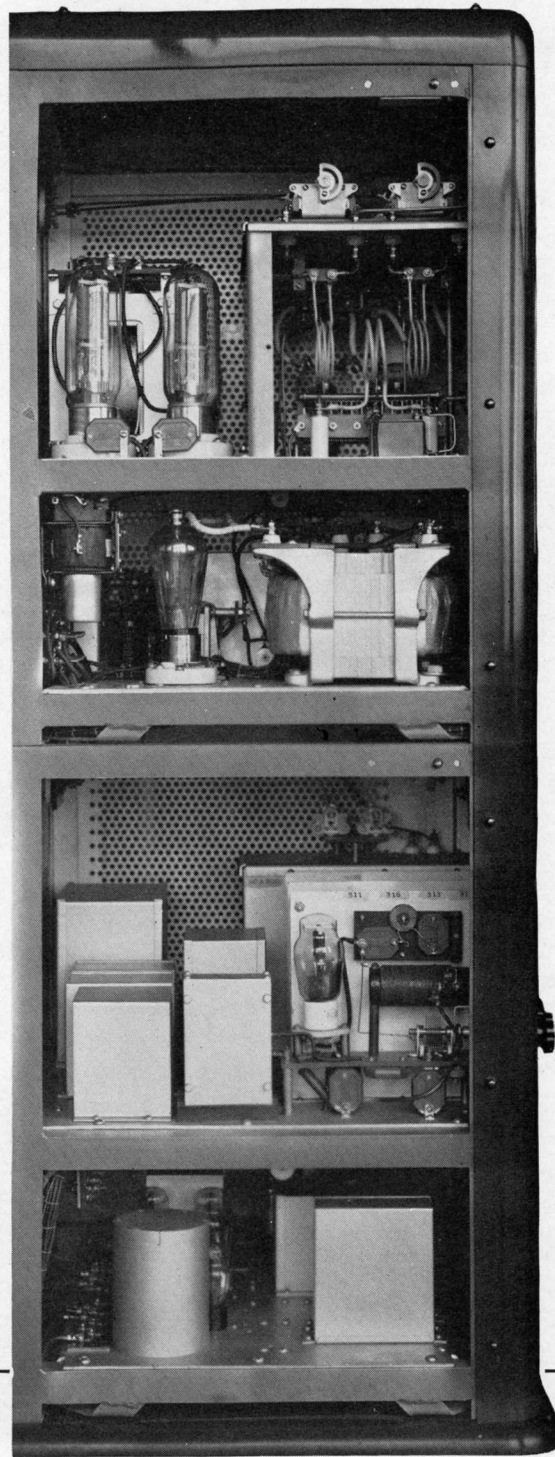
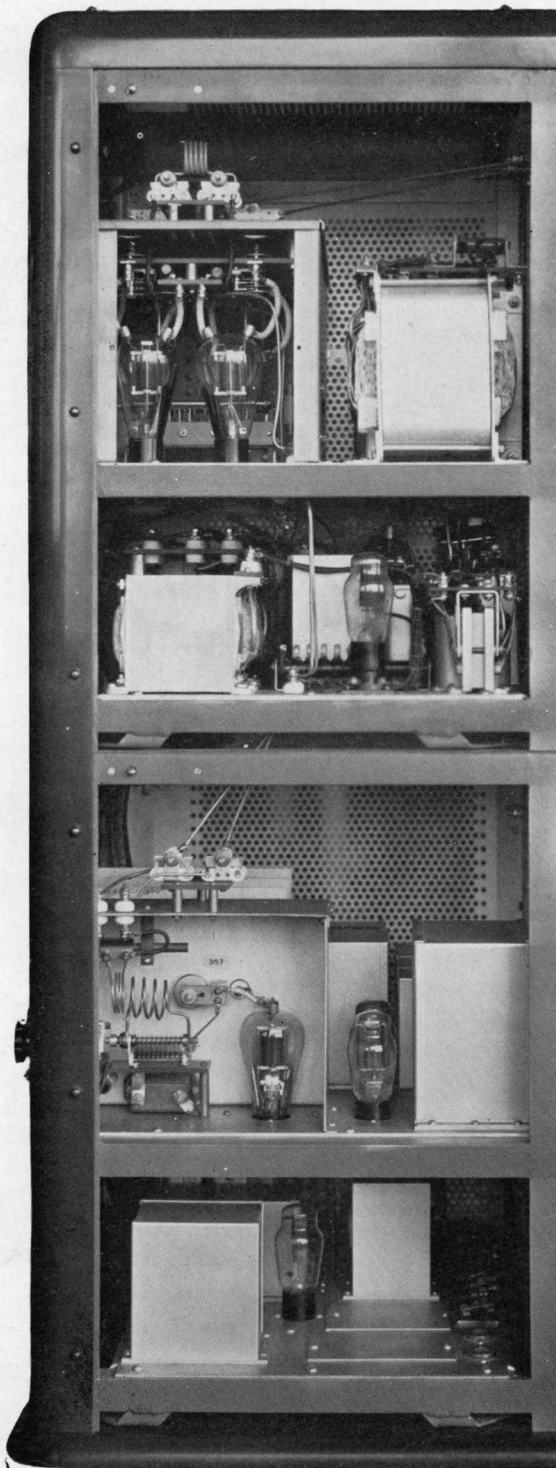
**DISTORTION
EXTRAOR-
DINARILY
SMALL**

The background noise-level in the Type 100-F Transmitter is 55 db. below the level of 100% modulation. This background level is that of all the hum and noises measured together and without weighting. The level in the middle frequency band (150 to 5000 cycles), or as measured with a weighted filter, is much lower. A noise-level of 55 db. down means, of course, that a volume (dynamic) range of 55 db. can be used without losing the weak sounds in the background.

**NOISE
BACKGROUND
REDUCED TO A
MINIMUM**

The unexcelled performance characteristics of the Type 100-F Transmitter are not only a guarantee of unsurpassed reproduction fidelity—and hence of continued audience favor—but also are a very real factor in reducing depreciation cost. Depreciation, usually the largest factor of broadcast station equipment cost, may be due to actual wearing out of the equipment, to the performance capabilities falling below increased standards, or to the equipment failing to meet increasingly

**ADVANCED
DESIGN FORE-
STALLING EARLY
OBSCOLESCENCE**



Above—Right and left side views of the Type 100-F Transmitter showing the clean-cut design, the rugged construction and the assembly of components on unit chassis.

exacting technical requirements. In the Type 100-F Transmitter there are no rotating machines or other parts definitely limited in life, and the only parts which might conceivably wear out over a period of years are relays and the like, that is, relatively inexpensive items. Thus depreciation due to actual wear is unlikely to be a factor. And, since the performance characteristics are in every respect as good as possible in the present state of the art, the transmitter will not be subject to early obsolescence. These assurances against early obsolescence are further augmented by the advanced design features of the Type 100-F Transmitter.

Low first cost and low depreciation cost are but two of the economies offered by the Type 100-F Transmitter. The third, and at least equally important, is low operating cost. The power consumption, approximately 1600 watts, is unusually low for a transmitter of this power, and particularly so for a transmitter operating at high frequencies. The use of inexpensive tubes, types chosen because of their proven hardihood and long life, results in minimum tube complement cost and maximum tube-hour life. Use of the finest components and construction materials—together with the RCA guarantee against defective parts and workmanship—practically eliminates replacement expenses other than tubes. Finally, the straightforward design and simplified construction reduce servicing to a minimum.

**LOW COST
OPERATION AN
IMPORTANT
FEATURE**

High frequency broadcast transmitters are ordinarily installed at an elevated point near the center of the district they are to serve. Such a location may be adjacent to the studios or it may be some distance removed. The design of the Type 100-F Transmitter provides equally well for either type of location. Thus it is complete with high gain speech amplifier—a maximum input of —15 db. (0 db. equals 12.5 mw) is sufficient—and with overload and time-delay relays, so that it may operate unattended. At the same time it is small in size, so that when installed at the studio location it will require a minimum of space. Moreover, it is fully self-contained and since it operates entirely from a 115 volt line it is almost as easily installed as a receiver. The attractive exterior, to which the illustrations hardly do justice, is definitely modern in appearance, but radicalism has been avoided so that the unit will blend attractively with the usual control room surroundings. The use of rounded corner moldings, particularly effective in setting off a unit of this size, is a pleasing feature. The two tone lacquer finish—light grey for the panel, darker grey for the trimming—is another. Tuning and power controls similarly emphasize trimness and modernity.

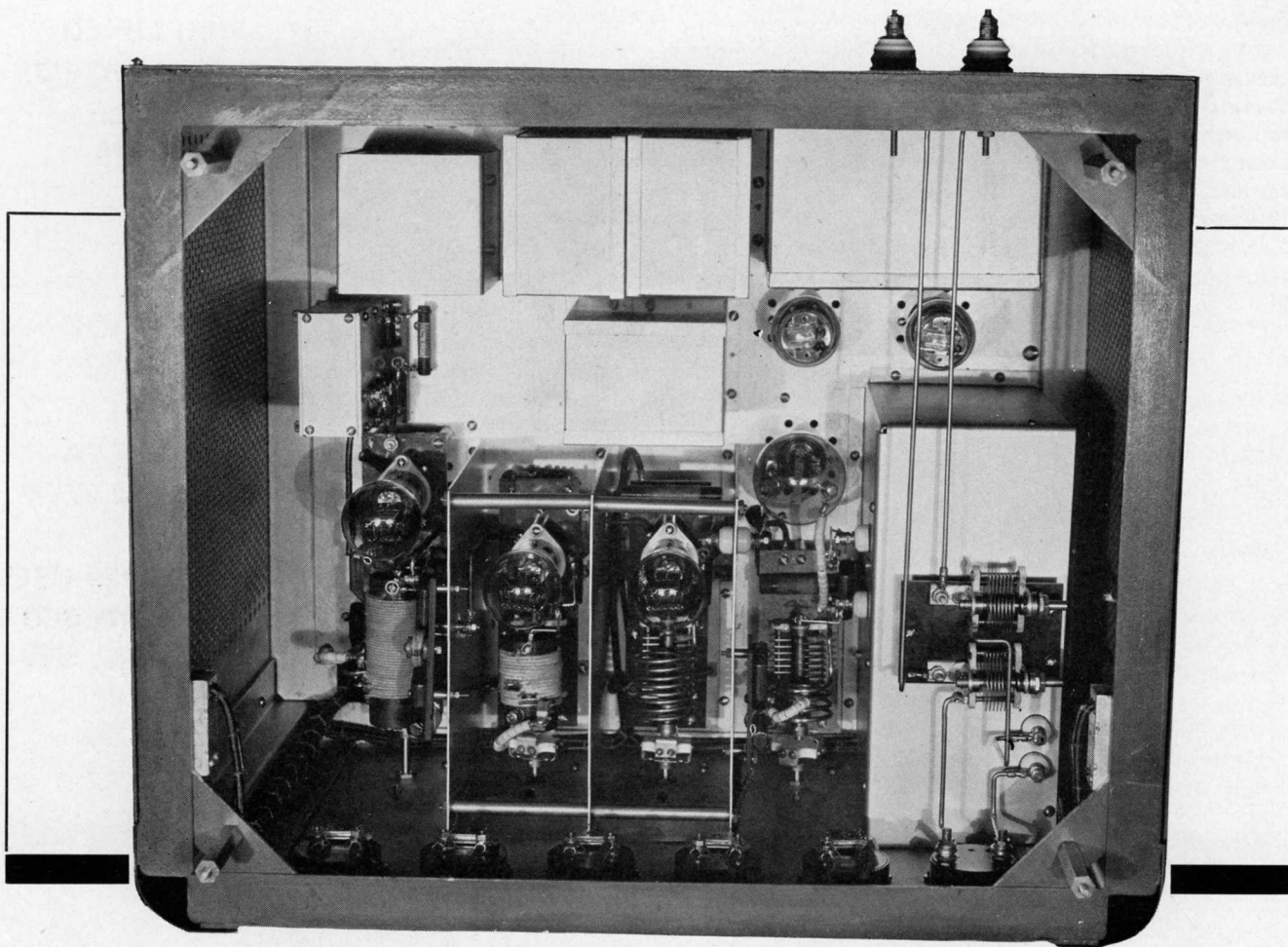
**MODERN
DESIGN, FOR
ANY TYPE
LOCATION**

Mechanical construction, important in any transmitter which must provide the utmost in reliability, is particularly important at high frequencies. It has been found that as the operating frequency of a transmitter is increased, the relative importance of the mechanical construction increases almost proportionally. Thus in the 30-41 MC broadcast band mechanical design shares equal importance with electrical design. RCA engineers, having pioneered in the development of standard transmitters for the high frequency field, have had unequalled experience in designing high frequency circuits. The advantage of this experience is evident in the finished and excellent mechanical design of the Type 100-F Transmitter, particularly in the careful arrangement of components, the use of mycalex and isolantite for r.f. insulation, the rigid constructions of the r.f. circuit elements and the complete shielding of circuits in which feed-back might occur. Many of these details are apparent in the several interior views of the transmitter which are shown; others, such as the careful wiring layout, are not so obvious, but are equally important in contributing to the extraordinary stability attained in this transmitter. To protect these carefully designed circuits the whole equipment has been made unusually rugged.

**CAREFUL
MECHANICAL
DESIGN AND
CONSTRUCTION**

Following the most up to date practice in broadcast transmitter design, the Type 100-F Transmitter makes use of a modified unit chassis assembly. Thus, referring to the side view of the equipment the bottom shelf is the speech amplifier unit, complete with its own power supply; the second shelf is the exciter unit, also with its

**NEW TYPE
UNIT CHASSIS
ASSEMBLY**



Above—Top view of the r.f. exciter unit (second shelf) of the Type 100-F Transmitter. Oscillator, doubler and buffer (in shield) stages are shown, left to right.

own power supply; the third shelf is the amplifier power supply; and the top shelf the high power modulator and amplifier. Each of these units is complete in itself. This allows them to be assembled separately, thereby facilitating testing and effecting a material reduction in manufacturing costs. At the same time adjustment and servicing of the equipment in the field are made easier since the several units may be tested separately.

LOW COEFFICIENT CRYSTAL CONTROL OF FREQUENCY

Crystal control of carrier frequency is a prerequisite to stability, but to date has been little used in high frequency transmitters because of the added complexity of design. For the Type 100-F Transmitter, however, RCA engineers have developed relatively simple circuits which, together with the use of low temperature coefficient crystals, provide this transmitter with the advantages of crystal control without unnecessarily complicating adjustment. The crystals are of the V-cut type, an exclusive RCA development. Unlike most low coefficient crystals, they are not cut down in size and hence not unduly fragile. On the contrary, they are of the same size and of very nearly the same thickness as older types—and, moreover, provide greater output. They have a temperature coefficient which is very low—the maximum variation being about 2 cycles per megacycle per degree (as compared to an average of about 50 cycles for former types). They require no temperature control whatever and yet provide frequency stability far superior to that obtainable in the past at these frequencies.

Because of the frequency multiplication required, high frequency transmitters have been of many and variegated designs. In amateur transmitters, and even in some commercial transmitters, short cuts such as trick circuits and high frequency crystals are often used. However, the first usually results in difficult and unstable adjustments, while the second demands crystals of too great fragility—so that neither can be counted upon to give the continued reliability necessary to high quality broadcasting. The circuits designed for the Type 100-F Transmitter by RCA engineers are, therefore, of the simplest and most straightforward. The crystals employed have a frequency of 4 mc to 5 mc ($\frac{1}{8}$ of the carrier frequency). An RCA-10 Radiotron is used in a crystal oscillator circuit. It is followed by an RCA-10 as a first doubler stage, another RCA-10 as a second doubler stage, an RCA-800 as a third doubler stage and a buffer stage consisting of an RCA-800 operating at the carrier frequency.

**SIMPLIFIED
STRAIGHTFOR-
WARD R.F.
CIRCUITS**

The output of the buffer stage furnishes excitation to the grids of the Class C power amplifier stage consisting of four RCA-800 Radiotrons in parallel push-pull. These, like the tubes of the other r.f. stages of this transmitter, are operated considerably below their maximum rating (actually at about half rating). This conservative operation insures long tube life and provides desirable flexibility. It is noteworthy that only two types of tubes, RCA-10 and RCA-800 (both noted for their hardihood and long life), are used in the r.f. stages of this transmitter, thereby reducing the number of spares which must be carried on hand. Bias and plate voltage rectifiers for the power amplifier and modulator are located on the third shelf of the transmitter. The plate rectifier utilizes two RCA-866-A Radiotrons in a full wave rectifier circuit. Fixed bias-voltage is furnished by a heavily loaded low voltage rectifier employing an RCA-83 Radiotron. In addition to this fixed bias, the power amplifier also has a certain amount of self-bias. The power amplifier circuits are enclosed in the shielded compartment which occupies the front half of the top shelf of the transmitter. A plate tuning control, plate milliammeter and plate voltmeter are located on the front panel.

**CONSERVA-
TIVELY RATED
POWER
AMPLIFIER USES
NEW RCA-800'S**

The speech amplifier located on the bottom shelf of the transmitter consists of an RCA-56 input stage driving a pair of RCA-2A3 Radiotrons in a push-pull amplifier circuit. The gain of this two-stage amplifier is sufficiently high that an audio input level of -15 db. (0 db. equals 12.5 mw) is all that is necessary for 100% modulation of the transmitter. This is a feature of much convenience in that it makes possible operation of the transmitter directly from line level.

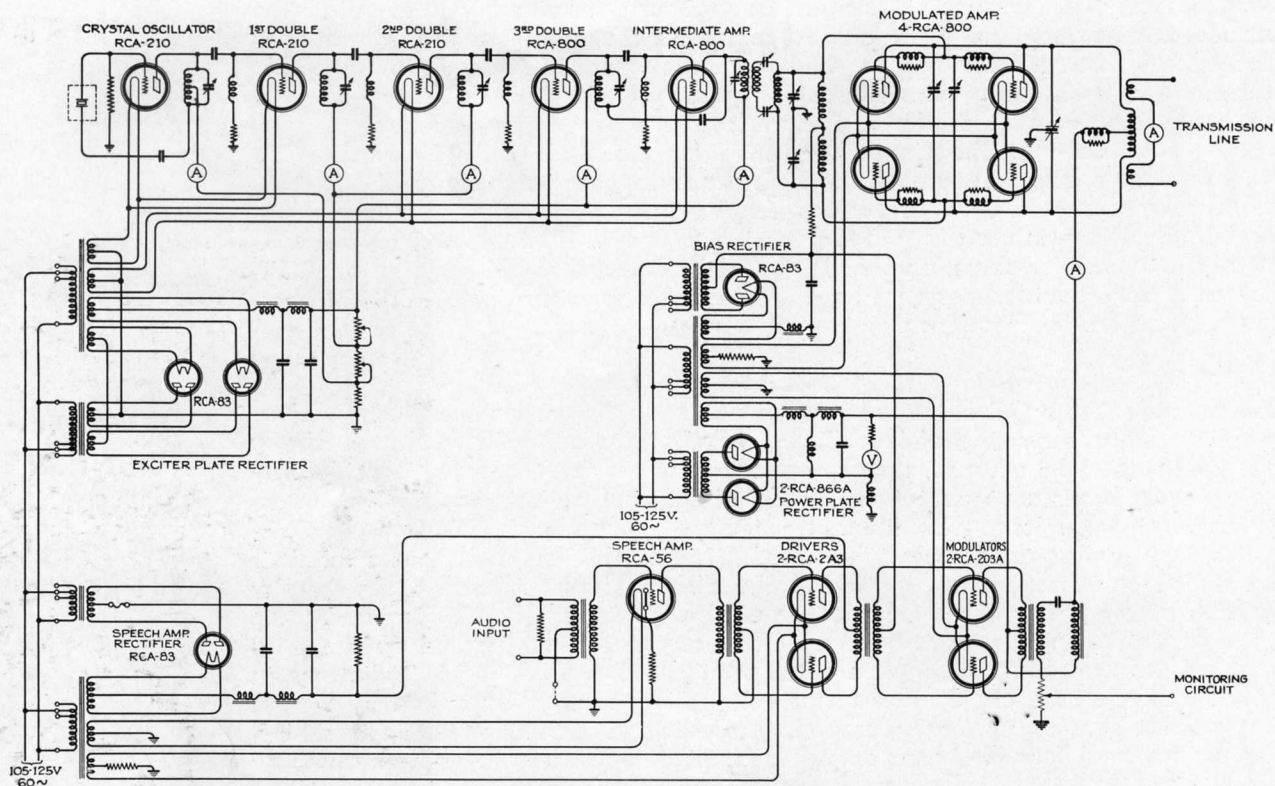
**BUILT-IN HIGH
GAIN SPEECH
AMPLIFIER**

The modulator stage, located back of the power amplifier shield on the top shelf of the transmitter, employs a pair of RCA 203-A Radiotrons as Class B modulators. These easily furnish the audio power necessary to 100% modulate the 100 watt carrier. The arrangement is identical with the Class B modulating systems used in many of the new RCA broadcast transmitters, including the 500,000 watt transmitter recently installed at WLW. The high efficiency, low distortion and general satisfaction given by this type of modulation are now recognized by all broadcast engineers. Its use in the Type 100-F Transmitter guarantees unsurpassed modulation quality with efficiency exceeding that of any comparable method, and with simple and uncritical adjustments not complicated by trick circuits.

**HIGH
EFFICIENCY
CLASS B
MODULATORS**

The Type 100-F Transmitter is primarily designed to feed a balanced transmission line or, with minor modifications, a concentric type transmission line. Two stand-off insulators for transmission line connections are located on the rear of the transmitter. The line is inductively coupled to the output stage and is tuned by a pair of series capacitors conveniently located on the top of the power amplifier compartment. An antenna ammeter is located on the front panel. The best type of antenna to be used with this transmitter depends very largely on the type of location—that is, whether it is on a high building, on the level in the open, or the like. The convenient dimensions of an ultra-high-frequency antenna are such that mul-

**SPECIAL
ANTENNA
SYSTEMS**



Simplified Schematic of the 100-F

multiple configurations are usually practical—and can be employed to obtain a several-fold increase in signal strength. RCA engineers have pioneered in the development of such antenna systems and their services are available for the design of special antennas for use with the Type 100-F Transmitter.

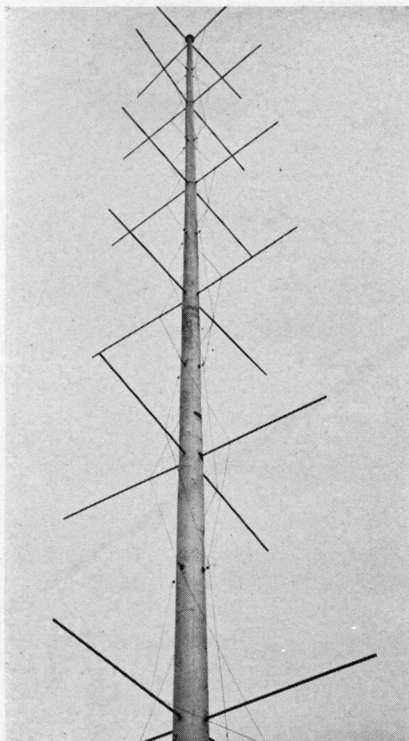
AUTOMATIC CONTROL, REMOTE OPERATION

The Type 100-F Transmitter is designed to operate from a 105-125 volt, single phase, 50-60 cycle power supply. Filament and plate switches are mounted on the front panel. Time-delay and overload relays are provided in these control circuits so that the equipment is fully protected against failure during operation and against improper sequence of starting. The sequencing relays are automatic in operation so that operation may be either manual or automatic. Moreover, terminals are provided for connection of a remote on-off switch, so that the transmitter can be controlled from a remote point and operate unattended. The doors of the transmitter are, of course, provided with automatic interlocks—and the transmitter designed to comply in every respect with the accepted safety standards.

SPECIFICATIONS OF THE TYPE 100-F TRANSMITTER

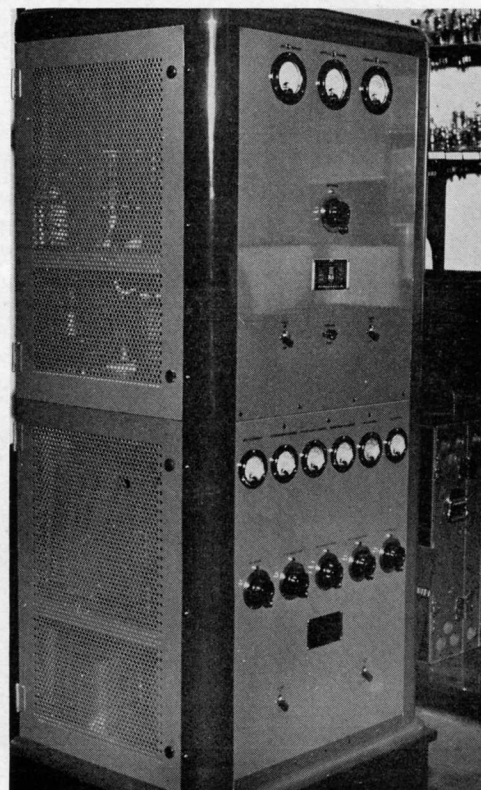
Output power	100 watts
Modulation capability	100%
Radio frequency range	30-41 MC.
Radio frequency deviation	±.02%
Audio input (for 100% mod.)	—15 db.
Audio frequency response	(within 2 db.) 30-14,000 cycles
Audio distortion (Arith. sum at 100% mod. better than)	5%
Background noise level (unweighted)	—55 db.
Power supply	105/115/125 volts, 50/60 cycles
Power consumption	1600 watts
Dimensions (overall)	55½" x 26¼" x 21¼"
Weight (unpacked)	650 lbs.

**Whether in the High Frequency Band or the Broadcast Band,
a majority of the leaders use "RCA TRANSMITTERS"**



Above: The signal-multiplying "turnstile" antenna designed for W8XH by Dr. G. H. Brown of the RCA engineering staff.

Right: The RCA Type 100-F Transmitter at W8XH. This station, operated in conjunction with WBEN by the Buffalo Evening News, was the first to schedule regular ultra-high-frequency programs, and is looked to as the leader in this field.



IMPORTANT!

RCA has pioneered in the development of the high frequency field and RCA engineers have had unequalled experience in the design of high frequency equipment.

For example:

RCA installed a commercial two-way high frequency telephone system operating with high power between the Islands of Hawaii in 1931.

RCA engineers have developed and put into practical use many new principles relating to high frequency service.

RCA pioneered the use of high frequencies for police service and has made more than 60 installations of this type, many more than any other organization.

RCA developed new tubes especially designed for these bands.

RCA was the first to make studies of high frequency transmission over large cities.

RCA installed the first high power, high frequency broadcast transmitter.

RCA was the first large manufacturer to extend standard broadcast receivers to cover the high frequency band.

The wealth of experience in this field makes it logical for RCA to provide your high frequency transmitter.



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