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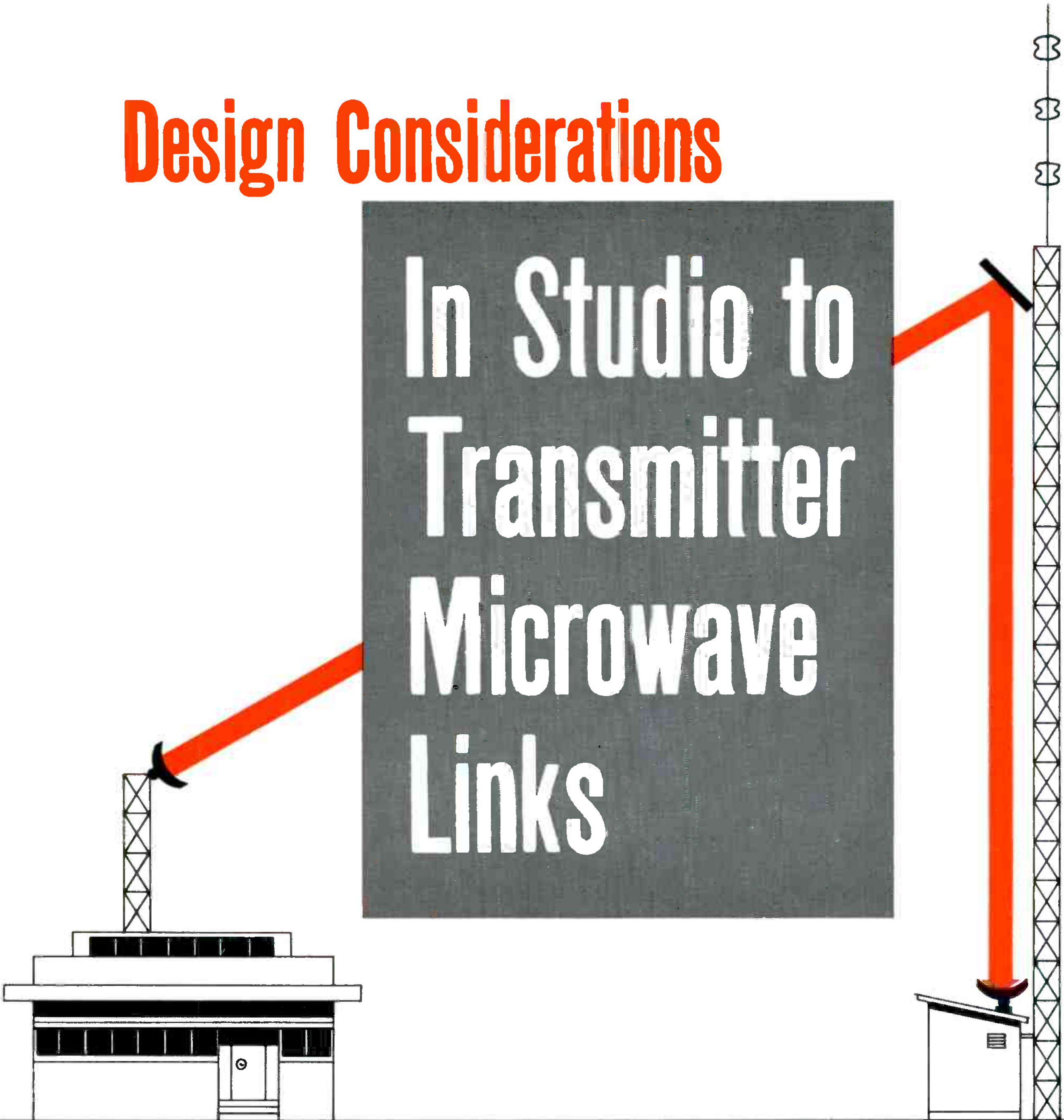
BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

Design Considerations

In Studio to Transmitter Microwave Links



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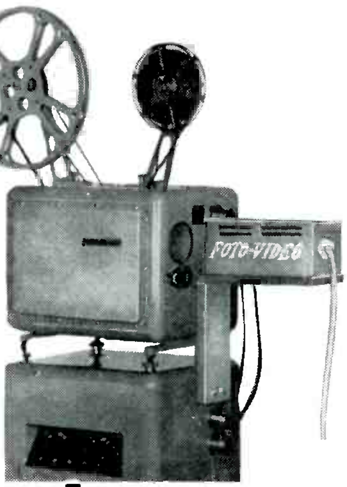
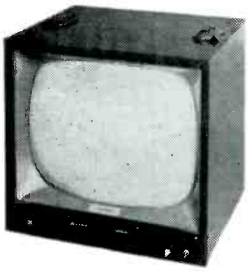


V-515 VIDICON CAMERA



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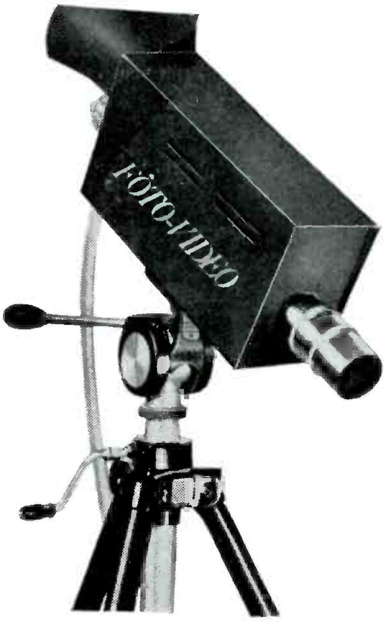
V-600 IMAGE ORTHICON CAMERA



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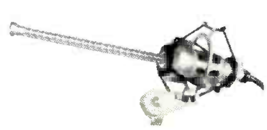

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BROADCAST ENGINEERING
THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

VOLUME 2 MARCH, 1960 NUMBER 3

Contents

Departments

Cover

A growing interest in Microwave Systems has brought numerous requests for information concerning intercity and STL use of microwave by broadcasters. In this issue the considerations involved in STL microwave planning are covered by Mr. Biagio Presti of the Sarkes Tarzian Co.

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Subscription Price: U. S. $6, one year; Outside U. S. A., $7. Single copies, 75 cents. Adjustments necessitated by subscription termination at single copy price.

Broadcast Engineering is published monthly by Technical Publications, Inc., 1014 Wyandotte St., Kansas City 5, Missouri, U. S. A.

Corporate Personnel: Robert E. Hertel, President; Frank D. Smalley, Executive Vice-President; E. P. Langan, Vice-President; W. J. Shaw, Vice-President; Kenneth Long, Vice-President; D. E. Mehl, Vice-President.

STABILITY

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GATES FM-5B

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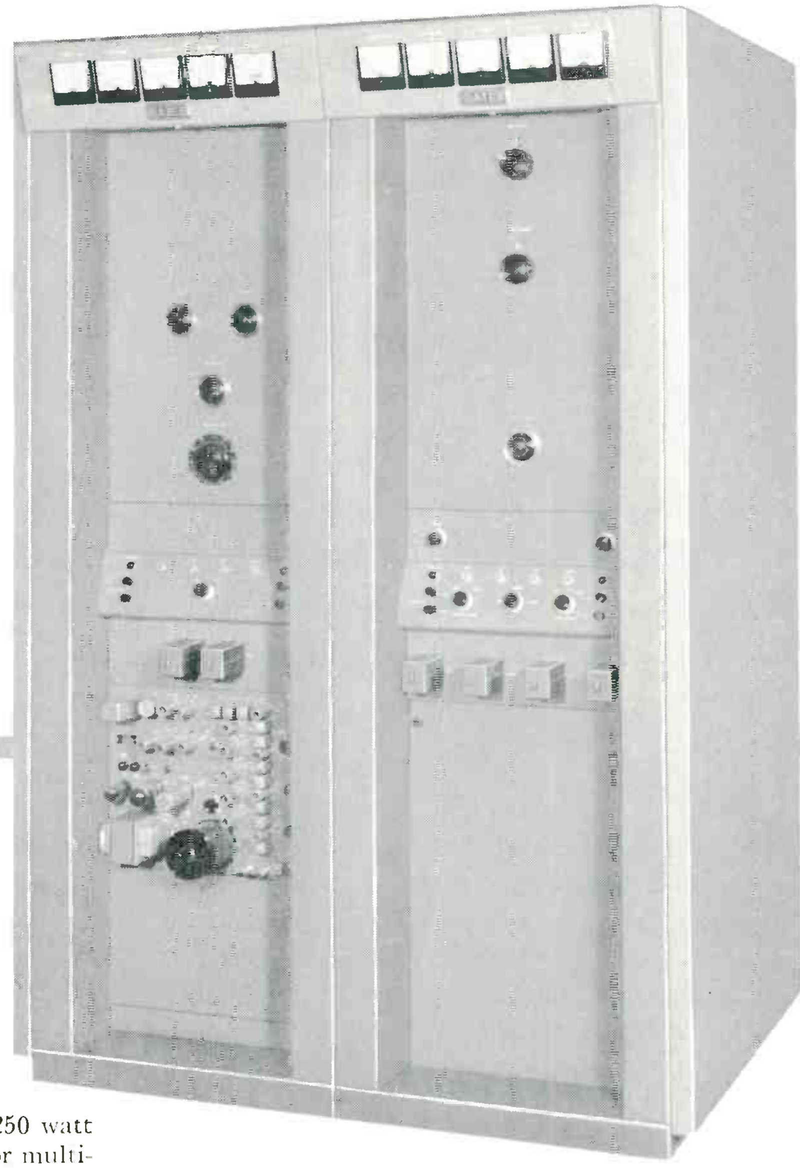

Stability is what station engineers look for in FM transmitters, and stability was the engineering objective during research and design of the Gates FM-5B 5000 watt FM broadcast transmitter.

The left cabinet of the FM-5B is a complete 250 watt FM transmitter, including exciter, provision for multiplex, 250 watt amplifier, control circuits and power supplies. The 5000 watt power amplifier is totally isolated in the right cabinet, with separate power supplies, relay equipment and metering. From exciter output at 10 watts through 5000 watts, there are only 2 radio frequency stages. This is *stability* for ease in tune-up and then staying that way.

Provision for single or dual channel multiplex eliminates adaptor arrangements when multiplex is added. The new Gates multiplex system is widely acclaimed for its new approach in simplicity and effective operation.

RF harmonics are handled from within, and an external coaxial style notch filter is standard equipment to protect the TV band. And, the twin 6076 tubes in the 5 kilowatt PA have a big conservative factor, very important in operating cost consideration through long tube life.

Stability spells *reliability* . . . that's one reason why the Gates FM-5B is the largest selling 5000 watt FM transmitter manufactured today. *Stability* is what engineers demand *and get* when they specify the Gates FM-5B for 5000 watts.

For additional technical information, write for the Gates FM Fact File, which includes price lists and engineering bulletins on all Gates FM transmitters, from 10 watts to 10,000 watts. Yours for the asking.

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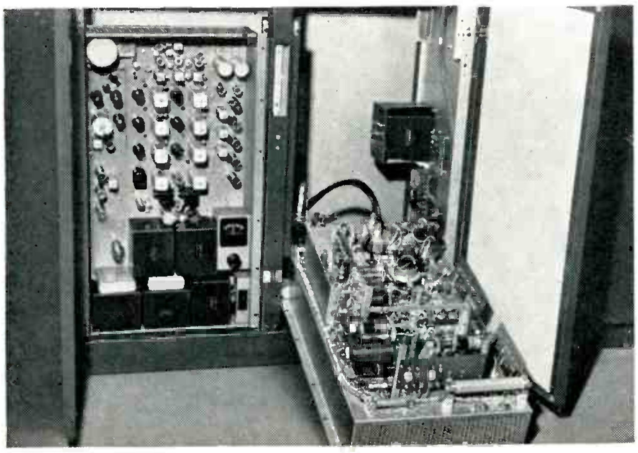
Space savings are effected through the use of common power supplies, walk-in cabinetry, and improved equipment layout. As a result, a reduction in floor area up to 40%, compared with previous 10 KW transmitter installations, can be realized.

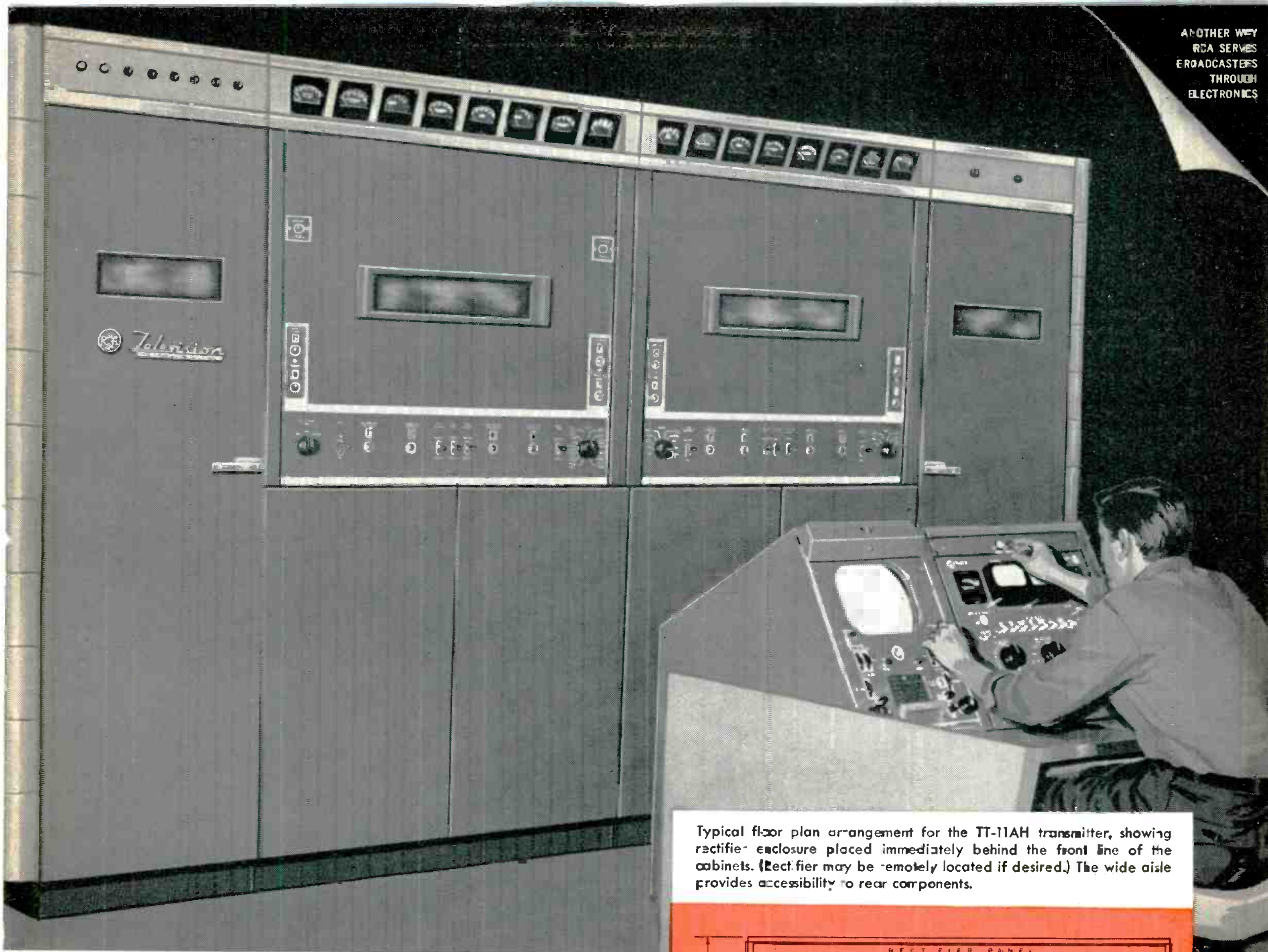
By providing a wide aisle inside the enclosure, between the front-line racks and the power equipment to the rear, all components are readily accessible. Modulator and exciter chassis can be tilted out, from the front of the transmitter, for ease of servicing.

Check the outstanding features of this transmitter (at right) which make it easy and inexpensive to operate.

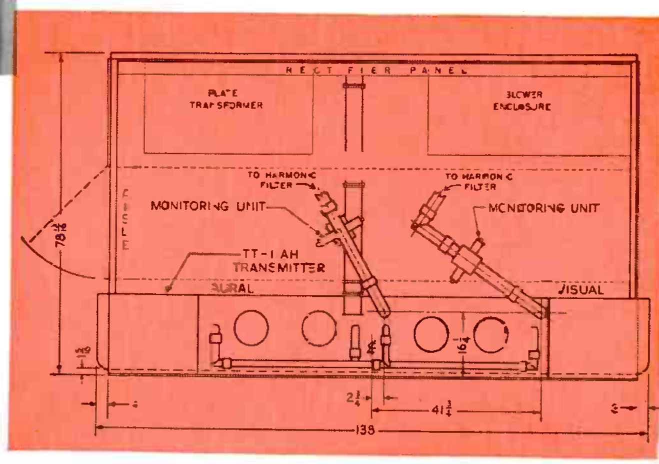
Get the complete story from your RCA Broadcast representative or write for descriptive literature to RCA, Dept. E-367, Building 15-1, Camden, N.J. In Canada: RCA VICTOR Company Limited, Montreal.



Modulator unit is shown tilted forward for ease of servicing; exciter unit is in normal position.



Typical floor plan arrangement for the TT-11AH transmitter, showing rectifier enclosure placed immediately behind the front line of the cabinets. (Rectifier may be remotely located if desired.) The wide aisle provides accessibility to rear components.



THESE OUTSTANDING FEATURES

1 WALK-IN DESIGN ACCESSIBILITY—Improved walk-in design, introduced with the TT-2BL and TT-6AL Transmitters, is an invaluable feature of the TT-11AH. A wide aisle is provided inside the enclosure between the front-line racks and power supply components to the rear. All components are readily accessible from this aisle.

2 TUNING SIMPLICITY—All tuning adjustments can be made from the front of the transmitter with power applied. Power amplifier cavity has been greatly simplified, and no change in frequency-determining components is required to tune to any high-band VHF channel.

3 WIDE AMBIENT TEMPERATURE RANGE—Operation over a wide ambient temperature range is provided by thermostatically controlled cooling of all mercury vapor rectifier tubes.

4 QUIET OPERATION—All tubes and components, other than the mercury-vapor rectifier tubes, are cooled by one main blower in a sound-insulated enclosure.

5 OVERLOAD PROTECTION—Overload protection is furnished for all circuits. Indicating lights in the control unit instantly show which circuit was at fault.

6 DESIGNED FOR REMOTE CONTROL—Provisions have been made for remote metering and control of all necessary functions from a remote point. These facilities may also be used to control the transmitter from a central point in the transmitter building.

7 FEWER TUBES AND COMPONENTS TO STOCK—Fewer spare tubes and components need be stocked since the same tube types are used in both aural and visual rf chains.

8 ILLUMINATED METERS—A row of large illuminated meters, mounted on a sloping-front panel for ease of reading, shows all important currents and voltages.

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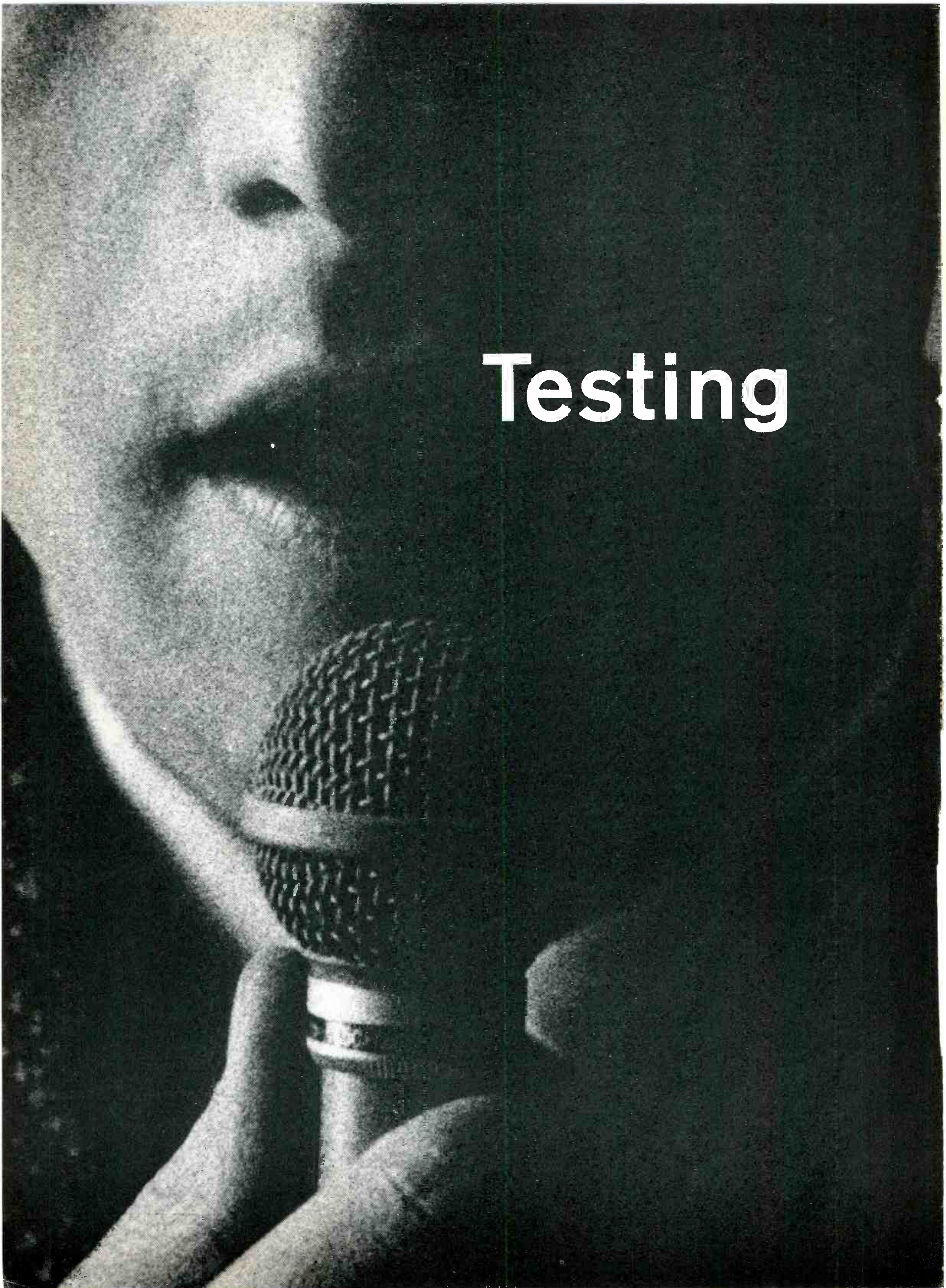

Testing

1

D 24 B Dynamic Mike

"Earwitness" recording begins at the mike — and for the finest in tapes, or any other audio need, AKG's D 24 B is a must. Cardioid pattern with about 22 dB discrimination suppresses background noise effectively; response 30 to 16,000 cycles ±2.5 dB; sensitivity 0.2 mV/µbar. Mount it properly on the AKG ST 200 stand—portable yet truly stable, with complete isolation through multiple rubber damping. Folds compactly, extends 3′6″ to 6′3″; 7 pounds. Both are from Vienna.

2

NAGRA IIIB Tape Recorder

For "Earwitness" tapes, this is the world's most-wanted portable tape recorder. Swiss-made, with even more than the expected precision —carefully miniaturized and ruggedized to assure studio quality far from the power lines. 3¾, 7½ and 15 ips, with wow and flutter well below NAB limits. 30 to 15,000 cycles ±2 dB at the two higher speeds. Hear its quality for yourself on Emory Cook's new #1134, Solo Guitar, recorded in Brasil by Luiz Bonfa. Nagra IIIB's are built one-at-a-time—order now and put yourself in line for the very best.

3

AKG Model K 50 Headphones

Give your listening hours a lift with these featherlight headphones, with the "Earwitness" fidelity and listening ease. Their distortion is vanishingly low from 30 to 20,000 cycles, three-ounce weight a joy during extended monitoring. Adaptable to both mono and stereo, require less than one milliwatt input. Watchmaker precision, ruggedness, and easy disassembly. Plug-in transformer for 800Ω and 5000Ω matching. Another product from Vienna, where they know the true Sound of Music.

4

EMT 140 Reverberation Unit

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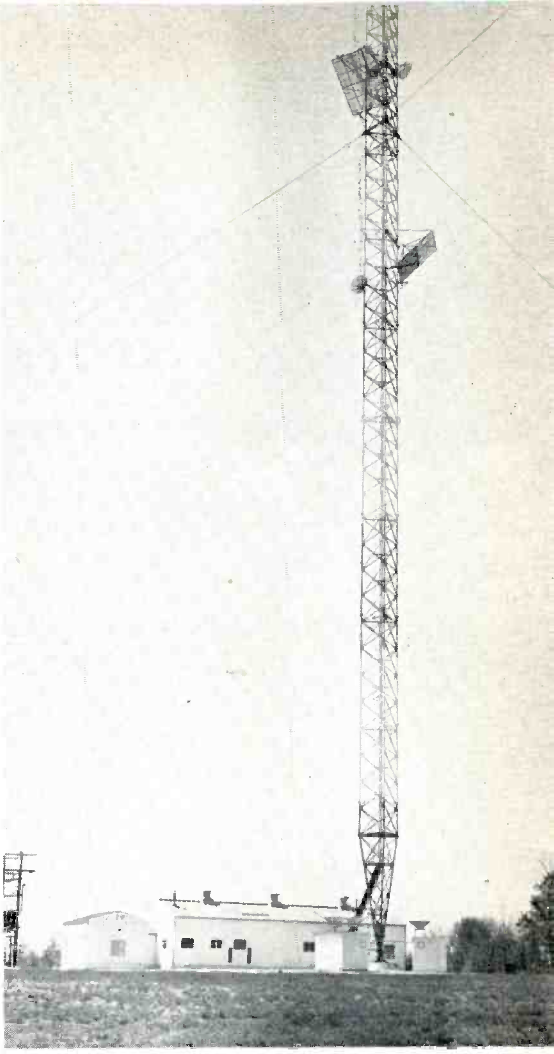
Design Considerations

IN MICROWAVE RELAY STUDIO TO TRANSMITTER SYSTEMS

The following factors must be considered in planning microwave links:

- Path profiles
- Propagation characteristics
- Fresnel zone
- System calculation
- Equipment requirements

By BIAGIO PRESTI*



Typical installation showing passive reflectors.

WHEN the TV station engineer is confronted with studio to transmitter (STL) microwave relay system design, the selection of the microwave sites is almost always predetermined by the TV transmitter location and studio location.

Engineering of the microwave path is essentially limited to consideration for the propagation characteristics of the path, and the selection of parabolic antenna sizes and heights.

In most cases the STL paths are short, 5 to 15 miles, and with few exceptions, are not very complicated. There are STL's which are up to 40 miles long, and a few short paths where the terrain is such that careful consideration of the propagation characteristics are mandatory for reliable performance.

Sometimes the TV station engineer has been required to install off-the-air network interconnection to the station, either for economic reasons, or because AT&T facilities have been unavailable.

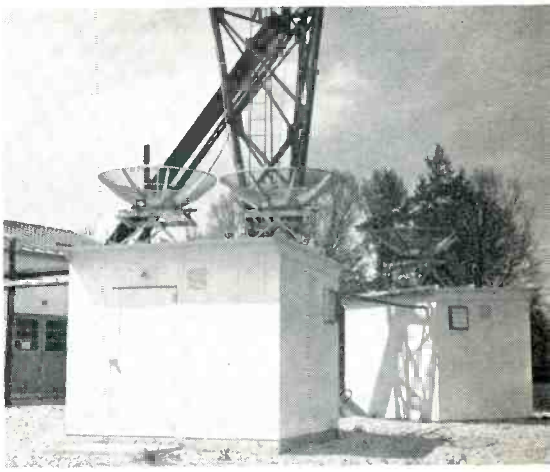
Path Profiles

To engineer the microwave system, we must draw a topographic profile of the path. This is accomplished by obtaining geodetic maps of the area from the U. S. Geographic Survey, Washington 25, D. C. When the area is west of the Mississippi River, maps can be obtained by writing the U. S. Geographic Survey in Denver, Colo.

Many areas of the U. S. do not have topo maps available to the general public. In these cases, we must make a physical survey of the path.

Physical surveys are made by obtaining suitable county maps or road maps and locating the path by drawing a pencil line between the two microwave sites.

Using a calibrated altimeter, the path is walked and readings are



Microwave dishes mounted at base of tower.

*Sarkes Tarzian Inc., East Hillside Drive, Bloomington, Ind.

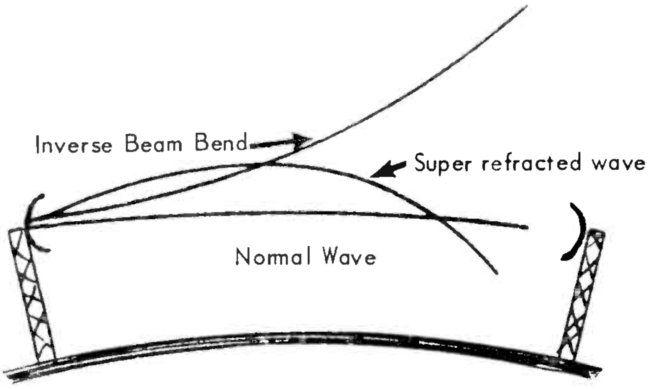


Figure 1. Diagram showing types of refraction or beam bending.

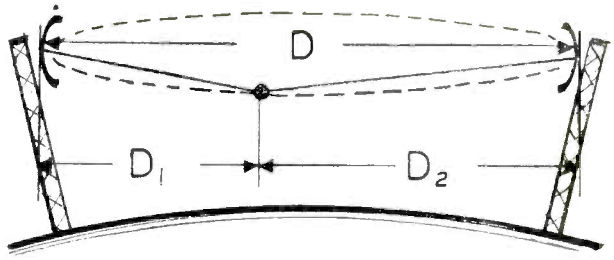


Figure 2. Diagram showing first fresnel zone path difference elipse.

taken at intervals along the path. In order to avoid errors, frequent calibrations of the altimeter are made against bench marks to be sure errors due to barometric pressure changes will not exist.

Propagation Characteristics

Where peculiar atmospheric conditions exist, or over water paths are involved, consideration must be given to multipath or inversion fading problems.

Multipath fading results from the microwave energy cone passing through areas of different refraction index. When the microwave beam strikes an area of smaller index of refraction, part of the beam is refracted toward the earth and can arrive at the receiving antenna to cause fading.

Beam bending, which can take the form of inverse bending or super refraction, is also tied to the variations or refractive index along the path.

Normally, a homogenous atmosphere is the rule; however, weather changes will produce variation in the refractive index. The refractive index of the atmosphere is governed by temperature, relative humidity, and pressure of the atmosphere.

All of these quantities vary with altitude. The magnitude of the effect is governed by the frequency and amount of change of index refraction. The higher frequencies are more severely affected.

A decrease in temperature with elevation over the ground, or the presence of water vapor, will bend the microwave beam upward away from the earth. This is inverse beam bending. Conversely, a rise in temperature with elevation will produce super refraction. The microwave beam will be bent toward the earth. See Figure 1.

In planning the studio to trans-

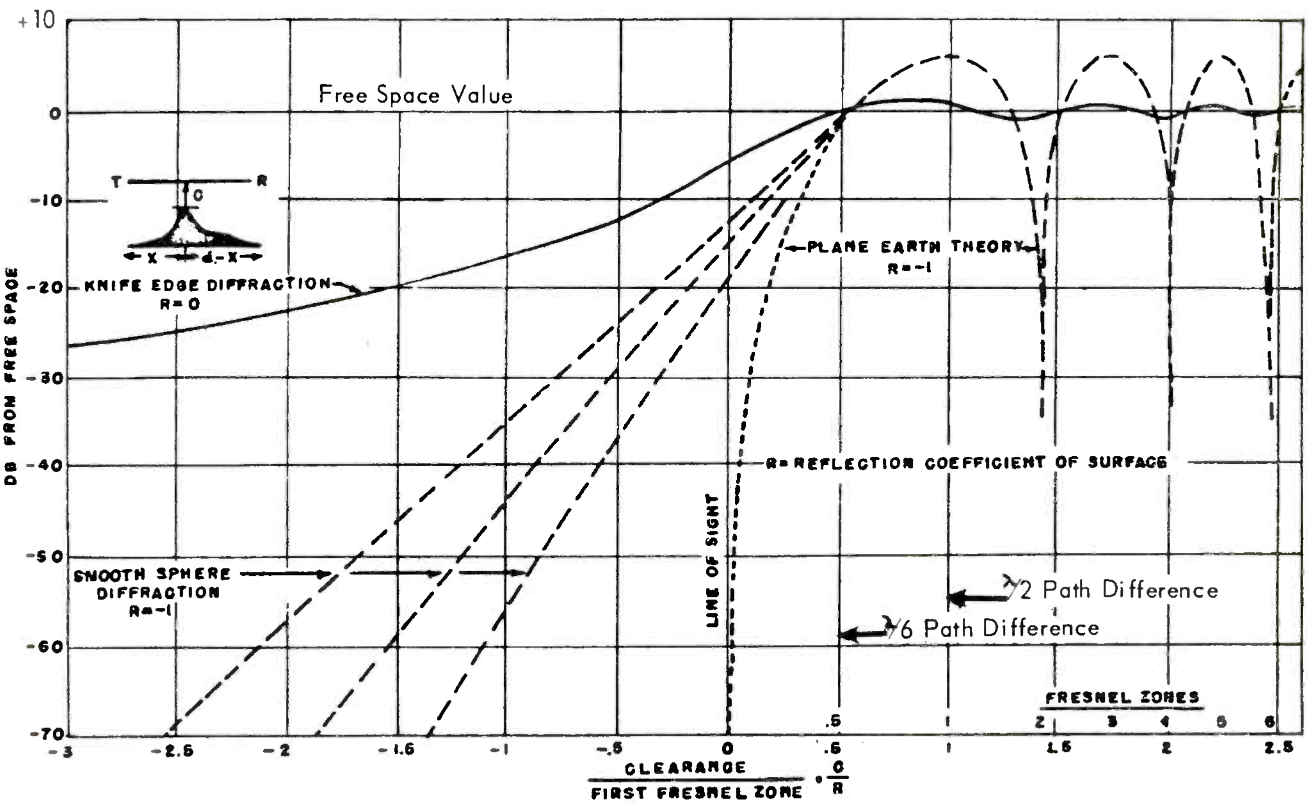


Figure 3. Received signal strength as a function of fresnel zone.

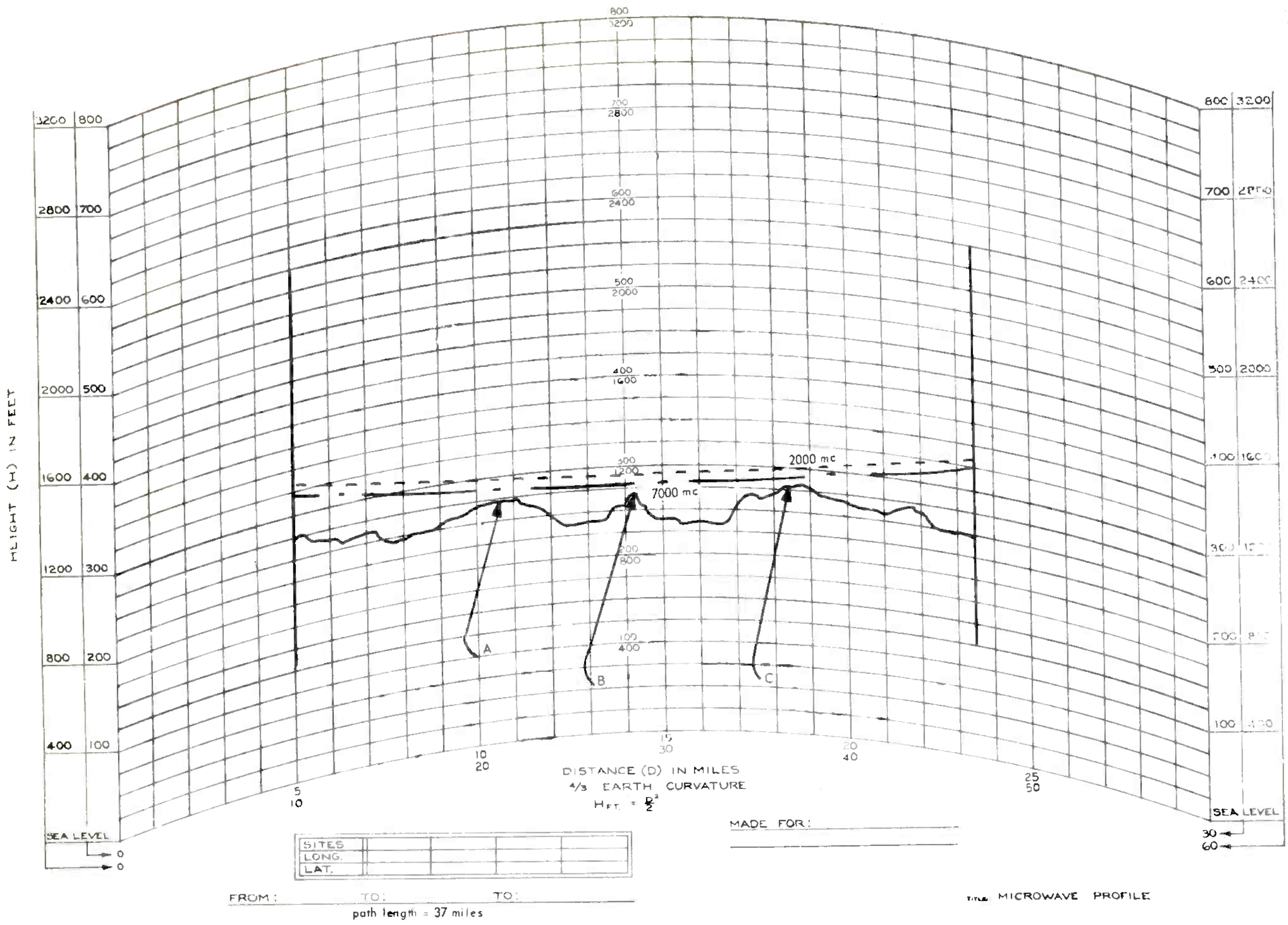


Figure 4. Sample topo profile based on 4/3 earth's curvature.

mitter link, all such factors affecting propagation must be considered.

Fresnel Zone

Microwave propagation is similar to light energy propagation; however, line of sight clearance is not satisfactory for microwave systems. We must obtain what is called Fresnel Zone clearance. The first Fresnel Zone is defined as a series of points for which the transmission path of a reflected wavefront—from transmitter to receiver antenna—is exactly one-half wavelength greater than the direct path. It can be expressed mathematically as:

$$R_1 = \sqrt{\frac{\lambda D_1 D_2}{D}}$$

where D_1 and D_2 represent the interference point distances and D the total distance of the path. All quantities are expressed in the same dimensions. Lambda is the wavelength. Higher order Fresnel Zones are alternately odd and even multi-

(Continued on page 30)

Figure 5. Comparison of 2000 and 7000 megacycle frequencies.

		7000 mc	2000 mc
Path—Length	—Miles	37	37
Maximum Fresnel Clearance	—Feet	60	97
Transmitter Antenna Height	—Feet	200	250
Receiver Antenna Height	—Feet	300	330
Space Loss with Moderate Rain	—DB	−146.5	−131
Transmitter Power Output (typical available equipment)	—DBW	0	10
Transmitter 6′ x 9′ Passive Reflector Loss	—DB	−3	......
Transmitter 1⅝″ Transmission line loss	—DB	......	−4
Receiver 8′ x 12′ Passive Reflector Loss	—DB	−1	......
Receiver 1⅝″ Transmission line loss	—DB	......	−5.2
Transmitter Parabola Gain	—DB	+40	+33
Receiver Parabola Gain	—DB	+40	+33
		......	......
Receiver Input Signal		−70.5 DBW	−64.2 DBW
Maximum Fade Tolerable		−24.5 DB	−35.8 DB
Theoretical Expected Reliability		99.6%	99.99+%
Hours lost/year		34.8	.87 hrs.
Predicted Fade Depth		35.5 DB	−26 DB
Predicted Reliability		95%	99.99+%
Hours lost/year		435 hrs.	.87 hrs.
Average Receiver input level for 26 DB S/N		−95 DBW	−100 DBW

MULTIPLEX MONITOR DESIGN

By DWIGHT "RED" HARKINS*

Part two of a description of design considerations for multiplex monitors.

*Harkins Radio Co., 1444 East Washington, Phoenix, Ariz.

In the first part of this article which appeared in last month's issue of Broadcast Engineering, the design parameters of the linear R.F. demodulation portion of a monitor were shown. This portion will continue from last month to detail the methods whereby the demodulated components are measured and the subcarriers recovered.

The first function of the monitor will be to measure accurately the percentage of deviation of all products that are modulating the main channel. These will consist of audio signals in the 30 to 15,000 cps range as well as supersonic tones up to the 75,000 cps point. The supersonic tones are, of course, the applied subcarriers which in turn are themselves frequency modulated.

The recovered modulation products from the linear detector shown last month are applied to the circuit of Fig. 1 to cause an indication of percentage of modulation. The unde-

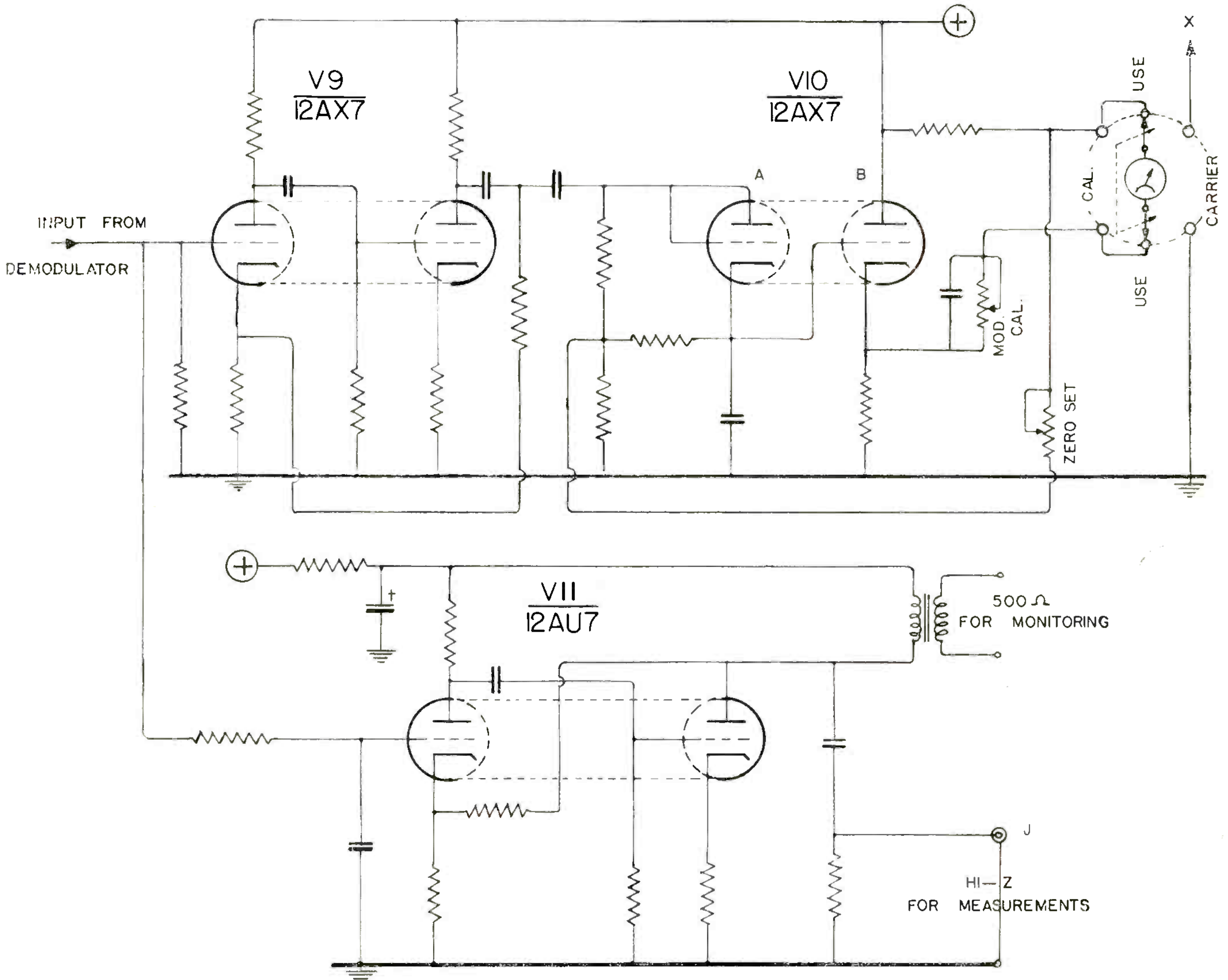


Figure 1. Portion of FM multiplex monitor which provides percentage of modulation indication, monitoring, and measuring provisions.

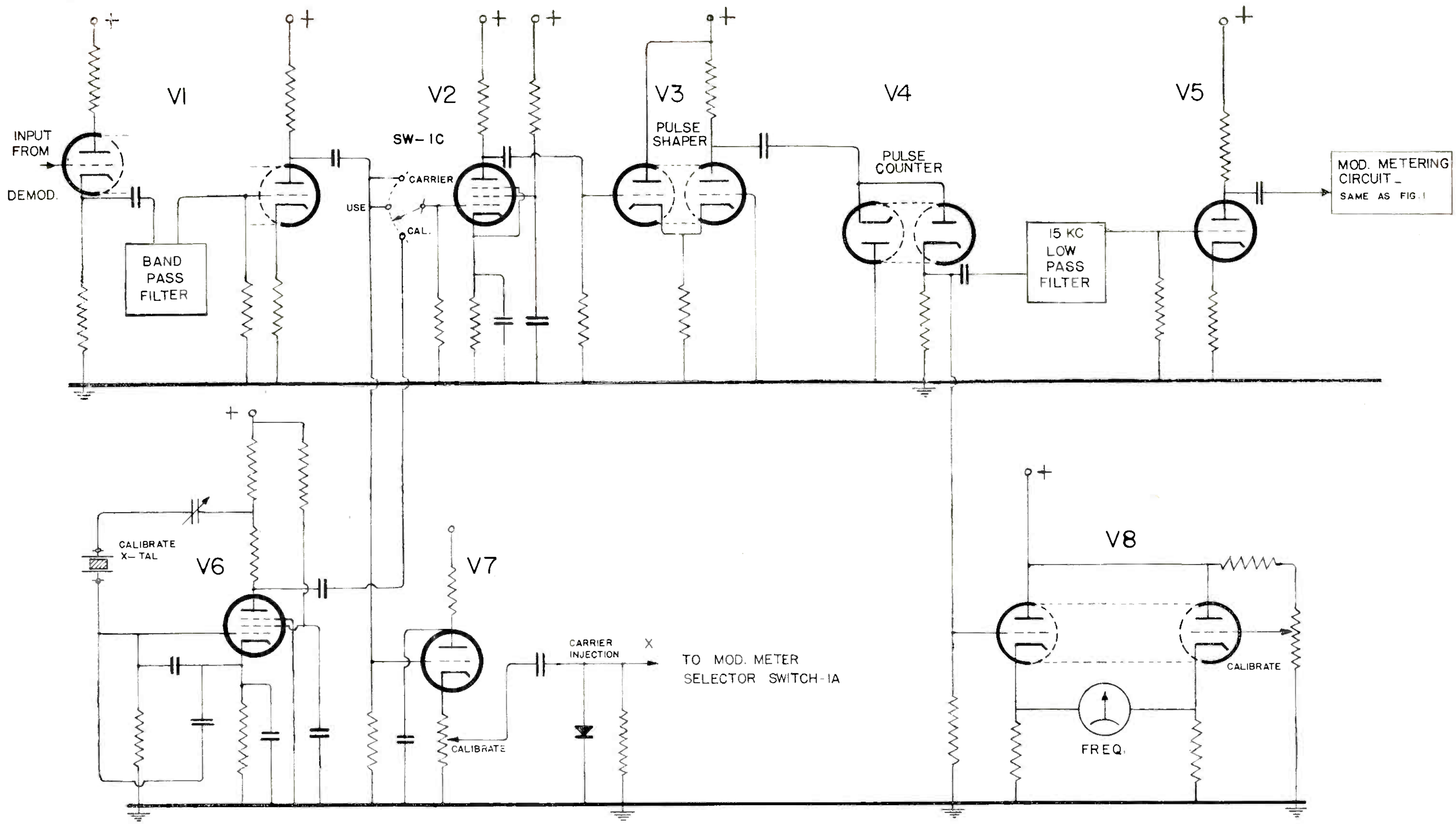


Figure 2. Subcarrier monitoring portion of monitor which provides carrier frequency, modulation percentage, and carrier injection level readings.

emphasized voltages are amplified by V9 which is a highly linear amplification circuit using inverse feedback. The amplified voltages are fed to the first half of V10 which is connected to operate as a diode. The second half of V10 acts as one leg of a bridge circuit to which the modulation meter is used to indicate bridge unbalance.

As the signal products are rectified by V10A, the resulting dc voltage is applied to the grid of V10B causing the bridge to become unbalanced and the modulation meter to indicate.

With no signal applied, the bridge is balanced for zero reading of the meter with the variable potentiometer in the reference voltage divider circuit. The sensitivity of the meter is adjusted by a variable pot in series with the meter. This is used to calibrate the meter so that 100 per cent indication agrees with plus and minus 75 Kc. deviation of the main carrier.

This metering circuit is linear within .5 db from 10 cps to over 200,000 cps thus permitting the reading of the supersonic components present on the main channel.

Along with the metering amplifier circuit, Fig. 1 also shows the amplifier that handles the audio portion of the signal for monitoring and measuring purposes. The products from the linear detector are also fed into V12 after passing through a standard de-emphasis network. The first half of this tube acts as an amplifier and the second half is coupled into an output transformer to obtain balanced 500 ohms audio at a level of plus 10 dbm. A jack on the front panel offers an unbalanced high impedance source of main channel audio for proof of performance measurements.

All of the features just described are also included in the metering circuit of each subchannel demodulator unit described later.

Subcarrier Portion

On a separate chassis, the subcarrier measurements take place. Either one or two subcarriers may be measured by adding the separate units since the main channel portion is designed to be used by itself for FM stations that are not multiplexing.

As shown in Fig. 2, the circuit of subcarrier monitoring portion permits reading of the carrier frequency, modulation percentage and carrier injection level.

All of the demodulated products appearing from the main channel are introduced into the grid of V1 which brings the signal into the low impedance band pass filter. This filter is designed to permit passage of the subcarrier and its sidebands without introducing phase distortion or intermodulation. In the case of the 65 Kc. unit, it is phase linear from 55 Kc. to 75 Kc. The audio portion as well as the second subcarrier or control tones (if used) are all rejected at this point so that only the desired subcarrier is dealt with in the following stages.

The second half of V1 serves as an amplifier. V2 is another amplifier with its input controlled by a switch which permits an unmodulated calibrate signal to be selected instead of the incoming subcarrier. V6 is a crystal controlled oscillator operating at either 65 Kc. or 26 Kc. as a source of signal for calibrating the frequency meter.

The subcarrier appearing at the grid of V2 is also routed into a cathode follower, V7, which in turn feeds a diode to produce a voltage that is used to indicate subcarrier injection level. Each subcarrier is first measured individually with the main modulation meter and by adjusting the cathode pot of V7, the indication of the modulation meter of this unit is calibrated while switched to the inject position.

The signal from V2 then goes into the pulse shaper V3 which makes sharp pulses for the pulse counter, V4.

The pulse counter not only produces a dc voltage directly related to the carrier frequency but also has superimposed upon this voltage, the audio products appearing from modulation on the subcarrier.

The dc voltage is applied to the metering circuit associated with V8. The meter is calibrated to read center scale zero by adjusting the reference voltage on the second half grid. This voltage is adjusted to equal the voltage produced by the calibrate crystal oscillator. When switched to the use position, the meter indicates any difference in frequency of the subcarrier itself.

The audio recovered from the pulse counter tube goes through a 15 Kc. low pass filter. This removes all of the carrier components that are present that would otherwise prevent proper measurements. V5 serves as a linear amplifier and brings the level up to a point where it can be introduced into the modulation meter and its associated circuits that are exactly the same as shown in Fig. 1.

The de-emphasis network used in the subcarrier modulation recovery circuit of course is designed to complement the pre-emphasis curve being used. The modulation meter reads the unde-emphasized products.

Operation

The main unit is coupled to the transmitter with RG-8U coax connected to a sampling loop in the proximity of the R.F. coupling to the antenna. Sufficient R.F. sample may also be obtained by rigging a small probe that enters the transmission line that feeds the antenna.

In order correctly to monitor the actual signal transmitted, it is im-

(Continued on page 21)

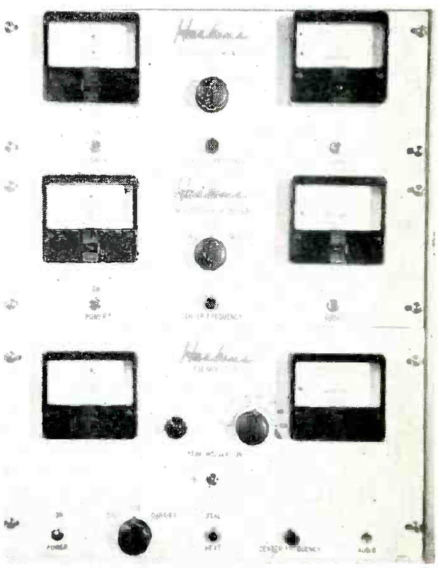


Figure 3. Main channel monitor is shown with two auxiliary multiplex channel units mounted directly above.

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For additional information write to: Hughes Products, Industrial Systems Division, International Airport Station, Los Angeles 45, California.

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DO YOU HAVE ADEQUATE

Equipment can only be kept in condition by a systematic program of:

- Cleaning
- Inspecting
- Measurements
- Servicing

An adequate maintenance program requires:

- Schedule
- Records
- Supplies
- Tools
- Test Equipment

The earning power of all broadcast stations depends on the efficient and dependable functioning of the equipment used to place the programs on the air. To obtain consistent operation of all types of apparatus a planned program of preventive maintenance is necessary. All breakdowns cannot be prevented; however, systematic inspecting, cleaning and servicing of station equipment will often disclose trouble before an actual breakdown occurs. If failures are anticipated and steps taken to prevent them the technical operation of a station will be more trouble-free and its quality improved.

Television stations and larger AM stations usually have well organized maintenance plans which are necessary due to the complexity and extensive nature of the equipment involved. Many medium-sized and smaller stations could also benefit by organizing a systematic program of preventive maintenance. This is especially important where transmitters are unattended or the services of skilled technical personnel are not available at the studio in the event of a breakdown. Equipment will be kept operating at optimum, the possibility of failure reduced, and F.C.C. requirements will be met by following a carefully planned maintenance schedule.

Preparing a Maintenance Schedule

In establishing a maintenance schedule a study should be made of all equipment and the instruction books reviewed for factory suggestions for maintenance procedures. Each required step should be outlined and it should be determined how often the step will be performed. Every station will have different requirements but the general procedures and methods of organization of the program are similar. A system of records and reports will be required and should show when each maintenance item is performed and any problems or irregularity which might have developed.

Maintenance Supplies and Equipment

Any maintenance program includes the thorough cleaning of all equipment, a careful inspection for any abnormal physical or electrical condition, measuring circuit constants, and routine service procedures such as lubricating, tube testing and tightening connections. To accomplish these tasks it is necessary to have the proper supplies, tools and test equipment for each operation. Sufficient tools should be available to perform any adjustment or repair which might become necessary. The correct tools for specific functions should be on hand because the use of improper tools can cause damage to the equipment. Repairs can also be performed more rapidly with the proper equipment. The tool inventory should be stored in an orderly manner which will make it possible to locate a desired tool quickly and also to determine if any tools are

PREVENTIVE MAINTENANCE?

missing. The tools should be kept clean and not allowed to rust or become damaged. Advance thought and planning in obtaining a complete selection of tools, materials, and equipment will make the repairing and maintaining of equipment a faster and more efficient operation.

Every station should have adequate test equipment in order to make measurements in all of the various types of circuits in the station, trouble shoot, make adjustments and test tubes. In surveying the station equipment to determine maintenance requirements, it should also be determined if adequate test equipment is available to test each item properly. Test gear should be organized so as to be readily accessible and easily used. A portable test bench, test wagon, or test room may be desirable.

Since cleaning is of great importance in maintaining equipment, the proper equipment and supplies for cleaning should be on hand. An air blower, vacuum cleaner, lint free cloths, cleaning agents and brushes are some of the required items.

Cleaning

All dirt, corrosion, rust, mildew and any other foreign matter should be removed from all tubes and components. An accumulation of dirt and grease reduces voltage insulation and is a cause of leakage currents and arc-over. Air filters should be checked, cleaned and replaced periodically, contacts on relays and components should be checked for corrosion, and any moisture removed from components. A vacuum cleaner and blower should be used to remove all loose dust from equipment enclosures. Care should be exercised in cleaning equipment parts so as not to cause damage accidentally.

Inspection

Inspection constitutes an important part of maintenance practices and includes checking components, connections and other apparatus by visual, feeling, and measuring to ascertain if the correct operating and physical condition exists. Defects will often be spotted by a complete and thorough visual inspection of station equipment. Misaligned parts, discoloration, blistering, bulging, wear of moving parts and other mechanical defects will often be spotted and corrective action can be taken before serious trouble occurs. In addition to visual inspection certain troubles will be revealed by feeling components and other parts. Overheated parts can be found by feeling immediately after the equipment is turned off. Excessive vibration or binding of moving parts will be detected and any loose connections or parts can be discovered by this means of examination.

Measurements

In addition to checking the physical characteristics of station equipment the electrical operation should be maintained by measuring circuit values which may give advance warning of trouble if a variation from normal is noticed. These measurements should be in addition to the regular Proof of Performance measurements and should include other checks in addition to the requirements of the F.C.C. Output levels of amplifiers, noise and distortion measurements, frequency response tests, hum levels and appropriate voltage and current measurements are among the electrical tests which should be periodically made and recorded. This procedure if followed systematically will be of great value in keeping equipment operating at optimum.

Servicing

As part of the maintenance plan a schedule of service procedures should be established and followed regularly. The purpose should be to keep all equipment in good condition and will include lubricating motors and other apparatus, replacing air filters, tightening connections, making electrical and mechanical adjustments, heating spare mercury vapor tubes and any other service procedure deemed necessary for a particular station.

Through the establishing and following of a program of maintenance as outlined in this article the engineering staff can have confidence that all equipment is in top shape and in addition will become more familiar with the equipment which will make it easier to find and correct trouble if it should develop.

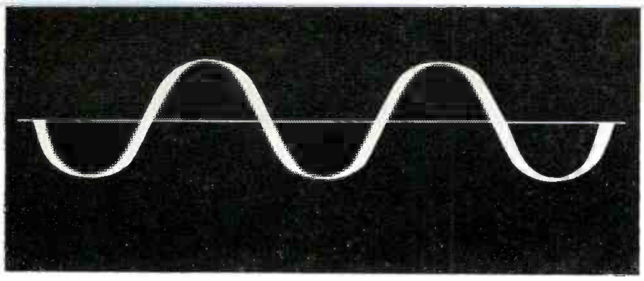


Figure 1A. Modulated subcarrier information remaining after main carrier has been removed, as seen on a standard oscilloscope.

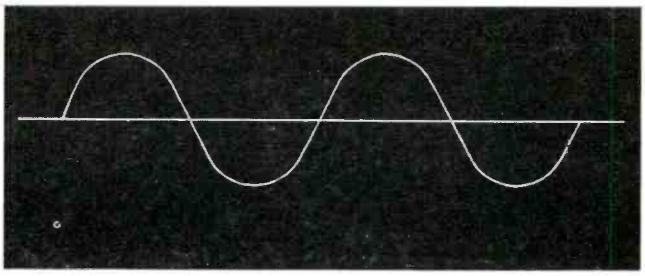


Figure 1B. Desired final information (recovered audio) after subcarrier has been removed (before amplification).

Multiplex Reception:

HETERODYNING VS. SELECTIVE FILTERING

By LEONARD E. HEDLUND*

A comparison of two methods of subcarrier recovery in FM multiplex receivers.

*Chief Engineer, Continental Mfg. Co., 1612 California St., Omaha, Neb.

THE PURPOSE of this report is to describe and discuss two basic types of FM multiplex receivers commercially available at the present time. This report will assist FM radio station engineers in their comparative analysis of the two types of receivers.

The principle of selective filtering was the first method of sub-channel reception up until a few months ago. Recent engineering developments by a few manufacturers working independently of each other suggest

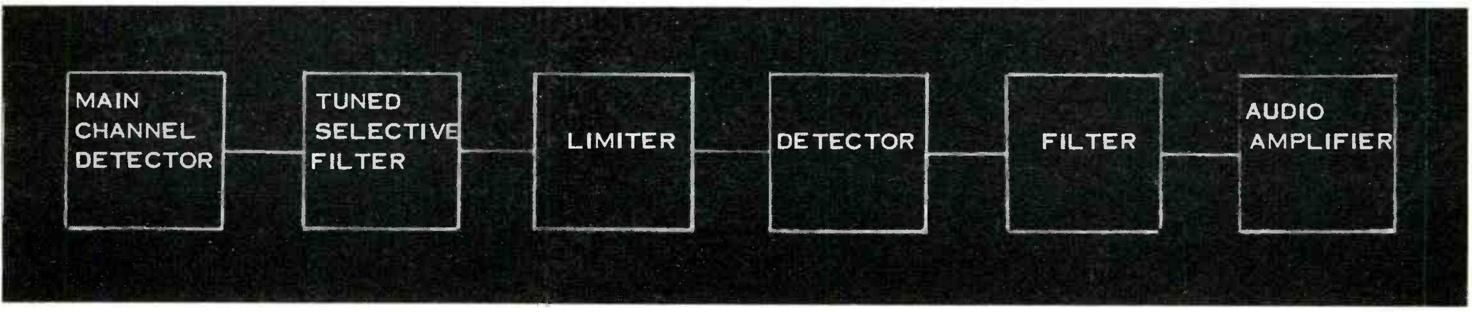


Figure 2. Block diagram showing stages used in selective filtering method of subcarrier recovery.

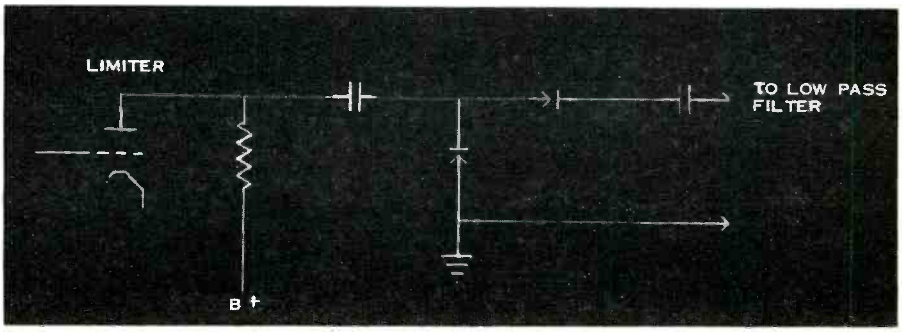


Figure 3. Diagram of counter type detector.

that an alternate method utilizing the principle of heterodyning will surpass the selective filtering system or method.

To compare the merits and drawbacks of each system it is imperative that the reader possesses a basic understanding of multiplexing. Suffice it to say that subcarrier frequencies lie between 20 and 75 kc as ordered by the FCC. It is the prime requisite of any multiplex receiver to detect the information conveyed on a specific subcarrier while at the same time rejecting the multitude of undesirable information which accompanies the transmission of this subcarrier. The biggest problem which a multiplex receiver must overcome is to reject the main (or mother) carrier's information while detecting the subcarrier that "rides" on the main carrier. (See Figures la & lb.) *

Selective Filtering

Selective filtering is the principle that permits the subcarrier frequency coming from the main channel detector to pass directly through the selective tuned filter while all other information is filtered out and rejected. Figure 2 illustrates how the selected subcarrier is then limited to eliminate noise, detected to identify the subcarrier information and filtered to eliminate any remaining subcarrier; after which the recovered audio is amplified.

The most outstanding advantage of this type of reception is that it permits the use of a simple counter type detector (see Figure 3) which is extremely linear and requires no tuning.

The greatest disadvantage of this type of reception is that selective filtering (in the 20-75 kc range) results in undesirable phase shift problems unless high quality inductors are used. The cost of the inductors is the reason why selective filtering is more expensive than heterodyning. You can see from Figure 4, a filter that has been designed to provide adequate selectivity makes good phase linearity difficult, by its very nature.

A further disadvantage is that this principle requires extreme care after detection, to be sure the RC filter completely eliminates the subcarrier. This engineering design is extremely critical because the modern audio amplifier has a frequency response going up and into the 50 kc range. As a result it is particularly susceptible to the subcarrier frequencies between 20-75 kc. Because of the amplitude or strength of this subcarrier, if it is not completely filtered, the audio amplifier will be overloaded.

An economic disadvantage of selective filtering (and one which is

(Continued on page 28)

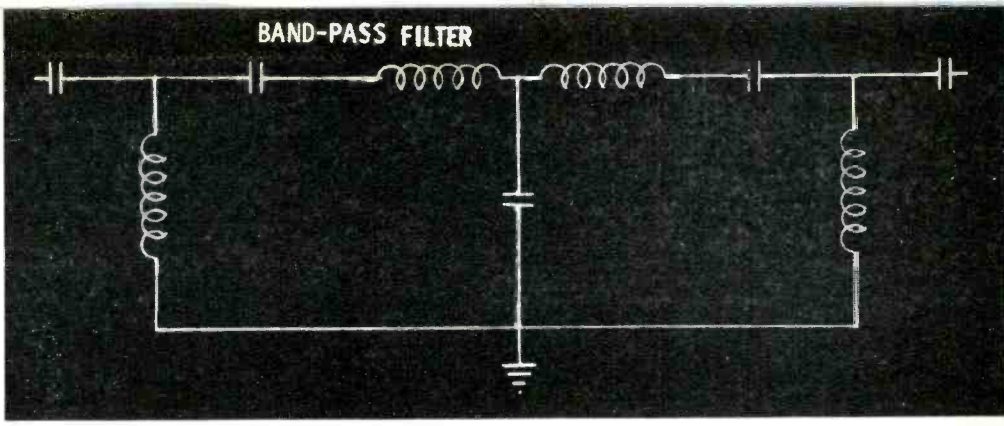


Figure 4. Diagram of typical filter which illustrates how phase shift can occur due to the necessary circuitry.

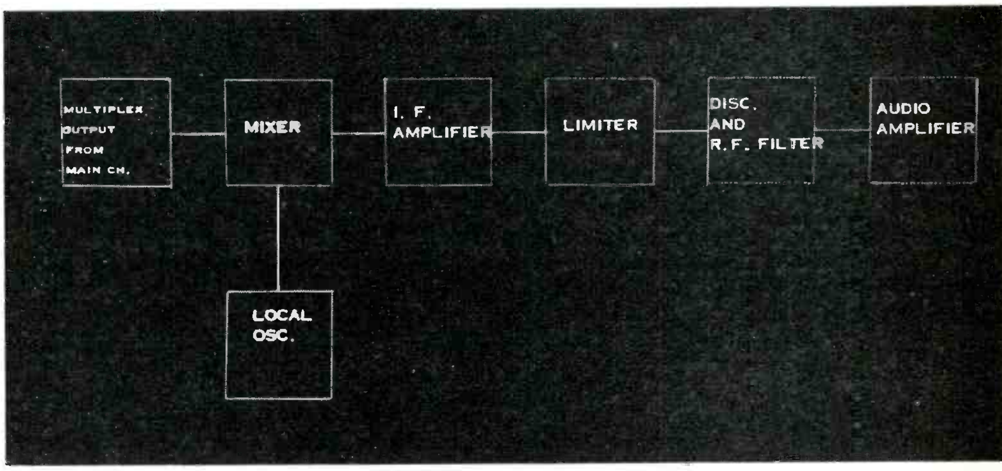


Figure 5. Block diagram of heterodyne method of subcarrier recovery.

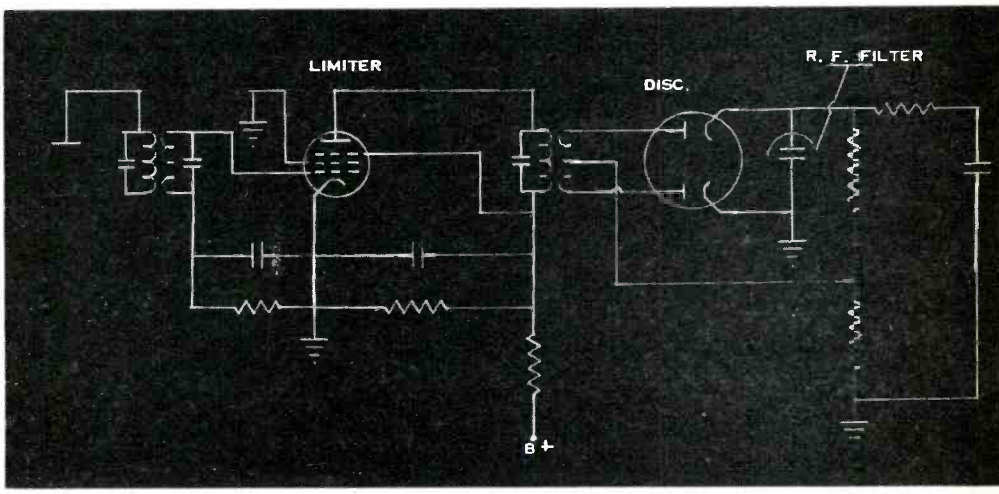
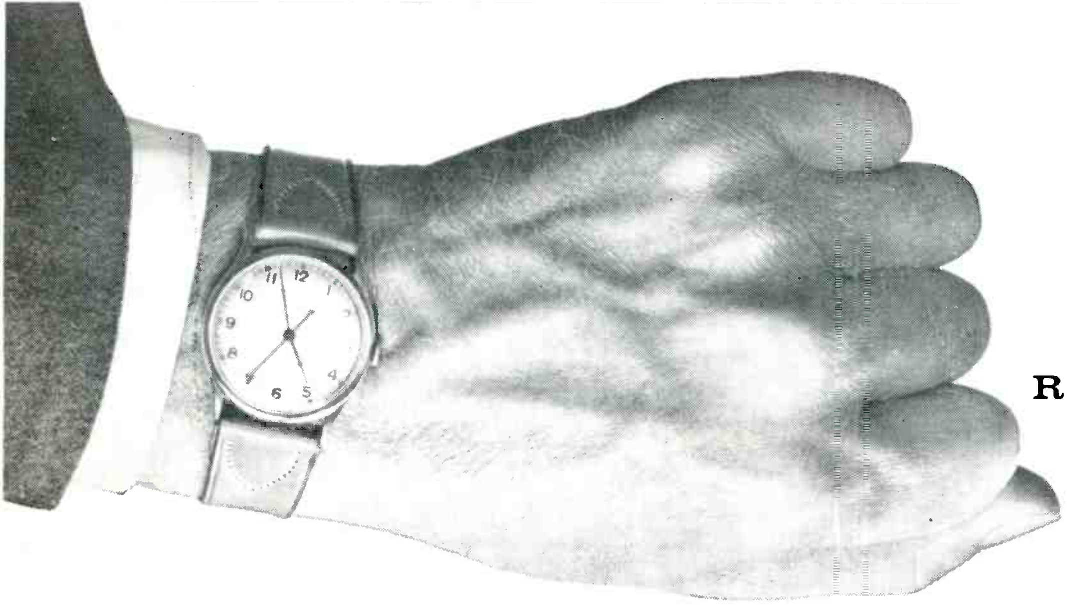


Figure 6. FM limiter and discriminator detector which can be used for the subcarrier.

Figure 7. McMartin multiplex receiver utilizing the heterodyne principle.



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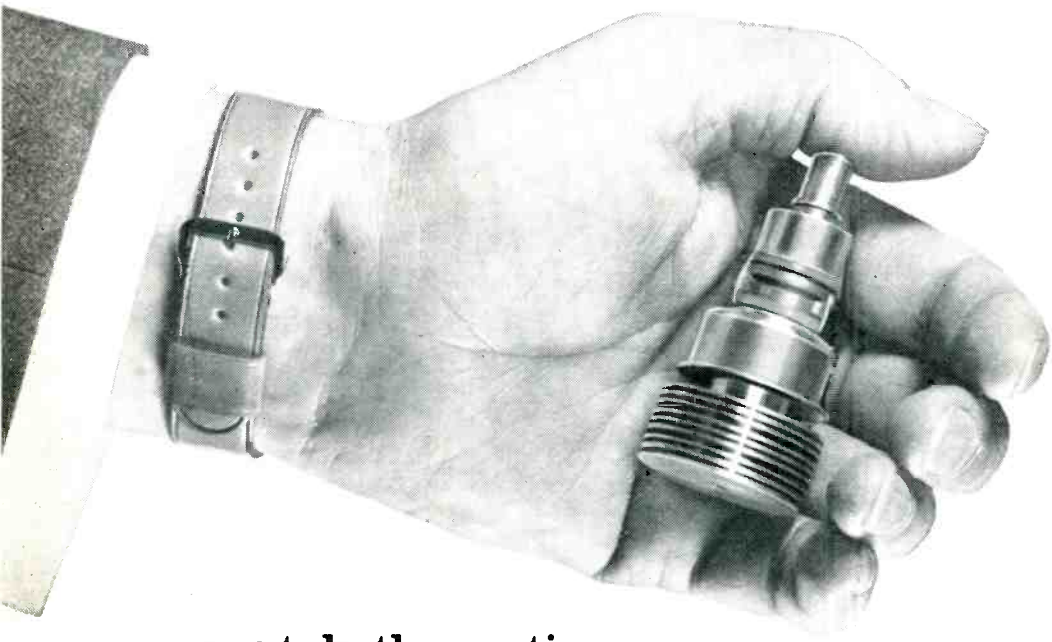

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". . . monitor becomes a valuable tool for diagnosis . . ."

MULTIPLEX starts on page 12

portant that the R.F. sample be as near to the antenna as is practical. If a stub is located between the transmitter and the antenna to correct high VSWR, the monitor will not necessarily render true indications of the transmitted signal.

In earlier articles the effects of a mistuned transmitting antenna have been discussed. Our experience has led to the conclusion that a correctly designed and tuned antenna will offer the proper load to the transmission line.

Approximately 15 volts of R.F. is required to operate the main monitor. A function switch on the panel enables the station engineer to easily check the R.F. level which is read on the modulation meter when the switch is in the carrier position.

With the auxiliary multiplex subcarrier monitor plugged into the main monitor, all functions of the subcarrier are measured. Noise, frequency response, percentage of modulation, and distortion measurements are made with standard procedure.

In order to make crosstalk measurements, the modulation is removed from the subcarrier and various tones are applied to the main channel. The crosstalk will appear on the meter being used to measure noise. The low inherent noise of the multiplex monitoring circuit permits signal to noise measurements of 55 db below plus or minus 10 Kc. deviation peaks.

With a perfectly adjusted transmitter and antenna system it is possible to find that application of 100 per cent modulation to the main channel of any tone will not cause the noise meter to rise out of the minus 55 db position. In most cases however, the crosstalk caused by 100 per cent modulation of the main channel will read around 4 to 6 db out of the bottom noise. Mistuned antennas, poorly neutralized transmitters and other transmission faults show up as badly as 15 to 20 db of crosstalk out of the bottom noise.

The monitor then becomes a valuable tool for the diagnosis and maintenance of an FM transmission system as well as to supervise the correct day to day operation of the subcarrier generator itself.

SUBLIMINAL MODULATION

The technical aspects of broadcasting to the subconscious mind are described for the first time. Detailed circuitry is available on request.

By PROFESSOR OSCAR VON DER SNIKRAH

During the past year, the art of communicating on a "SUBLIMINAL" level has been given considerable publicity; however, few people actually understand the meaning of the term.

"Subliminal" is an expression used to describe a communication or stimulus to the mind that is below the threshold of consciousness. In other words, the message gets through without perception. The so-called subconscious part of the mind which receives the stimulus will eventually convey to the conscious mind the received information either in the form of thought impulses or actions inspired by the "subliminal" stimulations.

Extensive experiments have been conducted the past year with theatre audiences by flashing messages on the screen during the regular movie presentation. The words were thrown on the screen for such brief flashes that they were not actually seen but, nevertheless, they got through to the subconscious. Messages such as "BUY POPCORN," EAT POPCORN," "DRINK POP," etc., flashed on the screen every few seconds throughout the performances created a desire for these products in the subconscious mind of the patron in the audience.

It was with these preliminary tests in theatres as well as on television that we started our research into the aspects of "subliminal" audio stimulation that could be applied to the entire field of broadcasting.

Somewhat similar to the field of hypnosis as used in modern medicine, the subliminal methods of reaching the inner mind do not require the state of trance as does the hypnotist. In the field we are now exploring, the conscious mind is completely bypassed.

We are deeply indebted to a former member of our engineering staff for his accidental discoveries made while working on another secret development. Just before leaving for the sanatorium, his discovery of the subconscious awareness to supersonic tones literally electrified our activities.

History will some day record his contribution. Fortunately, a great many of his observations were left in the form of memos and schematics that enabled us to carry on his work after they came and got him.

It is a well established fact that the human awareness to sound seldom permits perception of tones above 15,000 cps. The cutoff point as well as the response curve varies among individuals to a certain extent. It can now be shown, however, that a narrow band of frequencies between 15,000 cps. and 16,000 cps. will actually reach the subconscious mind by direct radiation rather than through the normal route of the ears.

The subliminal hearing phenomenon that was discovered needed only the right type of signal in order to be used. Needless to say, it is be-

(Continued on page 29)

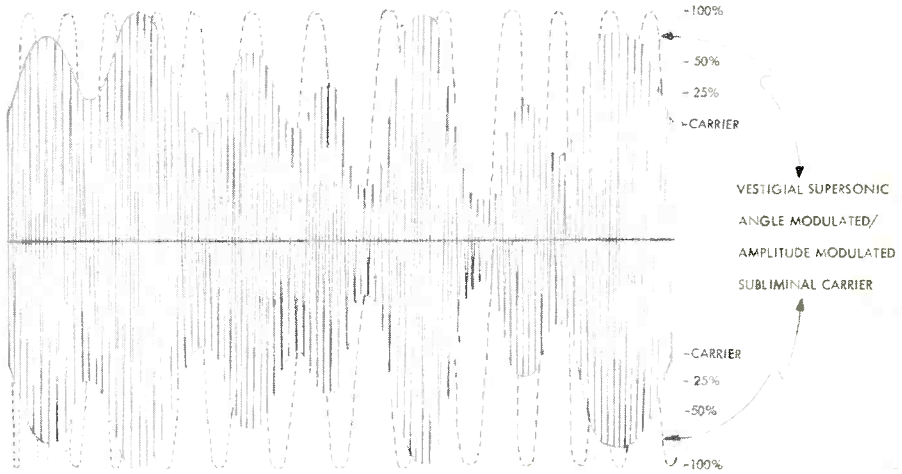

Figure 1. Dotted lines show the areas of an AM modulation envelope which are used for supersonic transmission to subconscious mind.

SOUND SYSTEM MAINTENANCE OF FILM PROJECTORS

Material courtesy of Eastman Kodak Co.

Sound on film has been with us for quite a few years now, and during this time the techniques of recording and playing back sound on film have been refined to a high degree. The technical literature abounds in information on all aspects of the motion-picture sound system. However, for those of us who do not have quite so avid an interest, it might be worthwhile to discuss some of the mechanics of maintaining a sound reproduction system, particularly as applied to 16mm projectors. In this case, we will describe in great detail the system in the Eastman 16mm Projector Models 25, 25B, 250 and 275. However, the principles should be just as applicable to other high-quality 16mm projectors.

The function of the photographic sound track is to intercept a beam of light directed onto the face of a photocell and to modulate this light beam. The subsequent variation in the amount of light falling on the cell will, in turn, vary the electrical output of the cell. This output is, in turn, amplified and reproduced as an audio signal.

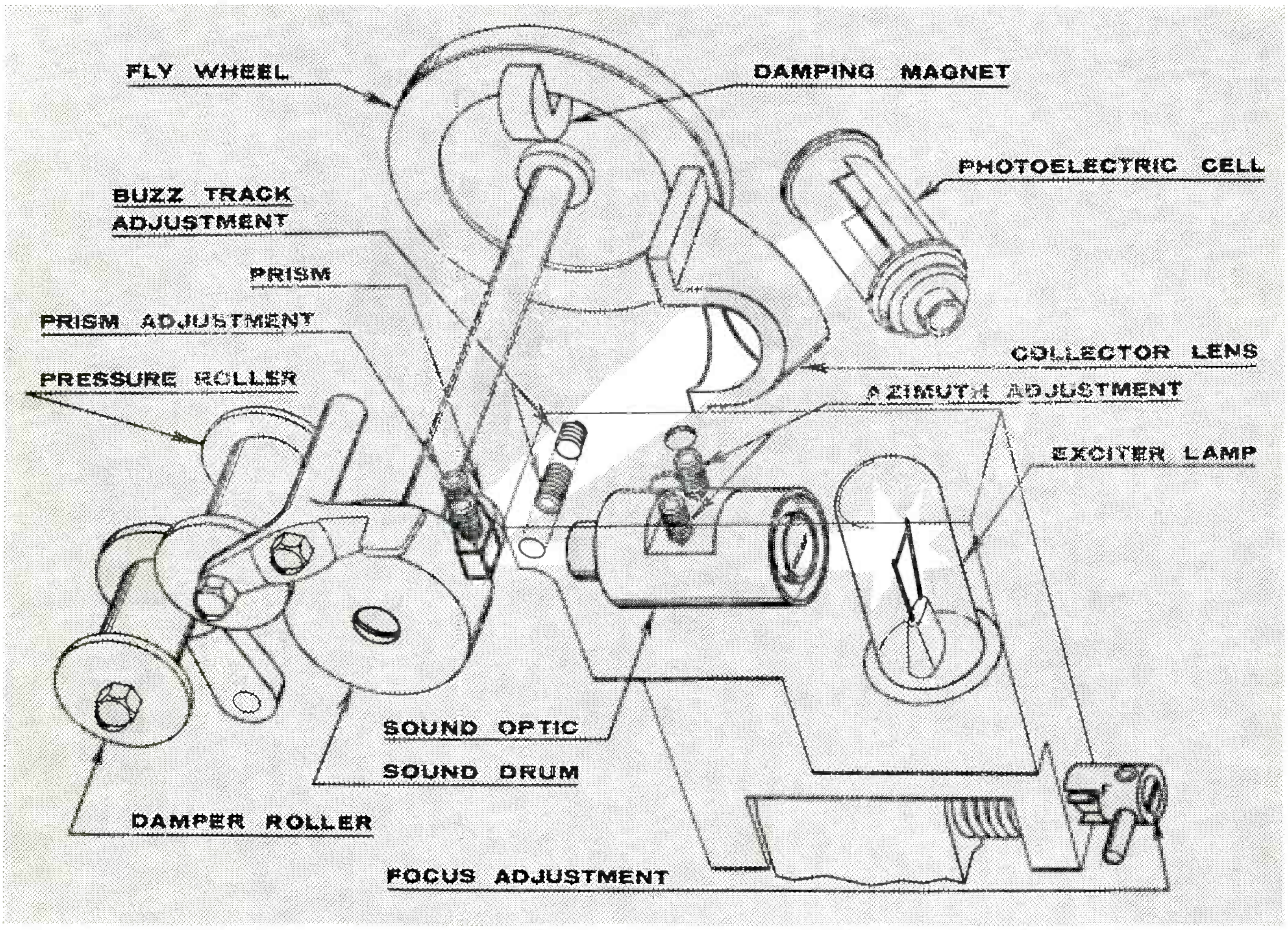

Figure 1.

The sound track can be either of two types, "variable-area" or "variable-density." In the case of the variable-density track, the light beam is modulated by the changes in density in the track. For instance, a single high-frequency note will consist of many closely spaced, narrow, dark segments across the entire track, whereas a low-frequency note will give wider segments spaced farther apart. Fig. 2 shows two sections of such a track. The first will produce silence (no modulation in density). The second will produce a 400-cycle-per-second signal.

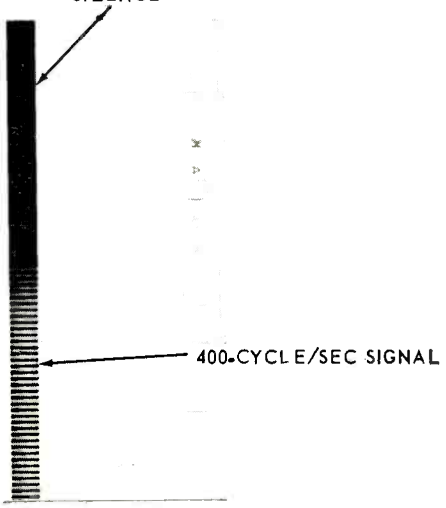

Figure 2. Variable-density sound track.

The variable-area track modulates the light reaching the photoelectric cell by the variation in the total opaque area of the track. The type of recorder used in making the original recording will determine the pattern of track produced, however; Fig. 3 is representative of a typical variable-area track. During a period of silence, the area is unmodulated, as shown in the first section; a 400-cycle-per-second signal produce a rather large wave form.

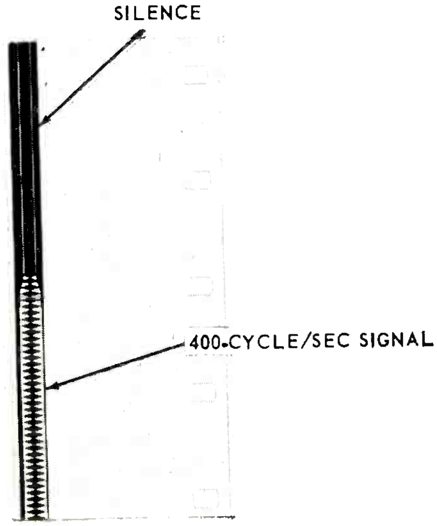

Figure 3. Variable-area sound track.

With these brief descriptions in mind, let us look at the individual components of the projector sound system and discuss the adjustments it is possible to make to each component in order to obtain optimum sound quality. Fig. 1 shows the individual components of the sound system in the Eastman 16mm Projector Models 25, 25B, 250, and 275.

The Exciter Lamp supplies the light to the sound system. It operates from a low-voltage, *direct-current* power source. The position of the lamp filament is most important since the lamp must fill the sound optics completely with a uniform light beam. For this reason, each projector model is designed to operate with a specific lamp having a certain filament height and shape. *The manufacturer's recommendations on the proper lamp size should be followed exactly.*

In the television industry, where the loss of even a short commercial can mean considerable loss in revenue, it is common practice to discard a lamp which has exceeded one-half its rated life expectancy.

The life expectancy of any lamp can be increased substantially by undervolting it slightly. It is not uncommon to find this principle applied to exciter lamps. However, if the life of the lamp is prolonged over too great a period, the filament may sag and cause a non-uniformly illuminated sound track.

The Sound Optic is a toroidal optical system which focuses the narrow filament image of the exciter lamp on the photographic sound track. A mask with a slit is included in the optics to exclude stray light from reaching the sound track. The focus, the size, and the tilt (the azimuth adjustment) of the light beam at the sound track will all contribute to the final quality of the audio output.

The Sound Drum is driven by the film passing around it. The light slit is focused on the sound track at the sound drum; it is essential that the film be moving at a uniform rate at this point. Any variation in speed will show up as wow in the audio output. For this reason, the sound drum is coupled directly to a stabilizing flywheel.

The Prism, Collector Lens, and Photoelectric Cell complete the sound system. The prism and collector lens combine to locate the light beam on the collector plate of the photoelectric cell.

The Preamplifier (and amplifier) completes conversion of the photographic track to an electrical signal. The preamplifier contains not only the controls for choosing the type of frequency-response curve desired but also a gain control for equalizing the audio output with that of another projector. The latter feature is particularly important in television, where the preamplifier of each projector feeds to a common external audio amplifier. It is also usual to include within the preamplifier, circuitry which will permit the selection of the output from either a photographic or magnetic sound track.

Wow and Stabilization Time

The linear speed of the film over the sound drum must be uniform to minimize wow. This is particularly important in 16mm production, where the linear speed of the film is only two-thirds that of the 35mm system. In order to maintain this constant film speed, the rotation of the sound drum is stabilized with a flywheel which, in turn, is magnetically damped. The flywheel and damping magnet are shown in Fig. 4.

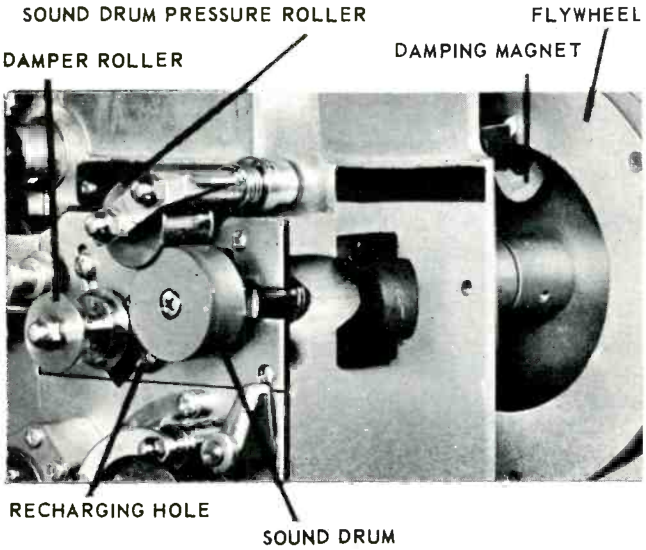

Figure 4.

The stabilization time of the sound system (that is, the time it takes for the linear speed of the film to become constant after starting the projector) is normally under two seconds. Should the sound drum become polished or the sound drum pressure roller fail to exert sufficient pressure, the film will slip against the sound drum and increase the stabilization time. For this reason, stabilization time becomes a good check on the condition of the sound drum and the adjustment of the system.

The position of the damping magnet is selected carefully during the final inspection of the projector so that it provides the proper amount of magnetic drag as the flywheel rotates; moving the magnet away from the center of the flywheel will increase its effect on the flywheel rotation. Always mark the location of the magnet before removing it during the disassembly of the projector. Handle the magnet with care since it is very brittle and can be broken easily if dropped.

During normal operation, the sound damper roller should ride about midway between its two extreme positions of travel. The location of the damping magnet on the flywheel will have an effect on the normal operating position of the damper roller. However, if the magnet's position has not been changed it should not require adjustment..

The position of the sound damper roller can be adjusted by moving the screw which retains the spring hanger up or down in the slotted hole directly behind the damper roller. If the adjusting screw holding the damper spring is moved up to its maximum position in the slot and the roller continues to ride at the bottom of its travel there is probably a drag on the film or mechanism somewhere in the system. For instance, something rubbing against the flywheel, etc.

The sound drum and flywheel are driven by the film as it passes over the sound drum. The sound drum has a matted surface to prevent slippage between the film and the drum; however, upon continued use, the surface of the drum can become polished. (This can happen after 500 hours where dust and dirt are present in the air or on the film or after several thousand hours in clean conditions.) It is a good idea to check the condition of the sound drum frequently and to replace it when it becomes polished.

In order to maintain good contact between the sound drum and the film, the sound drum pressure roller should exert a pressure of about 9 to 12 ounces on the sound drum. The pressure is measured at the finger pad on the end of the pressure roller arm and is the amount of pressure required on the finger pad to just raise the roller off the sound drum.

After operating for some time it is usually necessary to restore the silicone damping fluid within the damper. Without this fluid the sound stabilization time will become excessive. In recent model projectors, this can be done quickly with a hypodermic-type applicator. Insert the hypodermic charged with silicone fluid into the small hole which goes through the damper casting. A few drops of the silicone will be sufficient. Recent model projectors also have a split cover plate over the damper assembly so that the entire assembly can be removed easily for servicing.

Frequency Response and Gain

There are several adjustments which can be made on the Eastman 16mm Projectors which will affect the frequency response and the gain. As outlined previously, the high-frequency signals appear as small modulations on the sound track. In order to reproduce these frequencies, the light beam falling on the track must be very narrow—or, phrased another way, the projector cannot reproduce faithfully any frequencies which are narrower than the light beam scanning the track. The effective width of the scanning slit on these 16mm Eastman Projectors is .0003-inch. Fig. 5 shows the sound optic which focuses the slit on the sound track.

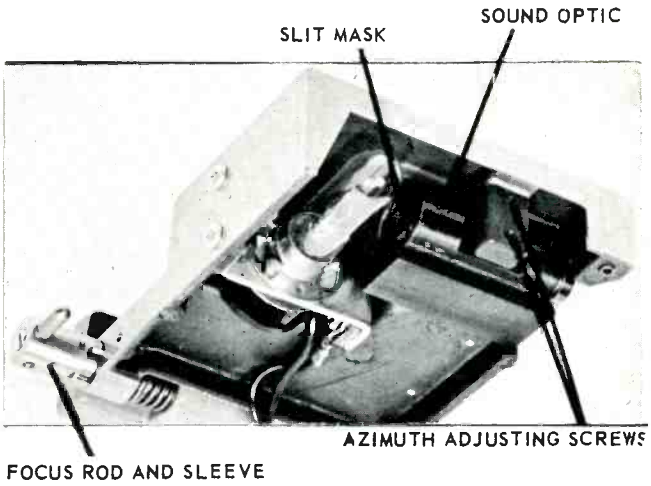

Figure 5.

It is essential that this slit be focused sharply on the track. If it is not, the fuzzy slit image will impair both output and response. The best way to check focus is as follows:

Sound Focus Adjustment

1. Slide the rotating sleeve off the end of the focusing rod. It will now be possible to move the entire sound assembly back and forth by rotating the slotted sleeve on the end of the rod.

2. Thread the projector with a sound focusing test film having a 5,000 or 7,000-cycle-per-second square wave sound track so that the emulsion side is toward the lens. It will help if a 6- to 8-foot continuous loop is made from a section of the test film so that the adjustments can be carried out without concern about the film's running out.

3. With the projector running, observe the audio output on a VU meter. Adjust the focus until a peak is obtained. Reposition the rotating sleeve so that the "F" marking is in contact with the stop. (The "F" designation means that the emulsion position of the print is facing forward, or toward the lens.) Be sure that this sleeve, when rotated, does not rub against the casting.

4. Rethread the projector so that the test-film emulsion faces the projection lamp of the projector. Rotate the sound focus sleeve to the "R" position. The output meter should read within 2 db of the previous peak.

Azimuth Adjustment

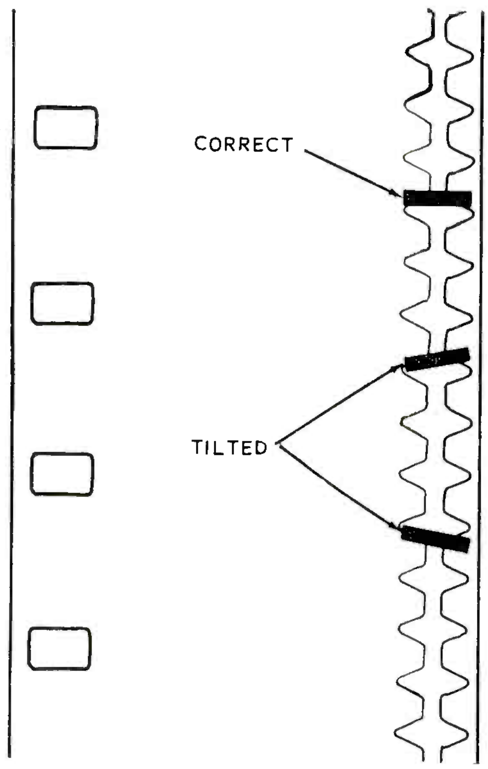

Figure 6. Azimuth adjustment.

If it is impossible to obtain a peak reading during the focus adjustment, the azimuth adjustment may be off. It is important for the slit of light to fall on the sound track squarely. If the slit is tilted one way or the other, it will be reading a portion of the track preceding or following the desired area.

The sound optic carrying the slit can be tilted from side to side by loosening one of the azimuth adjustment screws and tightening the other. This adjustment should be made with the same test film in the projector as for the focus adjustment. Both emulsion positions should be tested and should give results with 2 db of each other. Be sure that both azimuth adjusting screws are tight when the final tests are made.

Buzz Track Adjustment

The slit of light must fall on the sound track in the correct lateral position so that it will be modulated by the full-width track but yet the sound track should not be scanned beyond its edge. (This is important for maximum gain, as well as for a good signal-to-noise ratio.) A buzz track test film for checking this adjustment is available from the SMPTE. On this particular film, the normal track area is blank, but, on one side of the track area, there is a 1,000-cycle signal and, on the other a 300-cycle signal. Thus, if one or the other of the tracks is audible, it is apparent that the light slit is off center. See Fig. 7.

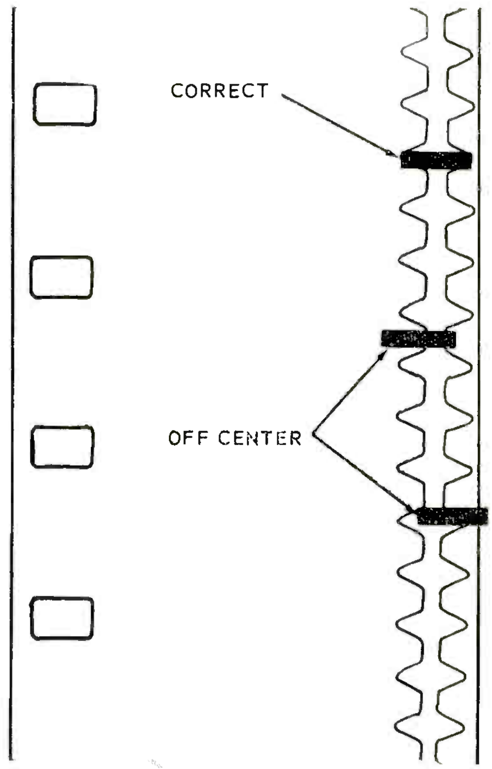

Figure 7. Buzz-track adjustment.

The buzz track adjustment screw controls the lateral position of the slit. The adjustment consists of two screws butting up against one another. See Fig. 7. The inner Allen-head screw protrudes and acts as a stop for the sound bracket in its closed position. The following steps describe the adjustment:

1. Thread the projector with a continuous loop of a buzz track test film. If either the 1,000- or 300-cycle track is audible, the slit is off center. The frequency of the note reproduced will determine whether or not the optics should be moved in or out.

2. Loosen the outer buzz track adjusting screw.

3. Lower the sound bracket assembly and turn the inner adjusting screw in or out to correct any misalignment. Return the bracket assembly to the running position and lock it firmly in place. This adjustment is a trial-and-error operation, and several attempts will probably be made before the exact point is located where neither the 1,000-cycle nor the 300-cycle track is audible.

4. When the exact location has been determined and the setting made, tighten the outer adjusting screw against the inner screw and recheck to see that the position has not been altered.

After the light slit strikes the film, it passes through to a prism which deflects the light beam onto a collector lens which, in turn, focuses the light onto a photoelectric cell. All of these optical components are aligned and locked in place during the manufacture of the projector. However, in time, for one reason or another, these may be jarred out of position.

Prism, Field Lens and Photoelectric Cell Adjustment

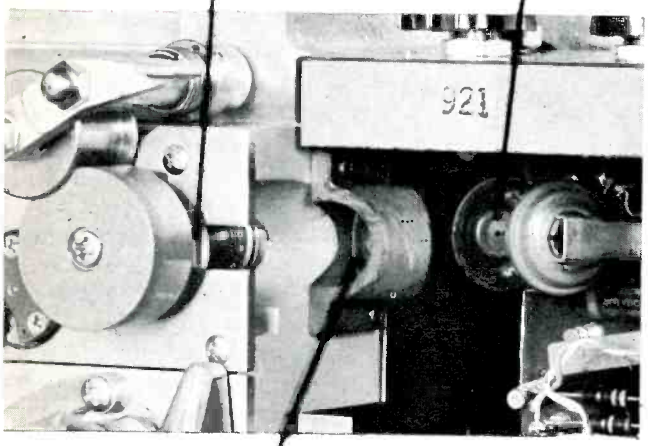

Figure 8.

1. Loosen the thumb screw in the bottom of the preamplifier and slide it out of the way.

2. Thread the projector with film and lower the sound optics so that a head-on view of the sound drum and prism can be obtained.

a. The sound track must fall exactly on the face of the prism.

b. There must be several thousandths of an inch clearance between the prism and the sound drum during the full rotation of the drum.

c. If adjustment is necessary, loosen the two set screws holding the prism and shift its position carefully. It will be necessary to remove the sound drum to do this.

3. The position of the light beam on the collecting lens should be checked next.

a. Remove the film from the projector.

b. Insert a small piece of white paper against the collecting lens and return the sound optics bracket to its normal position. The exciter lamp should be on. If the prism is positioned properly, the circular light beam should fall on the center of the collecting lens. (Viewing the collecting lens is awkward when the sound optics bracket is in position. It can be made somewhat easier by removing the rear cover plate from the pins which hold it to the sound optics bracket and sliding it over the power cord to the preamplifier.)

c. If the beam does not fall on the exact center of the collecting lens, move the prism forward or backward from its present position. After this adjustment, recheck to make sure that the sound track falls on the front face of the prism and that the *sound drum clears the prism.* The film should not contact the front surface of the prism as it travels over the sound drum.

4. After these adjustments are made, check the position of the light beam on the collecting plate of the photoelectric cell. The cell is mounted on metal clips within the preamplifier. These can be bent within a narrow range if it is necessary to reposition the cell in order to collect the entire spot of light.

Cleanliness

It should go without saying that all components of the sound system should be kept clean. Dirt and grease on the optical elements will impair the efficiency considerably. The sound prism seems to be a particularly vulnerable spot for the accumulation of dirt since it is so close to the film path. The sound system should be cleaned regularly.

As a final check on the performance of the sound system, a frequency-response curve can be plotted. A multi-frequency test film, such as that available from the SMPTE, will provide an excellent check material. In this manner, the output of the system over a frequency-response range of 50 to 7,000 cycles per second can be compared with the manufacturer's curves. Fig. 9 shows such a curve for the Eastman 16mm Television Projector, Models 250 and 275.

Magnetic Sound Playback

The use of the magnetic sound track has come into use in 16mm work during the past few years. Kits are currently available which will adapt the Eastman projectors to playback of this type of track. The installation of the magnetic head also requires a preamplifier which will accommodate the output from either the photographic or magnetic track. More recent projectors—for instance, the Models 275 and 25B—are equipped with this type of preamplifier at the time of manufacture. Fig. 9 includes this frequency-response curve for this magnetic playback.

The adjustments to the magnetic head are very similar to those possible to the light slit in a photographic sound system. Test films for aligning the magnetic head are also available from the SMPTE.

Multiplex Reception . . .

Starts on page 18

becoming increasingly important as more and more stations seek versatile receivers to meet all their needs) is that units can not be tuned in the field to different subcarrier frequencies. In fact the selective filtering method requires a complete new subcarrier circuit each time the station desires to change a subcarrier frequency.

Heterodyning

Heterodyning is the principle of taking two frequencies and combining them to make a third or "beat" frequency. In its application to multiplex reception the original subcarrier frequency is combined with a local frequency to produce the new "beat" or "IF" frequency. This resulting frequency is filtered, limited, detected and amplified, just as in selective filtering. (See Figure 5.)

The outstanding advantage of heterodyning is that the IF frequency derived can be higher than the original subcarrier frequency—high enough, in fact, to permit extremely sharp band pass filtering by use of conventional coupled IF tuned circuits. This is a much simpler and less expensive method of subcarrier detection.

Another strong advantage is that the local oscillator is tunable, permitting the selection of the desired subcarrier frequency by the simple adjustment of a thumbnut. The McMartin receiver, for instance, has the IF frequency always at 455 kc. If it is desired that a subcarrier frequency of 67 kc be received, the only adjustment necessary is to tune the local oscillator to 522 kc. The heterodyning mixing principal of the two frequencies results in the beat IF frequency of 455 kc.

A further advantage of heterodyning is that a simple FM limiter, and discriminator detector can be used. (See Figure 6.) After detection, RF filtering is no problem because the audio amplifier cannot respond to this 455,000 cps IF frequency.

It is ideal to have selectivity or band width exactly comparable to the band width transmitted at the station. A final advantage of heterodyning is that it permits simple circuit adjustment to give the desired band width for each field application. As an example, each McMartin receiver is shipped with a band width of 7.5 kc, to offer the maximum amount of selectivity to stations deviating 7.5 kc or less. If a band width is desired for 10 kc deviation, simple adjustment can be made at the factory or in the field by the addition of a 10 mmfd. capacitor for closer coupling of the primary and secondary 455 IF windings. A band width of 20 kc would require a 15 mmfd. capacitor.

What are problems to heterodyning? The local oscillator is tuned to a frequency very close to the best or IF frequency. As a result the oscillator energy must be kept very low to prevent overloading of the IF circuit and limiter. This problem can be overcome, however, by use of a balanced oscillator mixer which cancels out the oscillator carrier. Another way is to loosely couple the energy of the local oscillator to the mixer. Either method produces satisfactory results.

Summary

In conclusion, we may say that while selective filtering permits the use of a simple linear counter-type detector, it has several strong disadvantages such as increased cost due to the need for high quality inductors and critical engineering to avoid overloading the audio amplifier. Also, the inability to field tune to different subcarriers. These problems do not appear in heterodyning. Heterodyning permits simple and inexpensive methods of filtering, limiting and detecting. Heterodyning also permits the subcarrier to be varied by adjusting the tunable oscillator and the selectivity can be adjusted to suit the individual station requirement.

In a subsequent issue, we will discuss procedures and applications for selective muting of the Multiplex Receiver.

*AUTHOR'S FOOTNOTE:

One way to interpret this problem is to utilize the elementary electronic principle of "water-analogy" which visualizes a quiet, calm pool of water into which a heavy rock is dropped. Immediately, large waves are propagated just as a main carrier sends out its information. Now suppose that a tiny pebble is dropped into the pool and its resulting tiny ripples "ride" on top of the large wave. Further confuse the issue by making its speed of propagation much faster than that of the large wave, while the height (or amplitude) of the ripple is about 1/5th the height of the big wave. It is the purpose of a good receiver to separate the information supplied by the small ripple without permitting noticeable interference (called cross-talk) from the large wave or main channel information.

Subliminal Modulation . . .

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yond the scope of this article to detail the methods used in refining and developing the original discovery. (Full details will be released at a future date upon receiving clearance from the medical and psychiatric people.)

Due to certain non-linearities in the transmission path, a form of detection takes place as the subliminal supersonic wave passes through to the subconscious.

Theory has taught us that information can be transmitted on a carrier by varying any of the parameters of the sinusoid in accordance with the modulating voltage. In the case of AM, the peak amplitude is varied. The instantaneous phase angle of the sinusoid can also be varied as a means of conveying information. It was found that in some cases the subconscious received AM better than FM and in others the reverse was true.

In order to be fully compatible, it was decided to develop a carrier that was both AM and FM at the same time. FM, of course, is another way of referring to the angle method of modulation.

Now for the actual method of transmitting this Angle Modulated Amplitude Modulation subliminal carrier. (Since Amplitude Modulation and Angle Modulation both are abbreviated by the letters AM, to avoid confusion we will call the system "Double AM").

Fig. 1 shows a typical AM envelope during modulation. It is to be noted that program material reaches 100 per cent on peaks, but there is much of the time that the modulation is much less. Although many stations try their best with crafty limiters, etc., to maintain 100 per cent all the time the nature of music and speech forces intonations that are less than 100 per cent modulation peaks. It is our utilization of these unused portions of the carrier capabilities that makes our system successful.

The Double AM subliminal carrier fills out the regular carrier to the full 100 per cent at all times. Of course, since the subliminal carrier is supersonic above the range of hearing, no one will hear it, ... but then subliminally, ... ? ? ? ? ? ?

". . . the earth has a low coefficient of reflection . . ."

MICROWAVE starts on page 9

ples of one-half wavelength from the direct beam. See Figure 2.

The energy content in the reflected wavefront is always less than that in the direct wavefront. The actual amount of reflected energy is governed by the coefficient of reflection of the surface. Water is an excellent reflecting surface—having high coefficient of reflection—and therefore paths over water are more troublesome than over-land paths. Over-land paths have irregularities and the earth has a low coefficient of reflection.

A change in phase occurs when the microwave beam strikes a reflecting surface. In the case of a horizontally polarized wavefront, the phase change is 180 deg. at the first Fresnel Zone points along the wavefront. The phase change is less for areas inside the first Fresnel Zone.

Optimum first Fresnel Zone clearance can therefore cause an increase in signal strength at the receiving antenna! Remember, the First Fresnel Zone is defined as a path difference of one-half wavelength, or 180 deg. between the direct and reflected wavefront. And when the reflected wave strikes the reflecting surface, an *additional* phase change of 180 deg. occurs. The received signal then consists of the direct wavefront, plus an *additive* wavefront from the reflected signal. In the case of 100 per cent reflective surface, the received signal strength would be twice the direct signal strength. A graph of the received signal strength vs. Fresnel Zones is shown in Figure 3.

The theory of propagation and Fresnel Zone is too extensive to be treated in this discussion. For those who are interested, several references are included at the end of this article where extensive treatment will be found.

Microwave System Calculations

The method described here for system calculations is applicable to any frequency. The example assumes the assigned frequencies for television microwave.

Typical short hop systems are easily "engineered" by the station engineer by simply putting the dishes up and firing up the system. Many of the problems of propagation, etc., are simply ignored—and rightly so—because the system generally works.

However, when longer paths are involved or where topography is a problem, a system calculation is necessary to avoid costly errors. Many studio-transmitter links are 30 to 40 miles in length, or an off-the-air pick-up is needed for network interconnection which is quite long.

After due consideration for the propagation characteristics, the Fresnel Zone requirements at every point in the path, and for other factors affecting the system operation, we may now begin our system calculations.

Referring to Figure 4 as a typical microwave path, we may predict the equipment requirements and the performance of the system by considering the following:

1. Transmitter power output.
2. Line and connection losses to parabolic antennas.
3. Transmitter parabola sizes and gain requirements.
4. Path attenuation.
5. Fading depth probability.
6. Reliability percentage requirements.
7. Receiver parabolic size and gain requirements.
8. Receiver line and connection losses.
9. Receiver's sensitivity.
10. Receiver noise figure.
11. Receiver gain.
12. Required S/N ratio. (Not necessarily in the order shown.)

The choice of frequency used should be determined by calculation of the above, using the frequency channels available, and then selecting the frequency band giving the best performance. Where path lengths under ten (10) miles are involved, very little difference in performance will be found. The greater the distance, the more important proper frequency selection becomes. Frequency band selection should include considerations for maximum fade depths, receiver noise figures, etc.

Reliabilities and minimum acceptable signal levels are governed by the type of service required from the system. Reliability levels of 99.7 to 99.99 are most common of requirements. An accepted standard of 26 db peak signal to rms noise is usually used to describe the minimum acceptable signal. This lower limit in S/N ratio would occur only on the worst combination of fading expected.

System Calculation Procedure Summary

1. Check for Fresnel Zone clearance.

2. If first Fresnel Zone clearance exists, calculate path space loss.

NOTE: If Fresnel Zone clearance does not exist, refer to referenced reading (Article by Bullington, Proceedings of the IRE).

3. Calculate line or passive reflector losses for transmitter and receiver terminals.

4. Add steps 1 through 3.

NOTE: Add approximately ½ db per RF coax connector for safety margin.

5. Calculate transmitter power output in dbw (or dbm if desired). (Keep same dimensions throughout.)

6. Calculate transmitter and receiver parabola gains in db.

7. Total steps 5 and 6.

8. Take algebraic sum of line 4 and line 7.

9. The result on line 8 represents the level of input signal expected at the input terminals of the receiver.

Since the receiver has gain, the performance expected should be fairly conservative since we have not included the receiver gain in these calculations. Final summations will provide data on the expected S/N ratio and reliability directly. Note that the fade margin is dependent upon the receiver sensitivity, noise figure, etc., and represents a fade down to the minimum acceptable signal level of 26 db.

When the signal level fade depth is predicted to fall below the receiver minimum signal level, the noise increases rapidly and a complete system dropout occurs. Recovery time is determined by the time taken for the signal to rise in sufficient amount to improve the S/N ratio for usable signal levels. This can be, and is many times, as long as two hours.

Figure 5 is an example calculation comparing 2000 mc and 7000 mc frequencies. In order to make complete system calculation, it is convenient to use nomographs and charts where necessary data on path loss, Fresnel clearance, etc., can be obtained. Some of the referenced articles contain such data charts.

Recommended Reading

1. UHF Radio-Relay System Engineering, by J. J. Egli (Proceedings of the IRE, January 1953).
2. Propagation of VHF and SHF Waves Beyond the Horizon, by K. Bullington (Proceedings of the IRE, Volume 38, October 1950).
3. Planning an Overwater TV Link, by E. Wilson, Electronics Industries, June 1957.
4. Propagation Test on Microwave Communications Systems, by H. Mathwich, E. Nuttall, J. Pittman, and A. Randolph; AIEE Communications and Electronics, 1956.
5. Microwave System Engineering, by B. Presti (available from Sarkes Tarzian, Inc., in Bloomington, Ind.).

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

CONELRAD ATTENTION SIGNAL

Order Extending Time for Filing Comments

In the matter of amendment of CONELRAD Manual BC-3 to provide for transmission standards for the CONELRAD Attention Signal; Docket No. 13335.

The Commission has before it for consideration the following pleading in the above-entitled proceeding: Petition of National Association of Broadcasters (NAB) requesting that the time for filing comments be extended until April 11, 1960.

In support of its request, petition alleges that additional time is needed to compile data on the feasibility of such an amendment, together with its economic impact. It is further alleged that the additional time will place NAB in a better position to furnish the Commission with information of value in the matter.

Upon consideration of the view expressed, the Commission believes the public interest would be served by granting an extension of time to April 11, 1960, to file comments.

Accordingly, it is ordered, This 4th day of February, 1960, that the time for filing comments herein is extended from February 8, 1960, until April 11, 1960; and that the time for filing reply comments is extended from March 9, 1960, to April 25, 1960.

Miscellaneous Amendments

The Commission having under consideration the desirability of making certain editorial changes in Part 3 of its rules and regulations; and

It appearing, that § 3.188(b)(4) should be amended to change the reference to § 3.24 (b) (7) since that section is now § 3.24 (g) and that titles should be inserted for §§ 3.317 (e) and 3.687 (h); and

It appearing, that the amendments adopted herein are editorial in nature; and, therefore, prior publication of notice of proposed rule making pursuant to the provisions of section 4 of the Administrative Procedure Act is unnecessary, and the amendments may become effective immediately; and

It further appearing, that the amendments adopted herein are issued pursuant to authority contained in sections 4 (i) and 303 (r) of the Communications Act of 1934, as amended, and section 0.341(a) of the Commission's Statement of Organization, Delegations of Authority and Other Information;

It is ordered, This 18th day of February, 1960, that, effective March 1, 1960, §§ 3.188 (b) (4), 3.317 (e) and 3.687 (h) are amended as set forth below.

1. Section 3.188 (b) (4) is amended to change reference to § 3.24 (b) (7) to read § 3.24 (g) as follows:

§ 3.188 Location of transmitters.

* * * * *

(b) * * *

(4) The population within the blanket contour does not exceed that specified by § 3.24 (g).

2. Section 3.317 (e) is amended to add a title to the paragraph as follows:

§ 3.317 Transmitters and associated equipment.

* * * * *

(e) *Other technical data.* An accurate circuit diagram, as furnished by the manufacturer of the equipment, shall be retained at the transmitter location.

3. Section 3.687 (h) is amended to add a title to the paragraph as follows:

§ 3.687 Transmitters and associated equipment.

* * * * *

(h) *Other technical data.* An accurate circuit diagram, as furnished by the manufacturer of the equipment, shall be retained at the transmitter location.

CONSTRUCTION, MARKING AND LIGHTING OF ANTENNA STRUCTURES

Notice of Proposed Rule Making

1. Notice is hereby given of proposed rule making in the above-entitled matter.

2. The Administrator, FAA, in exercising his statutory responsibility of regulating the navigable airspace, plans to withdraw FAA's representative from the Airspace Division of the Air Coordinating Committee (ACC) and has recommended its abolishment. As a result of this the FAA has promulgated procedures and rules pertaining to airspace utilization. In this connection the FAA has transmitted to the FCC a proposed "FAA Procedures For Special Aeronautical Study of Radio and TV Antenna Structures" which, to be effective, would require amendment of § 17.4 (a), (b), (c) and (d). The portions of § 17.4 which refer to the Airspace Subcommittee of ACC would be amended to reflect the FAA as the place where proposed antenna towers will be considered with respect to possible hazard to air navigation.

3. The FAA procedures, propose to substitute the FAA for the Airspace Division of ACC and state that, "The procedures set forth the same general practices adhered to in the past," and are to become effective upon appropriate amendment of Part 17 of the Commission's rules. Determinations or findings by the FAA under these procedures are in the nature of recommendations to the FCC. The ultimate determination is made by the Commission.

4. The proposed amendment is issued under the authority of section 303 (q), (r) of the Communications Act of 1934, as amended.

5. Any interested person who is of the opinion that the proposed amendment should not be adopted, or should not be adopted in the form set forth herein, may file with the Commission on or before March 7, 1960, written data, views, or arguments setting forth his comments. Comments in support of the proposed amendment may also be filed on or before the same date. Rebuttal comments may be filed within 10 days from the last day of filing of original comments. 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 all such comments prior to taking final action in this matter, and if comments are submitted warranting oral arguments, notice of time and place of such oral arguments will be given.

6. In accordance with the provisions of § 1.54 of the Commission's rules, an

original and 14 copies of all statements, briefs, or comments shall be furnished the Commission.

Section 17.4 is proposed to be amended to read as follows:

§ 17.4 Commission consideration of proposed antenna structure with respect to possible hazard to air navigation.

(a) All applications which in the light of the criteria set forth in Subpart B of this part require special aeronautical study will be referred by the Commission through appropriate channels to the Federal Aviation Agency for its recommendation.

(b) All applications which do not require special aeronautical study in view of the criteria set forth in Subpart B of this part will be deemed not to involve a hazard to air navigation and will be considered by the Commission without reference to the Federal Aviation Agency or any other agency or organization.

(c) Whenever a recommendation for approval of any application that has been submitted to the Federal Aviation Agency, has been received from that agency, the application will be deemed not to involve a hazard to air navigation and will be processed by the Commission accordingly.

(d) Whenever a report recommending denial of any application has been received from the Federal Aviation Agency, the applicant will be so advised by the Commission and the Commission will take such further action as might be appropriate.

FAA Procedures for Special Aeronautical Studies Relating to Radio and TV Antenna Structure.

I. *Introduction.* The following procedures will be used by the Federal Aviation Agency (FAA) in conducting special aeronautical studies relating to applications concerning radio and television antenna structures.

Part 17 of the Rules of the Federal Communications Commission (FCC) relates to the construction, marking and lighting of antenna structures. Among other things Part 17 contains the criteria under which FCC will determine whether applications for the construction of these structures will be referred to FAA for special aeronautical study. Applications which do not require a special aeronautical study by FAA will be processed by FCC without reference to FAA.

The procedures set forth follow the same general practices adhered to in the past. FAA will circularize interested persons; afford applicants opportunity to present information; conduct the special aeronautical study and notify FCC of the results.

II. *Filing of applications.* Applications for radio-television antenna structure construction deemed by FCC to require special aeronautical study will be forwarded by FCC to the appropriate FAA Regional Office.

III. *Airspace conference.* Periodic airspace conferences are held by the FAA at each regional office location. Such conferences will include, as agenda for discussion, those proposed radio-television antenna structure cases described in paragraph IV B of this document. The agenda of the proposals to be discussed will be forwarded to interested persons well in advance of the meeting.

The Airspace Utilization Division, FAA, Washington, D. C., will also call airspace conferences at which aeronautical studies of radio-television antenna structures may be reviewed as required in accordance with the procedures set forth herein. In this connection, the FAA will distribute an agenda to interested persons well in advance of the conference.

All airspace conferences will be called by the FAA and the Chairman will be an FAA representative. Since the conferences are informal, no verbatim minutes will be published.

IV. *Applications referred to FAA.* All applications for radio-television antenna structure construction forwarded by the FCC to the appropriate regional office for special aeronautical study are subject to the following procedures:

A. *Informal processing of applications.* The FAA Regional Office will initiate an investigation to determine the effect the proposed structure will have on air navigation. In the course of the investigation, the region will request the comments of interested persons. If no objection or qualified approval is received from any interested person and the region finds the proposal acceptable the region will forward the application together with its findings to FCC in Washington, D. C. (copy to AT-100).

B. *Formal processing of applications.* In the event an objection to the proposed structure is received; a qualified approval is submitted; a person requests that the FAA hold a conference to discuss the matter, or it appears to the FAA Regional Office that there may be an unacceptable hazard to air navigation the region will arrange to have the matter discussed at one of its periodic airspace conferences. The region may, of course, hold a specific conference for the purpose. The applicant and all interested persons will be afforded the opportunity to attend the conference and explain in detail their position respecting the application.

a. After full consideration of the application the FAA Regional Office will forward a report of these discussions concerning a proposed radio-television structure to the Airspace Utilization Division, FAA, Washington, D. C.

b. After receipt of FAA regional report the Chief Airspace Utilization Division of FAA will notify FCC of the FAA findings or the scheduling of further discussion of the application at a Washington airspace conference.

c. The FAA will document all objections which are not resolved, identify the objectors, and include this information with FAA findings which are forwarded to FCC.

d. When the FAA finding is adverse to an application for the construction of a radio-television antenna structure the reasons will be included with the finding.

e. The FCC is expected to furnish the applicant with the findings of the FAA after they have been formally transferred to the FCC or upon receipt by FCC.

C. *Accelerated procedures.* When a special aeronautical study requires that the coordination with interested persons must be accomplished in a minimum of time in order to avoid undue hardship to the applicant or an interested person, the FAA will undertake to accelerate its procedures. Thus comments of interested persons may be obtained by telephone and the informal conference may be dispensed with. In any event, the FAA will obtain by the most expeditious means the comments of all interested persons and notify the FCC of the findings at the earliest practicable date.

PART 4—EXPERIMENTAL, AUXILIARY, AND SPECIAL BROADCAST SERVICES
Frequency Assignment and Sound Channels

At a session of the Federal Communications Commission held at its Offices in Washington, D. C., on the 10th day of February, 1960;

The Commission having under consideration amendments to §§ 4.502 and 4.603 of its rules; and

It appearing that on February 18, 1959, the Commission, after appropriate rule making to compensate the AM and TV (aural) STL service for loss of frequencies in the band 890-940 Mc when this band was transferred from non-Government to Government use, adopted the Fifth Report and Order in Docket No. 12404 (FCC 59-141) which, in part, amended the Table of Frequency Allocations in § 2.104 to make the band 942-952 Mc available to AM, FM and TV (aural) STL stations; and

It further appearing that the foregoing change, adopted in Part 2 of the rules requires a corresponding revision in the service rules in Part 4, to reflect the change so adopted; and

It further appearing that inasmuch as these amendments are dictated by orderly rule making processes and that the changes in substance have already been made after the required notice and rule making, prior publication of notice of proposed rule making under the provisions of section 4 of the Administrative Procedure Act is unnecessary and the amendment may become effective immediately; and

It further appearing that authority for the amendments adopted herein is contained in sections 4(i) and 303 of the Communications Act of 1934, as amended;

It is ordered, That effective March 17, 1960, §§ 4.502 and 4.603 are amended as set forth below.

(Sec. 4, 48 Stat. 1066, as amended; 47 U.S.C. 154. Interprets or applies sec. 303, 48 Stat. 1082, as amended; 47 U.S.C. 303).

Released: February 12, 1960.

FEDERAL COMMUNICATIONS COMMISSION,
[Seal] MARY JANE MORRIS,
Secretary,

1. Section 4.502 (a) is amended by inserting the phrase "or standard broadcast" between the words "broadcast" and the initials "STL". As amended, paragraph (a) reads as follows:

§ 4.502 Frequency assignment.

(a) An FM broadcast or standard broadcast STL station may be licensed on one of the following frequencies:

Mc	Mc	Mc	Mc
942.5	945.0	947.5	950.0
943.0	945.5	948.0	950.5
943.5	946.0	948.5	951.0
944.0	946.5	949.0	951.5
944.5	947.0	949.5	

2. Section 4.603 is amended by changing the present paragraphs designated (b) and (c) to (c) and (d) respectively, and inserting a new paragraph (b) so that the section will read as follows:

§ 4.603 Sound channels.

(a) The frequencies listed in § 4.602(a) may be used for the simultaneous transmission of the picture and sound portions of television broadcast programs and for cue and order circuits, either by means of multiplexing or by the use of a separate transmitter within the same channel. When multiplexing of a television STL station is contemplated, consideration should be given to the requirements of § 3.687 of this chapter regarding the overall system performance requirements. Applications for new television pickup, television STL, and television inter-city relay stations shall clearly indicate the nature of any multiplexing proposed. Multiplexing equipment may be installed on licensed equipment without further authority of the Commission: *Provided,* That the Commission in Washington, D. C., and the Commission's engineer-in-charge of the radio district in which the station is located shall be promptly notified of the installation of such apparatus: *And provided further,* That the installation of such apparatus on a television STL station shall not result in degradation of the overall system performance of the television broadcast station below that permitted by § 3.687 of this chapter.

(b) The following additional frequencies are allocated for assignment to television STL stations and television inter-city relay stations for the transmission of the sound portion only of television program material or communications relating thereto:

Mc	Mc	Mc	Mc
942.5	945.0	947.5	950.0
943.0	945.5	948.0	950.5
943.5	946.0	948.5	951.0
944.0	946.5	949.0	951.5
944.5	947.0	949.5	

(c) Any television STL station or television inter-city relay station used for the transmission of the sound portion only of television program material and for which there was outstanding a valid construction permit or license on April 16, 1958, specifying operation on any frequency between 890 Mc and 940 Mc may continue to be operated on such frequencies for the remainder of the term specified in such authorization and may, upon appropriate application therefor, be granted a renewal of license subject to the condition that no harmful interference shall be caused to the radiopositioning service operating in the band 890-942 Mc and subject to the further condition that the licensee must accept any interference which may be caused by the operation of radiopositioning stations in the band 890-942 Mc and industrial, scientific, and medical (ISM) equipment operating in the band 890-940 Mc.

(d) Remote pickup broadcast stations may be used in conjunction with television pickup stations for the transmission of the aural portion of television programs or events that occur outside a television studio and for the transmission of cues, orders, and other related communications necessary thereto. The rules governing remote pickup broadcast stations are contained in Subpart D of this part.

CLEAR CHANNEL BROADCASTING IN THE STANDARD BROADCAST BAND

Second Supplement to Third Notice of Further Proposed Rule Making

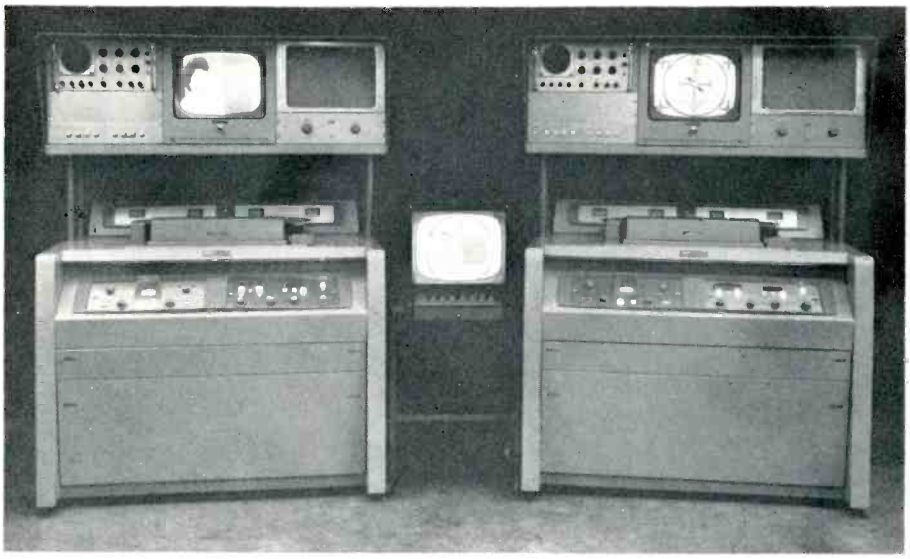
1. The Clear Channel Broadcasting Service has filed with the Commission on November 24, 1959, a Petition for Clarification of the Commission's third notice of further proposed rule making in the instant proceeding, adopted September 18, 1959, released September 22, 1959.

2. CCBS therein requests clarification of the following matter: (1) In the third notice comments have been invited on the plan of assigning new unlimited time stations on the Class I-A channels; (2) as heretofore there has been no nighttime duplication on Class I-A channels, the Commission's rules do not include engineering standards of protection to be afforded Class I-A stations from nighttime co-channel operations; (3) nor are such standards explicitly stated in the Third Notice as an adjunct to the requested formulation of comments. CCBS states its own opposition to any nighttime duplication on the Class I-A clear channels, but notes that CCBS and other

interested parties need a precise statement of the nighttime protection to be afforded Class I-A stations under the proposed plan in order to formulate their comments thereon. CCBS claims that this requirement is not satisfied by that portion of paragraph 13 of the Third Notice wherein it is stated that: "Each new station licensed under the amended Rule would be required to install a directional antenna, 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."

3. The proposal to consider new unlimited-time assignments on clear channels as set out in the third notice does not incorporate a formula, routinely applicable in each case, to determine a fixed maximum limit of radiation toward the dominant Class I station on the frequency. Such a formula would necessarily define one particular new concept of Class I-A operation, whereas, it was desired at this time, instead, to explore the various possible modifications of the existing concept of the Class I-A station. Possible bases for nighttime standards of protection to Class I-A stations exist in: (1) The 0.5 mv/m 50 per cent skywave contour which presently provides the basis for nighttime protection for Class I-B stations under the Commission's rules; (2) Type "E" or Type "F" service as defined in Exhibit 109 of this proceeding. There are also other possibilities which merit consideration with respect to their consistency with the general objective of allowing new unlimited time operations on clear channels while preserving, insofar as possible, the Class I-A character and usable service of the existing stations. It is, furthermore, noted that under the terms of the proposal set out in the third notice, the individual merits and deficiencies of each application for unlimited time assignment on a particular channel in the designated state or states would be studied, and due consideration given to, among other factors, the nighttime interference which would result from each proposed operation to the dominant station on the channel.

4. In view of the foregoing, interested parties are at liberty to include in their comments in response to the third notice consideration of: (1) The general interference situation which would result from implementation of the proposed plan; (2) the approximate pattern of nighttime utilization of any particular channel under this plan; (3) proposed engineering standards for the limitation of nighttime co-channel interference to Class I-A stations under this or any other plan involving nighttime duplication of the clear channels.



NEW VIDEOTAPE* DEVELOPMENT — By means of the new Inter-Sync device developed by Ampex for its Videotape recorder, the playback outputs of the two VTRs shown here are synchronized precisely for feed to a third monitor.

Inter-Sync Unit Combines Output Of Two or More VTR's

INTER-SYNC locks the recorder to the sync generator, so that the latter becomes the master instrument.

The Inter-Sync unit, which replaces the standard drum servo unit in the Ampex recorder, combines in a precise manner the output of two or more VTR's, field by field and line by line. Inter-Sync will also synchronize the playback of one or more VTR's with the output of TV camera, film chain, network feed or any other signal source.

For the local station, it also eliminates all chance of picture roll-over when switching from network feed to a local taped commercial, and vice versa. It also permits mixing and lap dissolving between network feed and local tape. With two Inter-Sync equipped VTR's, the station can, at will, insert taped commercials into taped programs without splicing and without picture roll.

As associated equipment, Inter-Sync can be installed on any existing VTR or ordered as optional equipment on a new machine. The electronic chassis is the same size as the present drum servo unit (master control) and replaces that unit.

Already operational, first engineering models of the Inter-Sync unit were used in production of the Pat Boone Show (ABC-TV) of Oct. 1, 1959. Lap dissolves from live to tape, and tape to live TV were readily accomplished. The network has ordered pre-production units which will be delivered later this month. Similar units will go to Electronic Videotape Editing Service, Inc., New York City, in March, and four pilot production units are scheduled for delivery to CBS-TV in May.

Tom Davis, manager of Ampex's Video Products Div., said a few more pilot production models will be available in May and June. Full production units will begin rolling off the lines in August in time for fall program changeovers.

*TM Ampex Corp.

Industry News

Paulson Appointed to Manager Post

C. R. Paulson

The appointment of C. Robert Paulson to manager of the Professional Audio Products Div. of Ampex Professional Products Co. has been announced by Neal K. McNaughten, Ampex Corp. vice-president. Paulson will continue in the position of marketing manager for the Professional Audio Products Div. until a replacement is appointed. Paulson started with Ampex as New York district audio sales manager in 1953 and later moved to the Redwood City offices as sales manager for the Professional Products Div.

New Adler Representative

Television Communication Products, Inc., 210 Casa Linda Plaza, Dallas 18, Tex., has been named authorized field engineering and sales representative for Adler Electronics in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas and Louisiana. Adler manufactures TV transmitting, rebroadcasting and microwave equipment.

Telectrosonic Names New Sales Manager

R. A. Donner

Robert A. Donner has been named sales manager of the Telectrosonic Corp., subsidiary of Telectro Industries Corp., according to an announcement released by Harry Sussman, Telectro president. It was also announced that Henry Berlin has been promoted to the new position of marketing operations manager.

RCA Broadcast Sales Representative Named

John P. Shipley has been appointed a sales representative in the Michigan area for the Broadcast and Television Equipment Div., Radio Corp. of America, it was announced by C. H. Colledge, division general manager. Mr. Shipley was formerly with the National Broadcasting Co. A native of Nebraska, he attended the University of Omaha and has been in the broadcast and communications fields for the past 20 years.

Forty RCA TV Tape Recorders Now Installed

Forty television tape recorders have been shipped to users with 100 more machines on order, it has been announced by T. A. Smith, executive vice-president, Industrial Electronic Products, Radio Corp. of America.

C. H. Colledge, General Manager, Broadcast and Television Equipment Division, announced the formation of a special Recording Products, High Power and Nucleonics Department, headed by M. A. Trainer. One of the functions of the new department will be development of advanced types of recording devices for the broadcast industry.

3M Offers Tape Recording Glossary

A glossary of high fidelity and tape recording terms has been reissued by Minnesota Mining & Mfg. Co. Called "99 Tape Recording Terms," the glossary is free upon request from the company, Dept. E9-520, 900 Bush Avenue, St. Paul, Minn.

Numerous words added to the English language as a result of magnetic tape's widespread acceptance throughout the recording industry prompted the compilation of the glossary. Typical of the terms defined are: cycles per second, decibel, distortion, equalization, feed through, fidelity, flutter, frequency response, gain, impedance, print through, signal-to-noise ratio, tensilized polyester, and wow.

Goldie Promoted at Tower Construction Co.

Dean Goldie

Dean Goldie has been promoted to special projects manager for the Tower Construction Co., according to the company president, M. M. Lasensky. Goldie, who has been with Tower for seven years, was a field supervisor of government contracts and overseas projects. His new duties call for planning and supervising all of Tower's special projects in this country and abroad. Goldie is a graduate of the University of Tampa.

Oden Jester Joins Shure

O. F. Jester

Appointment of Oden F. Jester to its sales division has been announced by Shure Bros., Inc., Evanston, Ill. Jester will handle special assignments in the division, according to F. V. Machin, sales vice-president. Previous positions held by Jester include those of distributor sales manager of Standard Coil Products, vice-president of the Meissner-Thordardson-Radiart Div. of Maguire Industries, Inc.; vice-president and general sales manager of Utah Radio & Electronic Corp.; and radio sales manager of Stewart-Warner Corp.

Rohrbach Named to Marketing Post

D. P. Rohrbach

Appointment of Donald P. Rohrbach as manager of marketing research has been announced by Shure Brothers, Inc., Evanston, Ill., manufacturer of microphones, phonograph cartridges, and electronic components. Rohrbach previously held marketing positions with Ekco-Alcoa Containers, Motorola, Westinghouse, and General Electric.

RCA Announces West Coast TV Tape Facility

A television tape engineering and application center will be established by RCA in Los Angeles to provide customer service ranging from engineering assistance to application planning and the supplying of components. In addition to meeting the problems of specific installations, a team of RCA experts will make a series of continuing studies on the tape recording needs of both the film and broadcasting industries.

Fink Rejoins Ampex

W. A. Fink

William A. Fink has returned to the Atlanta area as district manager for the Audio Products Div. of Ampex Professional Products Co. He had been on leave from Ampex while acting as marketing consultant for Orr Industries, Opelika, Alabama. The recent merger of Orr with Ampex Corp. resulted in the formation of Orr Industries Co., a division of Ampex Corp.

Adler Adds Six Engineers

Six project and senior level engineers have recently been added by the Systems Engineering Divisions of Adler Electronics, Inc. They are Martin Heller, project engineer; George Gould, Norton Hight, Abraham Rubenstein and Bernard Schechtman, senior engineers, and Jack Titen, administrative engineer.

Connector Directory Available From Allied Radio

A 16-page directory containing comprehensive listings of the most widely used electronic connectors has been released by Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. Alphabetically arranged by manufacturers, Ampenol, Cannon, Cinch-Jones, Harvey Hubbell, and Hart & Hegeman connectors are listed in numerical order for easy reference. It is available without charge.

Reeves Soundcraft Announces Video Tape

Reeves Soundcraft Corp. will start full production of commercial video tape in the first quarter of 1960, according to an announcement made by Frank B. Rogers, Jr., executive vice-president. He also announced the installation of a video tape recorder to be used in the production facilities.

New Cannon Factory Opens in Phoenix

A new manufacturing division of Cannon Electric Co. opened for business Jan. 4 in Phoenix, Ariz. Called the Phoenix Div., the new Cannon factory combines all engineering, manufacturing, and testing facilities under one roof. The new division is housed in a new 68,000 sq. ft. building adjacent to the Phoenix airport.

Houston Fearless Names Eastern Marketing Manager

Richard E. Holtzworth, former Washington marketing manager of Hughes Aircraft Co.'s communication division, has been named to the post of eastern marketing manager for Houston Fearless Corp. Prior to his Hughes association he was the Washington engineering liaison representative for Collins Radio Co.

Wurzel Appointed At Sprague Electric Co.

Leonard H. Wurzel has been appointed as resistor product specialist for the Sprague Electric Co. Prior to joining Sprague he was the Pittsburg district sales manager for Ward Leonard Electric Co. He is a graduate of the Columbia University School of Engineering.

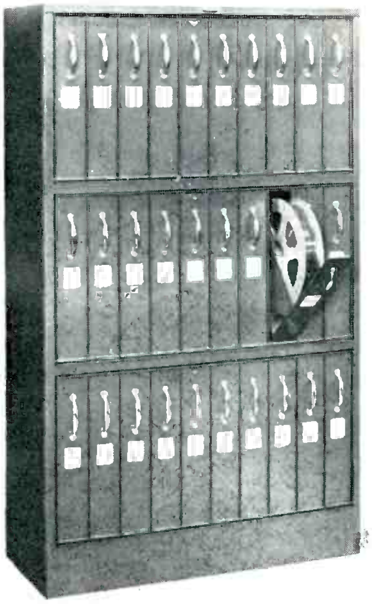
Audio Devices Sells Rectifier Division

Audio Devices, Inc., has sold its silicon rectifier division in Santa Ana, Calif., to the Lark Corp., Dallas, Tex. Audio Devices is increasing its research and development program for tape for sound, computer, and video uses.

Advertisers' Index

Classified

Product News



TV TAPE STORAGE CABINETS

Dustproof and fireproof storage for 6-inch, 8-inch, 12½-inch, and 14-inch TV tape reels is now offered by Neumade Products Corp., 250 West 57th St., New York 19, N. Y. Illustrated above is a storage cabinet for 12½-inch reels.

The illustrated cabinet holds 30 tape reels in three ten-compartment cabinets in an outer cabinet 62 inches high, 36 inches wide and 14 inches deep. Single ten-compartment cabinets are available. The cabinets are made of heavy gauge steel, with welded construction. The finish is olive gray with polished chrome hardware. In addition to cabinets Neumade also offers racks and custom designed storage units.

HIGH POTENTIAL TEST SETS

A new series of bench type, semi-portable high potential test sets with outputs to 30 kv. for determining dielectric strength in electronic cables, components, and assemblies has been announced by Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill. Models with either ac or dc output are available and provide continuously variable voltage control. Output voltage and insulation leakage current are indicated on separate meters.

NEW JACKS AND JACK PANELS AVAILABLE

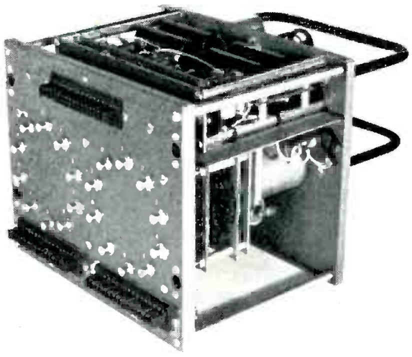
Nems-Clarke Co., a division of Vitro Corp. of America, announces new additions to their proprietary line of Video and RF Jack Panel equipment and components which provide increased flexibility in the planning of patching facilities.

The Type 925 Jack is similar to the former Nems-Clarke Type 964 Jack; the difference being in the provision of a BNC connector mounted on the back of the Type 925 Jack. The heavy silver plated contact surfaces of this Jack are protected with a gold flash, which is in line with Nems-Clarke Co.'s efforts to improve a majority of its patching equipments in this manner. Type 925 Jack is designed primarily for use in Types 921, 928, and 929 Jack Panels.

The Type 921 Jack Panel is made of aluminum and is 19 inches wide by only 1¾ inches high. It is provided with 12 Type 925 Jacks and is especially useful where space is at a premium.

The Type 928 Jack Panel is similar to the Type 921 in construction and provides for 24 Type 925 Jacks. It is 19 inches wide by 3½ inches high.

The Type 929 Jack Panel is similar in construction to the Type 921 and 928 Panels and provides for 48 Type 925 Jacks. It is 19 inches wide by 3½ inches high.



FERROELECTRIC CONVERTER VIDEO SWITCHING EQUIPMENT

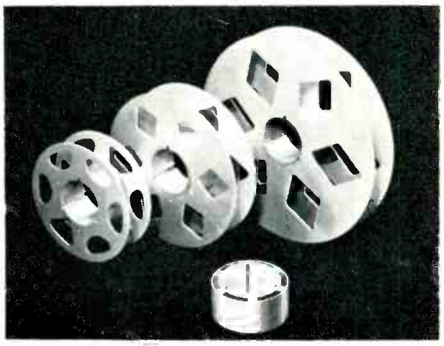
A new method of switching multiple circuits in television broadcasting operations has been announced by Telecontrol Corp., 1418 West 166th St., Gardena, Calif. The basic family of switching modules can be applied to all television switching operations, including studio, master control and distribution switching systems.

A new type of multiple circuit rotary stepping switch is used in the switching modules. Switching is accomplished within a one-inch radius. The stepping switch can handle simultaneous switching of various combinations of video, sync, audio, control and tally circuits within the same module. It also utilizes a wide range of control flexibility in remote positioning, including pulse control, rotary selector control and push-button selection. High speed off-air switching is provided with rotation to the extreme position in the order of 0.05 seconds. The three basic systems available are program switching systems, distribution switching systems, and special effects input switching systems.

AC VTVM KIT

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill., has released a new vacuum tube voltmeter kit featuring a motor-driven automatic range selector. The self-seeking selector automatically sets the VTVM on proper range the instant the probe is touched to the circuit. Panel lights indicate the range in use.

Trigger circuits are specially designed to assure positive switching between ranges. Featuring printed circuitry, the AC VTVM kit is supplied with all parts, probe, wire and solder. It uses 10 tubes plus rectifier.



NEW TV TAPE REELS

A complete new line of 2-inch magnetic tape reels for video use with wide-hub shoulders in die cast aluminum is now being produced by Tapac Corp. This wide shoulder gives these precision reels a larger mating surface with the tape deck hub, resulting in a positive reel-to-machine alignment.

These features may be obtained at little increase in price in comparison to the present reels with narrow shoulder or reels with no shoulder. Proposed new SMPTE specifications are met or exceeded.

Tapac makes tape reels of all diameters from 8 to 19½ inches with many flange and hub combinations. Hubs are made for video use in three styles: 1—no shoulder; 2—narrow shoulder; 3—wide shoulder. For detailed specifications and prices, write to Tapac Corp., 411 West Maple Ave., Monrovia, Calif.

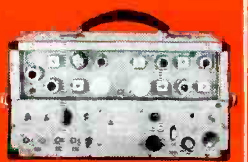
TELECHROME

The Only Complete Line of VIDEO TRANSMISSION TEST EQUIPMENT

IT'S PORTABLE

1003-C3 VIDEO TRANSMISSION TEST SIGNAL GENERATOR

Produces multi-frequency burst, stairstep, modulated stairstep, white window, composite sync. Variable duty cycle. Regulated power supply. Operates from internal or studio sync. Checks video tape recorders.



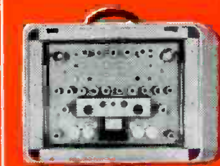
1004-B VIDEO TRANSMISSION TEST SIGNAL RECEIVER

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

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 of 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

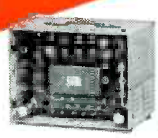
Permits test and control signals to be transmitted simultaneously with program material, between frames of TV picture. Any test signal (multiburst, stairstep, color bar, etc.) may be added to the composite program signal. Test signals are always present for checking transmission conditions without impairing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

1073-D1 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. Operates with internal or external drive. Now in use by major TV networks and telephone companies.

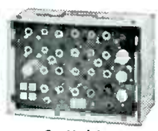
MODEL 490A SPECIAL EFFECTS GENERATOR

With Exclusive 'Joy Stick' Control



Waveform Generator

Remote Control Unit



Switching Amplifier

Improved System Produces over 300 Wipes, Inserts, Keying and Other Special Effects.

Full Specifications & Details Available on Request

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Midwest Engineering Division — 106 W. St. Charles Rd., Lombard, Ill., MAyfair 7-6026
Western Engineering Division — 13635 Victory Blvd., Van Nuys, Calif., STate 2-7479
Southwestern Division — 4207 Gaston Ave., Dallas, Tex., TAylor 3-3291

Television Zoomar for the 4½ Inch I-O Camera 2½ to 72" Remote Iris Control

. . . Now Ready for Demonstration

SUPER STUDIO and SUPER UNIVERSAL ZOOMAR LENSES newly designed for the 4½ inch Image Orthicon are now available for immediate delivery. Mount on new cameras in a minute.

The iris is remote controlled with both the SUPER STUDIO and SUPER UNIVERSAL in all ranges.

The zoom rod, which controls zoom—focusing and "tracking," runs through a shaft on the lower right side of the camera.

- SUPER STUDIO ZOOMARS zoom from 2¼ to 15 inches in two ranges:
- Iris remote controlled in both ranges.
- 2¼ to 7¼ inches (55 to 180mm) at f/2.7 with basic lens.
- 5 to 15 inches at f/5.6 with convertor #1.
- Maintains speed throughout zoom—change range in a minute—

SUPER STUDIO and SUPER UNIVERSAL ZOOMAR FEATURES:

- Iris remote controlled in all ranges.
- Completely color-balanced and corrected.
- SUPER UNIVERSAL speed f/3.9—zoom ratio 6:1.
- SUPER STUDIO speed f/2.7—zoom ratio 3½:1.
- Manual zoom control lets you regulate speed of zoom and focusing.
- No counter-balancing necessary.
- Convert from one zoom range to any other zoom quickly.
- Available for 3 inch or 4½ inch camera.
- Zoomars are serviced by the engineers who build them.
- One year guarantee and maintenance without charge.

SUPER UNIVERSAL ZOOMARS zoom from 2½ to 72 inches in four fast ranges:

- Iris remote controlled in all ranges.
- 2½ to 16 inches at f/3.9 with basic lens.
- 4 to 25 inches at f/5.6 with Convertor #1.
- 6½ to 40 inches at f/8 with Convertor #2.
- 12 to 72 inches with convertor #3.
- Maintains speed throughout zoom—change range in a minute—

SUPER STUDIO
2¼ to 15 inches

SUPER UNIVERSAL
2½ to 72 inches

For information on these ZOOMARS for the 4½ inch camera or ZOOMAR LENSES for the standard 3 inch camera. *Write or call.*

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Television Zoomar, the originator • 13 years of specialization in the manufacture of ZOOMAR LENSES for Television

OVER 500 ZOOMAR LENSES USED AT TELEVISION STATIONS AROUND THE WORLD