NOVEMBER, 1959

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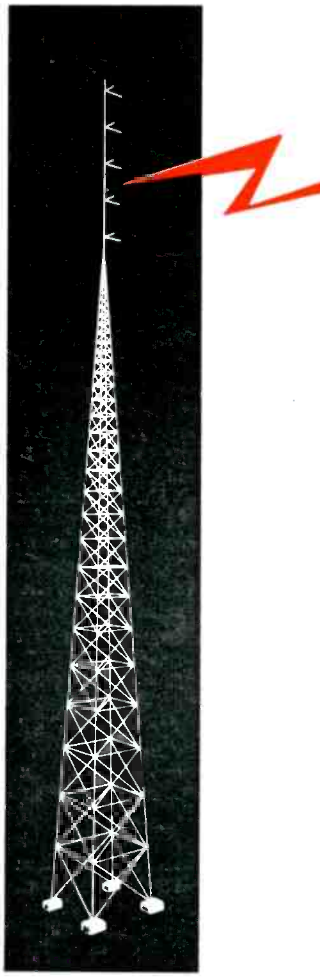
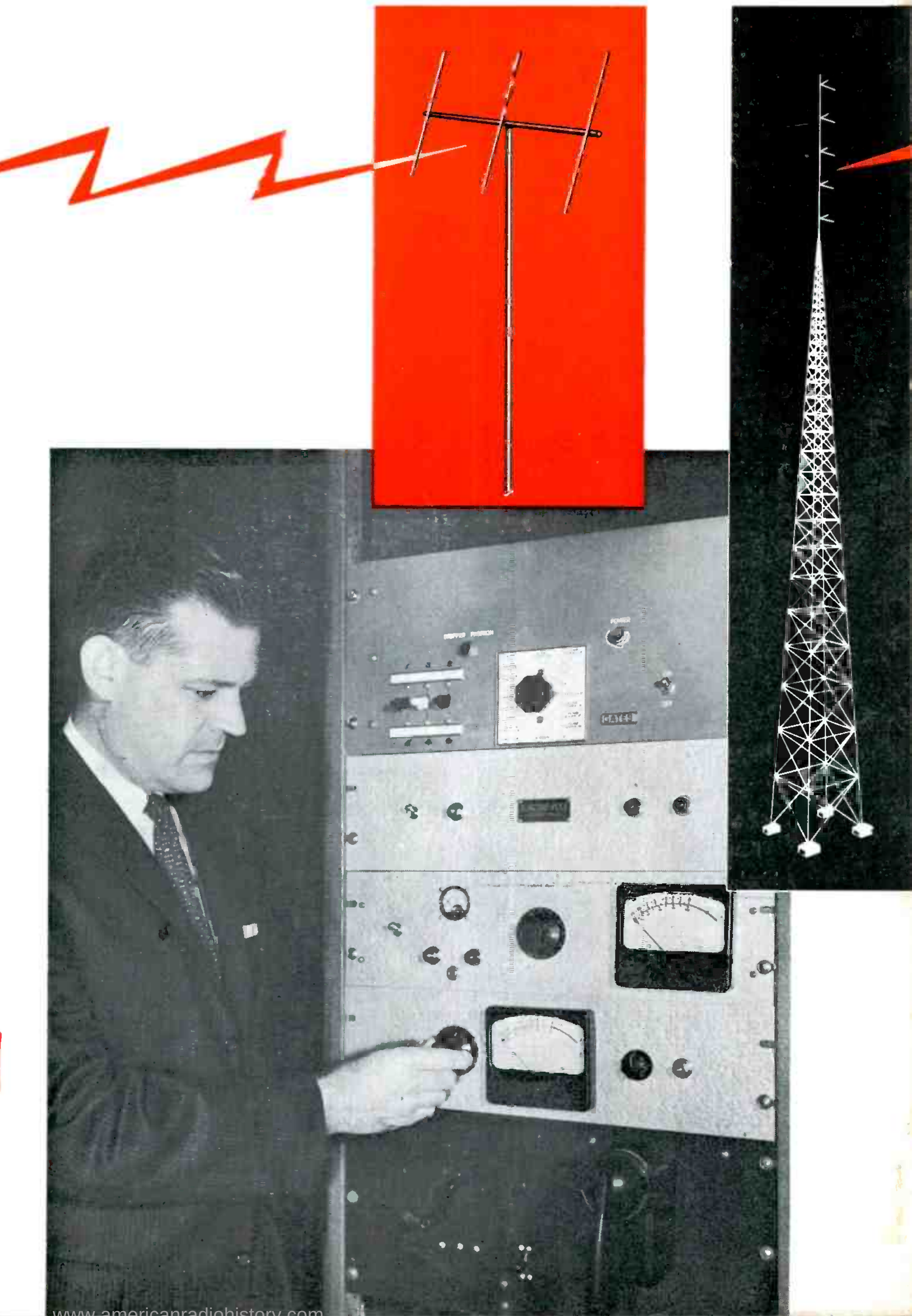
BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY





FM Relaying

See Page 6

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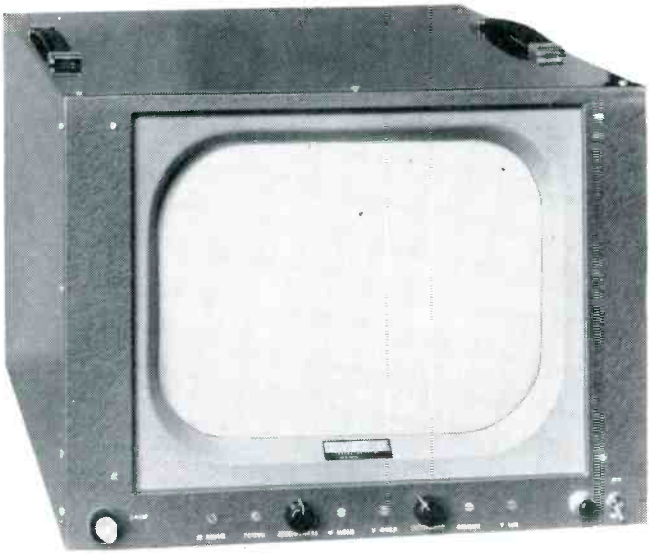

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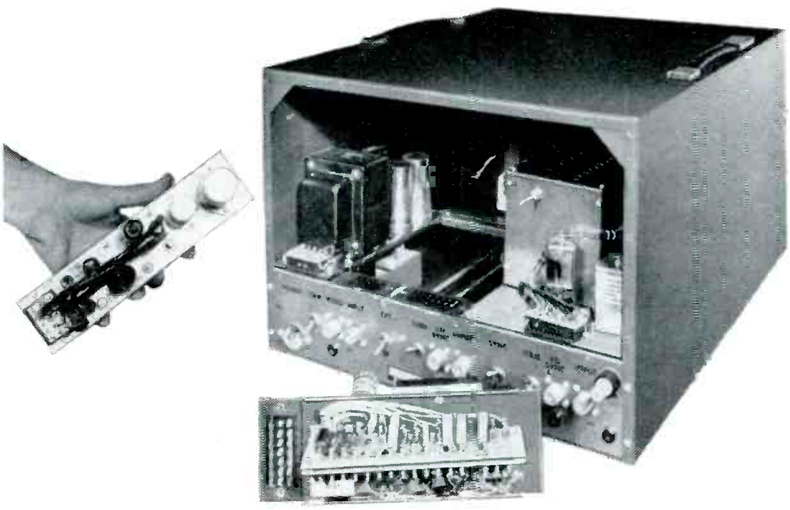

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6. With (left to right—see below) low-voltage module, video amplifier, vertical amplifier module and high-voltage unit snapped out, nothing is left inside the metal case except cathode-ray tube and its mounting frame. By removing four screws the terminal board also may be removed for inspection or repair.
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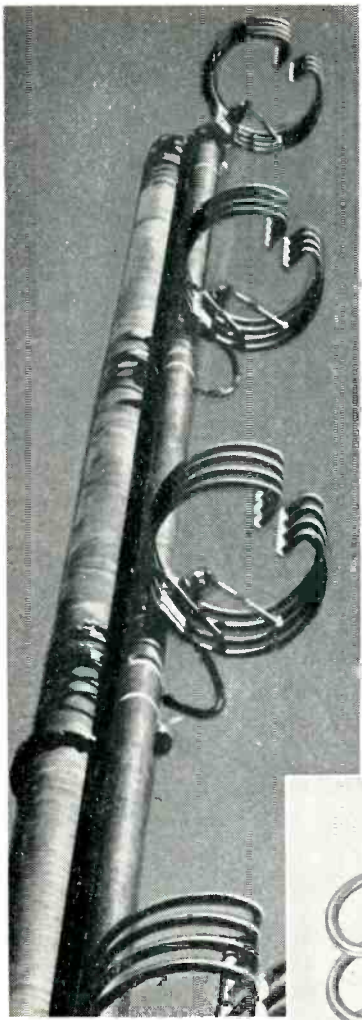

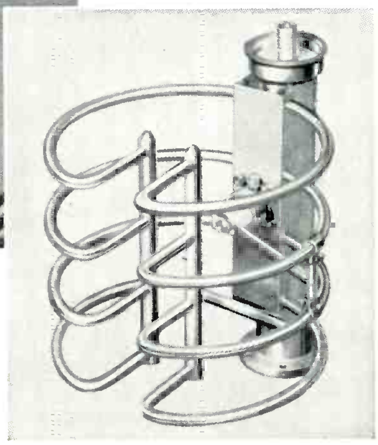

Above. Four sections of a BFA FM Antenna pole-mounted and interconnected by 3⅛" coaxial transmission line.

Right. Single section of antenna, showing radiator details.

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CAMDEN, N. J.

BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

VOLUME 1 **NOVEMBER, 1959** **NUMBER 7**

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With the current growth of FM broadcasting, the subject of using off-the-air pickups for relaying, rebroadcasting, and other services is receiving more attention. The use of multiplex channels offers more opportunities in FM relaying. A description of a relay receiver using a new detector design is given in an article beginning on page 6. The photo shows Mr. William Collins of the Electro-Plex Corp. demonstrating an FM relay receiver installed at WNTA-FM in Newark, N. J.

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This studio microphone provides a choice of eight patterns, any of which can be selected by a remote control unit, as follows:

2 cardioids with opposite directions of max. response
1 omnidirectional
1 figure 8
4 intermediates, 2 of which are hypercardioids.

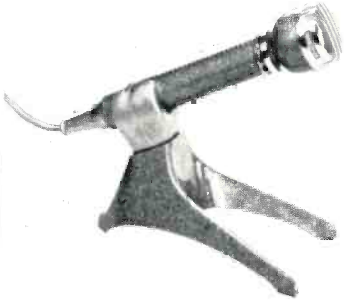
All patterns may be brought into operation during program pick-up without clicking or other disturbances. In addition, a bass switch allows the response curve to be dropped by 7 or 12 db at 50 cps, to increase shock resistance of the microphone and prevent over-emphasis of the bass at very short range.

The low shock sensibility of the D 45 B makes it particularly suitable for TV and film studios, or any other application entailing quick and abrupt movement.

TECHNICAL DATA

Frequency range: 30 - 15000 cps.
Frequency response: ± 2.5 db with reference to standard curve.
Sensitivity: 0.12 mV/μbar at 1000 cps.
Impedance: 150 ohms

Directional characteristics: Omni-directional, figure 8, and cardioid.



D 19 B
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With cardioid characteristic and bass cut switch, this microphone covers the entire frequency range from 40 - 16000 cps. Rising characteristic. The pronounced directional characteristic, especially in the lower frequencies means freedom from background noises.

TECHNICAL DATA

Frequency range: 40 - 16000 cps.

Frequency response: ± 3 db. with reference to standard curve.

Sensitivity: 0.18 mV/μbar (2.5 mV/μbar at high impedance).

Impedance: 200 ohms (high impedance 50K ohms).

Directional characteristic: Cardioid.

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LINKING FM STATIONS BY RADIO RELAY

By WILLIAM H. COLLINS*

A new FM relay receiver is described which features a detector with special advantages for this application.

THERE can be no question in any of our minds that FM has returned in full bloom, to stay. A look at the number of outstanding licenses three or four years ago contrasted with the now over 800 licenses the F.C.C. has issued, clearly indicates a deep interest in FM. At press-time, something over 200 S.C.A.'s for Multiplex operation had been processed by the Commission as well. Every metropolitan area, and nearly every major suburban area, is covered by one or more FM outlets.

As a result of this activity, things are happening. Small networks are springing up all over the country. Stereo is being experimented with. Background music companies are being formed. The static-free, consistent performance of FM broadcasting stations is being turned to more and more for such tasks, not to mention the matchless high fidelity audio reproduction of which FM is capable.

What better way in Civil Defense, for example, than a tightly knit FM link of the type recently formed in Florida. It serves the purpose of hurricane warnings as well. When the land-lines are down, FM gets the message through. An instant alerting system covering the entire United States could be effected through FM by means of a single push button located in the Pentagon.

All of this added up to an important thing at Electro-Plex—relay and rebroadcast equipment. The surplus market can no longer supply a certain type of high quality FM receiver often sought by FM stations for relay work. A development program was launched to produce a suitable relay receiver to tie up these new FM networks. Strangely enough, many AM stations also have urgent need for an FM receiver with which to rebroadcast special network programs, news events, concerts and the like. An FM receiver is often the finest audio source an AM station can have!

To cite an example of a practical application of FM relay receivers, reference is made to Radio Press International of New York and Washington, D. C., headed by George Hamilton Combs, prominent in radio broadcasting circles. RPI provides a news service to a chain of both FM and AM stations by means

*Electro-Plex Corp., P.O. Box 52, Westfield, N.J.

The author is shown adjusting the FMC-1 relay receiver.

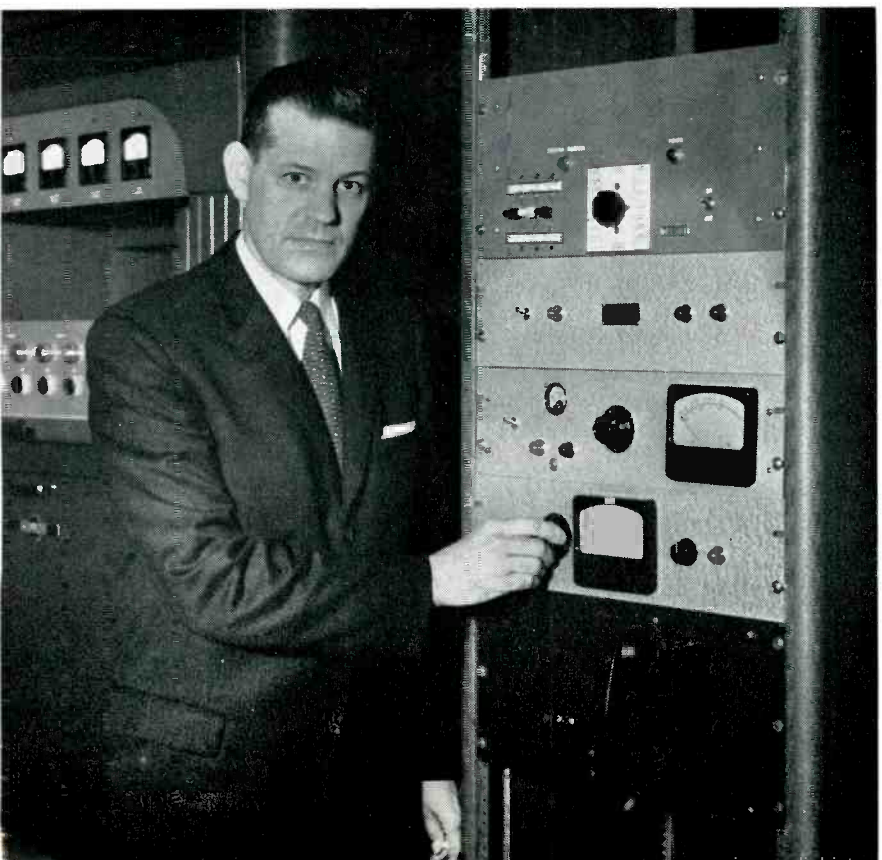
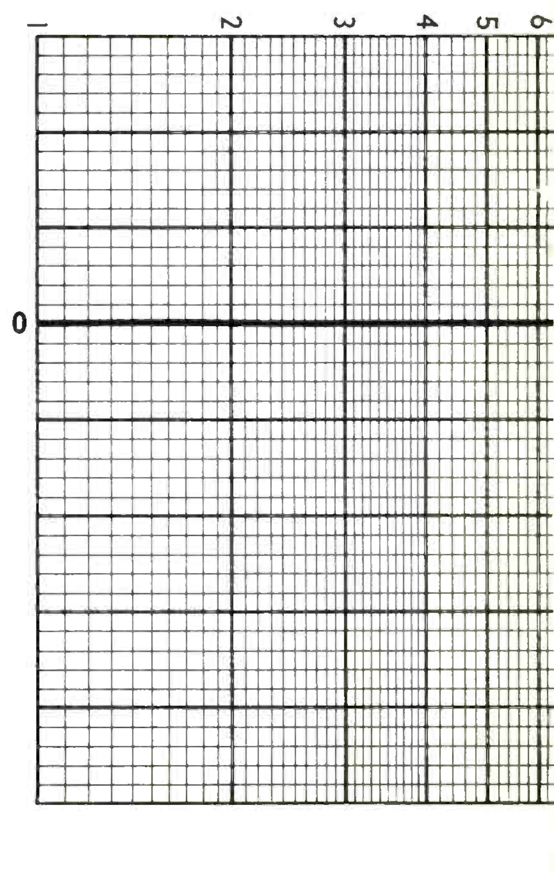


Fig. 1



of voice communication rather than teletype. Such transmissions may be rebroadcast directly by the subscribing stations or recorded on tape for editing and later transmission.

Through the use of the Communications Series of equipment designed by Electro-Plex, some of these functions may be effected automatically. For example, a special signal is transmitted by the originating station just prior to the broadcast. This signal is received by the subscribing stations in a given area, which starts into operation the equipment with which to record the transmission to rebroadcast it.

This shows briefly the way FM is heading, and the only limitation to the technical applications lies in the imagination of the engineer.

Receiver Design

It is safe to say that the last 20 years have not produced anything significant in basic FM receiver design to meet the special requirements as described above. Detection circuits have consisted mainly of limiter-discriminator or ratio detector types. Laboratory analysis will disclose serious shortcomings in these types of circuits, particularly when multiplex sub-carriers are used. One of these shortcomings is the serious high frequency attenuation beyond 20 KC. Another is the restricted band-width and phase non-linearity in the I.F. amplifier as well as the discriminator. These effects produce cross-talk in most cases. Drift, too, has been a serious problem.

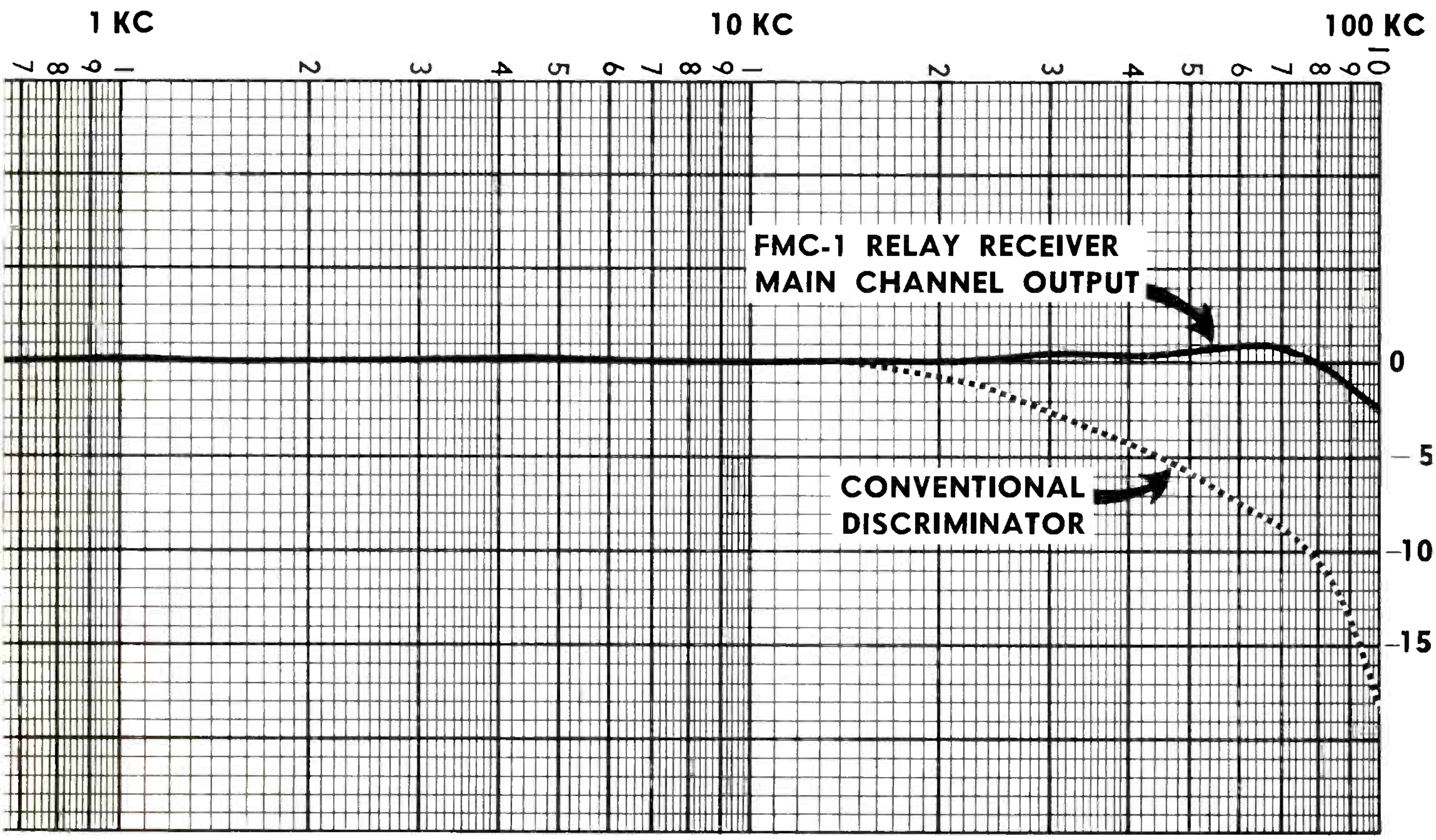
The Electro-Plex approach was to discard these elements and concentrate on an entirely new means of FM detection; new, at least, in this application. A rectangular pulse detector, or square wave detector, was developed which exceeded our fondest hopes as far as distortion, bandwidth capabilities, frequency response and output level were concerned.

The general receiver design was based on this improved detector circuit, the double superheterodyne being considered. Realizing the normally restrictive characteristics of a lower frequency I.F. amplifier as far as bandwidth was concerned, it was decided to employ wide band amplification and clippers to be followed by a square wave type of detector operating at 300 KC. The receiver employs two crystals, one for the station frequency and the other in an oscillator circuit operating at 11.0 MC to convert the 10.7 MC I.F. frequency to 300 KC when beat against it.

The type of detector chosen operates most efficiently at frequencies where there is wide deviation with respect to carrier frequency. Thus, with a 300 KC carrier, deviation of ±75 KC represents an ideal factor, which produces a considerably higher detector output than the conventional double-tuned discriminator.

Also, since the secondary I.F. amplifier and detector will respond without discrimination to what it sees out of the first I.F. amplifier, the drift factor is completely eliminated. The stability of the receiver is therefore dependent only upon the crystal used in the first oscillator circuit, the tolerance here being easily held to better than .005 per cent or 5,000 cycles at 100 MC.

Considering the fact that multiplex, too, will play an important role in future relay work, the capabilities of a receiver to pass the super-sonic sub-carriers without at-



BLOCK DIAGRAM OF FMC-1 FM RELAY RECEIVER

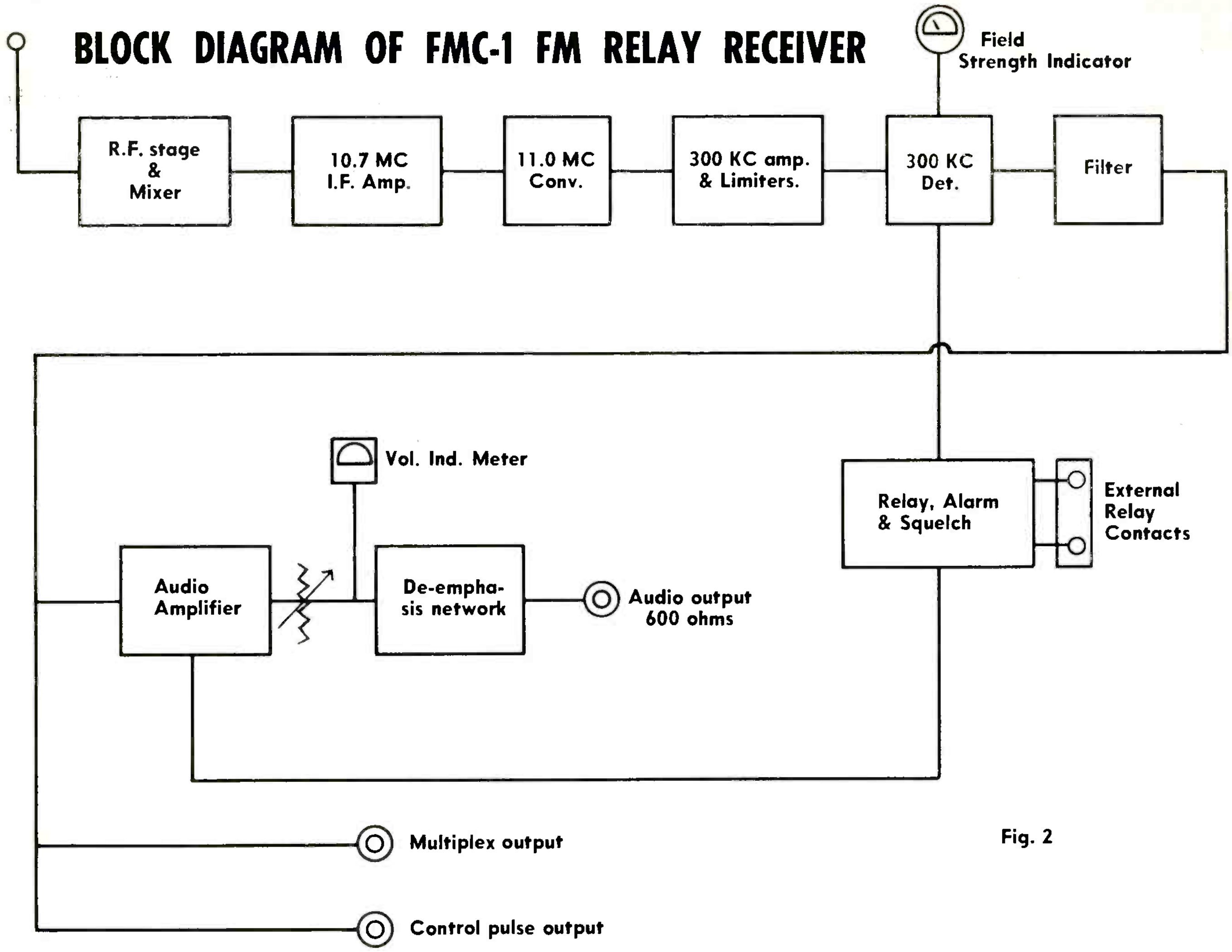


Fig. 2

tenuation becomes an important factor. Figure 1 shows the response of a conventional discriminator (dotted line), as compared with the new Electro-Plex design. As a function of this, a much higher voltage level of sub-carrier recovery is achieved.

Technical Details

The FMC-1 relay receiver employs a tuned R.F. stage using a high gain pentode. This is followed by a 6U8 mixer/oscillator which is crystal controlled. Then, two high gain I.F. amplifiers operating at 10.7 MC. Conversion to the lower frequency I.F. occurs in another 6U8 tube whose output is 300 KC. After the second converter, there is a 300 KC pentode amplifier, two clippers and the frequency counting detector. An audio amplifier circuit completes the chain driving the VU meter which is calibrated to provide three output levels: 0 VU, 5 VU and 10 VU in 600 ohms. Figure 2 shows the block diagram of the receiver.

In the event of carrier failure of the received station, the receiver is automatically muted, thus preventing disturbing noise from being transmitted by the relay station. In addition to this, a red light flashes on the front panel and an audible device, such as a bell or buzzer can be made to operate from relay contacts which have been brought out to the rear apron of the chassis.

The sensitivity of the receiver is 2 microvolts (75 ohm line) for 15 DB of quieting and 5 microvolts for over 40 DB of quieting. The I.F. bandwidth is nearly 300 KC wide but in rare cases of adjacent channel interference, the receiver may be furnished with a bandwidth of 150 KC. The 300 KC amplifier and detector circuits are flat from 10 cycles to 100 KC with less than 1½ DB variation.

In relay work involving the subcarriers themselves, the FMC-1 is well equipped. It has an output at sub-carrier frequencies of approximately one volt before demodulation, and this signal may be amplified and used to modulate the FM transmitter without first demodulating to audio. In such a case, the receiver could be used to rebroadcast both the main channel program and a sub-channel multiplex program simultaneously.

Completing the Communications Group of equipment is the MDC-1 multiplex demodulator and the ACC-1 control panel. These units are used in conjunction with the main FM relay receiver. The function of the multiplex demodulator is obvious and it is equipped with a VU meter and a calibrated output as well. The control panel responds to transmitted pulses and may be set up to perform a number of automatic functions.

It is hoped that by making these important tools available to the industry, that the broadcasters and the public may enjoy wider use and applications of FM facilities as this phase of communications grows and expands.

STRAIGHT TALK to BROADCAST ENGINEERS

A phasor designed with easily adjusted networks and conservatively rated components contributes greatly to the stability of a directional antenna array

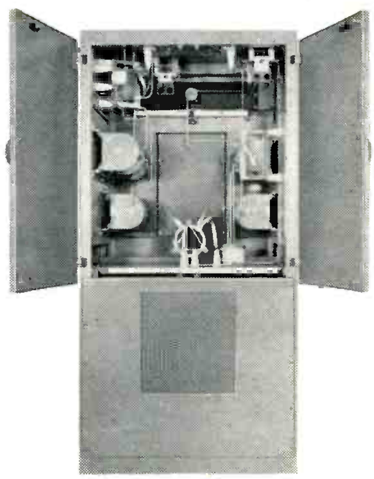
By FRED DAMM
Collins Radio Company

The successful tune-up of a directional antenna array depends to a great extent upon how well the phasing equipment meets the requirements of the array. No two directional arrays are identical in all respects. Consequently, your phasing equipment must be designed and built for your specific directional array if it is to be successfully tuned up in a reasonable amount of time. The circuitry of Collins phasing equipment is designed to give sufficient latitude of adjustment to include all conceivable variations in tower base and mutual impedances, transmission lines and other variations encountered in the normal tune-up of an array.

Precise information on parameters, physical layout and over-all requirements of your directional array and transmitting plant must be obtained before your phasing equipment is designed and built. Your consultant's approval concerning circuitry, components and design is obtained before construction of the equipment begins.

Other factors are important, too, in the design and manufacture of Collins antenna phasing equipment. Only components with generous overload factors are used. Where the rating of a component, such as a capacitor, is questionable because of unknown factors which could result in higher currents or voltages than the design anticipates, the component is duplicated or its rating is increased.

Complete compliance with the requirements of your directional array, the close consideration of your consultant and chief engineer, adjustment latitude, components with generous ratings — all are necessary factors in the design and manufacture of Collins directional antenna phasing equipment.



Collins 81M 1 kw Phasor

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PRE-DISTORTION AND PRE-EMPHASIS TECHNIQUE IN FM BROADCASTING

By DWIGHT "RED" HARKINS*

The use of pre-emphasis of the audio frequencies for both standard FM broadcasting and multiplexing is described and the application of predistortion of the audio frequencies in phase modulated FM systems is explained.

*Harkins Radio Co., 4444 East Washington, Phoenix, Arizona.

ALL SYSTEMS of FM broadcasting have a common denominator in the use of pre-emphasis of the audio frequency response. The amount of equalization applied to the audio is prescribed by the F.C.C. The term, pre-emphasis, is used to define the method of equalization that causes the higher frequency portions of the audio being transmitted to be amplified and to be transmitted at a proportion greater to the lower frequencies as indicated by the curve in Figure 1.

This pre-emphasis curve was the result of early experiments in the art of FM transmission which disclosed that certain components of noise were present in the transmitting and receiving system which were of a type that occurred in the range of audio frequencies above 3,000 cycles. This unwanted noise was caused in the transmission system by the by-products of the modulation method and in the receiving system by high frequency impulse noise and such side effects as tube hiss.

In order to enjoy the full advantages of frequency modulation, it was decided to pre-emphasize the higher frequencies at the transmitter and to de-emphasize them in a proportionate amount at the receiver. The result was the linear reproduction of the transmitted audio. At the same time the defects of the over-all system were attenuated by an amount equal to the pre-emphasis at the transmitter.

Another term that is in wide use throughout the field of frequency modulation is "pre-distortion." This term is used to describe the process whereby a phase modulation system is converted to a frequency modulation process. Since quite a few of the modern transmitters use phase modulation, or indirect frequency modulation, it is apparent that the engineer must understand what is accomplished by both pre-distortion and pre-emphasis.

First, let us describe the requirements that necessitate the use of a pre-distortion network in the audio circuits of a modern transmitter. In creating the transmitted signal, if the modulation process consists of a reactance tube modulated oscillator, the deviation is directly in relationship to the amplitude of the modulating audio voltage. Regardless of the frequency of the modulating voltage, the amount of carrier deviation is the same. This system has been called direct FM.

Direct FM does not lend itself to crystal control, therefore a complex system must be used to keep the carrier center frequency within F.C.C. limits.

Several methods have been developed, on the other hand, whereby the signal produced by a crystal controlled oscillator can be caused to shift in phase and produce the same net results as far as the receiver is concerned. This is called phase modulation.

Phase modulation has also been called indirect FM. The differences

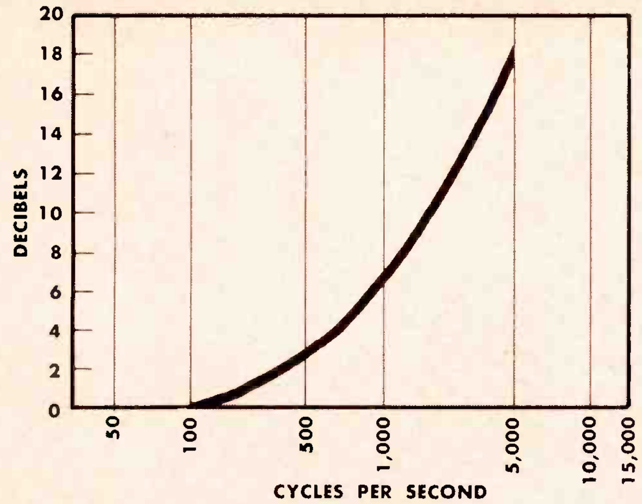

Figure 1. Pre-emphasis curve established for FM broadcast transmitters.

between direct and indirect FM lie entirely in the transmitter design as the received signal is the same in either case.

Indirect FM has the basic advantage of full crystal control that permits highly stable operation in broadcast service. In order to convert a phase modulation process into the equivalent of direct FM, it is necessary to use a pre-distortion of the audio frequency response. The characteristics of a phase modulated system are that as the audio frequency rises the amount of deviation produced also rises at the rate of 6 db. per octave. In other words, a frequency of 2,000 cycles would cause twice as much deviation as the same level of audio applied at 1,000 cycles. This is contrary to direct FM in which case the amount of deviation produced by any audio frequency remains directly related to its amplitude only.

In all phase modulated systems, therefore, it is necessary to utilize the pre-distortion equalization of the audio itself to convert the system to the same characteristics as direct FM.

The simple network required for producing the inverse frequency effect required is shown in Figure 2. This is used in addition to whatever network is used to produce the pre-emphasis curve. The reactance of the condenser C is kept relatively small at the lowest desired signal frequency in comparison with the R value. Typical values for use in a high impedance circuit are shown of 200,000 ohms and .2 mfd. which gives a time constant of .04 seconds. This simple network will give a 6 db. per octave attenuation to accomplish the pre-distortion that is required to convert phase modulation into the equivalent characteristics of frequency modulation.

Now that the pre-distorter has been explained as applied to phase modulation systems, let us go on to the pre-emphasis systems that are used with both types of transmitters. The use of pre-emphasis was prompted in the early development of FM to obtain the maximum possible signal to noise ratio over the total system. The audio frequency accentuation network is used at the transmitting and the de-accentuation network must be used in the receiver. The result of the two networks produces a flat over-all response heard at the receiver. The basic reason for using these networks is that the most disturbing audio frequency noise in the transmitter was found to lie between 5 and 15 Kc. Likewise, most of the system difficulties at the receiving end fell in the same band of audio frequencies. At the receiving end this included conversion hiss, impulse noise and other forms of system defects. Since the relative amplitudes of typical program material are generally small in the upper audio frequency range, the pre-emphasis does not affect the modulation capability of the system. The amount of high frequency pre-accentuation that can be used is governed by the energy content of the program being transmitted. It is also determined by the band width of the system.

In the case of the standard broadcast transmitter which must transmit up to 15,000 cycles per second, a pre-emphasis of 16 to 20 db. is permissible at the 15,000 cycle point. If greater pre-emphasis than this is attempted, it is found that the high frequency content of many programs would cause overload distortion in the transmitter as well as would create many unwanted sidebands possibly causing interference to other channels.

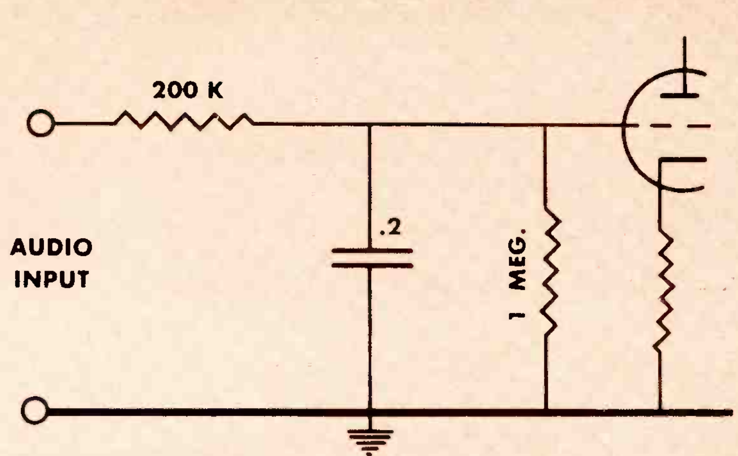

Figure 2. Circuit for producing pre-distortion of audio to convert Phase Modulation to Frequency Modulation.

In establishing standards, the

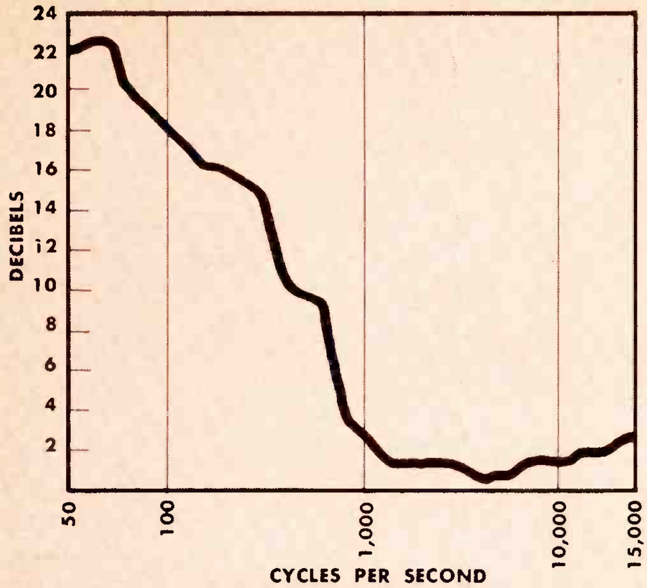

Figure 3. Energy content of average program material as related to frequency.

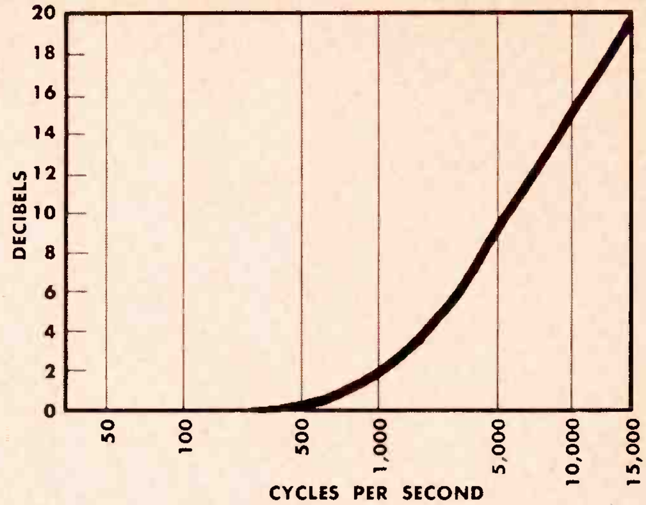

Figure 4. Audio pre-accentuation curve used in the Harkins system of multiplex subcarriers.

Federal Communications Commission made a careful study of the energy content of audio as reflected in Fletcher-Munson curves. In Figure 3, it is shown that the energy content of the higher frequencies is quite low compared to the lower portion of the audio spectrum. This phenomenon is the basis of determining the pre-emphasis of 75 microseconds for standard broadcast transmitters.

In the FM broadcast band, an over-all signal to noise ratio improvement of 23 db. is realized from the use of pre-emphasized FM with a deviation of ±75 Kc. and an audio frequency passband of 15,000 cycles per second. This improvement of 23 db. in signal to noise is in comparison to an AM signal.

The same principles of pre-emphasis and de-emphasis can be applied to a multiplex channel to obtain needed signal to noise ratio improvements. Certain other conditions exist which prevent the utilization of a 15,000 cycle audio spectrum; therefore, a different type of pre-emphasis curve can be utilized.

In multiplexing, the unwanted audio noise also lies in the higher frequency portion of the spectrum. In addition to the same problems of impulse noise as encountered with standard FM, multiplex subchannels are also subjected to cross-talk breakthrough from main channel modulation. This is most pronounced in the higher frequencies above 2,000 cycles. The Harkins multiplex system uses an audio equalization pre-emphasis curve similar to Figure 4. The maximum amount of pre-emphasis usable was determined by empirical means. It will be noted from the curve that since 17 db. of pre-emphasis occurs at the highest frequency used, the corresponding complimentary de-emphasis curve used in the receiver will attenuate the unwanted noise and crosstalk by a similar amount of 17 db. This marks a major improvement in the battle against crosstalk in the multiplex receiver. It also gives a considerable improvement in the elimination of impulse noise which is more troublesome to the subcarrier than to the main channel.

In order to use this curve in the generation of a subcarrier at the transmitting end, it is vitally necessary that none of the functions of the subcarrier generator are overloaded by high frequency components of the audio being transmitted. It is also necessary that the bandpass filter used in multiplex receivers be able to pass a signal that is being deviated ±10 Kc. by 5,000 cycles. With all parts of the system correctly designed at both transmitter and receiver, a consistently realizable 50 db. signal to noise ratio is easily achieved in the subchannel.

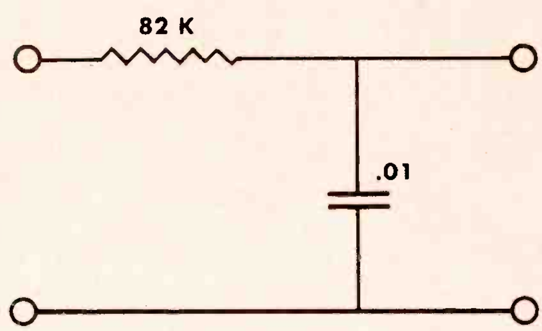

Figure 5. De-accentuation circuit used immediately following the detector of a subcarrier receiver. With the matched pre-accentuation at the transmitter the over-all response is within one db from 50 to 5000 cps.

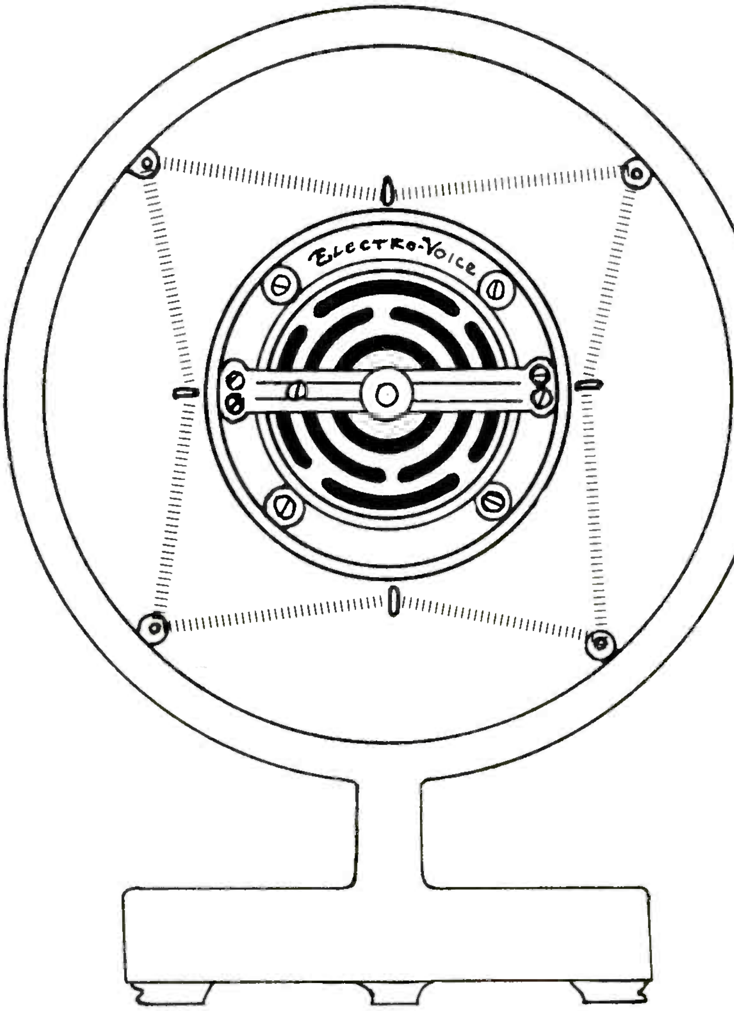

Figure 1. The early studio type carbon microphones were inherently noisy and lacked fidelity.

MICROPHONE

By GEORGE R. RILEY*

A review of the history and characteristics of the various types of microphones which have been and are used for broadcasting.

THE DEVELOPMENT of microphones from the days of early broadcasting to today's multiple demands of broadcasting, telecasting and recording closely parallels that of the electric light. Fifty years ago, a modern office contained a single bare light, dim though it was, hanging from a cord. As time went on, more lights, brighter lights were added with reflectors and ornamentation and new methods of lighting were developed. Today we have the soft fluorescent lights of the home, incandescent table lamps, the bright fluorescent lamps of industry, the concentrated spot light of commerce and the theatre.

So microphones have evolved from the early feeble carbon to today's fine nondirectional, bidirectional and unidirectional microphones. The significant point is that while microphones in general are quite versatile, no one microphone as no one electric light is best for all jobs. Specialization to some degree must take place and it is in this area that microphone technique is developed. It will be the purpose of this introductory article to review the significant microphone developments of the past, touching on theory of operation only where it is pertinent and setting the scene for a discussion of practical application in succeeding articles.

Microphone Fundamentals

Much has been written on the theory of microphones and an extensive amount of technical material is available in current textbooks in the field of audio engineering. The one aspect which as yet has not been covered, however, is the actual practical application of this relatively

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DEVELOPMENT AND TECHNIQUE

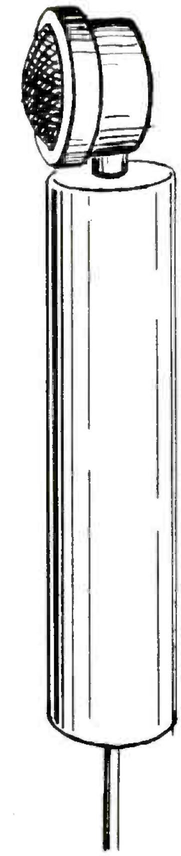


Figure 2. The condensor microphone followed the carbon type and provided many advantages in fidelity.

Figure 3. The velocity microphone was introduced in the early thirties and gave the industry high quality with a versatile, simple to use mike.

great amount of fundamental information. Perhaps the reason for this is that applications and conditions vary widely and opinions vary just as widely. But no matter how broad a subject may be, it is still possible to establish certain ground rules which may be derived on the basis of fundamental theory, empirically, or more usually, a combination of the two. It is the aim of this series of articles to establish these principles and discuss their derivation. It is hoped that these discussions will not only assist the operating engineer in solving day-to-day problems, but that it will stimulate his own thinking toward original application ideas.

Insofar as the use of microphones is concerned, as on any application of engineering, consideration must be given to fundamental principles. However, the formulas associated with the design of a particular instrument are of only casual interest to the user, the principle point being only what practical advantages that instrument will provide.

In their broadest sense, microphones can be classified into two categories: Generators and control devices. In the first category are the true voltage generators, the crystal, ceramic, dynamic and velocity or ribbon types. In the latter category is the carbon which uses acoustical power to vary the magnitude of a D.C. voltage supplied from an external source. The second type in this category enjoys greater interest and application — the condensor microphone, which uses acoustical power to vary the capacity of a condenser, one plate of which acts as a diaphragm. This change in capacity causes a variation of the D.C. polarizing voltage applied across the condenser plates, which is then amplified in a succeeding vacuum tube circuit. Of these types, only the dynamic, ribbon and condensor microphones find practical application in the broadcast and recording fields.

In present-day professional microphones, regardless of the type of generating element employed, the engineering art has advanced to the point where extended frequency range response is not a problem. Uniformity within that range in some types is a problem, particularly when characteristics can change with age. Except for unusual cases where high output level is required, this characteristic is not a problem since even ribbon microphones will supply level that permits a tolerable signal-to-noise ratio, the noise in this case being the thermal noise of the first speech amplifier tube. But by far, the most significant characteristic produced by present-day microphones, as far as applications are concerned, is the polar pickup pattern produced. Providing the most desirable pickup pattern for a given application along with uniform response characteristics, high output level, convenient physical size and inherently rugged construction would indeed provide the operating engineer with instruments that would facilitate use on the routine tasks and solve problems on the difficult ones.

Past Developments

Twenty-five years ago, broadcast studios had reached an important point in their evolution. Studio broadcasting was beginning to be truly an art. The quality of both transmitting and receiving equipment had been rapidly improved through the years. Acoustical treatment of studios was recognized as a prime necessity and the ground work for the fine studios of today was being laid.

Broadcasters had lived through the days of the bulky, inherently noisy carbon microphones which made audio modulation possible but, as receiving equipment improved, realistic reproduction impossible. (Fig. 1) Introduction of the dynamic loudspeaker in the late twenties accelerated the need for improved studio technique.

The first microphone that provided a significant improvement over the carbon was the condensor microphone which solved many problems and won it immediate acceptance. First, it was not subject to internally-generated noise, as was the carbon. Distortion was far lower and range response was greatly extended. It was possible for the first time to really apply the fundamentals of acoustics to the design of a microphone, using damping of the diaphragm and case design to obtain desired characteristics. Many of the first fine musical programs were broadcast using condensor microphones in the studio. The improvement in recording was equally remarkable and the early record players utilizing electronic audio amplifiers had appeared to take advantage of these improvements.

Yet, despite the long step forward, the condensor microphone of that day was doomed to a relatively short life. While the microphone itself was small, it was a very high-impedance device and had to be used with a preamplifier only inches away in order to overcome drastic losses and prevent stray induced noise pickup. This resulted in several configurations all of which were bulky, to say the least, since they had to house one or two tubes and batteries. (Fig. 2) They were not reliable and often became intermittent without provocation. Improved receiving equipment, rapidly growing popularity of recorded music and sound motion pictures all demanded an improvement in the vital sound pickup device. And they got it in the early thirties with the introduction of the first fine studio microphone, the long-popular velocity or ribbon type. (Fig. 3).

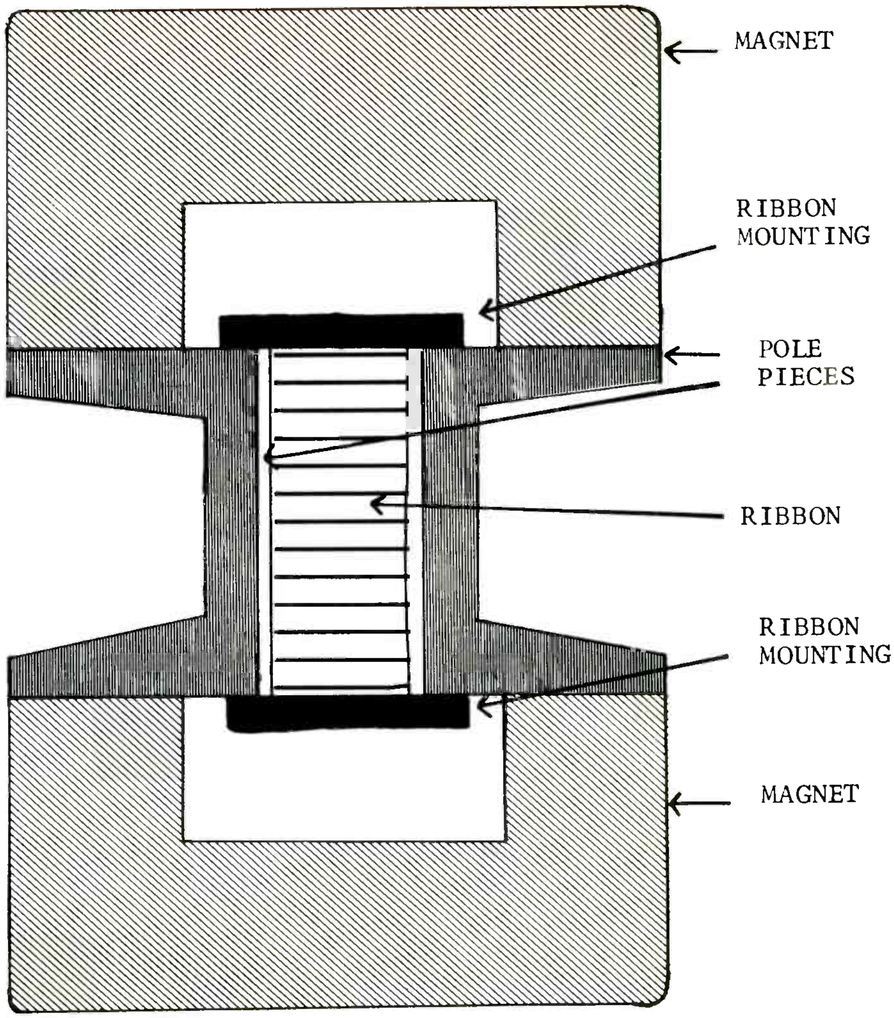


Figure 4. Construction details of a typical velocity microphone.

The velocity microphone is interesting from the aspect that it is an ingenious application of the simple idea that a voltage is generated when a conductor is moved through magnetic lines of force. In this element, the ribbon, made of very thin, corrugated aluminum, acts both as a diaphragm and as the electrical conductor. Suspended in a strong magnetic field, the slightest movement of the ribbon induced a voltage in it which could be taken off its ends by lead wires and amplified.

The simplicity of this design led to greater reliability and immediate popularity in all fields. No tubes to fail, no batteries to replace, it could be fed through long or short lines to the studio console. Frequency range response of even the early velocity microphones exceeded the requirements of associated equipment which then transferred the need for improvement to the reproducing equipment.

The velocity microphone was an outstanding development because it provided solutions to many existing problems. This was true both in and outside the broadcasting field. It widened the frequency range, it provided reliability, it was easy to use and significantly, it added a new dimension to all audio pickup techniques—that of directional control of sound pickup.

Up to this time, all microphones had been essentially non-directional. They picked up sound regardless of direction. No control at the microphone was possible to prevent pickup of reverberation or echo and any interferring noise was picked up without significant attenuation. The only control was acoustical treatment of the studio itself and in the early days of broadcasting, studios were known as "dead rooms" because of the great amount of absorbent material needed to line the walls, floor and ceiling. Because of this, voices tended to be "boomy" and music lacked the realistic crispness or "presence" so vital to realistic reproduction.

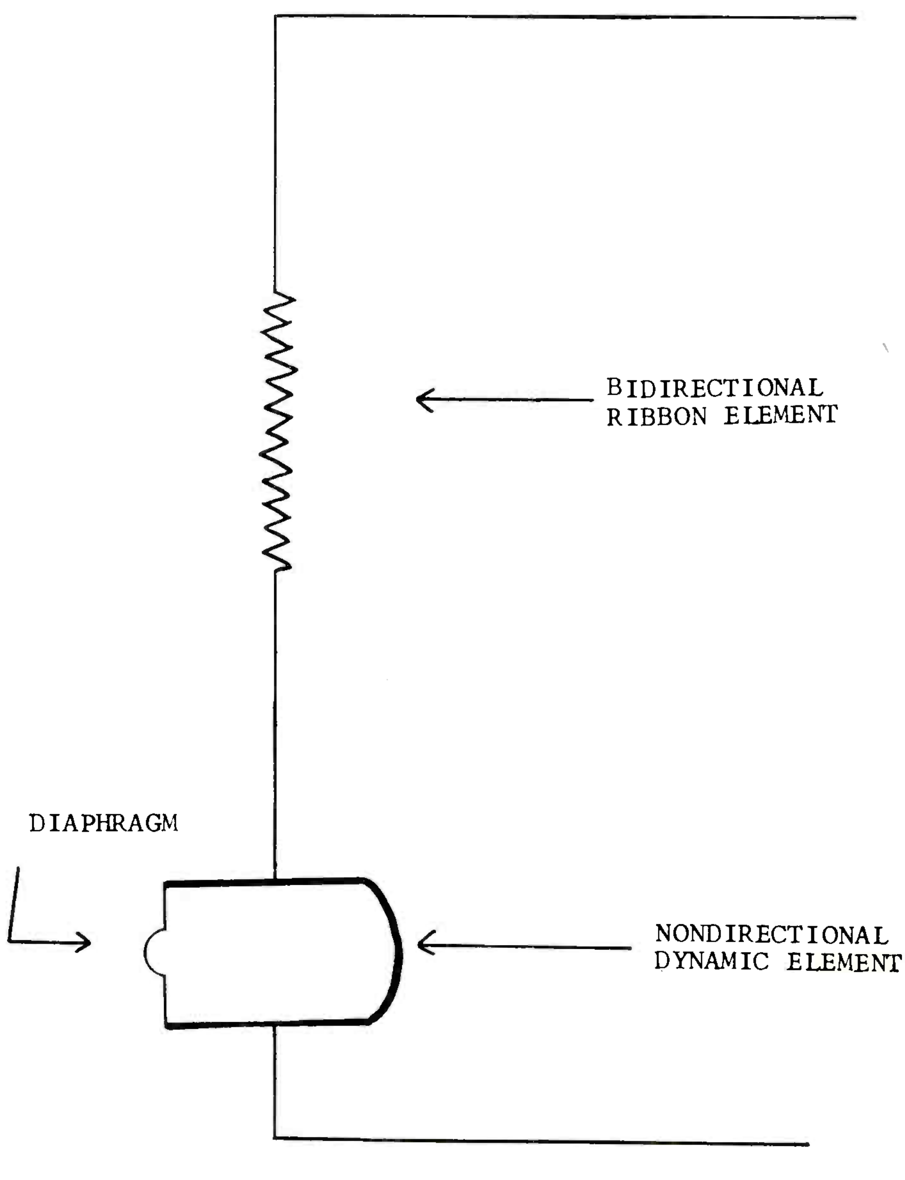
The velocity microphone added this important control making it no longer necessary to drape a studio with yards of monk's cloth and the first steps were taken toward the medium-live studios of today.

As can be seen from Figure 4, the velocity microphone reacts only to sounds originating in front of or behind the microphone proper. The flat ribbon and the baffle effect of the pole pieces prevent the advancing sound pressure wave from reaching the front and back of the ribbon simultaneously. The driving force acting on the ribbon is supplied by the difference in pressure between any two points in the sound wave. Since the velocity microphone operates on this difference in pressure on opposite sides of the ribbon, it is sometimes called a *Pressure Gradient* microphone. The term *Velocity* microphone comes from the fact that ribbon movement is approximately proportional to the velocity of air molecules in the advancing pressure wave.

This microphone represented a great step forward and forced improvements all along the way. Yet, it had its shortcomings. To operate properly, large magnets had to be used, leading to a necessarily large case. Use of smaller magnets and tiny ribbons in later years removed the problem of size in some models, but substituted the problem of low level at a time when demand called for higher output to provide better signal-to-thermal noise ratios. Extended and uniform range response required the ribbon itself to be extremely light and compliant. This made the velocity type an indoor microphone only, since the slightest breeze was sufficient to overdrive the ribbon causing non-linear movement and even collision with the pole pieces. The housing that protected the assembly had to be open on all sides and usually consisted of perforated metal or a formed screen. As a result, accidental mistreatment invariably led to damage to some part of the microphone.

Although the corrugated ribbon itself was extremely light, in time it tended to sag, causing changes in frequency response and problems of nonuniformity between units. Yet, despite these problems, the velocity solved more than it presented and quickly became predominant, gaining a following among artists and engineers alike that to some extent still exists.

As mentioned, the early carbon microphones were nondirectional—they would pick up sound regardless of the direction of origin. When broadcasts were made outside the studio and acoustics were poor or background noise was high, the signal quality suffered and could not be improved by any known means. The condensor microphones that followed displayed the same characteristics and suffered in like manner. The velocity, however, produced a bipolar pattern. Picking up sound originating principally from the front and back of the microphone and cancelling that which entered from the sides, it reduced room reverberation by a factor of 66⅔ per cent. Simply



DUAL ELEMENT CARDIOID MICROPHONE

Figure 5. The above drawing shows how a bidirectional ribbon element and nondirectional dynamic element are combined to produce a directional cardiod pattern.

by positioning the microphone properly, the effects of poor acoustics could often be completely overcome.

The properties inherent in the velocity microphone first demonstrated the great value of directional characteristics and advanced the state of the broadcasting art. Yet, as time went on, it was found that on many applications, particularly where large rooms, auditoriums and theatres were involved, sound pickup at the back of the microphone was undesirable. The need became apparent for a microphone which was sensitive only to sounds originating in front of it and which would cancel sounds from behind. The unidirectional microphone was the next logical step in microphone development and when it appeared, it took many forms and entailed far more engineering ingenuity than had yet been seen.

In the mid-thirties, dynamic microphones began to appear in broadcast studios. These were invariably nondirectional types and had the advantage over the velocity of ruggedness and relatively small size. Quality, however, was poor and these early units were relegated to station announcing and remote pickup applications. This type element was to play a part later on in the development of unidirectional microphones.

In the search for a practical unidirectional microphone, engineers found that the circular polar response chart of the nondirectional microphone could be superimposed on the bipolar response chart of the velocity microphone and adding the two together algebraically, a heart-shaped or cardioid pattern resulted. This was quite easily done on paper and the identical procedure was carried into practice. A nondirectional microphone element was connected in series with a bidirectional element having the same output level so that sounds arriving on the front axis of these elements added making the microphone assembly very sensitive when positioned toward the source of sound. Sound arriving from the back, however, moved the bidirectional element in the opposite direction to the nondirectional element and the output from one cancelled the other.

The types of generating elements were incidental as long as their polar characteristics were such that one was nondirectional and one was bidirectional. Early cardioid microphones utilized a conventional velocity element connected in series with another ribbon element which was enclosed behind the ribbon to form a nondirectional element. Later models used a ribbon and a nondirectional dynamic unit. (See Figure 5).

From this point on, many types of cardioid microphones were developed using a variety of systems to obtain the unidirectional pattern. Some included dual elements such as those described above. These required careful matching of the two elements so the output of one was equal to the output of the second and complete cancellation would result from sound arriving 180° off axis. Any change in the characteristics of either element upset this balance resulting in something less than a cardioid pattern. To overcome this problem various systems were devised using a single element. All used a time delay or acoustic phase shifting device which in some microphones took the form of a labyrinth and in others it was a diaphragm of compliant material placed at the rear of the main diaphragm and connected to it by a cavity.

The significance of the cardioid microphone was in the fact that it again advanced the state of the art by solving problems. Under studio conditions, it was possible to increase working distance almost twice that permitted by nondirectional microphones. Random noise and reverberation were decreased by a factor of 66⅔ per cent which solved many studio problems and improved the quality of remote pickups where little or no control of acoustics was possible.

The many applications on which cardioids were used revealed severe

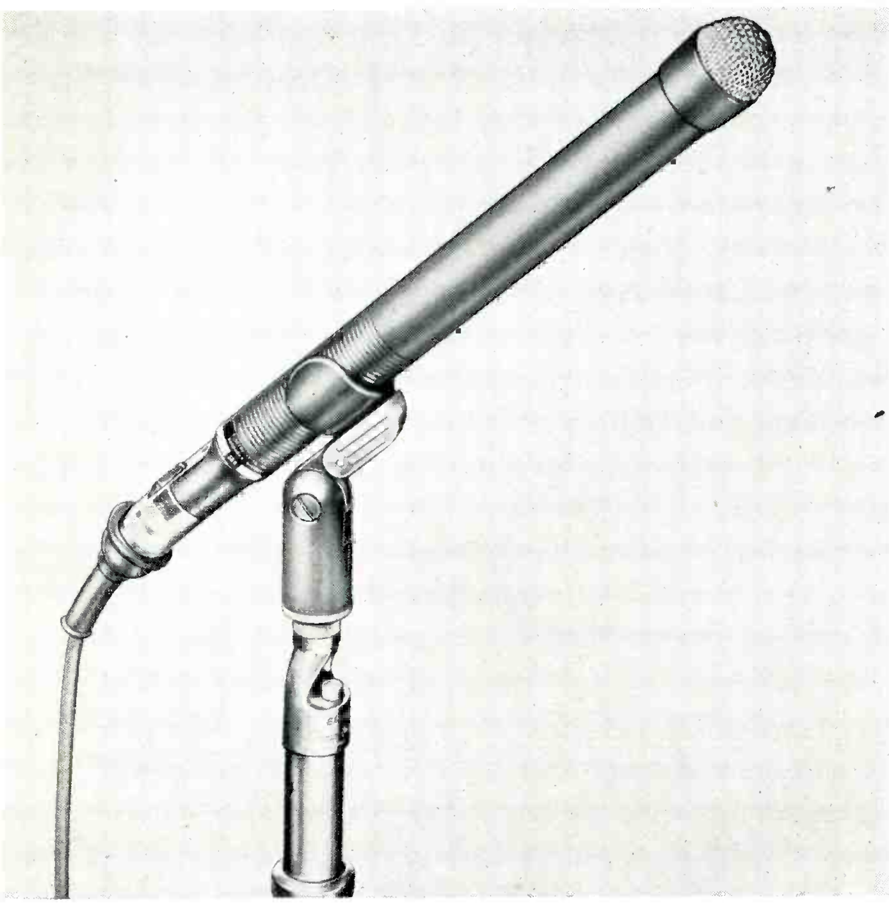


Figure 6. A wide range nondirectional professional microphone.

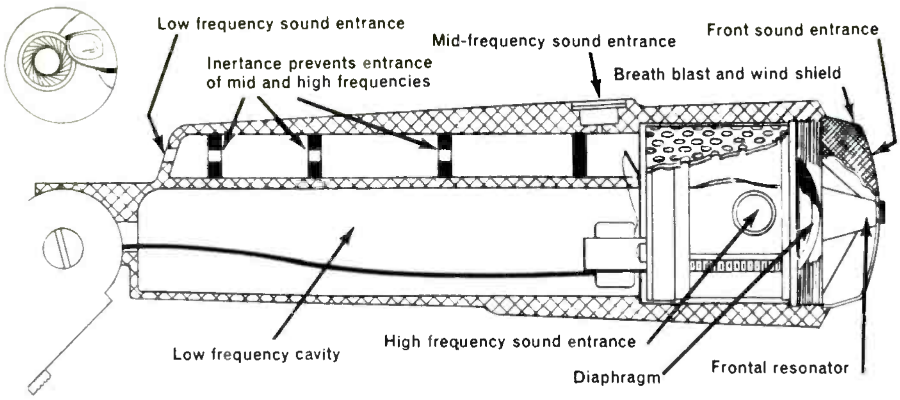


Figure 7. Shown above is the construction of the Variable-D cardiod microphone.

mechanical and electrical shortcomings. The case, as with the velocity type, had to be transparent to sound pressure which again made the physical structure inherently fragile.

Quite often, the phase shifting devices used generated resonances which resulted in undesired, peaked response. In some cases, the microphone provided a cardioid pattern only in limited portions of the audio spectrum, being bidirectional or even nondirectional, throughout the remainder. The shortcomings of the ribbon type generating element were carried over into all cardioids in which they were used.

The initiation of television broadcasting in the years immediately following World War II put new, greater demands on all equipment and particularly on microphones. In a very short space of time, completely new techniques and equipment had to be developed. In this period the nondirectional dynamic had reached the point in quality, in small physical size and in extreme ruggedness where it quickly became popular. Its forms varied from the long, slender desk and handheld types to the miniaturized lavalier worn on a neck cord. These microphones are highly dependable and easy to use. Their quality as studio microphones surpassed their predecessors regardless of structure . . . carbon, condensor or velocity. (Fig. 6).

In the mid-fifties, another type cardioid microphone appeared utilizing a single dynamic element which overcame the shortcomings of previous types. This highly developed unit utilized a series of three phase-shifting tubes of different lengths to provide a constant cardioid pattern throughout the range of the microphone. The result was that of a single tube that instantaneously adjusted its own length to provide a cardioid pattern for the frequency of sound being picked up. The physical design allowed extreme ruggedness and the limitations imposed by ribbons were eliminated. One long-standing problem with ribbon microphones was accentuation of low frequencies, or boominess, caused when working close to the microphone. This proximity effect for practical purposes was eliminated in the development of the Variable-D cardioid. (Figs. 7 and 8).

More recently, a development has taken place on a highly directional, wide range dynamic line microphone which promises to solve many problems now prevalent in the industry. Complete details of this unit will be covered in a succeeding article.

At the present time, frequency range response and control of that response for special applications is no longer a problem. Many of the limitations of the fine microphones of the past have been designed away. Wide range, high quality nondirectional and cardioid microphones are available on today's market at modest prices.

The significant tool, then, in choosing or using a microphone on a given application is its polar response. Succeeding articles will discuss microphone techniques and use of their polar response.

Figure 8. Professional Variable-D Cardiod Dynamic Microphone.

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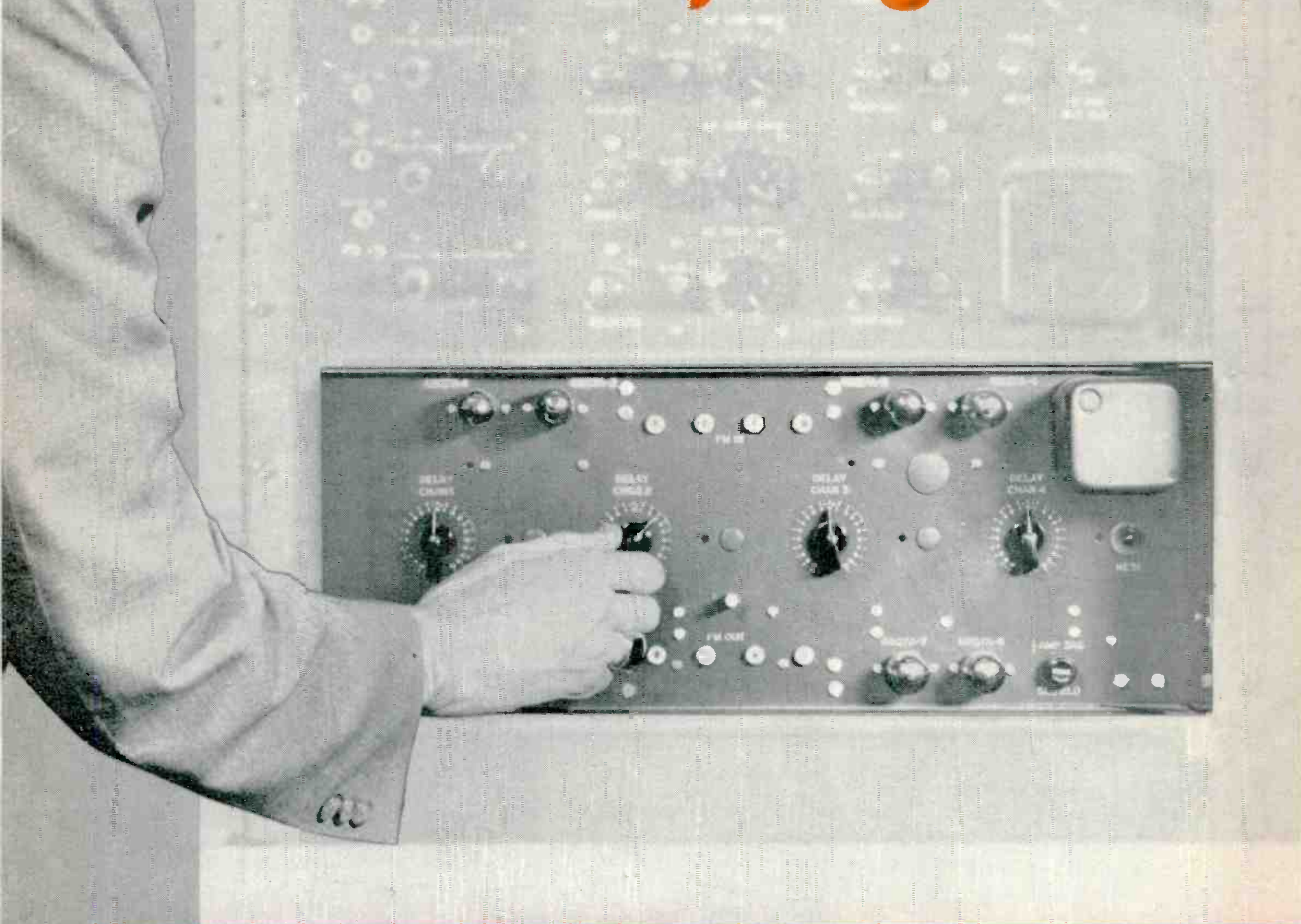

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A PRACTICAL APPROACH TO GOOD AUDIO

Each component of the audio system must meet the required specifications since the over-all system response is limited by the poorest component.

In this discussion no attempt is made to deal with specific problems of any particular audio system, but rather a general procedure for developing a good over-all system is described. At the present time when so much emphasis is being placed upon stereo, multiplex, and high fidelity, we have a tendency to neglect "just plain" good audio. This situation is particularly true with AM broadcast stations and should be a very real concern for them, since the public is becoming more aware of good sound.

In AM broadcasting certain standards are established by the FCC and NAB. The problem is how to meet these standards in the most practical and in many cases the most economical way. Speaking of economics, this article generally pertains to small and medium size stations, since in most instances the larger stations are equipped with a well integrated over-all system.

The old adage "a chain is no stronger than its weakest link" can well be applied to an audio system. There is no point in having a program amplifier, limiting amplifier, and transmitter capable of giving good frequency response and good distortion and noise characteristics, say from 30-10,000 cycles, if a microphone or turntable preamplifier capable of only 100-5000 cycles response is placed in the system.

The point is, regardless of how good or poor your audio system may be, you should maintain a system balance. In this article when system specifications is mentioned, we will be using minimum FCC equipment performance requirements as a basis for our remarks. However, minimum FCC audio performance standards are not very high when compared to the performance capability of the audio equipment and transmitters on the market today. So, it becomes increasingly important for every station engineer and manager, to strive to exceed these minimum FCC standards as much as possible with his existing equipment and look toward improving his system performance as new equipment is added.

Microphones

The microphone is probably the most fragile piece of equipment in use in a radio station, although in recent years they have been ruggedized to the extent that they can take a lot of punishment. The selection of microphones is dependent upon usage and facilities. If the station has studios with excellent acoustic qualities and broadcasts numerous live musical programs, a good quality microphone is necessary. Perhaps one with a uniform response from 30-15,000 cycles in the high price range would be desirable.

On the other hand if the studio acoustics are "just average" a microphone with a uniform response of 40-10,000 cycles in the medium price range would be adequate. The latter condition apparently being prevalent in many of the small and medium size stations.

Generally speaking, microphones of the moving coil or pressure type in the medium price range are the most practical. This type microphone can readily be used in studios or on remote broadcasts, is not bulky in size, and is more rugged than the ribbon types.

Turntable Pick-Ups and Arms

In recent years the industry has been flooded with new innovations and principles in pick-up cartridge and arm design. Much thought and effort has been put into this phase of the audio system by many design engineers and companies. All of this advancement is very good with the exception that it leaves us in a dilemma as to what particular equipment to select.

For broadcast use a professional type arm and cartridge is preferred and is the least expensive and troublesome in the long-run. A low impedance cartridge working into a low impedance equalizer ahead of a good preamplifier is a logical sequence.

Another point to keep in mind is the stylus pressure on the disc. With microgroove recordings in predominate usage, a low pressure one mil type arm and stylus is essential in order to protect the life of these fine groove recordings.

With standard groove recordings remaining in much use at 33 RPM, and quite a number of 78 RPM discs still available, the most practical method of getting quality reproduction and at the same time preserving the life of the discs seems to be the use of two arms and cartridges for each turntable. One for microgroove and one for standard recordings. This system is preferable over the single arm with turn-over cartridge or stylus, chiefly because it is more foolproof and rugged.

With the rather abrupt introduction of 45 RPM microgroove recordings, many stations were caught in the "squeeze" and were forced to resort to the use of light home and

FOR AM BROADCASTING

By ROBERT J. HENDRICK*

Audio equipment which must be carefully chosen, installed, and maintained to achieve good audio includes:

MICROPHONES
TURNTABLES AND PICKUPS
TAPE RECORDERS
CONSOLE
AMPLIFIERS
PROGRAM LINE EQUALIZATION
WIRING

semi-professional type turntables. These light turntables are adequate for strictly emergency use but are certainly not desirable for hard day to day service in a broadcast station. Their performance does not meet the requirements for rumble rating, speed tolerance, mechanical ruggedness, or ease of operation.

In selecting a turntable a three speed professional type turntable with a heavy duty hysteresis motor should be used as the standard equipment. Lighter, lower priced turntables may be used as emergency or stand-by units.

Pre-Amplifiers

As a link in the chain of our audio system, the pre-amplifier, whether it be a microphone or turntable pre-amplifier is a very important unit, since it amplifies comparatively weak audio responses. A good pre-amplifier gets the weak audio signals off to a clean start and thus poor audio all the way down the line is avoided.

In the selection of pre-amplifiers, standardization and system balance is again emphasized. Many installations use the same type pre-amplifier for microphone, turntable, and in some instances fixed remote and low output line amplifiers. Of course some compensation for impedances and levels must be taken care of with balanced H type pads. The advantage of using a standard unit for several applications is interchangeability and more spare units available in case of failure, also the investment can usually be reduced considerably by utilizing a system of this type.

Another alternative which should always be considered in a new installation and replacement of equipment in old installations is the plug-in type pre-amplifier units. These units can be mounted in standard 19-inch relay racks or they also come in desk type units in consoles. In either case they require little space and provide accessibility and interchangeability.

Program Amplifiers

Program amplifier is a somewhat broad classification, since it may be any amplifier which carries the program material transmitted by the station. However, as a rule the amplifiers meeting these requirements in most installations are the program amplifier associated with the control room consolette or the limiting amplifier, which may double as the main program amplifier in some stations.

In both instances these amplifiers play an important role in reaching our goal of acceptable audio for transmitting. Generally speaking these units, as well as the equipment mentioned previously should be procured from a reputable broadcast equipment manufacturer, rather than use a makeshift amplifier or composite equipment, which keeps station engineers busy in order to barely get the system past minimum performance requirements.

Wiring

Since a lengthy discussion would be required to adequately cover this subject, we shall merely mention the "high points". Good studio and control room practices should be followed throughout the installation. Use good quality shielded audio and microphone cable, keeping the low level and high level audio circuits well spaced. Where jack strips are used be sure to carry the shield connections all the way through and select your ground points so as to minimize ground loops, which are a source of trouble in many installations.

Telephone Line Facilities

Stations having transmitters remote from the studios require telephone line service. As with our other audio equipment these lines must meet the minimum performance requirements. Except for very short lines, these program loops must be equalized to meet the audio performance characteristics of our system. The telephone company will properly equalize and maintain the lines or if your station has the necessary equipment you may equalize your own program loop. In any event be sure your program line is properly equalized or the quality of your entire audio system may be seriously impaired.

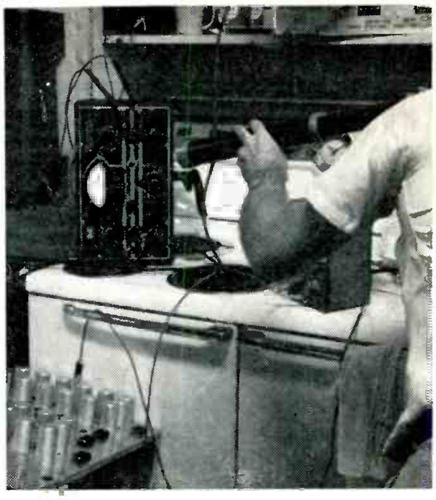
Summary

In summarizing we have not gone into the requirements which are necessary to achieve the ultimate in broadcast station audio systems, this goal will always remain a challenging assignment for the engineering personnel of each station.

Whether your audio system "just meets" minimum FCC requirements or far exceeds these specifications, the need for a well balanced, well integrated over-all system is again emphasized. Remember, just one piece of equipment improperly placed or with undesirable characteristics can upset the effectiveness of your entire system.

*1424 Nutwood Ave., Bowling Green, Kentucky

THE LIFE OF A WIFE OF A BROADCAST ENGINEER



Typical "kitchen" experiment. In this case the "MISSISSIPPI MOOCH" technique is being tried. The distortion meter is first calibrated in the horizontal position, then tipped onto its left side. Distortion measurements are improved due to needle weight by at least 11 RCH.

By PROF. OSCAR VAN DER SNIKRAH

After several years of exhaustive research, we are now authorized to make public the findings of a nationwide survey into the personal affairs of broadcast engineers. This survey was conducted by our organization under a special commission from a retired eccentric millionaire who prefers to remain anonymous.

The original purpose of the survey was to gather information that would promote the continuation of this rapidly becoming extinct species of Homo sapiens. It was felt that due to automation, remote control, etc., the race was dying out.

In examining the various methods under which most surveys have been conducted in the past, it was decided to adopt entirely different procedures since the normal survey is merely a sample and does not reflect the true conditions. Therefore, we set out on the long task of making a 100 per cent complete survey so that no facts would be lost by chance.

Although it is beyond the scope of this paper, the methods we adopted should be mentioned briefly. First, our survey was conducted on a highly secret basis so that the true answers would not be clouded with emotional feelings. Secondly, we conducted our fact finding mission by contacting the wives and families of the broadcast engineers instead of making a direct approach. It is obvious the true nature of the subject was more honestly reflected in this manner. Posing as Fuller Brush Salesmen or other typical door to door vendors, our agents were able to gain entry into the privacy of the home and get the real inside facts.

In spite of the fact that a great deal of information gathered is still being processed by electronic computers, our sponsor agreed to this report of preliminary findings since the survey is now 97 per cent complete. All of the trends have been established to the point where additional information still being processed could not affect the statistics one way or another more than a few per cent.

Even though the broadcast engineers proved to be a most unique group of the population, this survey took on an entirely different twist after the first few months of fact finding. It was discovered that the distaff side of the broadcast engineer's life probably had more material bearing on the habits of our subject than the engineer himself. But, first, a report of some of the general characteristics discovered; the majority of the engineers were married and had children, 93.7 per cent were married and living with their wives, 3.9 per cent were married and living at the transmitter, 2.4 per cent were just living at the transmitter.

The group as a whole had an average of 3.142 children per family. Of the old timers the number of grandchildren averaged 5.367 per engineer. Here then is the first important factual discovery. There is no truth, whatsoever, in the widespread rumor that working around strong R.F. fields has any physical effects that would produce sterility.

Less than .2 per cent was reported to be alcoholics.

None had ever appeared on relief and 72 per cent of the families had two cars.

At this point the survey would indicate that the group is highly sober and industrious. However, using the 100 per cent penetration method, certain aspects of the engineer's habits were found to be universal.

The engineer's wife appears to have unique problems, separate and apart from those associated with any other group of professional people. The first complaint was in regard to the working habits of the subjects. It showed that the wives resented the fact that their engineer husbands seldom worked normal hours. They invariably worked throughout the nights and, in addition to that, it was not uncommon to have reports of working 60 to 100 hours per week. This, of course, made home life abnormal. The survey further reveals that the wives feel that their husbands are more

(Continued on page 38)

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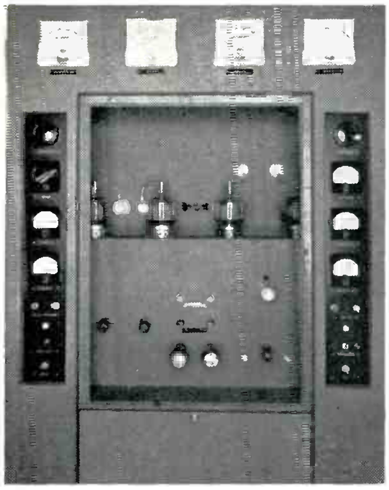
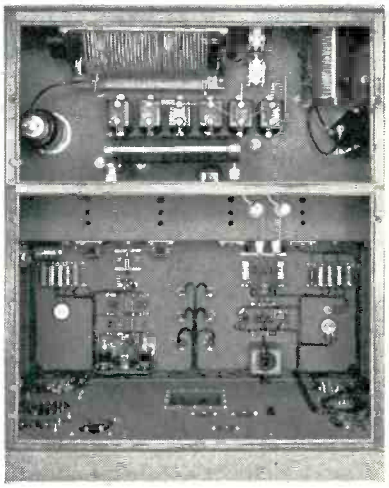
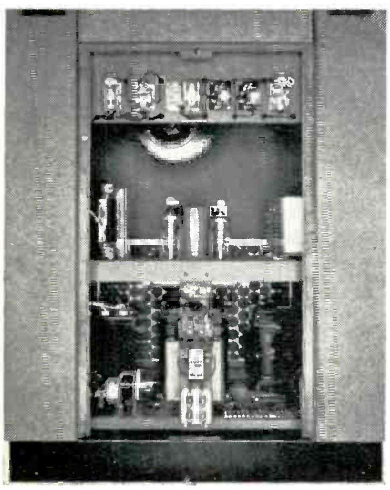


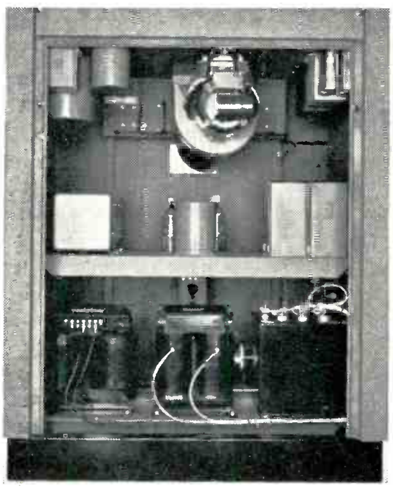
All audio and R.F. tubes are removable from upper door. Each critical circuit is separately metered.



Vacuum variable tank condenser, output circuitry, and accessibility of components are shown.



Relays are in a dust-free location. All components and circuit terminals are in convenient locations.



Heavy-duty rectifier components, constant voltage filament transformer, and modulation transformer are mounted in lower compartment.

FB-1000-J

FEATURES:

- TETRODE CIRCUITRY
- ONE TUNING CONTROL
- DUMMY ANTENNA
- NINE METERS
- UNATTENDED OPERATION
- COMPLETE ACCESSABILITY
- POWER CUTBACK

A Few of the Stations Using BAUER Transmitters

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KFWB—Los Angeles, Calif.
KEWB—Oakland, Calif.
KUTY—Palmdale, Calif.
KCVL—Colville, Wash.
KMYC—Marysville, Calif.
KTYM—Los Angeles, Calif
KWSD—Mt. Shasta, Calif.
KOHU—Hermiston, Ore.
KAGR—Yuba City, Calif.

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AMENDMENTS AND PROPOSED CHANGES OF F.C.C. REGULATIONS

CLEAR CHANNEL BROADCASTING IN STANDARD BROADCAST BAND

Third Notice of Further Proposed Rule Making

1. Notice is hereby given of further proposed rule making in the above-entitled matter. For purposes of identification the proceedings to be conducted pursuant to this notice shall be designated as Part III. The proceedings heretofore conducted pursuant to the Further Notice of Proposed Rule Making (FCC 58-350) issued by the Commission on April 15, 1958, have been designated as Part II. The proceedings heretofore conducted pursuant to the order issued by the Commission on February 20, 1945, by which this proceeding was initiated have been designated as Part I.

The Proceeding; Basic Questions To Be Resolved

2. The basic question to be resolved in the proceeding is what changes, if any, should be made in the use of the clear channels of the standard broadcast band which are available by international agreement for use of the United States. The Class I stations which operate on these channels are designated to render skywave (long range) service, as well as groundwave (short range) service. This permits them to render wide-area service and thus reach extensive land areas in the United States beyond the effective range of any other classes of radio stations. The United States has Class I-A priority for 25 stations on 25 of the 39 channels on which I-A priorities are recognized, and Class I-B priority for 34 stations on 20 of the 24 channels on which I-B priorities are recognized.[1]

3. Under the present rules, Class I-A channels with two exceptions are not shared at night by the Class I-A stations with any other stations within the continental United States. The Class I-B channels are so allocated that the Class I-B stations share the same channel with one or more other United States stations and with foreign stations. Thus, listeners are afforded a relatively high degree of protection from interference in reception of Class I-A stations and a lesser, though substantial, degree of protection from interference in receiving Class I-B stations. The skywave (long range) service furnished by clear channel stations is the only nighttime standard broadcast service now available to approximately 25,631,000 persons in an area in the aggregate of about 1,725,000 square miles, which comprises somewhat more than half the land area of the continental United States, with the exception of Alaska and Hawaii.

4. The fundamental conflict in the proposals for revision of the present Rules on clear channel usage lies between sustaining or increasing the capacity of the Class I stations to render wide-area service and increasing the number of stations permitted on these channels.[2]

The April 15, 1958, Notice

5. The April 15 Notice (FCC 58-350) invited comments on proposals to open 12 specified Class I-A channels for additional unlimited time assignments, to reserve for later determination proposals to increase power on the remaining Class I-A channels, and to leave unchanged the Class I-B channels listed in Section 3.25 (b) of the Rules.

6. On five of the 12 channels proposed for additional unlimited time assignments it was proposed to assign a new directionalized Class I station and require the existing Class I station to directionalize, with corollary reduction in service, with the result that each station would afford mutual protection from interference to the areas served by the other. On the other 7 channels it was proposed to assign unlimited time Class II stations in underserved areas.

Tentative Conclusions on the April 15, 1958, Notice

7. Comments in response to the April 15, 1958 Notice were filed by some 60 parties and reply comments were filed by about 44 parties. On the basis of the comments which have been filed it is shown that, although permitting the licensing of additional stations, the proposals would result in substantial reduction of the existing groundwave and skywave service, with the result that substantial new "white areas" would be created in which no groundwave service would remain available from any station and that other areas would be reduced in the number of services received from four, three or two groundwave services to a single groundwave service. In addition, substantial dislocations would obtain of present skywave service which would not be fully compensated by new operations. Also, we note that, a substantial number of assignment counterproposals have been made which fail to accomplish any substantial increase in groundwave service to white areas. Accordingly, it appears desirable in light of the comments to secure additional data in response to a further notice before proceeding toward a conclusion of the proceeding.

8. Although the Commission in its April 15, 1958 Notice did not invite comments on the question of increased power for Class I stations, some parties addressed themselves to it.[3] We do not discount the fact that historically the present power limit of 50 kilowatts was determined in substantial measure upon early radio equipment, whereas more powerful transmitting apparatus has now become readily available, the use of which in the United States could substantially increase the signal strength of the present nighttime skywave service on the clear channels and thus generally improve the signal-to-interference ratio thereof. We observe, however, as the record clearly shows, that the scope of the skywave service depends upon many variables including the type of transmitting antenna and the varying atmospheric noise levels as well as the broadcast station power. The record shows that the most satisfactory present skywave service does not necessarily coincide with the strongest signal areas but is instead realized in those geographic areas, with relation to the stations, where the absence of interference, of signal fading, and of atmospheric noise permits the use of optimum receiver sensitivity for adequate reception. The Commission's Exhibit 109, herein, which is based on the results of three Industry-Government Committees, includes cri-

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[1] The apparent summation of 63 channels (39 plus 24) on which I-A or I-B priorities are recognized follows from the fact that on three channels (640, 1010, and 1540 kc) both I-A and I-B priorities are recognized in different countries. The International Agreements designate 60 clear channels on which I-A and I-B priorities are delineated.

[2] The Committee on Broadcasting of the Institute of Radio Engineers published, prior to the adoption of present rules, a report on "The Clear Channel in American Broadcasting" in which the following conclusions were reached with respect to shared and clear channels. See, e.g., 21 Proceedings of the Institute of Radio Engineers 5 (1933).

"1. The field of the shared channel is to afford broadcast service to important detached centers of population, such as our cities and large towns.

"2. The field of the clear channel is to afford service to those vast intervening areas in which the density of population is so low that a broadcast service could not otherwise be supported and in addition to a single large center."

The consequences of increasing the number of shared channels at the expense of cleared channels are summarized in the report as follows:

"1. Decreasing the number of clear channels by assigning additional stations (for nighttime operation) to channels now used by only one station at a time would have the effect of affording additional services to certain localized urban groups but at the expense of decreasing the service to rural listeners and to those at remote points.

"2. Increasing the number of clear channels at the expense of the shared channels would have the opposite effect, assuming that assignments for the stations thus displaced could not be provided for on the remaining shared channels."

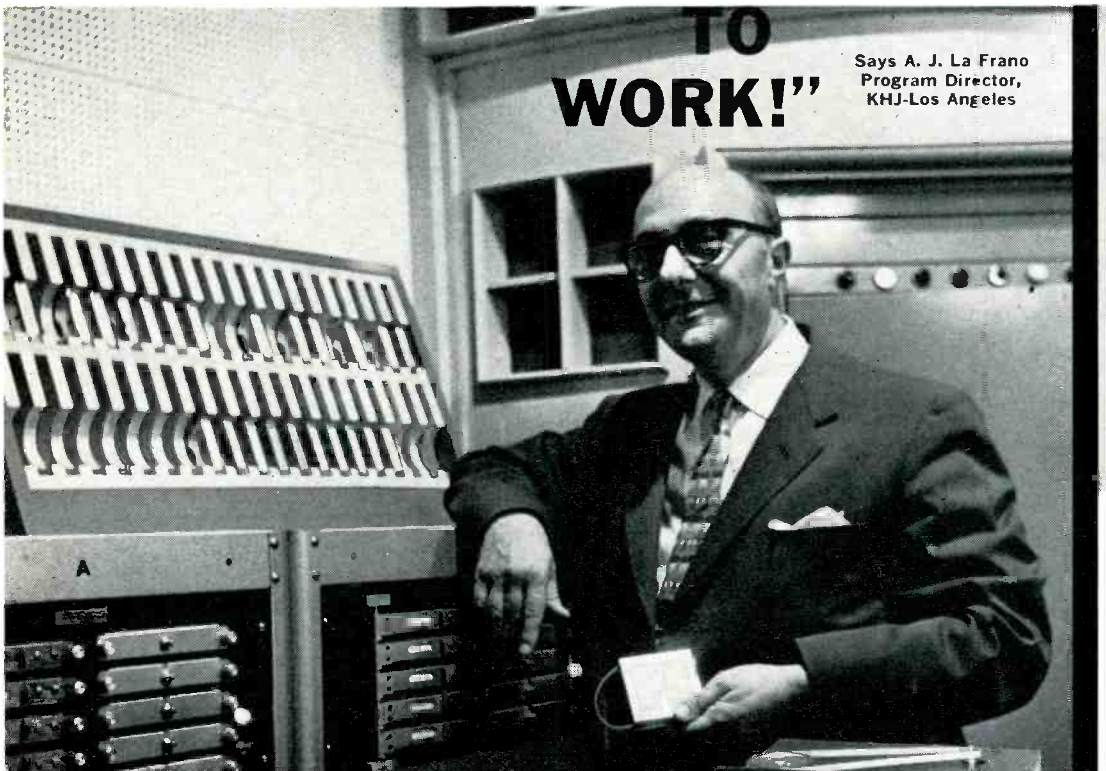
The principles thus stated in 1933 remain applicable today.

[3] Other parties indicated their desire to file comments on higher power at such time as the Commission invited updated comments on this mode of clear channel reallocation.

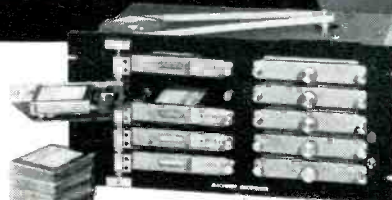
SUCCESS OF "RADIANT RADIO KHJ", LOS ANGELES IS CREDITED IN GREAT PART TO FAST, EFFICIENT OPERATION OF MACKENZIE ELECTRONICS AUTOMATIC AUDIO FIVE-CHANNEL REPEATERS • *Frequency 930 kilocycles, Los Angeles is "Radiant Radio KHJ" • And "Radiant Radio KHJ" features a new format... a format of fast, extra-fast news, music, and information put into effect when KHJ changed over from being a key network station to completely independent operation. The change was highly successful... made so by careful pre-planning, by careful rehearsal before format change, and by the use of newly-developed instant cuing, and instant-playing, tape machines manufactured by MacKenzie Electronics, Inc. • Mr. A. J. La Frano, vice-president and program director says..."Our programming, now made up of much smaller segments than before, had to appeal to and hold our listeners. It had to be tight, bright, and fast. In the success we have had we owe a great deal to the program repeaters manufactured by MacKenzie Electronics. They prevent missed cues, fluffs, and retakes. They save us time and save us money, and have been of tremendous help in smoothing out our operation."*

"IT HAD TO WORK!"

Says A. J. La Frano
Program Director,
KHJ-Los Angeles



Mr. La Frano credits MacKenzie Automatic Audio Five-Channel Repeaters for success of new "Radiant Radio KHJ" format of news, music, and information . . . one of radio's smoothest, fastest moving continuous programming operations.



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teria for three grades of skywave service, grading off in quality with respect to freedom from noise and interference.[4] These are all based upon the percentage of nights that radio service is realized throughout the entire year and are thus weighed down statistically by the perturbation of summertime static, the atmospheric noise resulting from the thunderstorms prevalent during the summer months. Thunderstorm activity is virtually absent during the winter months according to data on the seasonal distribution of atmospheric noise,[5] which shows reduction of approximately 19 decibels (nearly 100 times) during winter months as compared to summer. It follows that in many areas reception is now generally noise-free and satisfactory during winter although quite unsatisfactory during summer—thus depressing the grade of service on an annual norm basis—and that an approximately hundredfold increase in power to five megawatts would be necessary during summer months to secure noise-free service equivalent to that now available at the existing power during the winter months. However, nighttime conditions extend for several hours more each day during winter at most latitudes in the United States, than during summer. Thus nighttime skywave signals are of maximum quality at the time when maximum daily use thereof can be made. Conversely, during the long summer days, the daytime groundwave service is, on balance, of increasing significance. Already, basically free of station interference, groundwave service during these hours has been further augmented by the assignment of daytime stations in various parts of the country for operation during the hours between local sunrise and sunset, and the assignment of increased facilities to unlimited time regional and local stations during these hours. As a cumulative result, multiple groundwave services are available during daytime hours in most areas and there is almost no area to be found within the entire United States, excepting possibly Alaska and Hawaii, wherein there is an absence of all service meeting the groundwave service standards formulated during the course of the proceedings herein.

9. These considerations in our view offset to an extent the arguments offered in support of authorizing higher power for Class I stations. However, before reaching final decision on higher power, we deem it appropriate to afford an opportunity for all interested parties to submit such additional comments and data as will reflect changed conditions since 1946 when the basic record on this aspect of the proceeding was made.

10. During nighttime hours more than half the land area of the United States receives no groundwave service from any stations. Termed "white area," such is comprised principally of the rural and smaller urban communities throughout the U. S. As of May 1947, the total amount of "white area" was 1,802,665 square miles which amounted to 60.59 per cent of the total land area. Based on the 1940 Census a population of 23,252,000 lived in white areas. Between May 1947 and January 1957, fulltime stations increased from 1,339 to 1,875. The decrease in white area, however, has not been significant. The January 1957 white area totals 1,725,095 square miles which represents 57.99 per cent of the total land area. The population residing therein has increased to 25,631,259. With reference to geographical distribution, while the bulk of such area (74.8 per cent) is located west of the Mississippi River the bulk of the 1957 population residing therein (18,277,835 or 71.3 per cent) lives east of the Mississippi River. None of the figures include Alaska or Hawaii. A map of the population distribution according to the 1950 Census is attached as Appendix A.

11. Principal areas with no groundwave service during nighttime hours are located in northern New England, in the more mountainous regions of the Middle Atlantic States, throughout the South, in the northernmost part of the Great Lakes Area, within the great plains, and in many mountainous areas of the West. A map of nighttime groundwave service is attached as Appendix B.

12. The April 15, 1958 Notice stated that there are severe limits on the possibilities for reducing white areas by creating new groundwave coverage from new or expanded standard broadcast stations. This limitation is essentially basic due to the necessary limitation on the number of channels available for standard broadcasting and the disruptive interference which occurs in such great areas when two or more stations transmit during nighttime hours on the same frequency at the same time. Satisfactory reception in the presence of interference is limited to those areas sufficiently close to a transmitting antenna to receive a signal strong enough to buffet out the ambient interference on the channel. It has been ascertained that the service area to interference area ratio (area efficiency) of the generally shared (regional) channels is less than one per cent, despite the use of directional antennas to minimize interference among stations. Thus we conclude that we should limit our consideration, with respect to a sharing of the clear channels, to the assignment of new stations in specifically delineated geographical areas which could be determined upon the basis of need for the new or additional service and availability of an assignment to that area with minimum impact on the existing service under the service and interference criteria of Part I hereof.

The Further Proceeding

13. In this part (Part III) of the proceeding the Commission will give consideration to two matters. First is amendment of the Rules so as to provide for the assignment of new Class II station on each of the frequencies listed in Table I attached hereto. Each new Class II station on these frequencies would be licensed within a prescribed geographical area; viz., within a specified state or within one of two or more jointly specified states as set forth completely in Table I below and also shown on the map attached hereto as Figure I.[6] The Class I stations now licensed to operate exclusively in the United States on these channels, listed in Table I, would continue to operate with 50 kilowatts of power but would share operation on the channel with one newly licensed station located in the designated area. Each new station licensed under the amended rule would be required to install a directional antenna,[7] designed to control the direction of radiation of energy in order to provide a satisfactory degree of protection from harmful interference to the existing service in the United States on these channels. In order to secure maximum coverage by the new station, each new license would authorize operation with not less than 10 kilowatts of power.

14. The operations of KFAR, Fairbanks, Alaska, on 660 kilocycles and of KOB, Albuquerque, New Mexico, on 770 kilocycles are deemed to meet the criteria of this notice for purposes herein, with no additional assignments on these two channels. These are the two exceptions concerning channels listed in paragraph (a) of § 3.25, to which reference is made in an above paragraph.

15. In the case of each of the 23 remaining channels, some portion or all of the state or states selected for the new Class II assignments is more than 1,250 miles distant from the existing Class I station on the channel. Under this criterion there follows, from the geographical distribution of the existing Class I stations, the suitability of a greater number of channel assignments in the western states as compared with the central

[4] Skywave service of a clear channel station, under Exhibit 109, is considered to be limited by the noise from electrical apparatus to the 250 microvolt per meter contour in rural areas (Para. B3(c)(5) and to 0.5 millivolt per meter contour in urban areas (Para. F of Exhibit 109).

[5] Noise is highest in summer and lowest in winter at temperate latitudes; varies with frequency, decreasing with increasing frequency; and varies with geographic location, highest levels being encountered in equatorial regions and the lowest levels in the polar regions. Worldwide Radio Noise Levels Expected in the Frequency Band 10 Kilocycles to 100 Megacycles; National Bureau of Standards, NBS Circular 557, August 1955.

[6] Filed as part of the original document.

[7] FCC, Office of Chief Engineer, Technical Research Division, T.R.R. Report 1.2.7, September 6, 1957: Suppression performance of directional antenna systems in the broadcast band.

states, and in the central states as compared with the eastern states; thus other factors being equal, the easternmost state or group of states suitable under the criterion is indicated on Table I and Figure I in each instance. Consideration has also been given to: (1) The need for protection of foreign station coverage, in accordance with the North American Regional Broadcasting Agreement and the Agreement between the United States of America and the United Mexican States concerning Radio Broadcasting in the Standard Broadcast Band; (2) the need for adjacent channel interference protection; (3) the selection of a state or states in which the particular channel could be assigned anywhere within a wide area rather than in only a few limited locations; (4) the avoidance of adjacent channel assignments in adjacent states or in adjacent groups of states, to avoid interdependence between new assignments in adjacent regions; and (5) the placement of the new assignments in many states rather than multiple assignments in a few states.

16. There are indicated in the maps attached as Exhibit C[6] examples of the general impact upon the present capacity of the channels for skywave service resulting from 10 kilowatt directional antenna operation of new Class II stations at centralized geographic locations under Table I. These are included in the notice for illustrative purposes only, to show the general effect of the assignments listed therein. They should not be considered to constitute a determination that the capacity of these channels should be so delimited. A decision on those issues in this proceeding relating to sharing of channels, as indicated above, will not be reached prior to our determination upon the other issues herein.

17. As stated above, the Commission has decided to afford all interested parties an opportunity, at this stage of the proceeding, to provide comments and data concerning proposals that clear channel stations be authorized power in excess of the present maximum of 50 kilowatts. While the Commission is not persuaded, on the basis of the present record, that the authorization of higher power would be in the public interest, we defer final decision on the proposals for higher power until we have an opportunity to review the entire question in the light of updated comments and data.

18. All interested persons are invited to file, on or before November 20, 1959, comments concerning:

(1) The plan of assigning new unlimited time stations to the clear channels listed on Table I and reflected in Figure I, attached hereto.

(2) The use, by Class I-A clear channel stations, of power in excess of 50 kw,

under any of the proposals of record in this proceeding or any other proposals which interested parties may desire to submit. Parties desiring to do so may incorporate by reference submissions made heretofore in this proceeding.

Comments in reply to the original comments may be filed within thirty days from the last day for filing said original data, views, or arguments. No additional comments may be filed unless (1) specifically requested by the Commission, or (2) good cause for the filing of such additional comments is established. The Commission will consider such comments prior to taking final action in this matter. The requisite statutory authority is contained in sections 4 (i) and 303 of the Communications Act of 1934, as amended.

19. In view of the comprehensive nature of the proceeding herein and the desirability of concluding the proceeding as soon as possible it is desired that parties submit as much evidence as possible in the exhibits which they plan to submit. All proposals and counterproposals made in the comments should supply specific data relied upon to establish the need for, and the extent of desired new service which would be provided in the particular community or communities affected; and the resulting interference limitation arising therefrom upon existing service through the confusions of the received signals.

20. In accordance with the provisions of § 1.54 of the Commission's rules and regulations, an original and 14 copies of all statements, briefs, or comments shall be furnished the Commission.

TABLE I—NEW CLASS II UNLIMITED TIME ASSIGNMENTS ON CLEAR CHANNELS

Channel (kc)	Existing Class I station	State in which Class II assignment proposed
640	KFI, Los Angeles	Pennsylvania or Maryland or Virginia or W. Virginia
650	WSM, Nashville	Montana
660	WNBC, New York	See par. above
670	WMAQ, Chicago	Idaho
700	WLW, Cincinnati	Utah
720	WGN, Chicago	Nevada
750	WSB, Atlanta	Arizona
760	WJR, Detroit	Idaho
770	WABC, New York	See par. above
780	WBBM, Chicago	Nevada
820	WBAP/WFAA, Ft. Worth/Dallas	Washington
830	WCCO, Minneapolis	California
840	WHAS, Louisville	Alaska
870	WWL, New Orleans	Oregon
880	WCBS, New York	No. or So. Dakota or Nebraska
890	WLS, Chicago	Utah
1020	KDKA, Pittsburgh	New Mexico
1030	WBZ, Boston	Montana or Wyoming
1040	WHO, Des Moines	Oregon or Wash.
1100	KYW, Cleveland	Colorado
1120	KMOX, St. Louis	Calif. or Oregon
1160	KSL, Salt Lake C.	No. or So. Carolina
1180	WHAM, Rochester	Wyoming
1200	WOAI, San Antonio	N. Y. or Vermont or New Hampshire or Maine
1210	WCAU, Philadelphia	Kansas or Nebraska or Oklahoma

[F.R. Doc. 59-8035; Filed, Sept. 24, 1959; 8:49 a.m.]

DAYTIME SKYWAVE TRANSMISSIONS

Miscellaneous Amendments

In the matter of promulgation of rules and regulations and standards of good Engineering Practice concerning Daytime Skywave Transmissions of Standard Broadcast Stations, Docket No. 8333.

1. This proceeding was instituted by a Notice of Proposed Rule Making adopted May 8, 1947, "to receive evidence concerning the existence and extent of daytime skywave transmissions of Standard Broadcast Stations and to promulgate whatever rules and regulations may be necessary." The purpose, then, of this proceeding is to determine:

(1) The existence and extent of skywave transmissions of standard broadcast stations during daylight hours;

(2) Whether, in light of the Commission's basic allocation policies, stations receive an adequate degree of protection from such interference as may be caused by daytime skywave transmissions;

(3) If they do not, whether the Commission's rules should be revised to accord additional protection from such interference.

In March 1954 a Proposed Report and Order herein was adopted, announcing certain tentative conclusions which are referred to below (see FCC 54-333, 10 Pike & Fischer R.R. 1541).

2. Section 303 (f) of the Act provides inter alia that the Commission shall "make such regulations not inconsistent with law as it may deem necessary to prevent interference between stations." By this section, the Commission is delegated the authority to determine the extent to which stations shall be protected against interference, and, concomitantly the authority to determine the extent to which interference between stations shall be permitted to exist. This broad delegation leaves within our discretion (subject to the always-present criterion of the public interest) both the determination of what degree of interference shall be considered excessive, and the methods by which such excessive interference shall be avoided.[1]

3. The present proceeding is concerned with the standard broadcast (AM) band, from 540 kc to 1600 kc. Whenever two or more standard broadcast stations operate simultaneously on the same or closely adjacent frequencies, each interferes to some extent with reception of the other. The extent of such interference—which may be so slight as to be undetectable at any point where either of the stations renders a usable signal, or may be so great as to virtually destroy the service areas of both stations—depends on many factors, among the principal ones being the distance between the stations, their respective radiated power, and, of particular significance here, the time of day. Other factors playing a part in the extent of AM service and interference are the frequency involved, the time of year, the position of the year in the sunspot cycle, ground conductivity along the transmission path, atmospheric and man-made noise, and others. With the existence of these many factors, some of them variable, it obviously has never been and is not now possible for the Commission to make assignments of AM stations on a case-to-case basis which will ensure against any interference in any circumstances. Rather, such assignments are made, as they must be, on the basis of certain over-all rules and standards, representing to some extent a statistical approach to the problem, taking into account for each situation some of the variables (e.g. power and station separations) and averaging out others in order to achieve the balance which must be struck between protection against destructive interference and the assignment of a number of stations large enough to afford optimum radio service to the nation. An example of the over-all standards applied is the 20-to-1 ratio established for the determination of that degree of co-channel interference which is regarded as objectionable. By this standard, it is determined that where two stations operating on the same frequency are involved, objectionable interference from Station A exists at any point within the service area of Station B where Station A's signal is of an intensity 1/20th or more of the strength of Station B's signal at that point.

4. The 20-to-1 ratio for co-channel interference embodies one of the fundamental limiting principles which we must always take into account in AM assignments and allocations — that signals from a particular station are potential sources of objectionable interference over an area much greater than that within which they provide useful service. A second fundamental principle is that involved particularly in the present proceeding — the difference between nighttime and daytime propagation conditions with respect to the standard broadcast frequencies. This is a phenomenon familiar to all radio listeners, resulting from reflection of skywave signals at night from the ionized layer in the upper atmosphere known as the ionosphere. All AM stations radiate both skywave and groundwave signals, at all hours; but during the middle daytime hours these skywave radiations are not reflected in any substantial quantity, and during this portion of the day both skywave service and skywave interference are, in general, negligible.

[1] The material which was for many years contained in the Commission's "Standards of Good Engineering Practice Concerning Standard Broadcast Stations" was in 1955 incorporated into Part 3 of our rules, as §§ 3.181 to 3.190 thereof.

But during nighttime hours the skywave radiations are reflected from the ionosphere, thereby creating the possibility of one station's rendering service, via skywave, at a much greater distance than it can through its groundwave signal, and at the same time vastly complicating the interference problem because of the still greater distance over which these skywave signals may cause interference to the signals of stations on the same and closely adjacent frequencies. Because of the difference between daytime and nighttime propogation conditions, it has been necessary to evolve different allocation structures for daytime and nighttime broadcasting in the AM band, with many more stations operating during the day than at night.

5. It was recognized years ago that the transition from daytime to nighttime propagation conditions, and vice versa, is not an instantaneous process, but takes place over periods of time from roughly two hours before sunset until about two hours after sunset, and again from roughly two hours before sunrise until some two hours after sunrise. During the period of about four hours around sunset, skywave transmission conditions are building up until full nighttime conditions prevail; during the same period around sunrise skywave transmission is declining, until at about two hours after sunrise it reaches a point where it becomes of little practical significance. However, in this case as elsewhere it was necessary to arrive at a single standard to be applied to all situations, representing an averaging of conditions, and thus to fix particular points in time which would be considered the dividing points between daytime and nighttime conditions. It was determined that the hours of sunrise and sunset, respectively, should be used for this purpose. Accordingly, the 1938-1939 rules adopted these hours as limitations upon the operation of daytime stations. Class II stations operating on clear channels are required to cease operation or operate under nighttime restrictions beginning either at local sunset (for daytime Class II stations) or sunset at the location of the dominant Class I station where located west of the Class II stations (for limited-time Class II stations).

The same restrictions apply after local sunset in the case of Class III stations operating on regional channels, which after that time are required to operate under nighttime restrictions in order to protect each other. With respect to nighttime assignments, the degree of skywave service and interference is determined by skywave curves (Figs. 1 and 2 of § 3.190 of the rules (giving average skywave values. These curves were derived by an analysis of extensive skywave measurement data. It was recognized that skywave signals, because of their reflected nature, are of great variability and subject to wide fluctuations in strength. For this reason, the more uncertain skywave service was denominated "secondary" in our rules, as compared to the steadier, more reliable groundwave "primary service", and, for both skywave service and skywave interference, signal strength is expressed in terms of percentage of time a particular signal-intensity level is exceeded — 50 percent of the time for skywave service, 10 percent of the time for skywave interference.

Allocation Policies

6. As mentioned, the allocation of AM stations represents a balance between protection against interference and the provision of opportunity for an adequate number of stations. The rules and policies to be applied in this process of course must be based on objectives which represent what is to be desired if radio service is to be of maximum use to the nation. Our objectives, as we have stated many times, are:

(1) To provide some service to all listeners;

(2) To provide as many choices of service to as many listeners as possible;

(3) To provide service of local origin to as many listeners as possible.

Since broadcast frequencies are very limited in number, these objectives are to some extent inconsistent in that not all of them can be fully realized, and to the extent that each is realized, there is a corresponding reduction of the possibilities for fullest achievement of the others. Accordingly, the Commission has recognized that an optimum allocation pattern for one frequency does not necessarily represent the best pattern for other frequencies, and has assigned different frequencies for use by different classes of stations. Some 45 frequencies are assigned for use primarily by dominant Class I-A or Class I-B clear channel stations, designed to operate with adequate power and to provide service—both groundwave and (at night) skywave—over large areas and at great distances, being protected against interference to the degree necessary to achieve this objective. In dealing with these frequencies, the objective listed first above—provision of service to all listeners—was predominant; the other objectives were subordinated to it. The Class I stations on these clear channels are protected to their 0.1 mv/m groundwave contours against daytime co-channel interference. With respect to skywave service rendered at night, Class I-A stations are the only stations permitted to operate in the United States on clear channels specified for Class I-A operation, and so render skywave service free from co-channel interference wherever they may be received; Class I-B stations are protected at night to their 0.5 mv/m 50 percent time skywave contours against co-channel interference. Since the provision of skywave service requires adequate freedom from interference only Class I stations are capable of rendering skywave service. But nighttime operation by stations of other classes of course entails skywave interference to groundwave service, interference which is substantial unless steps are taken to minimize it.

7. With respect to other frequencies, these are designated as regional or local, and assigned for use by Class III and Class IV stations, respectively, stations operating generally with lower power. In the allocation pattern worked out for these frequencies, the provision of long-range service has to some extent been subordinated to the other two objectives —assignment of multiple facilities, and assignment of stations in as many communities as possible.

8. As mentioned, the primary allocation objective to be followed in the allocation of stations on clear channels is the provision of widespread service, free from destructive interference. During nighttime hours, because of the intense skywave propagation then prevailing, no large number of stations can be permitted to operate on one of these channels, if the wide area service for which these frequencies are assigned is to be rendered satisfactorily by the dominant stations which must be relied upon to render it. Therefore, under our long-standing allocation rules, on some of these channels no station other than the dominant (Class I-A) station is permitted to operate at night, so that the I-A station can render service, interference-free, wherever it can be received. On the remainder of the clear channels, the dominant (Class I-B) stations are protected as described above, and the relatively small number of secondary (Class II) stations permitted to operate on these channels at night are required to operate directionally and/or with reduced power so as to protect the Class I stations. In the daytime, on the other hand, since skywave transmissions is relatively inefficient, it is possible to assign a substantially larger number of stations on these channels. Additional Class II assignments for daytime operation can be made without causing destructive interference to the Class I stations or to each other, and by their operation provide additional service on these channels and additional local outlets for a large number of communities. Such additional daytime Class II assignments are appropriate if optimum use is to be made of these frequencies, and the Commission has over the years made a large number of them. Similarly, on the regional channels many Class III stations have been assigned either to operate daytime only or to operate nighttime with directional antennas and/or lower power.

9. Essentially, the question presented for decision in the present Daytime Skywave proceeding is whether our decision (in 1938-1939) to assign stations on the basis of daytime conditions from sunrise to sunset, is sound as a basis for AM allocations, or whether, in the light of later developments and new understanding, skywave transmission is of such significance during the hours immediately before sunset and after sunrise that this condition should be taken into account, and some stations required to afford protection to other stations during these hours.

The History of the Proceeding

10. The decision reached in 1938-1939 was made after the accumulation of a large amount of data and thorough study thereof. Since then, there has been a notable increase in the number of stations and also the accumulation of additional data and the development of new techniques for using it, leading to a better understanding of propagation phenomena. In 1947, affidavits were filed with the Commission by various clear channel stations alleging that extensive interference was being caused to the service areas of these stations during daylight hours, from Class II stations whose signals were being reflected from the ionosphere so as to create skywave interference. These assertions were the basis of appeals to the United States Court of Appeals for the District of Columbia, which in one case, on the basis of the claims, stayed the effectiveness of a construction permit issued by the Commission. In the light of these complaints and the increase in knowledge, the Commission recognized the need for a re-evaluation of the problems arising during these transitional hours. Accordingly, in May, 1947 the Notice of Proposed Rule Making in this proceeding was adopted. Hearings were held before a Board of Commissioners in June, 1947. In December, 1947 the Commission consolidated this matter with the Clear Channel proceeding (Docket 6741) and Oral Argument was held before the Commission in both proceedings. In August, 1953 the Commission severed the present proceeding from Docket 6741.

The 1954 Report and Order, and Subsequent Developments

11. On March 11, 1954, we adopted herein a Proposed Report and Order and Notice of Proposed Rule Making. Therein, we described at length the background and history of this matter, and announced certain tentative conclusions. These may be summarized as follows: (1) the record shows that skywave transmission during the transitional hours before sunset and after sunrise is of significant amount, and hence Class II stations cause considerable interference in some cases during these hours to Class I stations operating on the same frequency (the case of Station WCKY, Cincinnati, was noted particularly); (2) it is appropriate to consider correcting limitations only with respect to protection of Class I stations, since the record compiled herein dealt chiefly with interference to such stations and since, furthermore, the reason compelling the readjustment is the necessity of affording

some service to all areas and population. This is a primary objective in the allocation of Class I stations which are not intended to be subjected to extensive interference, whereas in allocation of other classes of stations other objectives are of more importance and interference is tolerated to a greater extent; (3) Class I stations should be protected on the basis of conditions as of sunset minus two hours, further limitation on Class II stations being too restrictive and this one representing a reasonable balance; (4) such limitation should be confined to the period of two hours before sunset and two hours after sunrise, and not extended through the remainder of the daylight period, because any additional protection during these hours is needless and unwarranted; (5) the protection of Class I stations against skywave interference during these daylight hours, which is in addition to whatever protection is afforded by our present rules concerning groundwave service and interference, should be limited to protection from co-channel skywave interference, since any adjacent-channel interference at SS minus 2 hours is so slight as not to require any protection rule; (6) with respect to all hours of the day other than the two hours before sunset and two hours after sunrise, existing rules would apply to assignment and the determination of interference, including use of the existing skywave curves for determination of nighttime radiations.

12. To implement these conclusions, we proposed the adoption of certain curves and a table (see Report and Order of March 11, 1954, Appendix II), from which there could be computed the maximum permissible radiation from a Class II station, on a given frequency and at a given distance and azimuth from the 0.1 mv/m groundwave contour of the co-channel Class I station, in the direction of that station, during the two hours before sunset and two hours after sunrise. The computation process involved determining from two sets of curves two figures of millivolts per meter (varying with distance from the Class I station's 0.1 mv/m contour and azimuth between the stations), multiplying each of these figures by a constant given for each frequency, and adding the sum of the two products thus obtained, to get the permissible radiation for the Class II station at the given distance and azimuth and on the given frequency. Through the use of these curves, the effect of frequency is taken into account in each individual case. We noted that the record shows that skywave transmission and interference are substantially greater at higher frequencies; therefore, in order to equalize interference conditions across the band (which is desirable especially because Class I stations on the higher clear channels are limited in their groundwave service because of poorer groundwave propagation) more restriction on Class II stations is required in the higher frequencies than on the lower channels.

13. Our Proposed Report and Order contained other proposals, relating to termination of the operation by limited-time Class II stations located east of the dominant Class I station during the "bonus hours" between local sunset at the location of the Class II station and sunset at the location of the Class I station, and relating to a partial lifting of the "freeze" on the processing of applications for facilities on clear channels. With respect to the scope of our proposed revisions, in the Report and Order itself it was proposed only to apply them to future authorizations; the question of the applicability of the proposed restrictions to presently existing stations was made the subject of a Notice of Further Proposed Rule Making issued at the same time. Lastly, we decided that instead of issuing the Report and Order in final form we would issue it as a proposal, with comments thereon to be received and oral argument held.

14. Oral argument on the proposals for prospective assignments was held on July 15, 1954. On January 26, 1955, the Commission adopted a Notice stating that:

* * * the Commission is of the present view that the proposal of the Commission upon which oral argument was held would appear to present a more equitable basis for a change in the Commission's Rules than any of the counterproposals submitted in the proceeding. Upon such review, however, we are not convinced that we should make final our judgment in this respect without the benefit of the comments which are to be submitted in the portion of this proceeding raising the question of the application of any rules that may be adopted to existing stations as well as to prospective applications * * *

Comments and replay comments were received until May 1, 1955.

15. Only two parties to the proceeding supported adoption of the Proposed Report and Order. All of the others opposed it, on various grounds. There was attack on the conclusions reached as to the existence and effect of skywave transmission during the transitional hours involved, including assertions that the data used as a basis was inadequate and/or not properly analyzed, that the extrapolation employed with respect to time of day and as to distance was not proper, that no consideration was given to finite ground conductivity and that groundwave rules used were based on soil conductivity values since superseded by a new soil conductivity map. It was also asserted that no adequate studies of areas and populations which would be affected by the proposed rules had been made. Some parties urged that the protection proposed is not sufficient, for example, that conditions at sunset or SS minus one hour should be considered as the basis instead of conditions at SS minus two hours. Many Class II and Class III stations urged that their operations should also be protected. Other parties urged that too much protection would be afforded; one aspect of this attack was upon the concept of affording protection to a Class I station's 0.1 mv/m groundwave contour, and it was argued that fading, noise, etc., make service out as far as that contour of little value in any event. It was also argued that daytime protection standards should be worked out and applied to particular situations where necessary, on a case-to-case basis. It was also urged that our judgment involved policy considerations which should not be decided out of the context of the clear channel proceeding. There was also attack on the Report and Order on procedural grounds—lack of sufficient notice with respect to the proposed changes; that the proposed changes in the Introduction to the Standards were "major" and "substantive" rather than "minor" or "editorial", and therefore required a separate rule making proceeding; that parties could not comment on the proposed rules without knowing

whether or not they would be retroactive so as to affect their operations; and that the proceeding as pursued amounted to a modification of existing license without the required procedures.

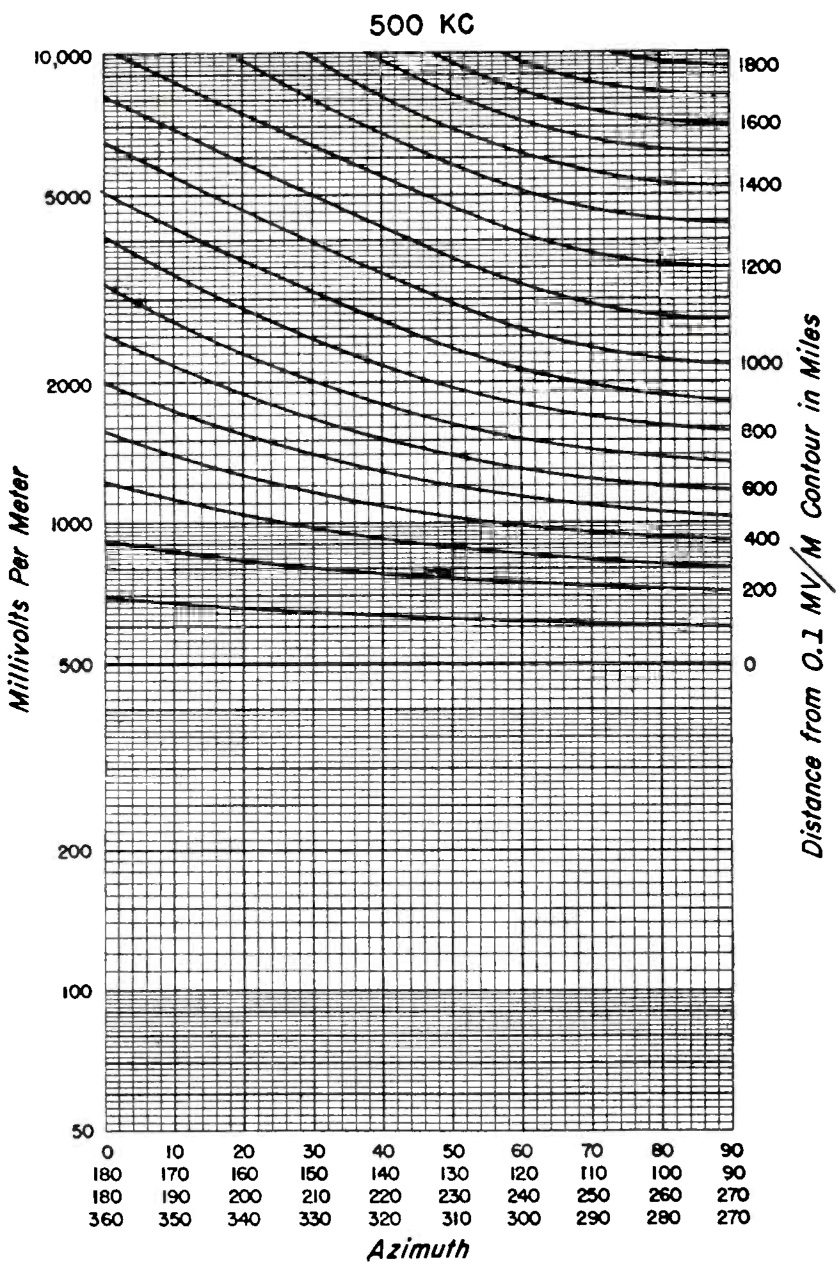
Decision

16. Upon review of our 1954 action and the comments concerning it, we affirm the basic conclusions therein reached. With respect to the adequacy of the record and the analysis to support our conclusions, we believe the showing is sufficient and probative. As we pointed out in the Proposed Report and Order (par. 21) a Commission witness introduced evidence of 6 years of recordings made on 17 transmission paths involving clear channel stations, from which curves have been derived. These curves indicate the existence of skywave transmission and interference during the transitional hours before sunset and after sunrise, and afford a reasonably accurate and suitable tool for determining the extent thereof, on an average basis. We dealt with certain objections to the statistical treatment used (Footnote 12). In paragraph 22 we referred to two specific examples of the extent of interference during these periods, interference suffered by clear channel stations WCKY (Cincinnati) and KOA (Denver) from Class II stations in Philadelphia and in Clayton, Missouri, respectively. These examples illustrate the problem. In Footnote 16 of that document we set forth the method of extrapolation used with respect to distances of over 1,000 miles and frequencies higher than 1500 kc. We affirm our Proposed Report and Order in these respects.

17. As to the degree of protection to be afforded, we are convinced that the concept which we tentatively adopted in our 1954 decision is correct, and that the 0.1 mv/m groundwave contours of Class I stations should be protected against that degree of co-channel daytime skywave interference which would otherwise exist at sunset minus two hours. It is, of course, possible to consider other alternatives, in either direction, ranging from protection of the 0.1 mv/m contour at sunset on the one hand, to no protection at all on the other. It does not appear that any of these other alternatives is to be preferred, keeping in mind the necessity of reaching an appropriate balance between the objectives of sufficient protection and provision for adequate service by a sufficient number of stations during daytime hours. It is apparent that this degree of protection, based as it is on conditions as of sunset minus two hours, involves relatively minor limitations upon Class II stations. These restrictions are the least which we can appropriately impose if the service of clear channel Class I stations — whose function and purpose is to provide widespread service to large areas and populations, in furtherance of our objective of bringing some service to all — is not to be seriously disrupted by the great number of daytime operations for which applications are now on file and may be expected in the future. For reasons stated in our earlier decision and repeated above herein (par. 11) we do not extend this protection to other classes of stations, nor do we adopt any restrictions designed to afford protection against adjacent-channel daytime skywave interference.

18. As to the method by which the appropriate protection standard would be applied in each case and the resulting restriction determined, in our Proposed Report and Order (par. 29) we proposed to adopt permissible-radiation curves, from which the maximum radiation permitted for a Class II station in the direction of a co-channel Class I station, on a given frequency, at a given azimuth from the Class I station, and at a given distance from the Class I station's 0.1 mv/m groundwave contour, could be determined. These curves and the accompanying tables were set forth in Appendix II of the Proposed Report and Order. It has been argued that the computational process involved in the use of these curves — which involves obtaining values from two of the three charts, multiplying each of the two values thus obtained by a constant for the particular frequency, and adding the

PERMISSIBLE DAYTIME RADIATION
FOR CLASS II STATIONS



sum of the two resulting products—is too complex. This argument must be rejected, because we know of no simpler means which can be employed with anything like the same degree of accuracy, and the process does not appear unduly burdensome. Therefore we adopt the material which was set forth in the earlier Proposed Report and Order and is set forth again in the present Report and Order.

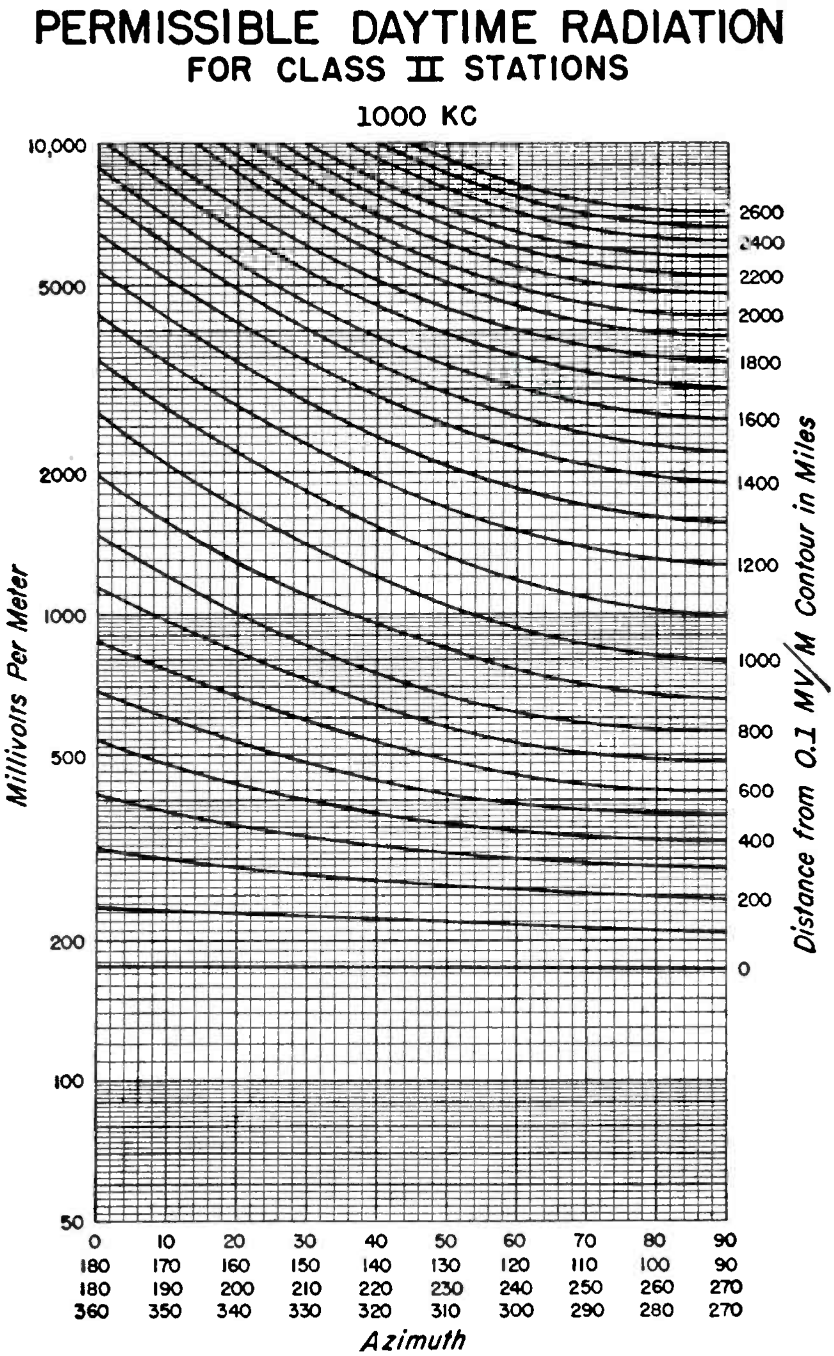
19. In the 1954 Proposed Report and Order, we proposed to apply these restrictions to the transitional periods of two hours before sunset and two hours after sunrise. In this connection we rejected (Paragraph 28) the concept that the limiting curves should be made applicable to the entire daytime period, holding that protection against daytime skywave interference during the middle daytime hours is unwarranted. We adhere to this determination. Accordingly, the permissible radiation curves adopted herein are applicable during the transitional periods of two hours before sunset and two hours after local sunrise.

Scope of Application of the Restrictions

20. In our earlier Proposed Report and Order, we proposed to apply the restrictions outlined to applications for new or changed Class II facilities; we left open the question of whether they should be applied likewise to existing Class II stations, issuing at the same time a Notice of Further Proposed Rule Making on that subject. In that Notice we enumerated four classes of existing stations—daytime-only Class II, limited-time Class II, unlimited-time Class II, and Class I-B stations located to the east of other co-channel I-B stations and beginning nighttime operation at the hour of sunset at the western Class I-B station. We expressed the tentative conclusion that as to existing daytime-only and limited-time stations, it was not desirable to apply the proposed restrictions to them. We did not express any tentative conclusion as to the other two classes of stations involved, and left the whole question open in the further rule making.

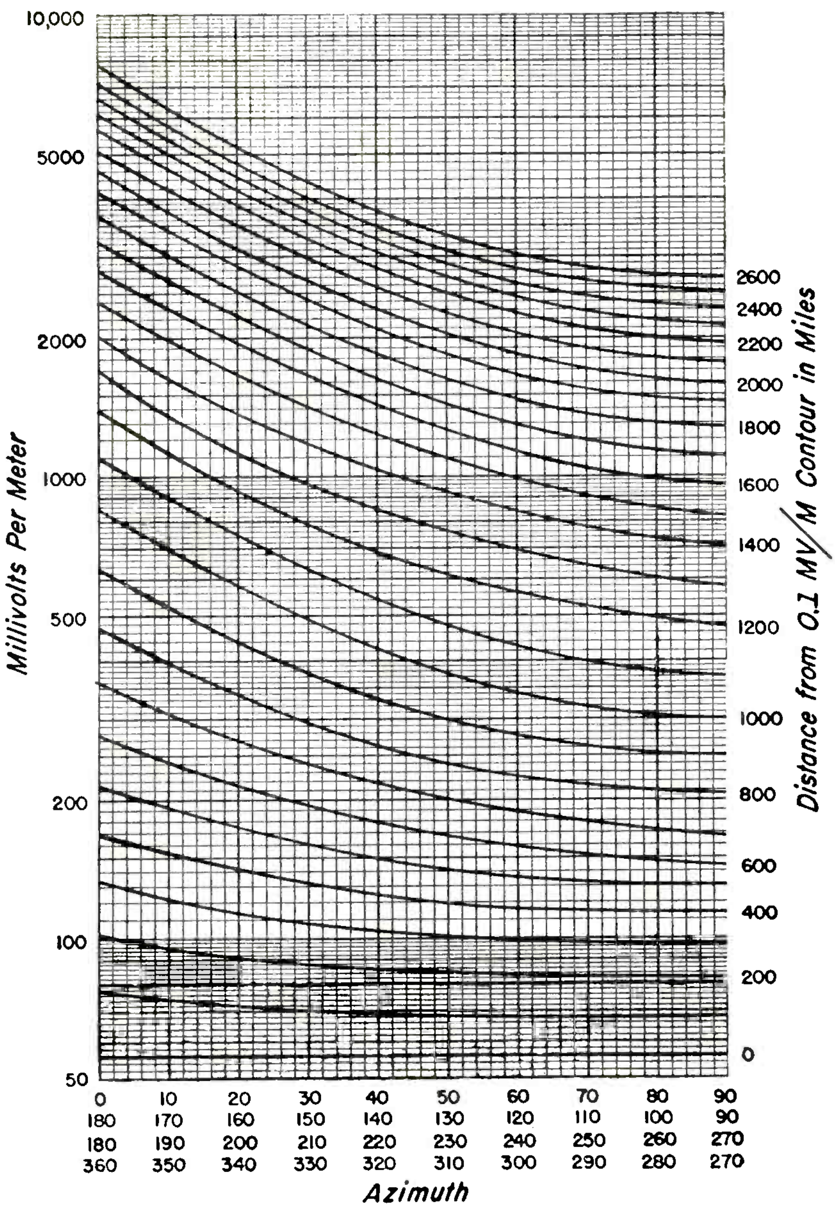
21. We adhere to the conclusion previously reached tentatively, and also conclude that the same considerations apply to the other two classes of stations mentioned. The existing stations involved (daytime, limited-time and unlimited-time Class II stations, and the easternmost of co-channel Class I-B stations) now render significant service, during the hours involved, to which listeners have become accustomed and come to rely upon. While, as mentioned, use of clear channels by Class II stations is essentially a secondary use, the stations which have been so operating have come to form a significant part of standard broadcast service. A fortiori, the same principle applies to the I-B stations involved. We must also take into account the undoubted value of adequate service of local origin. It is to be noted that the contentions made herein by those parties urging restrictions against daytime skywave interference, have for the most part emphasized the effect of such interference from proposed or future operations, rather than from the smaller number of presently authorized Class II stations. The radiation restrictions adopted herein are intended primarily to guard against the more severe instances of additional skywave interference which could result from additional or changed Class II stations on the clear channels. Therefore the rule we adopt herein applies only to new or changed facilities to be authorized in the future. It should also be noted that the new rule is limited in scope so that the protection afforded by it (apart from the protection afforded by other rules and policies) extends only to United States Class I stations.[2]

22. In our 1954 decision we emphasized that any determination reached in this proceeding was subject to whatever decisions might ultimately be reached in the Clear Channel Proceeding (Docket No. 6741). As a general principle, this caveat still applies; this is one reason why we have maintained a "freeze" on certain classes of applications for facilities on clear channels. But that proceeding has been recently under active consideration and study, and it is possible at this point to make certain tentative judgments therein, as a result of



which we can limit the classes of applications on which action must continue to be deferred. We noted in our 1954 decision herein (paragraph 34) that the clear channels allocated for Class I-A operations are much more deeply involved in Docket 6741 than are the Class I-B clear channels. In the Further Notice of Proposed Rule Making issued in Docket 6741 on April 15, 1958 (FCC 58-350), we concluded that there should be no change in the pattern of assignments on the I-B channels. We are today adopting another Further Notice in that proceeding, limited to possible assignments on the I-A channels. These developments make appropriate at this time certain changes in the scope of the "freeze", in two directions: (1) removing from the freeze those I-B frequencies which can have no relation, direct or indirect to possible changes in the I-A structure, and (2) changing the classes of applications covered by the freeze so as to reflect the impingement of such applications on the possible "clear channel" assignments rather than merely their daytime skywave effects. Accordingly, we are adopting simultaneously herewith an Order (FCC 59-971) amending § 1.351 of our rules so as to: (1) make the "freeze" apply pending a decision in Docket 6741; (2) remove from the freeze the frequencies 1500, 1510, 1520, 1530, 1540 and 1560 kc;[3] and (3) extend the freeze, in the case of applications for changes in existing facilities, to any proposal which would increase radiation or change station location.

PERMISSIBLE DAYTIME RADIATION
FOR CLASS II STATIONS
1600 KC



"Bonus" Hours of Limited-Time Stations

23. There remains one further matter. In our 1954 Proposed Report and Order, we tentatively concluded (par. 32) that both as to existing and as to proposed limited-time Class II stations, these stations which are located east of the dominant Class I station and are therefore under our present rules permitted to operate after their own local sunset time until the hour of sunset at the location of the Class I station, should be required to cease operation during these "bonus hours" and sign off at local sunset. We pointed out that during this "bonus" period the transmission path from the Class II station to the Class I station is largely one on which nighttime propagation conditions prevail, and therefore the resulting interference is substantial and should be eliminated. The present rules also permit existing Class II stations to operate during nighttime hours, if any, not used by the dominant Class I station or stations on the channel. In the main, however, the Class I stations operate throughout the nighttime hours, and thus the latter provision, in itself, is not particularly significant.

24. Upon review of this matter, we are persuaded that as to existing limited-time stations this decision should not be adopted. The considerations mentioned above, concerning the value of existing service by daytime and limited-time stations, applies equally in these situations. Accordingly, we adopt no change in the rules with respect to existing limited-time stations. The question remains as to whether any new assignment of stations on this basis should be made. We are of the view that no further assignments of this character are warranted. We pointed out in the Proposed Report and Order the extreme nature of the interference which may result from operation during these hours by the Class II station (paragraphs 22 and 32, referring to the Denver-Clayton (Mo.) situation). This becomes apparent when it is realized that at a moment just before sunset at the location of the Class I station, it may be considerably after sunset at the location of the Class II station, and nighttime conditions prevail at that point and over much of the transmission path to the west. While to a certain extent the effect of this interference would be lessened because new Class II facilities would be operating

[2] Daytime skywave interference may also exist between co-channel I-B stations. It is conceivable that, under some circumstances, consideration should be given to mutual protection between such stations in order to alleviate such interference. But since we conclude herein that no existing stations should be affected, it will be appropriate to decide the question of daytime skywave protection in such circumstances if and when it arises.

[3] The frequencies 940 kc and 1550 kc are of course no longer under the "freeze," having been removed by Order of July 28, 1958, amending § 1.351.

during these hours with facilities limited in accordance with the rule adopted herein, nonetheless the interference would be severe. Accordingly, it appears that we would not be justified in authorizing new stations on this basis and thus, except as to the stations now licensed, we are removing the provisions of the rules for the licensing of limited-time stations; the provisions for the licensing of the several other classes of stations being adequate in this respect.

25. In view of the foregoing, we are amending § § 3.23 (b) and 3.24 (b) of our rules, adding new § § 3.38 and 3.187, and adding three charts to § 3.190, to effectuate the conclusions discussed above. These changes are set forth below. Section 3.38 will state in substance that there will be no further limited-time authorizations. Section 3.197 will provide in substance that no authorization for new or changed Class II facilities will be granted if, during the four transitional hours, the radiation of the proposed station, in any direction toward the 0.1 mv/m contour of a co-channel United States Class I station, will exceed the values obtained by the use of that section. Section 3.187 will contain the table, and § 3.190 will contain (in addition to the material presently therein) the three charts, previously set forth in our 1954 Proposed Report and Order, and set forth below.

26. In our Proposed Report and Order of March, 1954 we had proposed amendment of § 3.7 (definition of "nighttime") and revision of the Introduction to the Standards of Good Engineering Practice (since then codified as § 3.181). Neither proposed amendment being necessary to the action taken herein, they are not adopted herein.

Order

27. In view of the foregoing: *It is ordered:*

(1) That effective October 30, 1959, Part 3 of the Commission's rules is amended as set forth below; and

(2) That this proceeding is terminated.

Adopted: September 18, 1959.

Released: September 22, 1959.

FEDERAL COMMUNICATIONS COMMISSION,

[SEAL] MARY JANE MORRIS, *Secretary.*

§ 3.23 [Amendment]

1. Section 3.23 (b) is amended to read as follows:

(b) Limited time is applicable to Class II (secondary) stations operating on a clear channel with facilities authorized before October 30, 1959. It permits operation of the secondary station during daytime, and until local sunset is located west of the dominant station on the channel, or if located east thereof, until sunset at the dominant station, and in addition during night hours, if any, not used by the dominant station or stations on the channel.

§ 3.24 [Amendment]

2. Section 3.24 is amended by the deletion of paragraph (h) thereof and the addition of the following paragraphs (h) and (i):

(h) That, in the case of an application for a Class II station, the proposed station would radiate, during two hours following local sunrise and two hours preceding local sunset, in any direction toward the 0.1 mv/m groundwave contour of a co-channel United States Class I station, no more than the maximum radiation values permitted under the provisions of § 3.187.

(i) That the public interest, convenience and necessity will be served through the operation under the proposed assignment.

3. The following new § 3.38 is added:

§ 3.38 Limited time authorizations.

No authorization for new Class II Limited Time facilities will be granted. No authorization for modification of existing Class II Limited Time facilities will be granted for a change in frequency, an increase in power, a change in antenna radiation pattern, or a change in station location.

4. The following new § 3.187 is added:

§ 3.187 Limitation on daytime radiation.

(a) No authorization for new or changed Class II facilities will be granted if the proposed Class II station would radiate, during two hours following local sunrise and two hours preceding local sunset, in any direction toward the 0.1 mv/m groundwave contour of a co-channel United States Class I station, values in excess of those obtained as provided in paragraph (b) of this section.

(b) To obtain the maximum permissible radiation for a Class II station on a given frequency (f-kc) from 640 kc through 990 kc, multiply the radiation value obtained for the given distance and azimuth from the 500 kc chart (Figure 9 of § 3.190) by the appropriate interpolation factor shown in the K_{500} column of paragraph (c) of this section; and multiply the radiation value obtained for the given distance and azimuth from the 1000 kc chart (Figure 10 of § 3.190) by the appropriate interpolation factor shown in the K_{1000} column of paragraph (c) of this section. Add the two products thus obtained; the result is the maximum radiation value applicable to the Class II station in the pertinent directions. For frequencies from 1010 kc to 1580 kc, obtain in a similar manner the proper radiation values from the 1000 kc and 1600 kc charts (Figures 10 and 11 of § 3.190), multiply each of these values by the appropriate interpolation factor in the K'_{1000} and K'_{1600} columns in paragraph (c) of this section, and add the products.

(c) Interpolation factors.

(1) Frequencies below 1000 kc.

(2) Frequencies above 1000 kc.

f kc	K_{500}	K_{1000}	f' kc	K'_{1000}	K'_{1600}
640....	0.720	0.280	1010....	0.983	0.017
650....	0.700	0.300	1020....	0.967	0.033
660....	0.680	0.320	1030....	0.950	0.050
670....	0.660	0.340	1040....	0 933	0.067
680....	0.640	0.360	1050....	0.917	0.083
690....	0.620	0.380	1060....	0.900	0.100
700....	0.600	0.400	1070....	0.883	0.117
710....	0.580	0.420	1080....	0.867	0.133
720....	0.560	0.440	1090....	0.850	0.150
730....	0.540	0.460	1100....	0.833	0.167
740....	0.520	0.480	1110....	0.817	0.183
750....	0.500	0.500	1120....	0 800	0.200
760....	0.480	0.520	1130....	0.783	0.217
770....	0.460	0.540	1140....	0.767	0.233
780....	0.440	0.560	1160....	0.733	0.267
800....	0.400	0.600	1170....	0.717	0.283
810....	0.380	0.620	1180....	0.700	0.300
820....	0.360	0.640	1190....	0.683	0.317
830....	0.340	0.660	1200....	0.667	0.333
840....	0.320	0.680	1210....	0.650	0.350
850....	0.300	0.700	1220....	0.633	0.367
860....	0.280	0.720	1500....	0.167	0.833
870....	0.260	0.740	1510....	0.150	0.850
880....	0.240	0.760	1520....	0.133	0.867
890....	0.220	0.780	1530....	0.117	0.883
900....	0.200	0.800	1540....	0.100	0.900
940....	0.120	0.880	1550....	0.083	0.917
990....	0.020	0.980	1560....	0.067	0.933
			1570....	0.050	0.950
			1580....	0.033	0.967

5. Section 3.190 is revised by adding new Figures 9, 10, and 11 and by amending the text to read as follows:

§ 3.190 Engineering charts.

This section consists of the following Figures 1, 2, R3, 5, 6. 6a. 7, 8, 9, 10, and 11.

The Life of a Wife of a Broadcast Engineer

(Continued from page 24)

interested in radio than they are in their family. This was evidenced, they stated, in complete preoccupation with their problems of engineering coupled with the fact that the majority of them brought work home with them, even to the extent of cluttering up the kitchen and living room with various experiments. Consensus of the spouses indicated that sometimes they wish that they had meters for eyes and looked like a radio transmitter so as to gain more attention.

Any form of social activity is lost since unpredicted transmitter breakdowns always occur at times that some event has been planned. The majority of the wives, for that reason, stopped planning any social events.

Although these complaints were 100 per cent throughout, the intensity seemed to be determined by the degree to which the engineer was involved in radio. Therefore, certain categories were quickly discovered. The intensity of the complaints were directly in proportion to the following four categories of engineering endeavor.

First degree — Straight broadcast engineer engaged in AM, FM, TV.

Second degree—Same as first except, also, a radio ham.

Third degree—Same as one and two except, also, a high-fi enthusiast.

Fourth (and worst) degree—An engineer who is a combination of one, two, and three but, also, is engaged in the art of FM multiplex operations.

Except for a few isolated cases, the condition was never found where any broadcast engineer ever engaged in such things as mowing the lawn or helping with household chores. Another unexpected fact that was uncovered was that very few of the engineer's children or grandchildren became interested in radio. Less than .9 per cent of the offspring ever became interested in the same profession as their father or grandfather.

This shows conclusively that the "radio disease" is non-communicable and is not inherited.

In inquiring of the wives as to whether or not they were playing an inspirational role for their husbands, the answer in all cases was negative since they felt their husbands were afflicted with a disease and needed no further inspiration. Each wife felt that she was alone in the world and no other wife could possibly have the same problems. At least, none of her neighbors or friends were in the same trouble. Since there is a lack of social intercourse between engineers' families there is no exchange of information.

Of those interviewed, 17 per cent volunteered that they believe there should be a federal law passed against radio engineers ever getting married.

In concluding this preliminary report, it must be recorded that the radio engineering fraternity owes more than it realizes to the little woman behind the scenes. Here then is a salute to the true unsung heroine of the industry—The Wife of the Broadcast Engineer.

Industry News

New Engineering Manager at Conrac

The new engineering manager of Conrac, Inc., Glendora, Calif., is Charles A. Nichols. He joins the Conrac technical staff assuming complete responsibilities of management of the engineering department.

Mr. Nichols has a long record in the electronics field. He brings to his new post 30 years of experience with several outstanding West Coast electronics manufacturers. Prior to his association with Conrac, he was vice-president in charge of engineering at Hoffman Electronic Corp., Consumer Products Division.

In his business affiliations Mr. Nichols lists senior membership in the Institute of Radio Engineers, and membership in the Audio Engineering Society, Society of Television Engineers, Veteran Wireless Operators Association. He is a registered professional engineer.

AES Convention Is Biggest In History

The Eleventh Annual Convention of the Audio Engineering Society which closed Oct. 9 at the Hotel New Yorker was the largest and most successful in AES history. Attendance was 25 per cent greater this year than last with more than one thousand AES members and guests registered to attend the technical sessions and visit the exhibits.

In the North Ballroom of the hotel, Society members and audio engineers had the opportunity, during the week-long convention, to see silent demonstrations of the newest professional audio equipment by companies prominent in the professional audio field. The increase in exhibitors this year was more than 50 per cent over 1958.

At the technical sessions more than 70 papers were read. Two full sessions were devoted entirely to audio applications, two to magnetic recording and reproduction, and two to stereo. Of significant interest to audio and broadcast engineers was the "Status Report of the National Stereophonic Radio Committee" given by Charles J. Hirsch, a member of the committee. The report was considered to be the first comprehensive survey of its kind, giving not only specifics about the NSRC and the status of its work to date, but general information on types of systems proposed for AM, FM and TV stereo broadcasting.

Ampex Ships 12 Videotape Television Recorders

Delivery of 12 more Videotape television recorders during the last week has been announced by Ampex Corp. Latest shipments bring the total of TV stations equipped to 154.

Most recent stations to install the Ampex equipment include KFDX-TV, Wichita Falls, Texas; KFDM-TV, Beaumont, Texas; WDBJ-TV, Roanoke, Va.; WHYY-TV, Philadelphia, Pa.; KOAC-TV, Corvallis, Ore.; KUAT-TV, Tucson, Ariz.; WILL-TV, Urbana, Ill.; WMSB-TV, East Lansing, Mich.; KDSP-TV, Des Moines, Iowa, and WTHS-TV, Miami, Fla. WGBH-TV, Cambridge, Mass., received its second Ampex machine, and a VTR was shipped to the University of Michigan.

Quinn Named to Eimac Marketing Position

A newly-created marketing position, manager of marketing operations, has been assumed by John R. Quinn at Eitel-McCullough, Inc., San Carlos, Calif., manufacturer of Eimac electron-power tubes.

Prior to this promotion, Quinn was manager of the customer services department at Eimac. He joined the company in April, 1958, as a member of the commercial marketing department. Before coming to Eimac, he was vice-president of a manufacturer of communications equipment and engineer-in-charge of International Short Wave, CBS, from 1945 to 1952. In addition, he was manager, technical operations, Radio Free Europe, in Munich, Germany, from 1952 to 1956.

Record Sales and Earnings at Adler Electronics

An extensive development program in the fields of communications systems, and low power UHF broadcasting and relaying resulted in record sales and profits for Adler Electronics, Inc.—despite a loss in the previous year due to the write-off of these developments. The company's annual report for the fiscal year ended June 27, 1959, showed earnings of $120,200 before taxes and $67,900 after taxes based on sales of $3,902,483—with write-off of continuing development costs included. Comparable figures for 1958 put sales at $3,169,384 with a net loss of $9,591.

In his annual progress review for stockholders, President Ben Adler predicts a steady rise in sales and profits based on the firm's concentration in areas where it has clearly defined and proven capabilities. Research and development activities will be stepped-up with the opening of the company's new 14,000 sq. ft. engineering building in December.

A major supplier of transportable communications systems for the Department of Defense, Adler Electronics also is a leader in the design and manufacture of low power UHF TV broadcast and repeater systems, TV microwave equipment, communication and data systems, and educational TV systems.

Pyle Becomes Director of Service at Collins

Herbert J. Pyle has been appointed to the newly created position of director of service at the Cedar Rapids Division of the Collins Radio Co.

Formerly vice-president of Precision Instrument Laboratories in Glendale, Calif., Pyle will be responsible for directing the service program for all of Collins products manufactured at its Cedar Rapids Division. They include flight communication, navigation and identification equipments, broadcast and amateur radio equipments and various ground-to-ground communications equipments and systems.

Dage Names Chapin Marketing Manager

The appointment of Wells R. Chapin to the newly-created post of manager of marketing for Dage Television Division, Thompson Ramo Wooldridge, Inc., was announced recently. James L. Lahey, manager of the Dage Division, said Chapin will be responsible for the division's rapidly expanding marketing activities.

He is a former chief engineer for *St. Louis Globe Democrat* stations KSLH and WIL, and a field engineer for Raytheon Mfg. Co. He has held the following positions with General Electric: district sales manager, Midwest; district sales manager, N. Y. C., and manager product planning—market research. He is an active amateur radio operator.

A graduate of St. Louis University, Chapin is a senior member of the I.R.E., and a member of the National Assn. of Educational Broadcasters.

Technical Hints

Turn on Transmitter Tube Filaments With Time Switch

The problem of insufficient tube warm-up, with its resulting harmful effects on tube life, has been eliminated for all time at our station. It used to be that operators, arriving late because of heavy traffic or heavy sleep, would turn the plates on almost as soon as the filaments were lit. Now, however, we have a time switch to turn the filaments on a good 15 minutes before sign-on time. The operator need only arrive at the last minute, punch the plate button, and we're on the air.

Dan Solo
Technical Director
KAFE
Oakland, Calif.

Gates BC-1J Modification

This transmitter uses two 10-watt, 220-volt pilot lights on the front panel. One indicates filament power and the other high voltage power. These lights are mounted in enclosed pilot light assemblies which after a few hours of operation become very hot. Due to the heat these bulbs failed in about four weeks of operation.

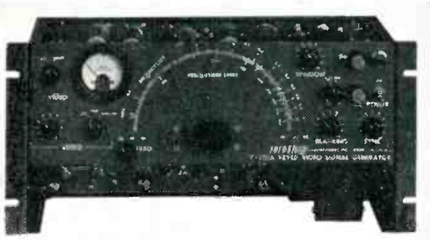
We solved this problem by inserting a 1500-ohm, 10-watt resistor in series with each bulb. This reduces the voltage to about 150 volts across the bulb, thereby reducing the heat generated and also reducing the current surge when power is applied. With this reduced voltage the bulbs will still light brightly. We made this modification over a year ago and haven't replaced a bulb since.

Albert J. Krukowski
Transmitter Engineer
WSPR
West Springfield, Mass.

Jampro Ships FM Antennas

Jampro Antenna Co. shipped a 12-bay FM antenna to WPTA-FM, Fort Wayne, Ind., and another 12-bay to WTTV-FM, Indianapolis, Ind., during the week of Oct. 13, 1959. An eight-bay Jampro antenna was shipped to KSRM-FM, Sacramento, Calif., on Sept. 28, 1959. The 12-bay antennas are rated at 55 kw input with a power gain of 12.

Product News

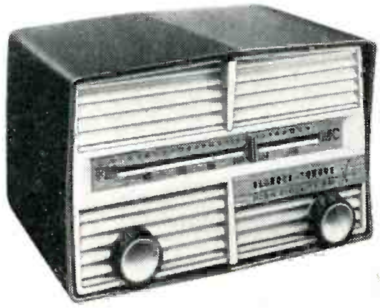


V-233A KEYED VIDEO SIGNAL GENERATOR
Foto-Video Laboratories, Inc.
36 Commerce Road
Cedar Grove, N. J.

The V-233A features a phase-locked sine wave variable-frequency oscillator for all frequencies between 90 kilocycles and 10 megacycles per second. The oscillator phase locks solidly to horizontal blanking pulses, and is followed by a keying amplifier which adds clean blanking and sync pulses if desired. The keying amplifier may be used independently to key blanking and sync into external signals such as sweep-generator signals, staircase signals, or saw-tooth generator signals. The internal oscillator may be used to add its signal to the external signal to form a modulated stair-step or saw-tooth waveform. When the phase-locked sine wave is added to a keyed external sweep generator signal a marker is placed on the sweep signal which may be positioned at any point within the range of the instrument. To permit checking low-frequency response for smear, a window signal generator has been incorporated. The unit may be driven from external triggers such as are provided by a standard EIA sync generator. An internal 15.75 kilocycle square wave generator is built in for field use. A front panel peak-to-peak voltmeter provides set-up and monitoring facilities.

PROFESSIONAL 55 STEREO CARTRIDGE
CBS-Electronics
Danvers, Mass.

A new high-compliance version of the Columbia CD stereo cartridge has been announced by CBS-Electronics. The cartridge is supplied complete with two pairs of miniaturized, plug-in equalizing networks, one for low and the other for high-level inputs. Designed especially for use with transcription turntables, the cartridge features a 0.5 mil diamond stylus. A tracking force of only 1.5 grams results in low stylus and record wear.



NEW FM RADIO
Blonder-Tongue Laboratories, Inc.
9 Alling St.
Newark 2, N. J.

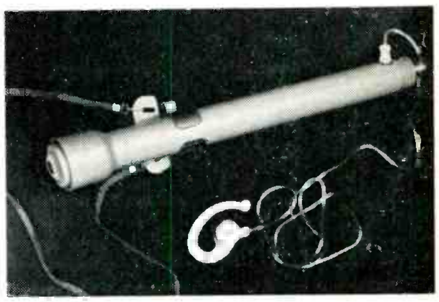
A new FM radio priced at $39.95 and featuring a drift free tuner has been introduced by Blonder Tongue. The Model R-20 uses six tubes and is designed with a permeability tuner. It is available in decorator-color combinations of dawn grey-smoke white, sandalwood-antique white, and all-white, with matching gold or silver trim.

NEW MONOBLOC SUPBMINIATURE PLUGS
Cannon Electric Co.
P. O. Box 3765 Terminal Annex
Los Angeles 54, Calif.

A new line of subminiature plugs for critical applications is known as the "Golden-D's." They feature monobloc insulators, test probe-proof socket contacts, low engagement and separation forces, and a finish of gold Iridite over cadmium plate. Four styles are available. These include plugs with miniature contacts, with ungrounded coaxial contacts, with grounded coaxial contacts, and with high voltage contacts. The ungrounded coaxial contacts are designed to be snapped into the insulators after they have been attached to cables. Miniature contacts accommodate wire size No. 20 and smaller.

VOLTAGE/CURRENT AMPLIFIER MODEL 154A
Hewlett-Packard Co.
275 Page Mill Road
Palo Alto, Calif.

The new dual channel amplifier permits direct observation of current waveforms as well as voltage waveforms when plugged into Hewlett-Packard's Model 150/AR Oscilloscope. The unit has a current-sensing probe which clamps around a wire providing fast measurement and observation of current from 50 cps to 8 mc; sensitivity is calibrated from 1 ma/cm to 1 amp/cm in a 1-2-5 sequence. The clamp around probe eliminates loading, voltage drop due to resistor insertion and the breaking of circuits. Sensitivity of the voltage channel is 50 mv/cm to 20 v/cm and the bandwidth is dc to 10 mc. In addition it provides a simple and direct comparison between current and voltage waveforms. In this operation, electronic switching between the current and voltage channels provides simultaneous viewing of both waveforms so that phase angle may be measured.



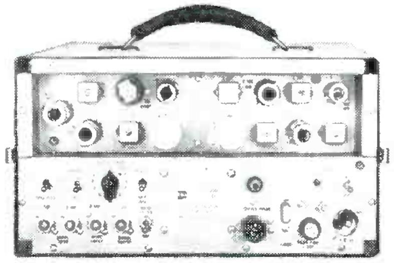
M-60 REMOTE MICROPHONE
Collins Radio Co.
Cedar Rapids, Iowa

The Collins Remote Microphone M-60 combines a one-channel remote amplifier and a high quality microphone into one compact 12-ounce unit. The self-contained remote mike includes a transistorized amplifier, mercury battery and an ear-plug headphone. The mike has a non-directional lavalier head. It is completely sealed and attaches to the threaded amplifier assembly allowing the two units to be separated without disturbing the microphone's factory sealed chamber. The amplifier has six 2N241A long-life transistors. It has a phase inverter coupled to a push-pull output stage providing wide frequency response and low distortion. The transistors are the plug-in type for easy removal. Amplifier output is ± 12 dbm at 2% or less distortion. Frequency response is plus or minus 1.5 db, 60 to 15,000 cps. The mike is powered by a 5.4 v mercury cell with a life of at least 100 hours.

Advertisers' Index

1003-C VIDEO TRANSMISSION TEST SIGNAL GENERATOR

Produces multi-frequency burst, stairstep, modulated stairstep, white window, composite sync. Variable duty cycle. Regulated power supply.



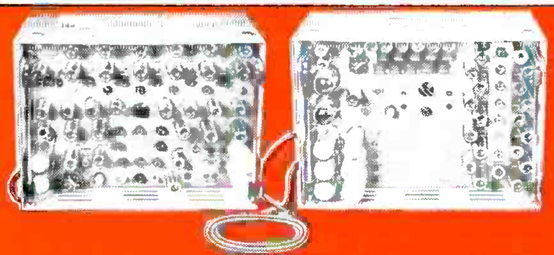
1004-B VIDEO TRANSMISSION TEST SIGNAL RECEIVER

Very rapid and accurate measurements of differential phase and differential gain characteristics of video facilities. Responds to standard stairstep test signal modulated with 3.58mc, or any differential phase or gain test signal.

VIDEO TRANSMISSION TEST EQUIPMENT

In Daily Use by All Major Networks, Stations and Telephone Co. Coaxial Cable, Microwave, and Intercity Facilities.

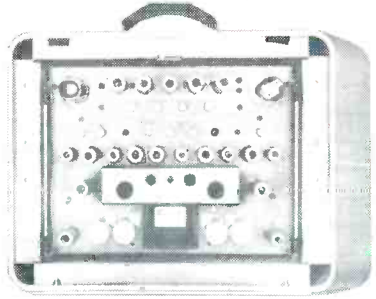
ALL CARRYING CASE UNITS IMMEDIATELY ADAPTABLE TO STANDARD RACK MOUNTING



1005-A VIDEO TRANSMISSION TEST SET

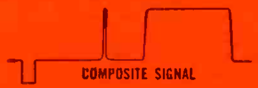
1005-A1 — Produces composite television waveforms suitable for measuring amplitude vs. frequency; differential gain vs. amplitude; dynamic linearity; differential phase vs. amplitude; high frequency transient response; low frequency transient response; low frequency phase or streaking, smears, mismatches; and other video characteristics.

1005-A2 — Supplies composite EIA Sync, blanking, horizontal and vertical drive signals and regulated B + power for itself and 1005-A1. Features magnetic core binary counters.



1008-A VERTICAL INTERVAL KEYER

Permits test and control signals to be transmitted simultaneously with program material, between frames of TV picture. Any test signal (multiburst, stairstep, color bar, etc.) may be added to the composite program signal. Test signals are always present for checking transmission conditions without impairing picture quality. The home viewer is not aware of their presence.



1073-CR
SINE SQUARED (SIN²)—SQUARE WAVE GENERATOR

Produces new waveform for testing TV or other pulse unit or system for amplitude and phase characteristics. Sin²—Square Wave pulse is equivalent to TV camera signal and is more sensitive than a Square Wave in indicating ringing. Video test signal adjustable for 1.0 volts or 1.4 volts peak to peak. Now in use by major TV networks and telephone companies.

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medium waist shot

Because advertising agencies and producers wanted it—we made a close-up adapter for the SUPER UNIVERSAL ZOOMAR. With the camera 4 to 6 feet from the subject, you zoom the entire range of 2½ to 16 inches with exact precision. It takes 30 seconds to mount the adapter on the SUPER UNIVERSAL. The wide angle shot is a medium waist shot of announcer and product. The telephoto shot fills the receiver with a pack of cigarettes . . . an area 3 inches by 4 inches.

TO THIS!

This is a must for producers making taped or live commercials. It has additional application for educational television.

SUPER UNIVERSAL

Color Corrected
Speed f/3.9
Zoom Range
2½ to 40 inches
Two converters
Zoom Ratio 6 to 1

No counterbalancing necessary
Self-Supporting • Change Zoom Range in a minute
Zoomars serviced by the Engineers who build them
Zoomars change from camera to camera in a minute
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Dr. FRANK G. BACK, the originator • 12 years specializing in the manufacture of ZOOMAR LENSES for Television