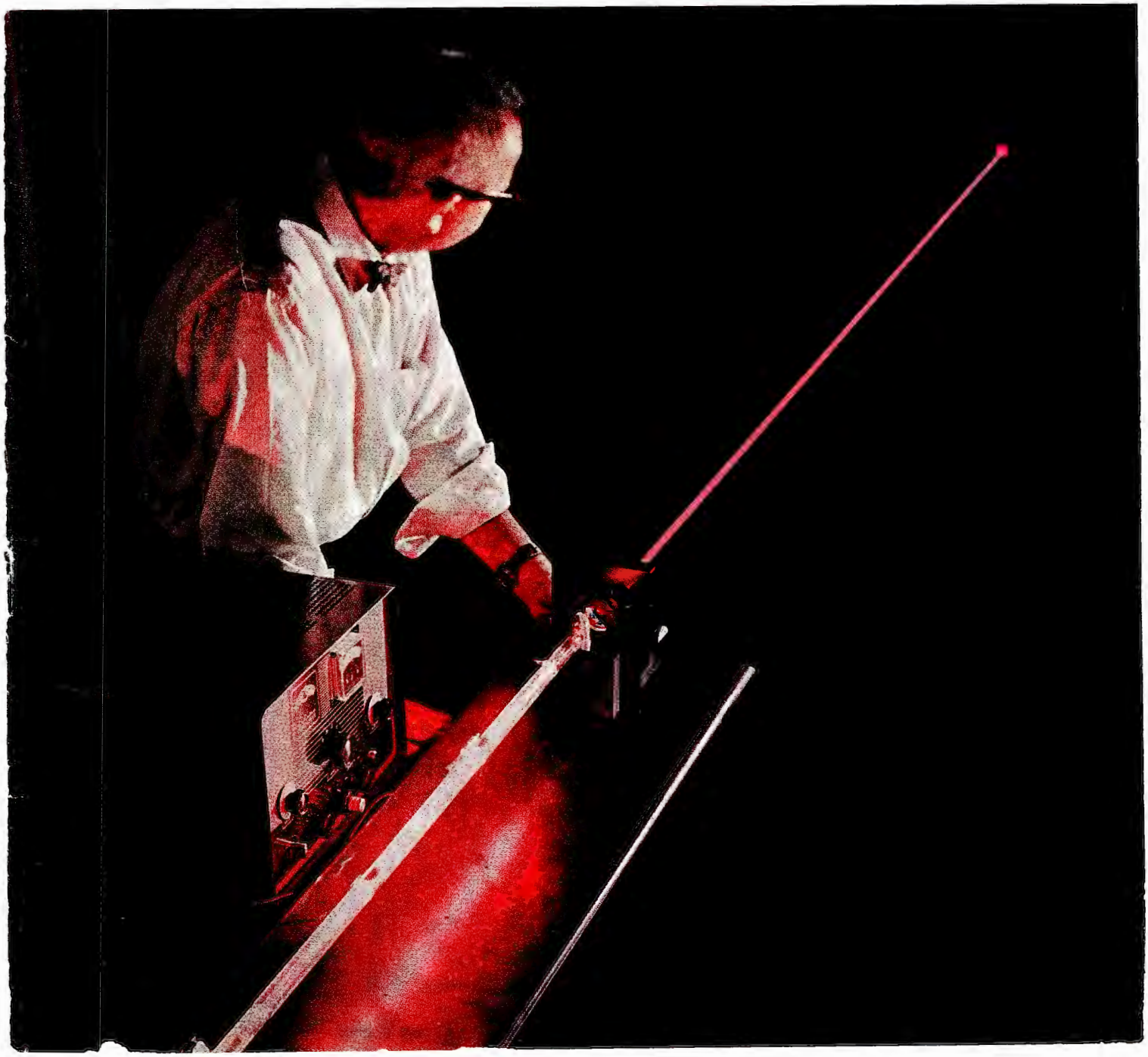
A HOWARD W. SAMS PUBLICATION

AUGUST 1963 75c

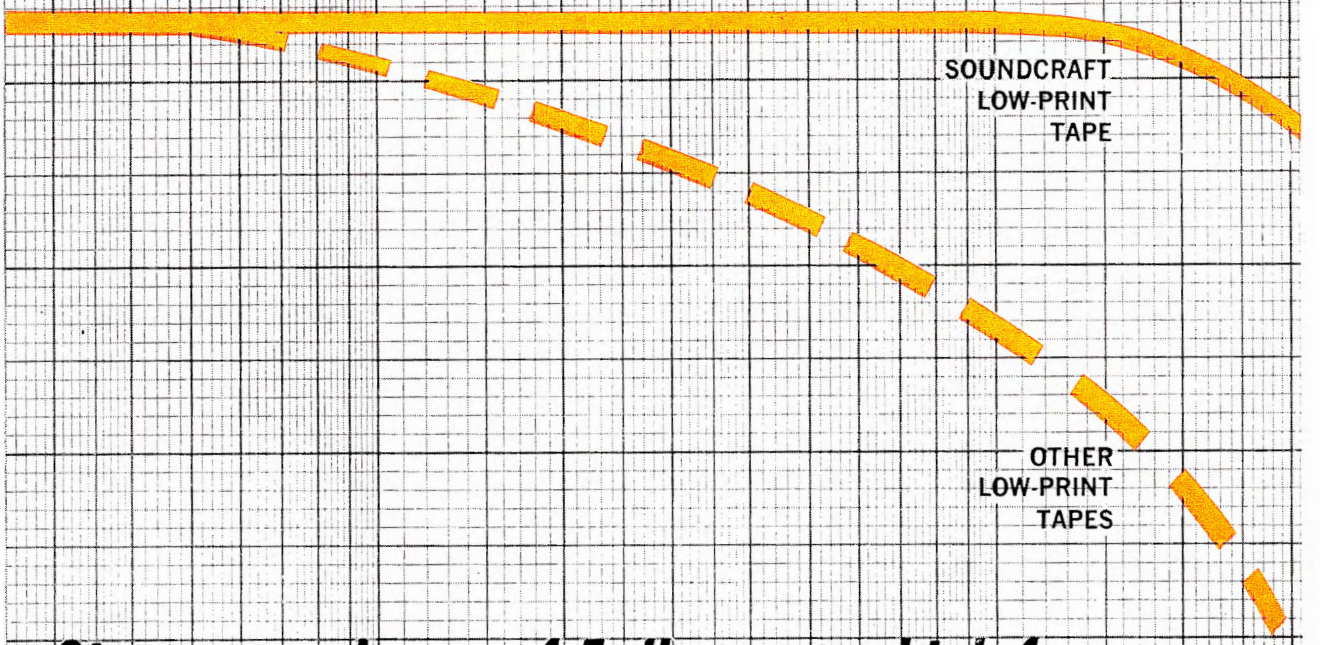
FEATURING:

Broadcast Engineering

the technical journal of the broadcast-communications industry



A NEW LOW-PRINT MASTERING TAPE WITH NO SACRIFICE IN OUTPUT!



Gives you a bonus of 5 db greater high frequency output than any other low-print tape!

Now, for the first time — a professional low-print mastering tape you can intersplice with standard mastering tapes because **its output characteristics match these tapes!** To achieve this, Soundcraft has provided this tape with a high frequency boost . . . 5 db more output than other competitive low-print tapes . . . to assure you of master recordings with lower background noise and wider dynamic range. All this, in a tape that offers 8 db better print-through than standard mastering tapes. No static noise, no editing squeal. Exclusive Soundcraft manufacturing processes help to produce a physically perfect tape — among these:

- **Micropolishing**® for mirror-smooth defect free surface, perfect high frequency response without break-up.
- **Precision-slitting** for complete absence of edge burrs and skew.
- **Chemical balance** of base material and oxide coating to prevent cupping.

And two more Professional Tapes to improve your recordings:

SOUNDCRAFT HIGH OUTPUT MASTERING TAPE— Provides optimum combination of high output, high signal to noise and low distortion characteristics — resulting in wider dynamic range for your critical master recordings.

SOUNDCRAFT DUPLICATING TAPE — Has 25% greater high frequency output and 7 db better signal to noise ratio than conventional duplicating tapes. Used throughout the industry when quality reproduction is required.

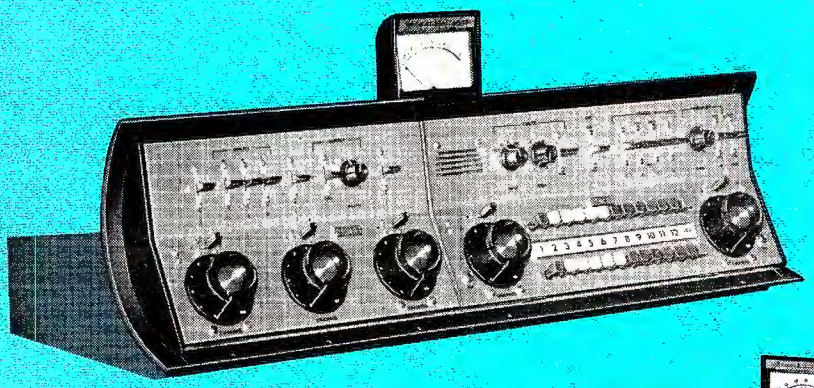
Write for your free "Guide to Soundcraft Professional Recording Products".

REEVES SOUNDCRAFT

Division of Reeves Industries, Inc., Danbury, Conn.
New York · Chicago · Los Angeles · Foreign Division: 25 Warren St., N.Y.C. · Canadian Reps: Vancouver · Toronto

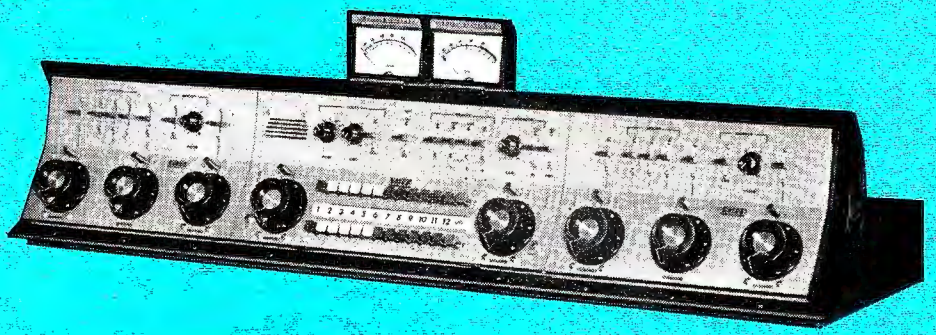
Circle Item 1 on Tech Data Card

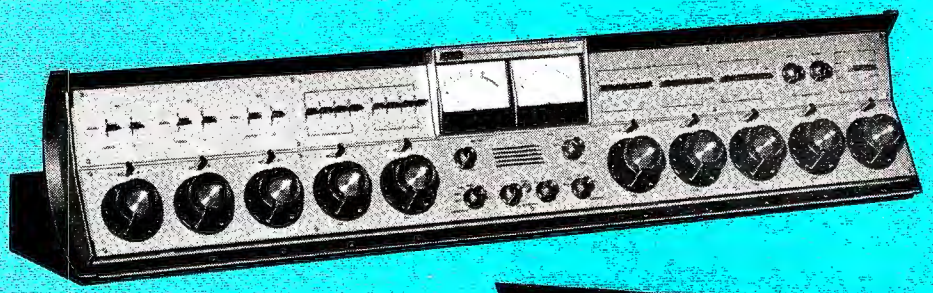
Choose From 4 Transistorized Consoles



Gates **Ambassador** single channel transistor console. The 24-position touch-control nerve center handles many combinations of turntables, tape machines and projectors. Mixing is provided by five step-type faders.

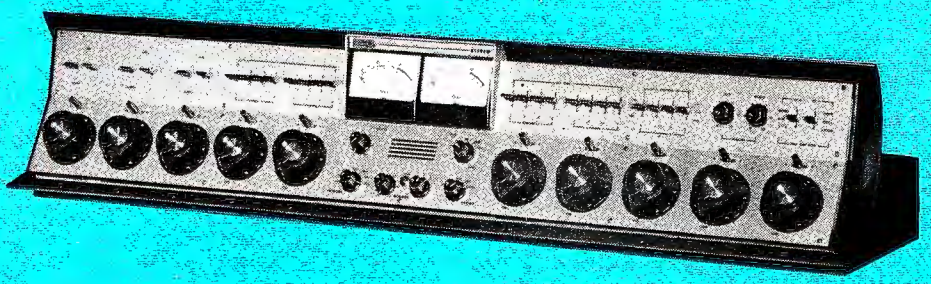
Gates **President** dual channel transistor console, featuring a 24 position pre-set master control for medium level inputs. Program selection is by individual illuminated touch-control keys for precise fingertip command. Eight ladder-type controls accommodate 28 inputs for exceptional versatility in AM, FM, TV or recording.





Gates **Diplomat** 10-position dual channel transistor console. Designed for the most demanding monaural broadcast operations.

Gates **Executive** stereo transistor console, for either full 10-channel stereo operation or monaural AM, FM and TV dual channel broadcasting with stereo inbuilt for your future needs.



Summit Meeting

President . . . Ambassador . . . Executive . . . Diplomat . . . the "Solid Statesmen" of broadcasting. All from Gates. As transistor audio control consoles of a new era, they stand out in the crowd . . . combining the space age quality and reliability of solid-state devices with versatile control facilities for future expansion.

Naming all of the special features of these "Statesmen" takes thirteen pages in your new Gates catalog. If you need a copy, write for Catalog No. 95.

GATES

GATES RADIO COMPANY

A Subsidiary of Harris-Intertype Corporation

QUINCY, ILLINOIS

HARRIS INTERTYPE CORPORATION

Offices in: Houston, New York, Los Angeles, Washington, D.C.
In Canada: Canadian Marconi Company, Montreal
Export Sales: Rocke International Corporation, New York City

Circle Item 2 on Tech Data Card

the technical journal of the broadcast-communications industry

®Broadcast Engineering

Volume 5, No. 8 **August, 1963**

CONTENTS

FEATURES

DEPARTMENTS

PUBLISHER: Howard W. Sams **GENERAL MANAGER:** Mal Parks, Jr.

EDITORIAL: Executive Editor, Verne M. Ray; Editor, Forest H. Belt; Managing Editor, Stuart N. Soil; Consulting Editor, John H. Battison.

CIRCULATION: Manager, Pat Tidd; Assistants, Katherine Krise, LaVon Willard.

PRODUCTION: Manager, Robert N. Rippy.

ADVERTISING: Sales Manager, Dave L. Milling; EAST: Charles Horner, Howard W. Sams & Co., Inc., 3 West 57th Street, New York, N. Y., Phone—MU 8-6350; MIDWEST—Hugh Wallace, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis 6, Ind., Phone AX 1-3100; SOUTHWEST—C. H. Stockwell Co., 4916 West 64th Street, Mission, Kansas, Phone—RA 2-4417; LOS ANGELES 57, CALIF., Maurice A. Kimball Co., Inc., 2550 Beverly Blvd., Phone—DU-8-6178; SAN FRANCISCO, Maurice A. Kimball Co., Inc., 580 Market Street, Phone—EX 2-3365; PARIS 5, FRANCE, John Ashcraft, 9 Rue Lagrange, Phone—ODeon 20-87; LONDON W.C. 2, ENGLAND, John Ashcraft, 12 Bear Street, Leicester Square, Phone—WHitehall 0525; TOKYO, JAPAN, International Media Representatives, Ltd., Kisha Kurabu 14, 2-chome Marunouchi, Phone—(502) 0656.

SUBSCRIPTION PRICE: U.S. $6.00, one year; $10.00, two years; $13.00, three years. Outside U.S.A. add $1.00 per year for postage. Single copies, 75 cents.

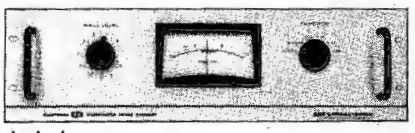
BROADCAST ENGINEERING is published monthly by Technical Publications, Inc., an affiliate of Howard W. Sams & Company, Inc. Editorial, Circulation, and Advertising headquarters: 4300 West 62nd Street, Indianapolis 6, Ind.

A HOWARD W. SAMS PUBLICATION

BPA

Hang onto your audience

—even when it's in fringe areas with those tiny transistor sets or in autos. Use the AUDIMAX® automatic level control! It's your route to as much as quadrupling your effective marketing area without increasing station power a single watt! Here's how: the exclusive gain platform principle of the AUDIMAX insists on maximum modulation... a clear, natural signal, even in fringe areas, with no distortion. The AUDIMAX logic and memory circuits discriminate between momentary and general changes in signal, to maintain gain at just the right level regardless of input. □ Yes, the AUDIMAX acts almost like another station engineer. The AUDIMAX thinks for itself! For details, call collect or write Professional Products, CBS Laboratories, a division of Columbia Broadcasting System, Inc., High Ridge Road, Stamford, Conn.



CBS LABORATORIES

Circle Item 4 on Tech Data Card

LETTERS
to the editor

DEAR EDITOR:

Author, Tom Haskett, and BROADCAST ENGINEERING are to be complimented on the Audio Level Devices article appearing in the June issue. The compilation of the various units available is revealing, and useful, to the serious broadcaster.

In the tabulation of limiter specifications, the noise level of the Gates SA-39B Peak Limiting Amplifier is listed as —46 dbm. Actually, Gates Radio specifications show this figure to be —65 dbm—substantially better than the figures quoted. We know your readers will appreciate this correction.

LARRY PFISTER
Manager, Audio Products
Gates Radio Co., Quincy, Ill.

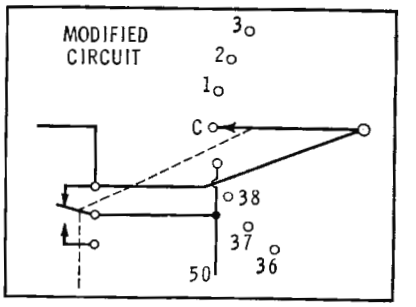
And we also, Larry, as well as your generous thoughts. Interest such as yours helps us maintain accuracy.

DEAR EDITOR:

A mistake has been made in the modified stepper relay circuit shown in the May Engineers" Exchange department. The wire from terminal 39 should be shown connected to the relay armature.

PETER H. VAN MILLIGAN
Maintenance Supervisor, WMBI-AM-FM
Chicago, Ill.

The corrected circuit appears below. —Ed.



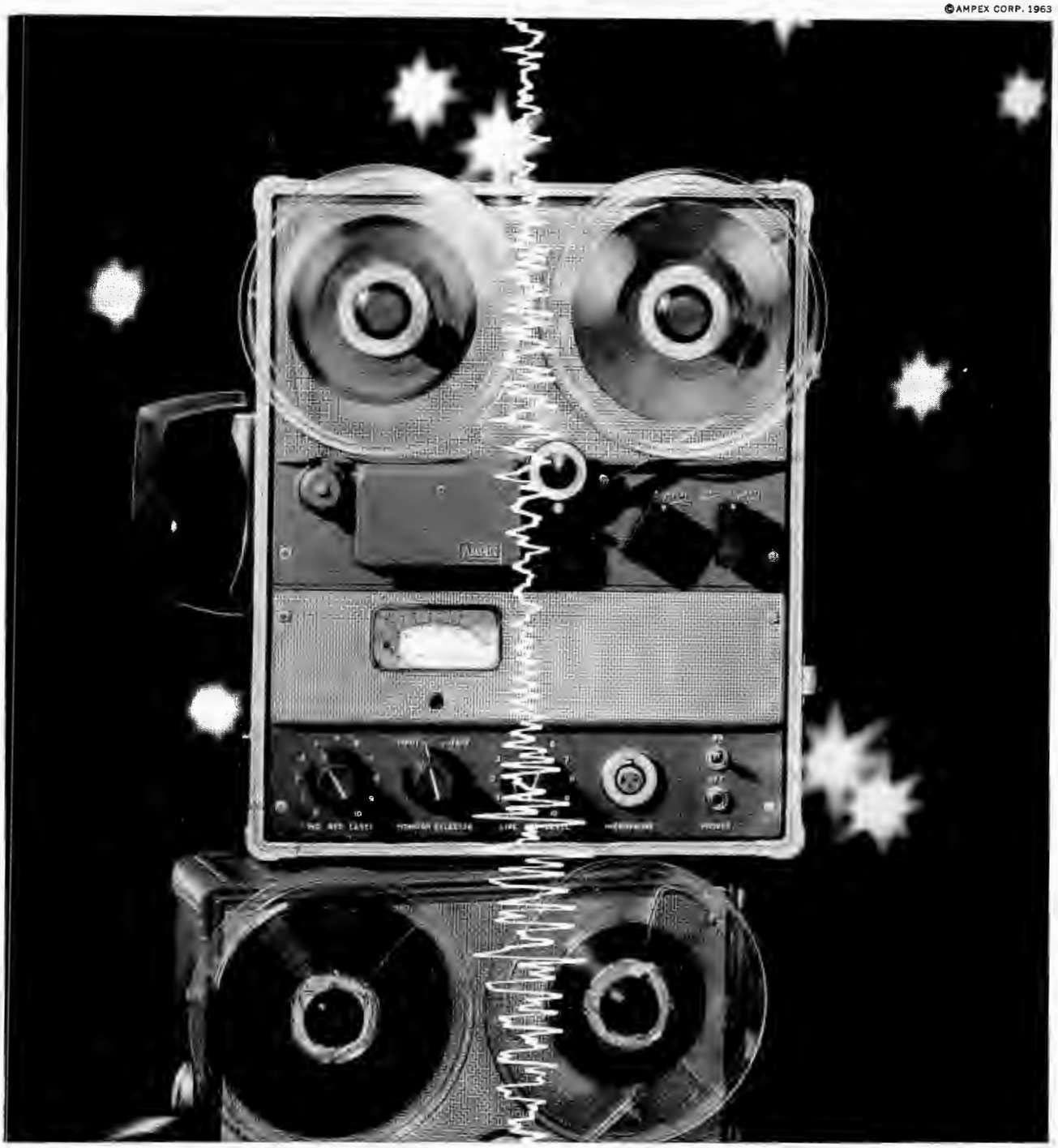
DEAR EDITOR:

The video switcher in the May issue of BE seems to be missing a few wires. The power supply operates fine with the collector Q1 connected to the junction of R1 and C3. I presume this is where it is supposed to go. Now, how do you propose to get the sync mixed with the video? Loose capacitive coupling, maybe? Mounting Q7 close to Q3 does not help much. C11 and/or C15 seem to be out of place; how about letting me know which one and where.

Yours is a fine magazine, but it could use one slight improvement—new proofreaders.

DAVID G. STORBERG
Chief Engineer, KRSD-TV
Rapid City, South Dakota

But if we hired new proofreaders, Dave, you might not ever write to us. Seriously though, please see author French's letter on page 8.—Ed.



What can possibly follow the 601? **AMPEX 602**

It's quite a number, the 602. A lightweight, low-cost, true professional field recorder made, of course, by Ampex. It's built on the foundation of the Ampex 601 (the recorder that was the workhorse of the entire broadcast industry), and the new Ampex 602 promises even to outdo the 601. Here's why. The 602 features completely new electronics circuitry. It has new solid-state rectifiers to keep the chassis cool, helping to prolong the life of the other components. It has XL type connectors for all line inputs. A built-in low impedance mike transformer. A higher power balanced or unbalanced 600 ohm output. And improved signal-to-noise ratio. These are just some of the advancements. The 602 is portable—ideal for field applications. Or it can be rack mounted. And it comes in a one-channel or two-channel model. Both backed by the Ampex "Four Star" One-Year Warranty. Both built to be extremely reliable—to follow and outdo the 601. For more information write Ampex Corp., Redwood City, Calif. Worldwide sales and service.

Circle Item 6 on Tech Data Card

DEAR EDITOR:

In reading the May issue of BE, I found a few errors in my article, "The Economy Video Switcher."

1. In Fig. 3, the negative side of C-15 should be connected to the Q-7 collector, not to —18v.
2. R-15 in the parts list should be 3.8K instead of 3.8 ohms.
3. In Fig. 4, the Q-1 collector should be connected to the junction of R-1 and C-3.

JAMES FRENCH, JR.
KRMA-TV, Denver, Colo.

Thanks, J. F. I'm sure this answers the questions of many readers, including those of Mr. Storberg.—Ed.

DEAR EDITOR:

After reading "Grid Modulation, Theory and Techniques" in the June issue of BE, I find some of the statements confusing.

Quoting, "Amplitude modulation, as we are considering it here, involves the changing in amplitude of a constant carrier by the application of an audio signal. . . . No matter what the depth of modulation is, the strength of the carrier will not be affected, and always remains constant."

In the first quoted sentence, the word "constant" must refer to carrier frequency, since it is stated that amplitude is being changed by the application of audio. As we are considering it here, I believe the words "strength" in the second sentence and "amplitude" in the first are synonymous, and the statements are therefore conflicting. The second statement, by itself, is clear and accurate; the same may be said of the statement regarding creation of sidebands.

It seems unfortunate that the professional groups failed to support the suggestion that the misnomer "amplitude modulation" be changed to "envelope modulation." This suggestion was prompted by the evident confusion in interpreting the oscilloscope display of a modulated envelope.

I find BE interesting and profitable reading, and hope that pointing out this area of confusion may be helpful.

RAY WILSON
Transmitter Supervisor,
WMSB/WILX-TV
Onondaga, Mich.

How about it readers, what should it be—amplitude or envelope? Study your scope display once more, and let's hear from you.—Ed.

DEAR EDITOR:

Thank you for sending the January and February 1963 issues of BROADCAST ENGINEERING to my new address, as requested in a recent letter. I keep a file on all BE issues, and find many of the articles very helpful in my position.

BART B. BONNEY
Chief Engineer, WZUM,
Pittsburgh, Pa.

You're welcome, Bart, glad to help. Remember readers, when you move advise us of your new address. Then we'll keep your copies coming without a miss.—Ed.

About the Cover

The cover, this month, features a continuous-wave sealed gas laser. Called the most dramatic scientific and engineering achievement since transistors, lasers (short for light amplification by stimulated emission of radiation) have many possible applications in communications, medicine, and metallurgy. As a communications medium, a single laser using an extremely high frequency signal may someday carry as much information as all channels now in existence. The laser operates in the following manner: A quartz tube filled with gas at a low pressure, is subjected to an RF field which excites the contained atoms. Photons spontaneously emitted by some of the excited atoms, are reflected back into the gas mixture from 99% reflecting mirrors at both ends of the tube. These photons stimulate neon atoms in the proper excited state which then emit additional photons precisely in phase with the stimulating photons. The continuous repetition of this process produces a self-sustaining oscillation which constitutes the desired coherent laser radiation. The useful portion of this radiation escapes through one per cent transmissive mirrors as an intense, coherent beam which can be made exceedingly narrow and highly directional.

Tubes designed from the user's viewpoint

...use them wherever reliability is essential

When reliability really counts—as it does in airline communications—be sure with tubes custom-designed and tested for the job.

Sylvania engineers traveled the country—met with engineers and maintenance groups in broadcasting, public service radio, industry, the airlines—listened to their problems and studied them. From this came GB Gold Brand, a superior line of new and upgraded tubes, each tailor-made to a specific job. A given tube may have, for example, low noise, exceptional stability or vibration resistance. Or a critical parameter may be as much as three times the usual value. In each case, performance and reliability have been verified by actual user experience as well as laboratory testing.

This extra effort has paid off. "Excellent results," says an airline official. "No failures," reports a highway patrol department. "Hundreds of dollars saved in program interruptions," reports a TV station. "Less costly in the long run," discovered a county government. Similar results can be yours with a truly reliable, genuinely interchangeable GB Gold Brand Tube.

Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

AVAILABLE FROM YOUR SYLVANIA INDUSTRIAL TUBE DISTRIBUTOR

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS

Circle Item 8 on Tech Data Car

FM STEREO PROOF-OF-PERFORMANCE MEASUREMENTS

*by Harry A. Etkin** — How to make measurements of transmitter and stereo generating equipment for meeting FCC standards.

After years of study by the FCC and field tests made by the National Stereophonic Radio Committee (NSRC) under the sponsorship of the Electronic Industries Association, the Commission has established performance standards for stereo systems which are detailed in Part 3 of the Rules. The measurements pertain to transmitter performance on both main and stereo channels and also include the stereo generating equipment. The system adopted by the Commission will produce a true stereo effect and yet be compatible with existing monophonic reception.

FCC Approved System

The FCC approved system transmits time division multiplex L and R information which is switched at a rate of 38,000 times per second. The composite information contains all signal components of the L and R channels, in proper amplitude and phase, plus additional signals supplied by the 38 kc keyed signal.

The spectrum of the broadcast signals and their respective modulation levels are shown in Fig. 1. The sum (L+R) and difference (L—R) signals are permitted 45% modulation each, and the 19-kc pilot signal 10%, for a total of 100%. With Subsidiary Communication Authority (SCA or storecasting) multiplex operation, the modulation of the main carrier by the SCA subcarriers should not exceed 10%.

Method of Signal Generation

The FCC has specified what the generated standard composite signals should be, but not the method for transmission. Broadcast transmitter manufacturers have designed three different methods of transmitting a compatible stereophonic signal. The first makes use of a matrix network and a suppressed carrier modulator. Another method uses a two-channel square-law modulator, and the third is the time multiplex system.

The preferred method of stereo signal generation, and incidentally the method used to make these measurements, will be described. Complete matrixing is used to break down the L and R signals into the sum of the left and right signals (L+R) and the difference signal (L—R). In the matrix the L and R signals are added to obtain the L+R signal. The matrix reverses the polarity of the R channel, which then becomes the difference signal (L—R). The difference signal (L—R) is processed to become a double sideband, suppressed carrier (DSB) signal which amplitude modulates the 38-kc suppressed carrier. This signal combines with the L+R signal to obtain the composite stereo information.

A pilot carrier, at one-half the subcarrier frequency (19 kc) is

*Staff engineer, WQAL-FM, Philadelphia, Pa.

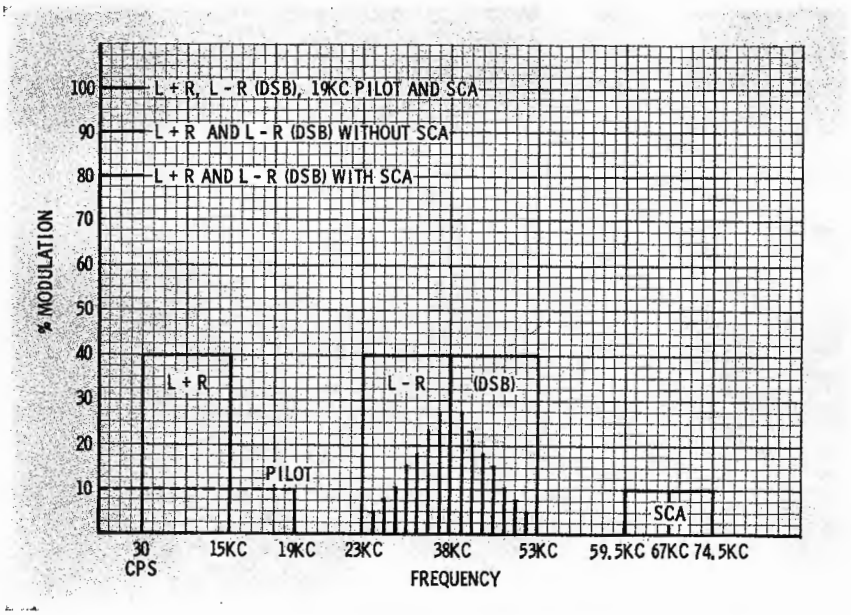


Fig. 1. Stereophonic spectrum distribution.

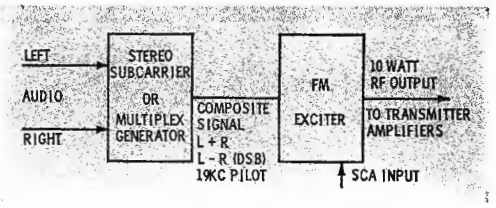


Fig. 2. Diagram of the stereo subcarrier generator and FM exciter, with signals.

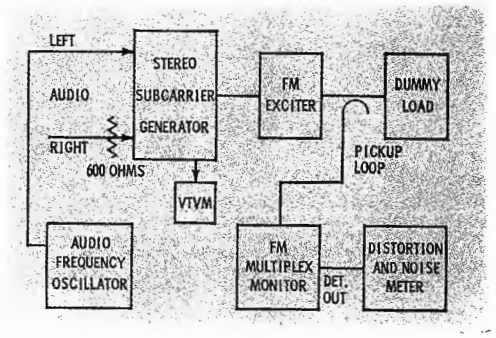


Fig. 3. Diagram of test setup for performing audio response and distortion tests.

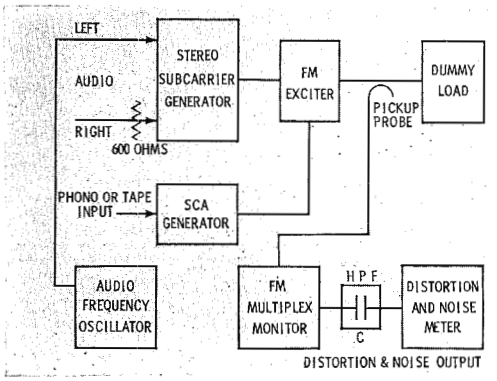


Fig. 4. Diagram of setup for signal-to-noise and hi-pass filter measurements.

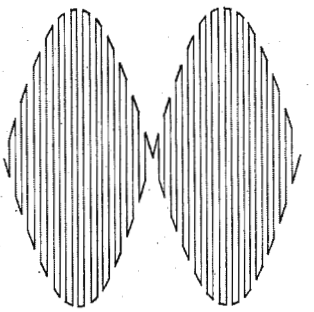


Fig. 5. Wave at stereo generator output; L-R modulated by submultiple of 38 kc.

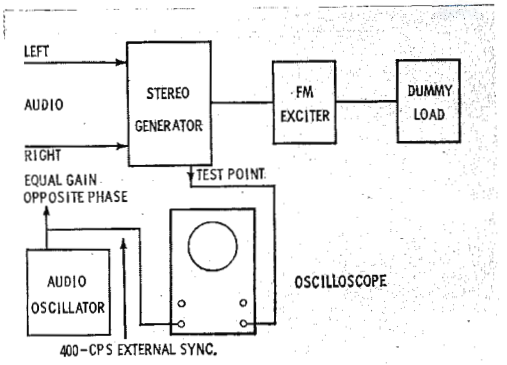


Fig. 7. Test arrangement for stereophonic balance determination steps 3 (a) & 3 (b).

transmitted for demodulator synchronization. The resultant final composite signal occupies a frequency spectrum between 50 and 53,000 cps. (38 kc ± 15 kc) which frequency modulates the main RF carrier.

SCA Subcarrier Added

An SCA subcarrier (multiplexing) centered at 67 kc can also be added to the composite signal. With the addition of the subcarrier the frequency also utilizes the spectrum between 59.5 kc and 74.5 kc. When all subcarriers are used to modulate the main carrier, the maximum peak deviation should not exceed more than ±75 kc.

With simultaneous SCA and stereophonic transmissions, any spurious signals from the SCA subcarrier must not exceed 60 db below 100% modulation of the RF carrier in the frequency range between 50 and 53,000 cps. Fig. 2 is a block diagram of the stereo subcarrier, or multiplex, generator and FM exciter.

Proof of Performance Methods

The following method of measurement should assist the station engineer to operate in full accordance with FCC approved standards. Prior to proceeding with any tests or measurements, acquaint yourself with the requirements of the FCC Rules and Regulations, Volume 3, Part 3, Sections 3.317, 3.319, 3.322 and 3.254. Also be sure to read Part II of the Fifth Edition of the NAB Engineering Handbook which gives special emphasis on Procedure for FM Stations (pages 8-205 to 8-214).

The equipment required to make the measurements consists of:

1. Audio oscillator or generator (audio frequency harmonic content less than 0.1%), 30 to 17,000 cps.
2. FM modulation monitor (multiplex monitor).
3. Stereo adapter de-emphasized (H. H. Scott type 335, Fisher MPX100, or equivalent).
4. Distortion and noise meter.
5. Exciter output dummy load.
6. Oscilloscope (vertical amplifier response from DC to 300 kc).

With all equipment properly tuned and aligned, proceed as follows:

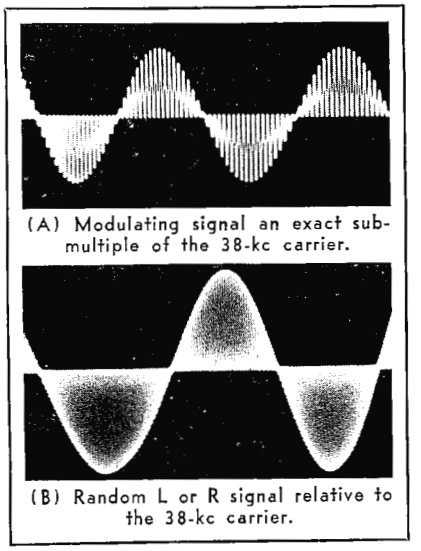
1. Audio frequency response and audio frequency harmonic distortion.

(a) Terminate right channel input to the stereo subcarrier generator with 600 ohms.

(b) Connect audio oscillator to left channel input.

(c) Place stereo switch (stereo subcarrier generator) in the off position (mono).

(d) Feed a signal to the left channel



(A) Modulating signal an exact submultiple of the 38-kc carrier.

(B) Random L or R signal relative to the 38-kc carrier.

Fig. 6. Waveforms showing proper relationship of L + R and L-R (DSB) signals.

to produce 1 volt peak-to-peak at the output test point of the stereo generator.

(e) Measure audio frequency response with the station monitor as required by the standard proof-of-performance check.

(f) Record all data and plot curves as required. See Fig. 3 for the equipment arrangement to make the audio frequency response tests.

The left and right signal (L + R) frequency response is measured, and the L + R channel harmonic distortion is obtained by using the same methods used to measure a regular proof-of-performance check.

The L — R frequency response will be obtained when the L versus R channel separation is measured. The L — R (DSB) harmonic distortion will be measured using a wave analyzer.

2. Signal-to-noise ratio (output noise).

(a) Remove such components as the 19-kc pilot, L — R (DSB) signals, the 38-kc suppressed carrier, and the SCA subcarrier. (Manufacturer's instructions should be followed.)

(b) Make signal-to-noise ratio measurements as required by the standard proof-of-performance procedure for monophonic mode (see Fig. 4).

To obtain an accurate reading in the range from 50 to 15,000 cps, a 50-cycle high-pass filter should be inserted between the FM multiplex monitor and the distortion and noise meter. To obtain the desired value of the high-pass filter capacitor, the stereo switch of the stereo subcarrier generator should be placed in the off position and a 50-cycle tone should be fed into the right or left channel and adjusted to provide modulation of at least 30%. Adjust the distortion meter to read 0 db. Insert various capacitor values at the input of the distortion meter to reduce the reading by 3 db.

3. Proper stereophonic balance: All measurements prior to stereophonic balance are required during a regular proof-of-performance check in accordance with FCC Rules and good engineering practice. To determine proper stereophonic balance, proceed as follows:

● Please turn to page 38

AM-FM RELAY NETWORK TECHNIQUES

by Phil Whitney* — Small station networks can be built around the judicious use of FM subcarriers in conjunction with AM-FM stations.

In the early days of broadcasting, when the idea of interconnecting two stations together for the first network was conceived, one problem encountered was the high noise level and relatively poor frequency response characteristics of the "open wire" telephone lines then available. Frequency response was not too important at first, since the entire broadcast system was comparatively "low fidelity," but the expense factor made it possible to relay only extremely important or "large budget" shows from city to city.

As the "tomato can" sound slowly changed to "high fidelity," the telephone line became a bottleneck. The class A telephone line was set up for the major stations, and some were forced to make the best of class C and D. With class A frequency response somewhat less than most transmitter capabilities (100 to 5000 cps), the network program generally suffered in comparison with the local origination.

During this period a few stations jury-rigged large loop antennas and communications receivers which they used to pick up AM network stations. Of course, more than a few summer programs were cancelled because of thunderstorm activity! After 1935 it didn't take operators long to discover that the superior frequency response and static characteristics of FM could overcome many old problems. By 1947 a few FM networks had evolved, and in the 50's stations in small communities discovered that they could offer their listeners FM sports broadcasts and other programs which they could not have previously hoped to carry on AM. Where line charges had previously been beyond a station's budget, by simply purchasing an FM tuner they made it possible for thousands of listeners to hear the programs they wanted. Many farm networks came to life, such as the Rural Radio Network in upper New York State, and a specialized program service which farmers needed became available on FM in a wide area.

Because of FM's superior frequency response characteristics, fine music networks came into being. The QXR network became possible because FM is the only practical way to distribute a program requiring low background noise and wide frequency response. In small market areas, groups of AM and AM-FM stations found a single high-power FM station could supply them all with an otherwise unobtainable program service. Thus, small networks sprang up, such as the Mid Atlantic Network built around the Virginia FM pioneer WRFL, which at one time fed sports programs and special features from the annual Apple Blossom Festival to some 35 stations. A combination of FM relay and wire lines made it possible to feed professional baseball from Washington and Baltimore down through the Carolinas.

Recently a new problem beset the FM network. Many stations switched to an independent good music format on the FM station while carrying sports via AM. Naturally reluctant to break into this blocked programming on an FM facility, these stations petitioned the FCC to allow a program relay service on the 67-kc FM subcarrier.

*Director of Engineering, WINC, Winchester, Va.

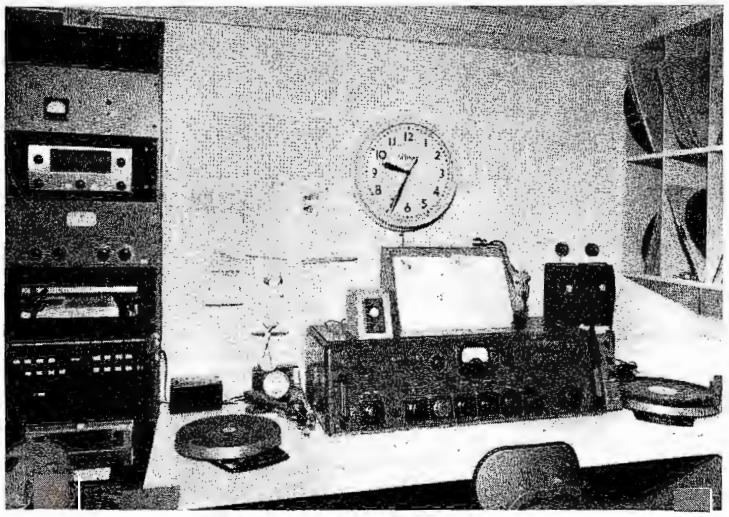


Fig. 1. WRFL No. 2 control booth; FM receivers are in rack at left.

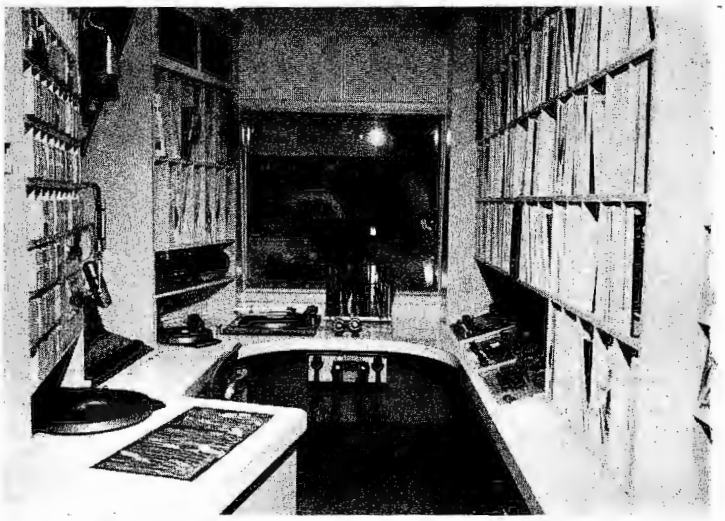


Fig. 2. Master control room; operating position is at left.

After a period of experimentation, rules were changed to allow this service. Unfortunately, stations which were on the fringe of an FM station's coverage lost their feed, for a signal which is entirely adequate on the main carrier often is unusable as a subcarrier feed. The recent increase in FM grants, however, has eased this problem by supplying more signals for selection.

KDKA-FM in Pittsburgh, WBAL-FM in Baltimore, and WRFL in Virginia were early users of the subcarrier sports program feed. In some cases good results were reported out to nearly 100 miles. Audio quality and noise specifications for subcarrier use are not as stringent as for the main carrier, but they still exceed those for a class-A telephone line.

Under the guidance of the FCC and State Industry Advisory Committees, FM networks have been established and tested as emergency back-up program facilities to be used during weather emergencies or national disasters. FM storm warning networks in Florida have functioned under these conditions and have received special FCC awards. It is possible that the entire East Coast could be covered with one FM network. Such a network can be set up on a moment's notice after preliminary organization and test.

Basic Systems

Today tuners are still being used by broadcasting stations for network relay purposes. Some stations have specially-designed, crystal-controlled single or multiple-channel FM pickup receivers. Impedance matching circuits are used to operate receiver outputs of 10,000 to 50,000 ohms into 600 or 150-ohm lines.

WINC and WRFL(FM) in Winchester, Va., have been feeding and receiving FM network programs for more than ten years. These stations rely rather heavily upon an FM pickup system for programming, and the installation pictured is the result of several years of experience. The system is flexible in that any tuner can be jacked into any amplifier or line to any of three control rooms. RF preamplifiers and antennas can be easily switched to any of the receivers. The five FM receivers were made by four companies. Two are standard Fisher tuners, one is a Magnavox, one a Radio Craftsmen, and one is a crystal controlled, single-channel subcarrier receiver by Calbest. Some of the tuners are equipped with discriminator-voltage-actuated warning relays which operate indicator lights for Conelrad and carrier failure (see Fig. 4). All have simple audio amplifiers or matching transformers to feed a 500-ohm line (Figs. 5 and 6). The outputs are adjusted to provide nearly the same audio level from each tuner.

Two receivers are needed to provide succeeding programs from two separate pickup points. One receiver constantly monitors an FM Conelrad station. The tuner which is used as house monitor for the remotely-controlled FM transmitter can be used in an emergency as a net-feed pickup. The subcarrier receiver is utilized both for main channel and 67-kc subcarrier programs. Other FM receivers in another rack are used to indicate signal strength and supply subcarrier telemetering information for the remote transmitter which is operated through a 900-mc link 25 miles away in the Blue Ridge Mountains.

Three FM antennas feed distribution amplifiers and networks so that all receivers can be multiplied to any single antenna, or divided evenly among them. All the antennas are broad-band yagis designed for the FM band. One feeds a transistor preamplifier at the top of the mast. This, in turn, feeds an RG-59 U coaxial cable which terminates in the rack near the receiver. By using the antenna-mounted preamplifier and coax line, a noticeable improvement in signal-to-noise ratio is obtained on long-haul pickups. One word of caution: These transistor preamps can give trouble in high intensity RF fields through crosstalk or actual burnout in extreme cases. Of course, the antennas are equipped with rotors, and a map is provided at the operating position so that the best pickup direction is quickly found.

Selection of Equipment

Thanks to the national increase in FM listening, good tuners, antennas and preamplifiers are readily

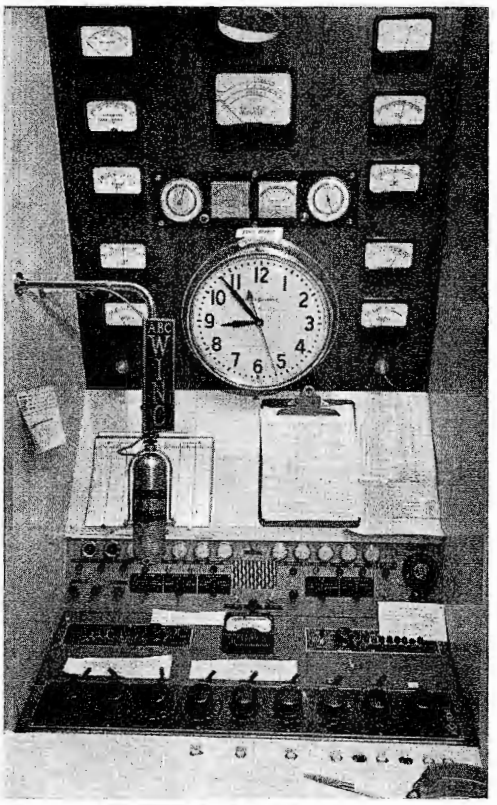


Fig. 3. WINC-WRFL master control position, all switching is performed here.

available. Several companies also build FM relay receivers specifically designed for networking. A few have developmental crystal-controlled receivers, with a selector switch for five stations.

An experimental multichannel crystal-controlled FM receiver is being tested at WRFL. The crystals are switched from the operating position by a dial which actuates a step switch in the receiver. This type of receiver ap-

• Please turn to page 36

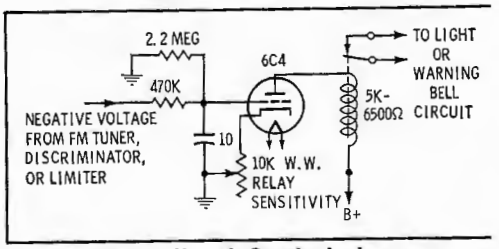


Fig. 4. Carrier-off and Conelrad alarm.

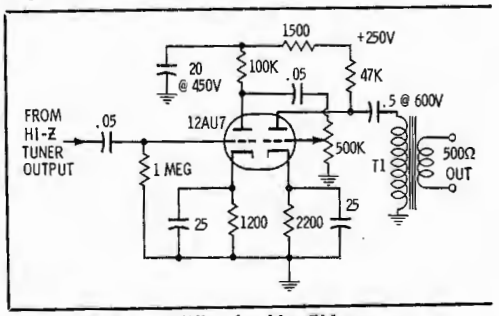
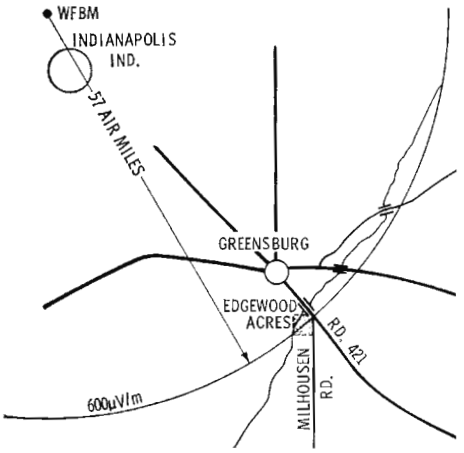


Fig. 5. Audio amplifier for hi-z FM tuners.

TRACING TELEVISION INTERFERENCE

*by Bob Brockway**— An experienced broadcast engineer tracks down a troublesome interference source, and gives insight into techniques and equipment.



Map showing location of interference source with respect to station transmitter.

One of the hazards of any broadcast engineer's day is the barbaric ritual of opening the morning mail. At first blush the stack of envelopes looks innocent enough, but what they contain sometimes sets the tenor for the entire day. Some may even open the door to an exciting adventure, which was my experience as a result of the following comments in a letter received at the station a few weeks ago.

"Dear Sirs: What is the matter with your station? For the last two weeks we have been unable to get Channel 6 here in Greensburg. All of the other channels are OK. I called our TV serviceman and he says there is nothing wrong with my set—it must be the station . . . etc." The following mail delivery brought additional letters reporting trouble in Greensburg (about 50 miles out), and in the meantime, there were some phone calls—all establishing beyond the shadow of a doubt that there was an interference problem in Greensburg. It also meant that a broadcast engineer, wearer of many hats and player of many roles, was about to turn detective and embark on a quest to ferret out some malfunction, inspired by man and/or nature, currently inflicting havoc on the old bread-and-butter channel.

The first impulse was to grab the gear and take off for Greensburg, because it was apparent that dozens of receivers were completely blanked-out, both audio and video. Moreover, several hundred—that's right, several **hundred**—other receivers displayed video, but distorted by herring-bone, severity varying with the distance from the source of the interfering signal. From the reports, we estimated the trouble area covered about 30 square miles.

We have learned from experience, when receiving the first letter reporting a trouble, that the initial step is to determine whether or not the report is authentic. When I was a tenderfoot in the vast wastelands I was taken in occasionally by glowing accounts of trouble that would include the statement, "everybody in Blankville is having the same trouble." Many times, this was a little white lie to prod you into action. One such case I recall was a big dirty lie, because I later discovered that the complainant's antenna had blown down and everyone else in "Blankville" had perfect reception. There is no iron-clad rule to use in determining the legitimacy of a single report; I usually wait a day or two to see if any more come in. If the complaint is well-composed, I sometimes make inquiries via telephone to an acquaintance or serviceman in the area.

The single, isolated letter almost always means receiver trouble; yet, on the other hand, it might be the real thing. In the Greensburg case, the trouble had persisted **two weeks** before the station was notified. This was not a breakdown in communications, it was simply that no one had bothered to write or call the station—although several had already called their serviceman.

On the subject of legitimacy of interference reports, I believe there is a limit to which the station should go in solving the problem. We all agree that good reception is the result of maintaining a good signal-to-noise ratio. In the outer reaches of the fringe area, the signal is so weak that the slightest interference causes troubles; in these areas I do not believe the station is morally responsible to police its signal. I personally like to keep the coverage clean wherever the signal is above 300 microvolts-per-meter. This is a fairly ambitious job in itself, and I must confess I have gone hunting in areas beyond the 300 μv/m contour on occasion.

It is interesting to note, however, that the people out in what I call the super-fringe seldom complain of interference. Either they are endowed with great forbearance, or have simply accepted their fate.

Analyzing the Problem

It is safe to say that when you receive more than one letter reporting interference in the same neighborhood you have a **bona fide** case of trouble. You are now in that jolly position of having something you can dig your teeth into.

Several reports from Greensburg made mention of a herring-bone pattern, which is indicative of a radio-frequency signal. (Already the search is narrowed down to 1,001 possible sources of RF.) The letters provided another valuable clue, however unpleasant; only channel 6 was affected, all others were clear. This can be construed to mean that the RF frequency was something between 82 and 88 mc (channel 6) and although we could

*Chief Engineer, Technical, WFBM Stations, Indianapolis, Ind.

not formulate an opinion from the reports as to its bandwidth, we could only assume that it was less than 6 mc wide.

The next and last piece of information we had to have before beginning the search is to me the most important for saving valuable time in the field. So often an engineer will zero-in on a device which is producing noise, but not enough to disturb the picture. Remember, the receiver will reproduce both wanted and unwanted (interfering) signals, and the stronger will be the more apparent on the screen. Assume a signal-to-noise ratio of 10:1; the noise in this case would be barely discernible and totally unobjectionable. It is this ratio that accounts for perfect reception in Grade A areas; the noise is there, and plenty of it, but the signal completely overrides it.

The Greensburg mail established that the black-out area was limited to the Edgewood Acres subdivision at the south edge of the city. All other areas reported only herringbone, so the source of the RF signal was in, or close to, Edgewood Acres. Since we were dealing with a black-out condition, the "other" signal must be far stronger than the signal from the transmitter. Edgewood Acres is 57 airline miles from our transmitter, and the signal-strength there should be approximately 600 microvolts - per - meter. The instrument we use is a VHF field-intensity meter, which is nothing more than a two-terminal voltmeter which reads in microvolts. When using a resonant dipole antenna, we must multiply the meter reading by 1.78 to get microvolts-per-meter. Conversely, we can divide μv/m by 1.78 to get signal strength in microvolts. Since we were using an antenna less-sophisticated than a resonant dipole we estimated the station signal would produce 300 microvolts at this location, so we set this figure as the MINIMUM signal to observe.

Only those signals that exceeded 300 μv registered on the meter, so weaker ones were automatically ignored, keeping us from following up on many blind-alleys. Once our initial analysis was complete, we knew four things: (1) The interference was a source of RF; (2) We could pinpoint its general location; (3) We knew the approximate frequency; and (4) We knew the minimum level of its strength. The next step was to assemble the proper equipment and head for Greensburg.

The Equipment

The sky's the limit when it comes to the equipment and hardware you can employ in making interference runs. I know of a number of very opulent stations that have fully-equipped mobile units just for this service. The actual choice is left pretty much up to the station engineer—the important thing is to get the job done with some modicum of efficiency.

For making field-strength measurements, as well as reading interference, we use ordinary field-intensity meters, three in number. We have the usual one that covers the standard broadcast band; a VHF meter that covers the spectrum from 54 to 220 mc; and one that covers a part of the UHF spectrum, used principally in conjunction with our 450-mc News Dept. two-way system. As would be expected, the instrument we use the most—the VHF set—is not a portable, but it is mobile if a supply of alternating current is available. We have a small inverter that plugs into the cigar-lighter of an automobile (12-volt system) to supply AC to the meter. When hunting TV interference I find that a battery-operated TV receiver is also very helpful.

The antenna used for tracking down interference is anything but a resonant dipole—it looks like it has been salvaged from a junk yard. This most unprofessional - looking apparatus is affectionately known to us as the "tired rabbit-ears." It used to be a shiny, brand new set of rabbit-ears, but the passing years of constant usage have caused its beauty to fade. Nonetheless, it's still a work-horse. Ridiculous as it might seem, a rabbit-ear antenna, tired or otherwise, makes an excellent unit for this purpose. It is light in weight and therefore maneuverable, and it is bi-directional which is sufficient directivity for triangulation. Fig. 1 shows the equipment in operating position; the spare tire provides an ideal base for the meter. During readings, the rabbit-ear unit is held far enough from the car to avoid reflector effect and give an erroneous bearing. Fig. 2 shows the invertor in its wife-approved location in the family car.

A Hunting We Will Go

Like fishing, getting the first "bite" in the field requires plenty of patience and a few moves to other locations and usually—nay, always—there will be nothing at the first place you have set up shop.

• Please turn to page 40

Fig. 1. Field intensity meter and antenna in operating position.

Fig. 2. Inverter power source for AC operated intensity meter.

AUDIO LEVEL DEVICES

*by Thomas R. Haskett** — Part Three. A listing and discussion of available compressors, concluding Part Two, plus an addendum to Part One.

Some Available Compressors

Altec-Lansing 436C and 438C Compressors—The only difference between these two units is that while both provide bridging inputs, the 438C additionally contains a 12AY7 low-noise mike preamp. This feature is of particular value in such things as semi-permanent remotes (churches, baseball, etc.), since a 438C, a mike, and a pair of headphones are all the equipment needed. Also, the bridging input on the 438C can be used simultaneously with the mike, making it possible to do a music remote using one mike and a turntable (or tape).

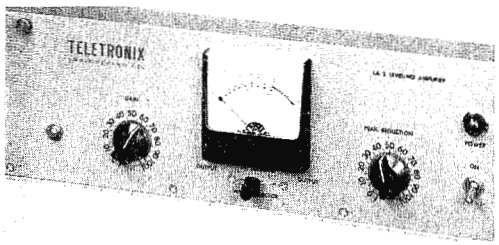
The circuit is conventional, using a 6BC8 in the controlled stage. The output will match either 150 or 600 ohms, and the front panel contains an nput attenuator as well as threshold and release-time controls (which have shaft locks for security). The power supply is self-contained and uses solid-state components. A remote compression meter is available as an accessory.

Gates M-5167 "Sta-Level" — Gates employs the standard circuit, with the addition of a buffer amplifier, running fixed-gain, between input and output stages. Also, a VR tube holds operating voltages constant for the critical input tube, which is the familiar 6386. Input and output attenuators are furnished, and there's a front-panel switch (marked **double-single**) for changing the attack-release time constant from compression to averaging action. Additionally, a resistor kit is supplied so the release time can be lengthened or shortened to suit station preference.

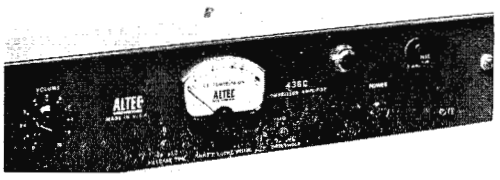
Teletronix LA-2 Leveling Amplifier—The circuit is unconventional, as the accompanying illustration shows. Incoming audio is passed through P1, a photoresistor, and R1, the manual gain control. Signal then goes to the two amplifier stages V1-V2 and the ouput transformer. The ouput signal is further amplified by V3 and V4 and fed to lamp L1, which is physically situated near P1. As output signal increases, so does the intensity of L1, causing the resistance of P1 to decrease. Since P1 is shunted across the incoming signal, this signal is attenuated. Gain reduction occurs without measurable distortion and without thump, as only a resistive circuit performs the compression. Degree of compression is set by R2.

Other notable features of the LA-2 are: High negative feedback of 19 db produces less distortion and greater operating stability. The output stage is a piggy-back cathode follower, another unusual circuit, which is coupled to the load through a transformer for a combination of very low phase distortion and excellent high-frequency response. Input and output match 50, 150, 250, and 600 ohms, and gain and peak reduction are adjustable from the front panel. Two LA-2's may be paralleled for stereo; an interconnection between attenuators insures that compression occurs simultaneously in both channels.

GE BA-9-A/B "Uni-Level" — The BA-9-A is a plug-in model (four such units can be mounted in 7″ of rack height) which requires an external power supply, while the BA-9-B is self-powered and mounts directly in a 19″ rack; otherwise the two are identical. The traditional circuit is used here, in a very simple but effective configuration. A two-position dual-average switch is provided for changing attack and release times; the



Teletronix LA-2 Leveling Amplifier

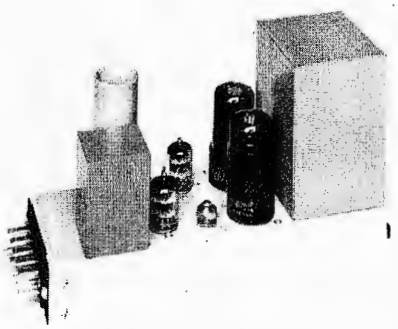


Altec-Lansing 436C Compressor

*Broadcast Consultant, Michigan City, Ind.

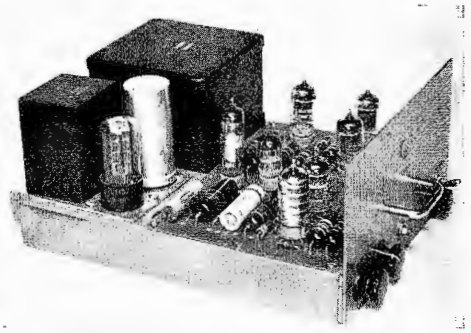
Model	Attack Time msec	Release Time sec	Compr. Ratio	Input Level dbm	Output Level dbm	Gain db	Noise Level dbm	Frequency Response
Ampl. Corp. of America 740-C	10 to 50	0.5 to 2.0	20:1	— 35 to — 5	+ 8	35	— 52	± 1.0 db 20 to 20,000 cps
Altec-Lansing 436C	50	0.3 to 1.3	2:1 to 4:1	— 40 to + 10	0 to + 24	40 to 90	— 50	± 1.5 db 30 to 15,000 cps
Altec-Lansing 438C				— 90 to — 40				
Teletronix LA-2	Inst	0.06 to 5.0	4:1	— 40 to + 16	+ 10	40	— 60	± 0.1 db 50 to 15,000 cps

Specifications of some



GE BA-9-B "Uni-level"

Quindar QCA-2 Compressor



RCA BA-25A AGC Amplifier

threshold and compression ratio can be varied with an internal control; and the input and output will match either 150 or 600 ohms.

Quindar QCA-2 Compressor — This unit has been designed primarily for speech, and due to its restricted frequency response (4000 cps) it probably isn't suitable as a main-channel controller. However, it can be used where high frequencies aren't important, as in portable, transistorized tape machines or remote-pickup transmitters for news and special events, or order-wire circuits. A compact, plug-in, transistorized module, it requires an external power supply delivering 45 ma @ 12 VDC, regulated. Input and output are 600 ohms.

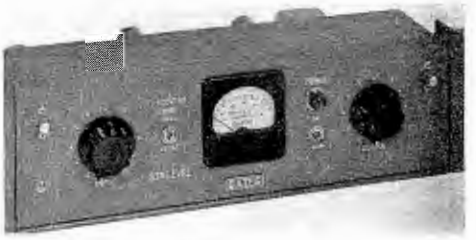
Langevin AM-5301 "Leveline" — The three-stage circuit is used here, with a 6ES8 used as the variable-gain input amplifier; the tube's transfer characteristic has a two-fold feature, compressing just above threshold and peak-limiting at higher levels. Negative feedback is used around the last two stages of the "Leveline," minimizing supply-voltage-produced gain changes. Semiconductors are used in the full-wave control-voltage rectifier circuit, the threshold and compression ratio are continuously variable, and the usual dual-average time-constant switch is provided. If desired, the "Leveline" can be used as a monitor amplifier — it delivers 6 watts output. No power supply is included, the unit having been designed for plug-in operation in an integrated system. The requirements are 6.3 VAC or DC @ 90 ma (+37 dbm output) or 50 ma (+26 dbm output). Input and output will match either 150 or 600 ohms.

RCA BA-25A AGC Program Amplifier — RCA has adopted an elaborate circuit: A 12AY7 low-noise input stage is followed by a 6386 variable-gain controlled stage, a 12AX7 driver, and a pair of 12AU7's as output. Negative feedback is used around the driver and output stages, and a VR tube is placed across the 6386 plate supply. Because of the 12AY7, this unit will work at very low level points — compression can start as low as —60 dbm. There is an input potentiometer, a threshold control, and a metering switch on the front panel. When used with an external meter, the user can monitor gain reduction or measure cathode current of signal-channel tubes. The threshold control adjusts both the compression ratio and the threshold. Since the fixed time constants are relatively slow, the BA-25A is an averaging device. An external source of bias may be utilized for remote-gain-control application. Input and output will match either 150 or 600 ohms. The assembly does not come ready for direct 19" rack mounting, having been made for installation in the MI-11597 Mounting Shelf, which requires 5¼" of rack space. Two BA-25A's can be mounted side-by-side on such a shelf.

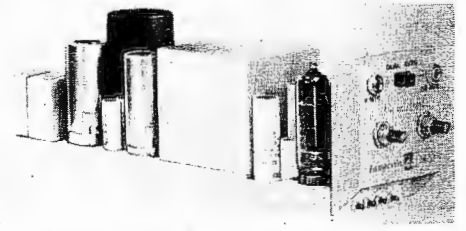
ITA AGC-1A AGC Amplifier— ITA uses the conventional circuit, modified slightly to include an intermediate amplifier between input and output stages, for better isolation. Also, a VR tube maintains input-stage supply voltage constant, minimizing dynamic shift. While the unit is normally an averaging device, with fixed attack and release times, instructions are pro-

Harmonic Distortion	Meter	19" Rack Space Height	Depth	Price	Model
Below 5.0% (30 db compression)	Yes	7"	8¾"	$245.00	Ampl. Corp. of America 740-C
Below 1.5% 35 to 15,000 cps (25 db compression)	Yes	3½"	6"	165.00	Altec-Lansing 436C
				199.00	Altec-Lansing 438C
0.5%	Yes	5½"	6¼"	235.00	Teletronix LA-2

available audio level devices.



Gates M-5167 "Sta-level"



Langevin AM-5301 "Leveline"

Fairchild 666 Compressor

Collins 26J-1 "Auto-Level"

vided for altering the RC network to change the time constants and compression speed.

Fairchild 666/666A and 663 Compressors — The 666/666A's compression is not done by shifting bias on the input stage; rather the input signal level is varied by changing the resistance of a semiconductor circuit. The result is no noise and no increase in distortion with increased compression, unlike most compressors. In addition to flat compression, an equalized mode is available which provides increased gain reduction in the 3 to 4 kc range. Input and output level, release time, and degree of compression can all be adjusted on the front panel. The input accepts 150 to 50,000 ohms; the output can be 150, 300, or 600 ohms. Note: The 666A is a compressor only; the standard model is a 666, which is a compressor with an integral 661 "Auto-Ten" unit.

The 663 is a compact unit; completely transistorized, it can be installed on the front panel of a console, as it's about the size of a vertical attenuator. Hence, console inputs can have individual compressors, ahead of mixing. Each channel then has its own compression and release time, to suit various needs. Like its big brother, the 666A, the 663 changes input resistance and compresses the signal before amplification, maintaining low distortion and noise levels. It will accommodate impedances from 150 to 50,000 ohms at input and output, and threshold, release, and meter-adjust controls are provided on the panel. There is no power supply; the 663 requires either 6 VAC or 9 VDC at 150 ma.

Collins 26J-1 "Auto-Level" and 356E-1—Both of these units employ the basic, four-tube circuit outlined above, and both have

ITA AGC-1a AGC Amplifier

dual/average time-constant switches and threshold - setting controls. In addition, the 26J-1 has a panel meter reading compression in db, input and output attenuators, and a defeat switch which disables the gain-reduction circuit and makes it a straight amplifier. Completely self-contained, its power supply uses solid-state components; Input and output are standard 600 ohms.

The 356E-1 is a cut-down, plug-in version of the "Auto-Level," having been designed for modular use in the console, where it replaces the program amplifier. It requires an external power supply, and has no attenuators or meter, although jacks are provided for an external gain-reduction meter. Input and output will match either 150 or 600 ohms.

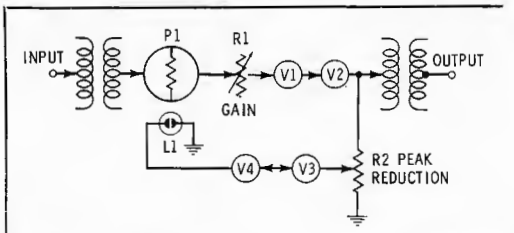
Additional Limiters

The following manufacturers' products were inadvertently omitted from previous sections of this series. The author regrets this oversight. Comparative specifications are given in the table; individual features are listed below.

Amplifier Corporation of America 740-C—Although termed an AVC Amplifier by the manufacturer, the 740-C is essentially a limiter, considering its circuit and function. It consists of a two-stage, push-pull circuit with 6BD6 pentodes as the variable-gain controlled amplifiers. A bridging input is furnished, and the unit will accommodate either balanced or unbalanced lines. Power, meter transfer, and input attenuator controls are provided on the front panel (the output gain is fixed), and internal adjustments control attack and release time. A self-contained power supply makes the 740-C entirely independent.

ITA LA-1B Limiter—This is the latest model and supersedes the previous model LA-1A. Comparing the two, I find a general tightening of specifications—compression ratio

Amplifier Corp. of America 740-C



Block diagram of Teletronix LA-2.

is now 10:1, instead of 6.7:1. But the major feature of the new unit is a solution to the FM limiter versus pre-emphasis problem. An RC circuit adjusts gain versus frequency at the high end of the program material fed in, rolling off the high end of the limiter output slightly. This prevents the transmitter from being overmodulated when highs are boosted by the standard FM pre-emphasis network. This means a station can maintain a high level of modulation for the low- and mid-range audio, without overmodulation by the highs.

Manufacturers Addresses

Altec-Lansing Corporation
1515 South Manchester Avenue
Anaheim, Calif.

Amplifier Corporation of America
398 Broadway
New York 13, N. Y.

Collins Radio Company
Cedar Rapids, Iowa

Fairchild Recording Equip. Corp.
10-40 45th Avenue
Long Island City 1, N. Y.

Gates Radio Company
Quincy, Illinois

General Electric Company
Defense Electronics Division
Technical Products Operation
Syracuse, N. Y.

ITA Electronics Corporation
Broadcast Division
130 East Baltimore Avenue
Lansdowne, Pennsylvania

Langevin Division of Sonotec, Inc.
503 South Grand Avenue
Santa Ana, Calif.

Quindar Electronics, Inc.
5 Lawrence Street
Bloomfield, N. J.

Radio Corporation of America
Broadcast and Communications
Products Division
Camden 2, N. J.

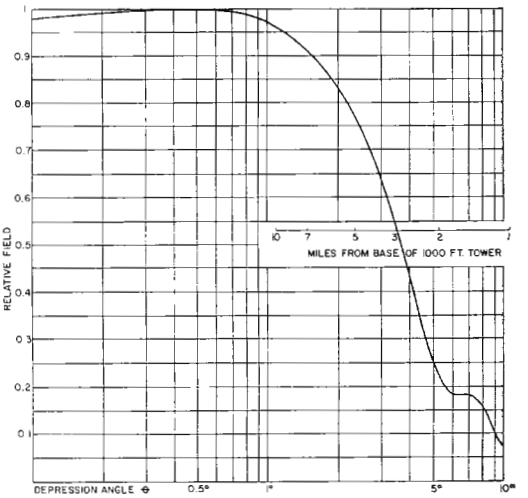
Teletronix Engineering Company
4688 Eagle Rock Boulevard
Los Angeles 41, Calif.

CO.EL. Low Band TV Antennas Put The Signal Where You Want It . . . more economically. Here are some of the features that can improve your station signal, and reduce your expenditures: **Very Low VSWR Permits Transmission of Highest Quality Signal** - VSWR 1.04 or better ■ **Excellent Vertical Patterns** - provide uniform signal strength close to the antenna ■ **Suitable For Stacking** - standard antennas can be stacked with other antennas now in use . . expensive side-by-side mounting unnecessary with CO.EL. antennas ■ **Fast Economical Installation** - modular construction permits installation and check-out in less than a week, without need for ground check ■ **No De-Icers Required** - even with heavy icing conditions ■ **Expert Checkout Service** - by qualified antenna engineering specialists.

Let CO.EL. furnish you with information on an antenna for your requirements. Other CO.EL. products include: Broadband high band and UHF antennas, 10mc bandwidth FM antennas, towers, VSB filters, notch diplexers, filterplexers, harmonic filters, rigid transmission line, and microwave parabolic antennas.

How to get improved TV coverage for less!

Vertical pattern of CO-40L/M Antenna, Channels 2 - 6. Gain with this vertical pattern varies from 8.6 on Channel 2, to 10.1 on Channel 6.



This CO.EL. 8-Bay Broadband Dipole Antenna, Channels 2 - 6, is one of a 100 TV antennas installed in 21 countries.

co el

Specialists in Advanced Antenna Systems

24 CAROL ROAD, WESTFIELD, N. J. / AD 2-0250 / Cable: COELTENNA WESTFIELD

A Division of Complementi Elettronici S.p.A., Lacchiarella (Milan), Italy

Circle Item 9 on Tech Data Card

A ROTATING CARTRIDGE RACK

*by Terence King** — Here's a "Lazy Susan" type rack you can build for use at the operating position.

The cartridge rack described in this article was designed to fill the need for a compact unit that could be placed in our control room operating position. It is a desk-top "Lazy Susan" rack, which holds 120 cartridges while taking up a minimum of space (Fig. 1).

The rack is constructed of a series of masonite discs which are assembled over thirty-two ½-inch wood dowels (Fig. 2). These dowels support the discs vertically and also form the "pockets" which hold the cartridge in position on each shelf. Half-inch plywood discs at top and bottom function, respectively, as a solid base for construction and a strong top. (Formica and aluminum trim were later applied to the top disc to improve the unit's appearance.) A vertical ¾-inch diameter steel shaft with an angle iron base passes up through the center hole of the rotating rack, and two or three large steel washers at the bottom promote easy turning.

The drawings show a unit with 13 decks holding 104 cartridges, while the original model has 15 decks and holds 120 cartridges. Height variations can be easily made according to requirements.

*Chief Engineer, Radio Station WILI, Willimantic, Conn.

Construction

The first disc is laid out on a masonite sheet by temporarily driving in a small nail and using the string and pencil method to mark the outside diameter and inner dowel circles (Fig. 3). The disc is cut out, taking particular care to ensure an accurate circle. This master disc is used to mark out the rest of the discs on the masonite and plywood sheets. The locations of the dowel holes are then marked accurately on the master disc, and center-punched. All of the masonite discs are stacked together with one plywood disc on the bottom and the master disc at the top. Large "C" clamps are used to hold them securely for drilling. The discs are all marked at one point for later assembly in the same position.

The ¾-inch center hole and the ½-inch dowel holes are drilled through all the discs while they are clamped together. The use of a drill press is recommended if it is available. If a hand electric drill is used, another person should help by "sighting" the drill to ensure vertical holes. A power wood bit is used to drill the ¾ inch center hole. After drilling, the clamps are removed and the discs are numbered for later assembly in the same order. The master disc is placed wrong side up on the remaining plywood disc, clamped to it, and the assembly mark is carried over. The depth stop on a drill press will help in drilling the ½-inch holes about ⅜ of an inch into the plywood, although this can be done by hand drilling on a hard surface.

All of the dowels are cut in half to make thirty-two 18-inch pieces. The bottom plywood disc is tacked down to the work surface. The eight dowels in the inner circle and every other dowel in the outermost circle are inserted into the disc and held in place with small brads driven in from the edge of the disc (Fig. 4). A wood block and pencil are used to mark all the outer dowels at one inch above the disc and a staple gun is used to drive staples with their top edge on the one inch mark.

Fig. 1. Cartridge rack console operating position.

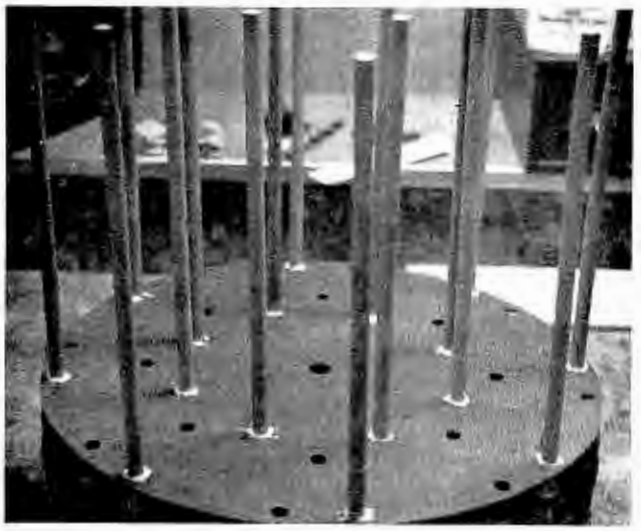
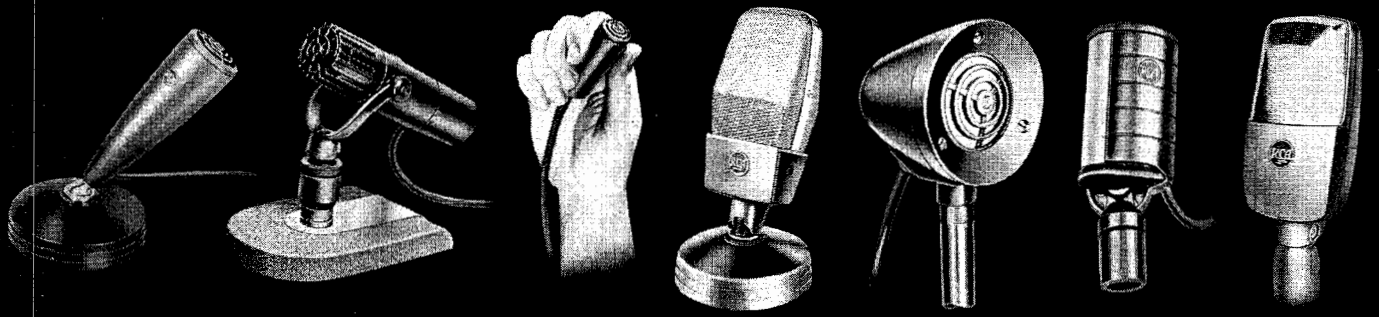


Fig. 2. Construction view showing supporting dowels.

Famous RCA Broadcast Quality Microphones

Now available through Local Distributors

RCA Polydirectional
ribbon-type microphone
MA 2311—chrome
MA 2312—TV grey



RCA MA 2313
Non-directional
dynamic mike

RCA MA 2314
Uniaxial ribbon mike

RCA MA 2315
Semi-directional
dynamic lavalier

RCA MA 2316 Bi-directional ribbon mike

RCA MA 2317
Non-directional
dynamic mike

RCA MA 2318
Non-directional
dynamic mike

RCA MA 2319 Bi-directional ribbon mike

Now—for the first time you can get world-famous RCA microphones RIGHT OFF THE SHELF—from local Authorized RCA Microphone Distributors.

This is good news for broadcasters. No longer need you accept substitutes for your favorite RCA microphones in emergency situations. RCA Microphone Distributors carry complete stocks available for immediate delivery. Call your nearest RCA distributor for fast microphone service.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

GET FULL TECHNICAL INFORMATION. CALL YOUR NEAREST RCA MICROPHONE DISTRIBUTOR OR ATTACH COUPON TO 4¢ POSTCARD AND MAIL

The Most Trusted Name in Sound

Circle Item 10 on Tech Data Card

Commercial Engineering, Section H-115-MC
RCA ELECTRONIC COMPONENTS AND DEVICES
415 South Fifth Street
Harrison, N. J.

Please send me the New RCA Microphones Select-A-Guide 1S1014

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State____

The dowels are liberally glued where they meet the disc. The next disc, in order, is then slid down over the dowels until it hits the staples evenly. The procedure continues in order: mark, staple, glue, and add next disc. For easy assembly it is important that the discs are added in the same order and radial position in which they were drilled, and that the assembly is checked periodically for straightness. It will be necessary to open out the holes in each disc with a round file so that they will slide down over the dowels easily. All of the holes in each disc are enlarged at the same time, for the remaining dowels must be inserted later on. The additional dowels are inserted through their respective holes and the outer ones are glued at each level. The dowels are marked at 1⅜ inches above the top disc and cut off. The top plywood disc is tried for fit on the dowels before glue is applied to its holes, and then is put into final position. This completes the assembly of the rack itself. The glue is allowed to dry for a few hours and the assembly is then removed from the work surface. The ¾-inch steel shaft is tried for fit in the center hole. If it is too tight for easy turning its top edges can be peened with a hammer and notched with a file so that it can be used as a makeshift reamer to enlarge the holes. The original base has angle iron crosspieces to hold the vertical shaft; another type of base, perhaps built into the control desk, could be substituted if desired.

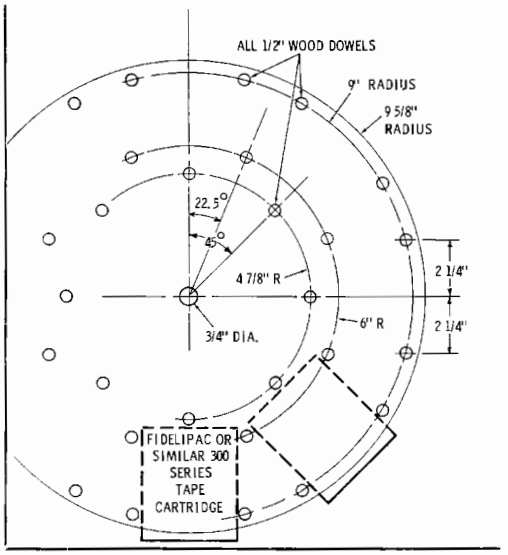


Fig. 3. Master disc layout drawing.

We originally planned to make up alphabetical tags for the rack, but found that the needed cartridge could be located easily without their use. With the rack in its present position next to the control board, cartridges can be selected easily even when the operator is on the air. The saving of valuable control room space and the elimination of stacks of easily dropped cartridges have made the unit a welcome addition to our operation. ▲

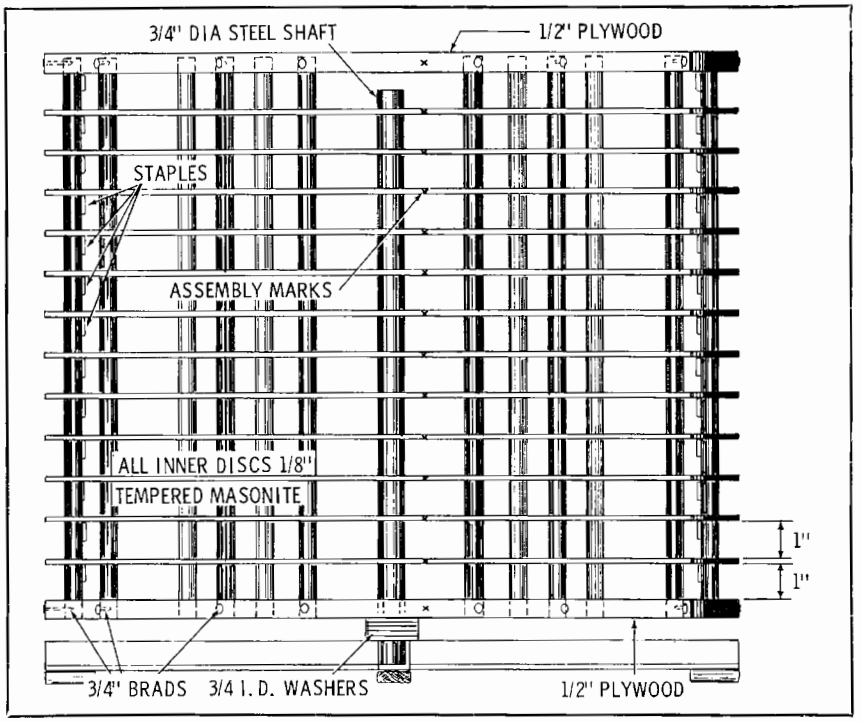


Fig. 4. Assembly drawing showing shelves and center shaft.

YOU'LL NEVER FORGET

the day you try RCA Red Seal Magnetic Tape

Try just one reel of RCA Red Seal Magnetic Tape! You'll be so pleased that chances are you'll never use any other brand of tape again. This is the tape RCA sound engineers developed for their own use, and they won't compromise on quality.

Every inch of Red Seal tape is minutely tested by experts for frequency response, distortion, drop-out, noise, and print-through. It's got to measure up to the stiffest specifications for coating thickness, anchorage, layer-to-layer adhesion, aging, cupping, slitting and tolerances. Precise controls give every reel the same magnetic properties, the same bias characteristic — so you can use tapes interchangeably. Don't forget to try Red Seal Magnetic Tape soon. Why not take a few seconds right now to fill in the coupon and send for complete details on this new tape today!

RCA The most trusted name in sound

Magnetic Tape Products Marketing
RCA Victor Record Division, Dept. BE83
155 East 24th Street, New York 10, N. Y.

Please rush me specifics on RCA Red Seal Magnetic Tape including all essential physical and magnetic characteristics.

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Circle Item 12 on Tech Data Card

FREQUENCY VERSUS WAVELENGTH CALCULATIONS

Technical Talks* — Here is data in the form of chart, graph, and explanation which will facilitate calculations.

This month by way of a change we are presenting some data sheets and information that can help make computation much easier. If there seems to be further need for such material, as evidenced by readers response, we shall include similar data in upcoming issues.

Frequency Versus Wavelength Versus Degree Calculations.

Although this is generally a simple and basic computation there are times when a slide rule is not available, and other times when one cannot recall the exact formula — in cases like these the following table and graph will be found very useful.

If a slide rule is available it is a simple matter to set up an expression that will give a direct reading of feet versus degrees for all values required. All that has to be done is set the frequency in megacycles on the lower (D) scale and over it on the C scale set the constant, 2.73. This is the first part of a simple ratio expression.

To read feet corresponding to any number of degrees you merely find the desired number of degrees on the D scale and read the number of feet against it on the C scale.

Table of distance in feet corresponding to one wavelength.

Frequency In kc/s	Wavelength In Feet	Frequency In kc/s	Wavelength In Feet	Frequency In kc/s	Wavelength In Feet
540	1821.45	1900	1092.87	1260	780.62
550	1788.33	910	1080.86	1270	774.47
560	1756.39	920	1069.11	1280	768.42
570	1725.58	930	1057.61	1290	762.47
580	1695.83	940	1046.36	1300	756.60
590	1667.09	950	1035.35	1310	750.82
600	1639.30	960	1024.56	1320	745.14
610	1612.43	970	1014.00	1330	739.53
620	1586.42	980	1003.65	1340	734.02
630	1561.24	990	993.52	1350	728.58
640	1536.84	1000	983.58	1360	723.22
650	1513.20	1010	973.84	1370	717.94
660	1490.27	1020	964.29	1380	712.74
670	1468.03	1030	954.93	1390	707.61
680	1446.44	1040	945.75	1400	702.56
690	1425.48	1050	936.74	1410	697.57
700	1405.12	1060	927.91	1420	692.66
710	1385.32	1070	919.23	1430	687.82
720	1366.08	1080	910.72	1440	683.04
730	1347.37	1090	902.37	1450	678.33
740	1329.16	1100	894.16	1460	673.69
750	1311.44	1110	886.11	1470	669.10
760	1294.19	1120	878.20	1480	664.58
770	1277.38	1130	870.43	1490	660.12
780	1261.00	1140	862.79	1500	655.72
790	1245.04	1150	855.29	1510	651.38
800	1229.48	1160	847.91	1520	647.09
810	1214.30	1170	840.67	1530	642.86
820	1199.49	1180	833.54	1540	638.69
830	1185.04	1190	826.54	1550	634.57
840	1170.93	1200	819.65	1560	630.50
850	1157.15	1210	812.88	1570	626.48
860	1143.70	1220	806.21	1580	622.52
870	1130.55	1230	799.66	1590	618.60
880	1117.71	1240	793.21	1600	614.74
890	1105.15	1250	786.86	.....	.....

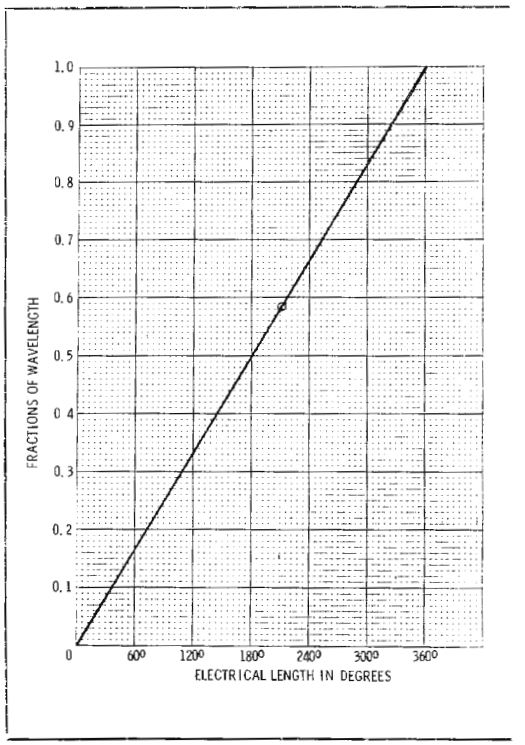


Fig. 1. Degrees versus wavelength graph.

Example: Find the number of feet in 200 degrees at 1500KC.

1. Set 1.5 (1500 kc = 1.5 mc) on the D scale, and set 2.73 immediately above it on the C scale.
2. Now find 200 on the D scale and read 364 feet on the C scale immediately above it.

If a slide rule is not available, or if you forget the combination, use the next method; this is also more accurate because there is no need to estimate fractions of a division on the slide rule.

The table provides a complete tabulation of distances in feet cor-

*John H. Battison, Consulting Editor, Washington, D. C.

SARKES TARZIAN
Tube Replacement Silicon Rectifiers

BIG
in broadcasting...

More and more broadcasting stations of all kinds are proving that the reliability and long, *long* life* of these units pay off in station on-time. Send for free replacement chart covering 95% of the vacuum tube rectifiers now in common use, price information, and case history data.

* *Not to mention instant warm-up, no appreciable heat radiation, no filament supply, compact size, ruggedness, and dc current ratings up to three times as high as the tubes they replace.*

SARKES TARZIAN, Inc.

World's Leading Manufacturers of TV and FM Tuners • Closed Circuit Tv Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices

SEMICONDUCTOR DIVISION • BLOOMINGTON, INDIANA

Canadian Licensee: Marsland Engineering Limited • 350 Weber Street North, Waterloo, Ontario

Circle Item 13 on Tech Data Card

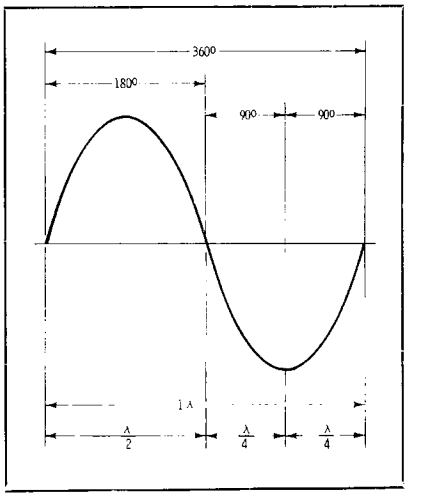


Fig. 2. Degree-wavelength relationship.

responding to one wavelength, to two decimal places throughout the frequency range 540 to 1600 kilocycles.

Fig. 1 shows the fractions of a wavelength as a decimal corresponding to degrees from 0 to 360°. This works both ways of course so that knowing one, the other can be found. In conjunction with the table, any desired calculation involving accurate measurements in degrees or feet can be made.

To use the graph proceed as follows:

Convert degrees to wavelength — Find the desired degrees on the horizontal scale. Now follow the division line up to the diagonal line. At this point, follow the intersecting horizontal division line to the vertical axis to read wavelength, directly.

Example: Find the physical length of 210° at 1100kc.

1. From the graph, we find the 210° division line intersects the 0.585 wavelength division at the diagonal line.
2. From the table, 1 wavelength at 110° kc equals 894.16 ft.
3. Therefore, 210° at 1100kc is:

$$894.16 \times 0.585 = 523 \text{ ft.}$$

Fig. 2 is a refresher sketch showing the various relationships involved in wavelengths, feet, and degrees. ▲

What's the lowest-cost fully transistorized broadcast VTR*? AMPEX VR-1100

Now: any station can enjoy the advantages of Videotape*—with all the quality of Ampex. Reason: the new Ampex VR-1100—a transistorized broadcast Videotape Television Recorder that costs less than $35,000. And here's what you get for the price: two speeds—7½ ips and 15 ips; recording time up to 3 hours; compatibility with all 4-head recorders; half the floor space of previous VTRs; half the weight; single camera production capability; low power requirements; new convection cooling system; no need for blowers or special air conditioning in the station; minimal controls; low maintenance; suberb reliability and performance. It's all in the Ampex tradition. For details on a complete production system, including Marconi 4½-inch image orthicon camera and accessories, call your Ampex representative or write: Ampex Corporation, Redwood City, California. Sales and service offices throughout the world.

AMPEX

*TM Ampex Corp.

Circle Item 15 on Tech Data Card

TELEVISION OFF-AIR PICKUPS

*by Patrick S. Finnegan** — How one station solved problems in receiving TV signals for rebroadcast.

Many occasions arise when it is desirable to rebroadcast programs from another television station which reaches your area, even though the signal may be weak. WLBC-TV (Channel 49) has many opportunities for obtaining programs in this manner, so we decided to explore means for achieving signal pickup. Our intention was to try for a direct off/air pickup, without any intermediate microwave facilities. Since we have contracts with the three networks and were interconnected by AT&T microwave, we also explored the possibility of receiving our network programs in this manner.

*Vice-President and Chief Engineer, WLBC, WLBC-TV, WMUN, Muncie, Ind.

Problems

The nearest stations are located 55 miles south, Indianapolis channels 4, 6, 8, and 13. We knew that our biggest problems would be noise and co-channel interference, even with the fairly good signal levels these stations provided in our area. The most logical place for our receiving antenna location was naturally on our own television tower. But our tower is located within 50 feet of a main highway, which has a heavy flow of traffic. Ignition noise at this station is severe.

Another source of noise is a 13,000-volt power line, which runs between our tower and the highway.

Solutions

With knowledge of the obvious problems, a test setup was made to determine what we could do to develop reasonable solutions. A Nems-Clarke receiver was purchased, and a regular all-channel antenna was mounted at the 150-foot level on our tower, connected to the receiver by standard 300-ohm twin-lead and matching transformer.

This test setup showed us just how serious the noise was going to be. Ignition noise was almost constant because of the continual highway traffic. As a result, the received picture was full of noise spikes, which proved disastrous to the clamp circuits in our stabilizing amplifiers.

Our primary network is NBC, carried on Channel 6 (WFBM-TV). Pickup tests on this channel dis-

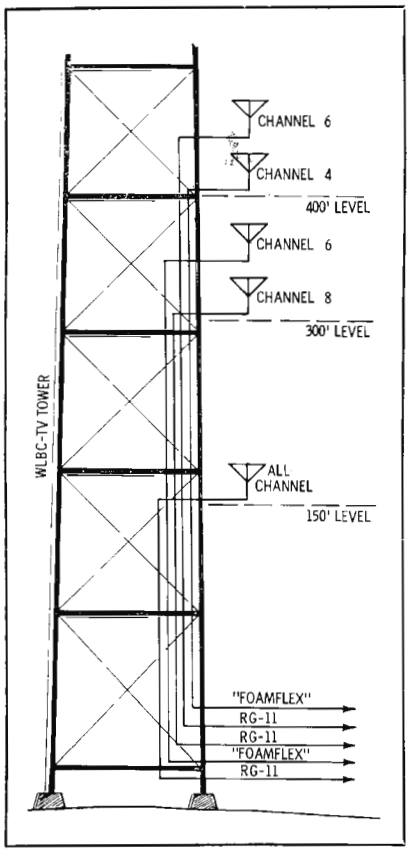


Fig. 1. Antenna system used at WLBC for off/air pickup of four TV stations.

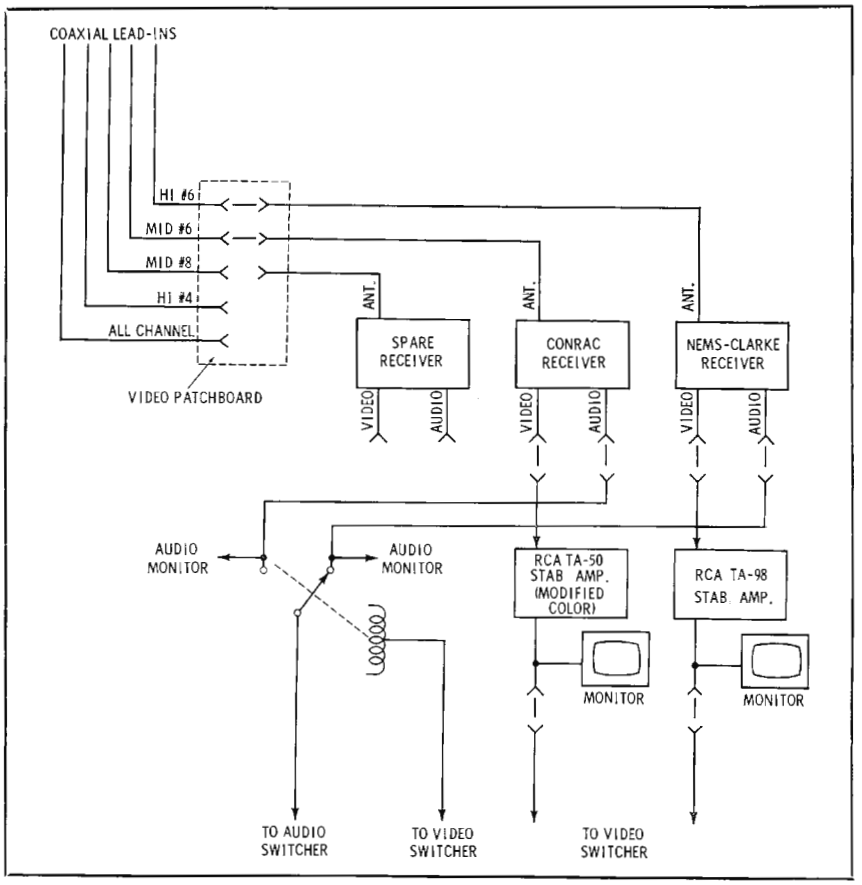
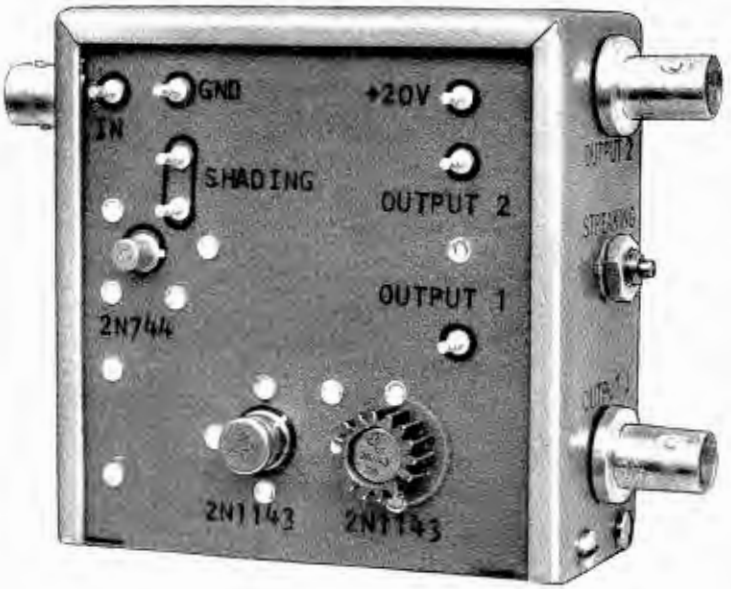


Fig. 2. Diagram of equipment setup for/signal conversion and transmitter feed.

COMPLETELY TRANSISTORIZED MODEL TCA 3 CAMERA AMPLIFIER



FEATURES

- STREAKING CONTROL.
- HIGH FREQUENCY PEAKING CONTROL.
- 600 LINE DEFINITION.
- NON-MICROPHONIC. NO HUM.
- PROVISION FOR HORIZONTAL SHADING THRU PRESENT CAMERA SHADING CONTROL.
- SIGNAL-TO-NOISE EXCEEDS VACUUM TUBE AMPLIFIERS.
- GAIN AND FREQUENCY RESPONSE EQUAL TO VACUUM TUBE MODELS.
- SECOND OUTPUT TO FEED CAMERA VIEW FINDER.
- OUTPUTS TERMINATED TO MATCH 51-OHM CAMERA CABLE WITH 0.4 VOLTS PEAK TO PEAK INTO CABLE AND 0.8 VOLTS PEAK TO PEAK INTO VIEW FINDER FROM 51-OHM SOURCE.

The TCA3 is a completely miniaturized (3¼ x 3¼ x 1¼) camera amplifier that replaces vacuum tube models in **all** image orthicon cameras. It is quickly and easily mounted within available space in the camera.

Operating voltage is obtained from 285 volt source in camera and is regulated within the TCA3. The TCA3 has a built-in protective device in case high voltage blocking capacitor at image orthicon anode short circuits.

Signal connectors are BNC type as well as solder terminals.

The TCA3 is factory guaranteed to give years of completely trouble-free service and is priced below all present vacuum tube models.

These units have been on-the-air proven for more than a year and a half. In excess of 100 are currently in daily service in such cameras as:

RCA TK 10/TK 30 RCA TK 11/TK 31 GE 4PC4A1 DUMONT TA 124E

THE TCA3 IS DESIGNED FOR OPERATION IN **ANY** IMAGE ORTHICON CAMERA!

Price, complete with accessories, installation — operating manual . . . F.O.B. NASHVILLE $295.00

INTERNATIONAL NUCLEAR CORPORATION

608 NORRIS AVE. • NASHVILLE 4, TENNESSEE

Circle Item 16 on Tech Data Card

closed another problem. One of our TV transmitter multipliers fell right in the video portion of Channel 6, producing such a beat pattern that the picture was completely unusable. (The receiver is within 15 feet of the transmitter.)

Before we did anything else, this beat pattern had to be eliminated. Rather than attempt to trap or filter the unwanted signal at the receiver, or move the receiver to another location, we decided to try and squelch the interference right at the source. This proved to be very simple. Our multiplier lineup was triple, double, double. A new coil in the plate circuit of the first multiplier permitted this stage to double, and the constants were sufficient for the next stage to triple. This changed the multiplier lineup to double, triple, double, which eliminated the beat pattern.

Next we tackled the noise problem. First, RG/11u coax cable was installed, with an impedance transformer at the antenna, to minimize noise pickup by the transmission line. Some improvement was noted, but reception was still far from satisfactory. The transformer, we discovered, had an 8-db loss, plus insertion loss, on Channels 6 and 8, and the antenna had unequal gain on the low and high channels.

After some thought, we decided to try for more signal level. Our chief sources of loss were the transformer, coax line, and unequal gain of the all-channel antenna. We selected another antenna, a TACO commercial type used in CATV systems. This is a double stacked yagi, with good front-to-back rejection ratio as well as good side rejection.

Using an antenna cut for Channel 6, signal strength measured in the control room had increased appreciably, but unfortunately, so did the noise pickup. We had more signal, but were not much better off than before. With more signal available, we decided to place the antenna higher on the tower. Moving it up to the 300-foot level increased the signal level more than enough to make up for the loss in the additional coaxial line. Also, the ignition noise dropped well below the signal level, although not quite enough. Since the higher VHF channels are not bothered as much with this type of noise, we installed a Channel-8 antenna at the 300-foot level, for CBS outlet WISH.

At the same time, we moved the Channel-6 antenna up to the 400-foot level. Here we reached the point of diminishing returns, because line loss was becoming severe. Fortunately, however, the noise was now almost gone, with only intermittent spikes coming through when a truck or car with a very dirty spark went by. These spikes were tolerable, but they still affected the clamps. We purchased an RCA TA-9B stabilizing amplifier with clamps which were more immune to noise. A further improvement was achieved by changing the resistors in the clamp circuit sync separator to variable types which could be critically adjusted.

At this point, we went to an off/air pickup of our network programs. We purchased a Conrac receiver with crystal control on Channel 6. Picture quality from this system was as good as we received from the AT&T microwave, including color.

At this point we were pretty well committed to an off/air system, and additions and refinements were made. A rugged Channel 4 antenna was installed at the 400-foot level for pickup of the Sarkes Tarzian WTTV signal. Another Channel 6 unit was placed at the 300-foot level as a backup for the higher antenna.

When Communication Products Co. introduced their low loss "foam-flex" coaxial line, we installed it for the Channel-6 antennas. This provided us with a higher signal-to-noise level for our primary NBC network pickup.

Channel 13 (WLW-I) was not on the air when the system was first installed, but came on later as the ABC outlet. We discovered our Channel 8 antenna would work very well on Channel 13, even though there was greater signal loss. There was no noise problem, however, so we decided against an additional antenna. Fig. 1 is a sketch of the final antenna arrangement.

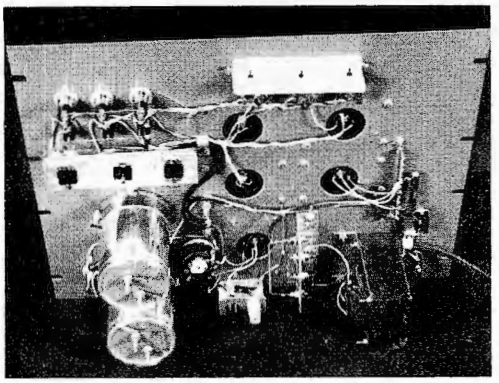
As a further refinement, we tried feeding the antenna coax through our regular video patch board. This worked out perfectly without any ill effects. Consequently, each antenna now appears on a video jack, as does each receiver, and we can now patch any receiver to any antenna with ease and convenience (Fig. 2).

Our systems have been in operation since 1956, picking up programs from Channels 4, 6, 8, and 13 on a regular daily basis, 17.5 hours each day. Service has been satisfactory 98% of the time, and the color comes through perfectly.

Some troubles have occurred, but most have been minor.

The most serious problem occurred about a year after the system was installed. This showed up as a double row of horizontal spikes, with a frequency of about 120 cps. It was nonsynchronous and therefore rolled through the picture. This interference was intermittent, absent during certain times of the day, sometimes gone for several days at a time. When it came on, it hit full force and then disappeared just as abruptly. We suspected it was some equipment in an industrial plant nearby. When we discovered we could hear this noise on a car radio, we went hunting. In no time at all, we were able to single out a new shopping center about a quarter of a mile away and directly in line with the stations we received. The power company cooperated by supplying climbers, engineers, and equipment. They worked the new high lines for several blocks in all directions from the shopping center. (I had never noticed all the gadgets, meters, and other things mounted on the tops of these poles before; several months of looking at the tops of power poles gives one quite an education. You would be surprised all the noises that can emanate from this equipment and be picked up on a radio, and what defects will show up when you slam the base of a pole with a sledge hammer.) The trouble was finally traced to a transformer bank behind the shopping center. A curious feature of this bank is that it was in the quietest of all the locations. The culprit turned out to be leaky lightning arrester.

Over the years, our initial investment has been recovered many times by the money saved on microwave rental fees. In addition, we wound up with a bonus feature. The all-channel antenna at the 150-foot level, with coaxial lead-in, provides a tremendous signal for off/air pickups of FM radio stations around the state. ▲



NEXT MONTH

Transistors and Automation including:

PLANNING FOR AUTOMATION

Important considerations which concern all broadcasters who are looking to automation.

•

REMOTE TRANSMITTER CONTROL

Discussion of the steps to going remote, including regulations and system operation.

•

A TRANSISTORIZED CROSS-BAR SWITCHER

Description of a solid-state preset video switcher, with a discussion of design and application.

•

AUTOMATIC TRANSMITTER LOGGING

Summary of the rules, and a description of some available equipment.

•

Special Construction Features

- Transistorized Power Supply
- Audio Isolation/Distribution System.

PLUS — Many other features, items, and departments of up-to-date interest, including the popular Engineers' Exchange.

Reserve your issues now, and receive the Broadcast Engineers' Maintenance Guide absolutely free, by filling out out and sending in the convenient subscription card.

NEWS OF THE INDUSTRY

Machtronics Names Sales Agent

Kurt R. Machein, president of **Machtronics, Inc.,** Mountain View, Calif., announced today that **Storer Programs, Inc.,** wholly-owned subsidiary of Storer Broadcasting Co., Miami Beach, Fla., will handle all broadcast-connected sales of Machtronics products in the United States and Canada. Simultaneously, he announced that the company has developed a portable television tape recorder designed specifically for television broadcasting. The compact, 68-pound unit permits remote television tape recording by a single person wherever a 110-volt power source is available, and its transistorized circuitry eliminates warmup time. Other immediate applications include network backup, auditions, sales presentations and program rehearsals. Several networks already are using prototypes for experimental broadcast work and as supplemental recording equipment, Machein noted. He pointed out that NBC used a Machtronics recorder at Cape Canaveral during the launching of the Faith-7 space capsule which carried Maj. Gordon Cooper into orbit around the earth, and ABC used similar equipment in covering President Kennedy's European tour.

Stainless Ships 1751-Ft. Tower

WBIR-TV, Knoxville, Tenn., has received 297 tons of prefabricated steel that will go into the tallest TV tower ever to be constructed. According to John P. Hart, general manager of the CBS-affiliated station, the 1,751-ft. structure will replace an existing 700-ft. support, and according to engineering calculations will extend the WBIR-TV coverage over an area approximately 50% greater than now reached. WBIR-TV operates with 316,000 watts on Channel 10. The tower will be equipped with a two-man elevator for the purpose of making repairs or changing lights. A man would take an estimated three hours to climb the ⅓-mile height. The elevator can make the ascent in 15 minutes, said Hart. Designed and fabricated by **Stainless, Inc.,** North Wales, Pa., the guyed, triangular tower will support a high gain helical TV antenna. The present world's tallest structure, also built by Stainless, is a 1,749-foot tower in Columbus, Georgia, shared by WTVM and WRBL-TV.

Negotiations Terminated

General Precision, Inc. recently announced termination of negotiations with **Thompson Ramo Wooldridge** looking towards acquisition of TRW's Dage Division industrial television activities by General Precision's GPL Division. Both Dage and GPL are producers of industrial/commercial and broadcast television equipment. General Precision, Inc. is the principal operating subsidiary of General Precision Equipment Corp.

Colledge Named Director

Charles H. Colledge, division vice president and general manager, **RCA Broadcast and Communications Products Division,** Camden, N. J., has been elected a member of the board of directors of the **RCA Victor Company, Ltd.,** Montreal, Canada. Mr. Colledge has been the Division's chief executive since 1958 when he joined RCA after a long career with the National Broadcasting Company. At NBC he held the position of vice president, facilities operations. The Division which Mr. Colledge heads produces radio and TV broadcast equipment, microwave and two-way mobile radio system, and various other electronic products.

Home Taping of Television Programs

Low-cost equipment for home taping of television programs has been developed by **Telcan Ltd.,** East Bridgeford, Nottinghamshire, England, and is expected to be on the market before the end of the year. Called Telcan, it works the same way as a sound tape recorder, recording both sound and video simultaneously on standard ¼" magnetic tape. Replay procedure is the same, and tapes can be erased and used again. The recorder will cost about as much as a sound-only model in the medium price range and can be used simply as a sound recorder. It comes either as a separate unit or as a unit that can be built into a television set, in which case only minor receiver modifications are said to be needed. The equipment will record a program the viewer is watching or one on a channel other than the one he is viewing. The recorder can be made to operate on the 405-line British system, the 525-line American, and the 625-line continental systems. Using a domestic television camera a family could make its own television films, feeding the signals into the tape recorder instead of directly into the receiver. The system could be used by libraries to store tapes of educational television material in much the same way phonograph records and sound tapes are stored. The equipment is 17" long by 9" wide by 2" deep, with 4" protrusion for motor housing; weight is 15 lb. Specs are: playing time, 40 min.; maximum spool size, 11"; resolution, 300 lines peak white; system rise time, 0.2 micro sec.; signal to noise ratio, 28 dbs.; system tape tracking, double; sound system signal to noise ratio, 40 dbs.

Shows and Conventions

Latest equipment in the fields of motion pictures, television, photoinstrumentation and high-speed photography will be exhibited Oct. 14-17 during the 94th Convention of the **Society of Motion Picture and Television Engineers,** at the Somerset Hotel in Boston. SMPTE Exhibit

Chairman Lester E. Bernd, Cine Service Laboratories, Watertown, Mass., has announced that the exhibit area will have 30 booths, most of which will be 8 x 8 ft. Among the firms that already have announced plans to exhibit equipment are Arriflex Corp. of America, Hi-Speed Equipment, Inc., Pathe Products, Inc., and Quick-Set, Inc. Included in the 2,000 persons who will view the exhibits will be commercial motion picture producers, owners of processing laboratories, television engineers, medical researchers, persons involved in educational television, and space-research scientists. The Society's Exhibit Award Committee will again present a plaque to the firm that has the most interesting and effective exhibit.

International Radio, Television, and Electronics Exhibition, (FIRATO), Sep. 13-22, 1963: To be held in the R. A. I. Buildings in Amsterdam, Holland, the show will include broadcast and other electronics equipment, as well as demonstrations of live TV programs broadcasted from a special studio at the show.

The world's fair of the fifteen billion dollar electronics industry will be held this fall in McCormick Place, Chicago, Ill., it was announced today by the **National Electronics Conference.** McCormick Place will be a showcase where over 20,000 scientists and engineers will view the practical technological application of the newest in scientific theory and discovery. Over 500 electronics firms will exhibit their products. R. J. Napolitan, General Manager of National Electronics Conference, said. All conference activities, he went on, are directed by fourteen committees of top executives and educators. Sponsors of the NEC include Illinois Institute of Technology, Institute of Electrical and Electronics Engineers, Northwestern University, and University of Illinois. Participants are the Universities of Michigan, Notre Dame, Wisconsin, Wayne State, Iowa State, Marquette, Michigan State, Purdue, Electronic Representatives Association, and Society of Motion Picture and Television Engineers. President of the Association is John S. Powers of Scientific Sales Company who said the committees will provide a program of panels, speakers, and meetings that will bring together 20,000 educational, professional, and industry leaders from the nation and the world to exchange ideas and information.

Camera Prices Increased

Price increases ranging from three to 16% and covering certain closed-circuit and broadcast television cameras have been announced by **General Electric's Technical Products Operation.** H. E. Smith, TPO manager of marketing, said the new prices are necessary to permit profitable operations without sacrificing quality of the transistorized video equipment. He announced that the PE-20-B, 4½-inch image orthicon camera and the three-IO live color camera prices have been increased three to five per cent.

ENGINEERS' EXCHANGE

The Third Log

by Vincent P. Marlin, Chief Engineer, WFBL, East Syracuse, N. Y.

The Federal Communications Commission is soon to require a maintenance log in addition to the station operating and program logs. In checking into the proposed ruling, we found that some of the items are new, while others have simply been moved from the operating log to the maintenance log. Originally, the FCC required this log to go into effect in May, 1963, but now has issued a delay.

We here at WFBL have been using a maintenance log that fulfills all of the present FCC requirements for inspections and readings. It also has room for incomplete work.

WEEK ENDING SUNDAY, 11:59 P.M. _____ WFBL MAINTENANCE LOG ON AIR WITH 1KW XMTR TOTAL TIME _____

R.F. MONITORING EQUIPMENT	INSIDE BUILDING
EXCITER SECTION 5KW XMTR	OUTSIDE BUILDING
POWER SECTION 5KW XMTR	TOWERS AND TUNING HOUSES
P.A. SECTION 5KW XMTR	AUDIO EQUIPMENT
PHASING CABINET	REMOTE EQUIPMENT
AUXILIARY 1KW XMTR	RECORDING EQUIPMENT

FREQUENCY CHECK DATE		TOWER NE#1		TOWER SW#2	
EXTERNAL	MONITOR	READ	ADJ. TO	READ	ADJ. TO
ANTENNA BASE CURRENT					
REMOTE BASE CURRENT					
PHASE MONITOR READING					
DATE AND TIME					

NOTES :

EXPERIMENTAL OPERATION :

STATION INSPECTION 5 WEEKLY			
DATE	TIME	SIGNATURE	STATEMENT

TOWER LIGHTING 7 WEEKLY			

Updating the Model 300

by Geo. Hrischenko, Staff Technician, CBE, Windsor, Ont.

When we received our new Ampex 300C the first improvement we noticed was a change in the tape holddown knobs. On the older model 300 the holddown knob is a pressure type, while the new knob merely drops over the shaft. The reason for this was obvious—the old style knob would slip at times and score the shaft. The worse the shaft was scored the more the reel would slip. In an effort to tighten the knob some strong-armed operator would press down hard on the knob and push the end of the motor out! To avoid future trouble it was decided to modify all our old machines to accept the new style knobs.

If you have both types of machines the job will present no problem; if you only have a model 300 you should visit a friend and look at a model 300C. A visual inspection will show that three holes will have to be drilled into the 300 turntable and three pins inserted near the shaft. Take a piece of paper and push it over the 300C shaft. Punch a pencil through the paper into the three holes in the turntable. You now have a drilling template.

Place the template on the 300 turntable, spotting the holes as accurately as possible. Use a No. 34 drill for the initial hole. Drilling is a two-man job — one holds the turntable steady and positions a vacuum cleaner near the drill to remove the chips; the other does the drilling. Finish up the holes with a No. 1 (.228) drill. Cut the rubber or cork pad away for free passage and you are all set for the 10″ reels. If you rarely use the 7″ reels you can quit here. Store the old knobs away in the cabinet so they won't disappear.

To modify the turntable for 7″ reels, 3 pins will have to be located around the shaft a la 300C. Set a plastic reel in place and drill one pilot hole into the turntable. The type of pins used will determine what size bit should be used. We used small finishing nails with the heads cut off for pins. The hole was slightly smaller than the nail and the nail was gently tapped into the hole. After the first pin is in place the other two can be located and inserted.

AM-FM Net

(Continued from page 13)

pears to have many advantages because only one receiver is needed for up to five network stations, there is no drift, and the front end has both high sensitivity and a low noise figure.

Care in the selection of a good receiver is important, particularly in avoiding the necessity for replacing a receiver which turns out to be unsatisfactory because of high noise level or bothersome drift. Some of the more advanced kit receivers, carefully put together, are satisfactory, and audio magazines periodically publish a directory of available tuners and associated equipment.

Installation Tips

A good installation job will pay dividends. It should be made in an enclosed, well-grounded rack. RF filters on all audio and power lines coming into the cabinet may be necessary if the transmitter is in the same building. At WRFL a 900-mc link, because of the many multiplier stages, introduced an interfering program every megacycle or so on the FM dial. Extensive shielding of both the tuner and link was necessary. In extreme cases, it may even be necessary to use braid to ground the back door. Of course good solder joints are essential; even poor joints in guy wires can cause interference in the FM band. Strong FM signals in the area can be reduced with a quarter-wave stub of 300-ohm line attached to the antenna terminals at the back of the tuner. Start with 39 inches and cut back until the signal is materially reduced. An open quarter wave line looks like a short at its resonant frequency.

Absorption traps which can be tuned to notch out the interference are also available. One point to remember when setting up a feed from another station: FCC regulations stipulate that pickup of another station's programs for rebroadcast requires **WRITTEN** permission from the originating station. A copy of this letter is usually filed with the FCC. When broadcasting programs such as sports events, permission also must be obtained from the program originator or owner, such as a ball club.

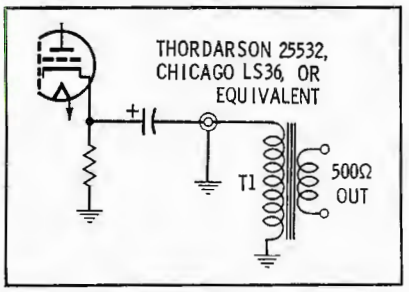


Fig. 6. Output circuit for low-Z tuners.

Operating Practices

In cities where there is no specific network station, it is often possible to purchase certain sports features from the network at a rate determined by them. In this case permission must be obtained from both network and feed station.

When setting up a network, it is good practice to run a proof through the complete system, at regular intervals, from originating station to the last relay on the line. This is easily done when the station picking up the programs knows the proof schedule of the originating station.

One problem often encountered is especially noticeable in sports relay work. If one or more of the stations along the line uses an automatic gain control amplifier or limiter, the stations near the end of the line will notice an upsurge in crowd noise every time the sports announcer stops talking. It is therefore good practice to patch out automatic gain amplifiers and set limiters just below the limiting point when relaying.

Unless standards are rigidly adhered to throughout the network, the signal will become degraded after five or ten stages. This is not as important in a sports broadcast as it is in a live symphony program. It is certainly true that one weak link in the FM chain will affect all who come after it. With the equipment obtainable today, there is no excuse for failing to meet the FCC requirements, except possibly on very long and difficult "hauls." WRFL has picked up FM relays from as far away as 100 miles with no apparent degradation of quality.

Broadcasting stations all over the country should be able to offer better programs and realize additional revenue as a result of their affiliation with an FM or AM-FM relay network. ▲

Stereo Proofs

(Continued from page 11)

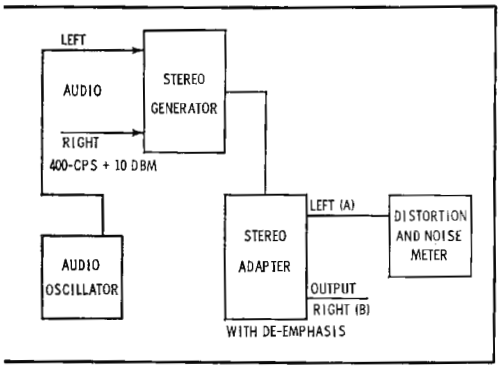


Fig. 8. Test setup for steps 3c and d; connect distortion meter to right channel

(a) Feed + 10 dbm 400-cps signals of equal amplitudes but opposite in phase to the left and right channel inputs of the stereo subcarrier generator. Connect oscilloscope to output test point of stereo generator using 400 cps from audio oscillator to externally synchronize oscilloscope. With stereo switch on and pilot amplitude or gain control fully CW, adjust pilot phase control to obtain a waveform similar to Fig. 5.

(b) Apply a +10 dbm 400-cps signal to left channel. Adjust L — R (DSB) amplitude to obtain waveform display as shown in Fig. 6. Adjust for a straight base line. See Fig. 7 for test setup relating to tests a and b.

(c) Adjust pilot gain control to ¾ CW. Discount output of the stereo generator from FM exciter and connect the stereo generator output to the stereo adapter input. Connect the distortion and noise meter to the left output of the stereo adapter and feed 400 cycles at +10 dbm to left channel of stereo generator. Adjust the gain control in both the adapter and distortion meter for 0 db.

(d) Without changing gain control settings, connect the distortion meter to the right channel output of the adapter, and adjust the adapter balance control for a minimum output of about —35 db. See Fig. 8 for test setup relating to tests 3c and d.

(e) Reconnect the stereo generator output to the input of the FM exciter. Connect the stereo adapter to an FM stereo tuner for monitoring purposes. Without changing the balance control setting, slightly advance the L — R (DSB) gain or amplitude control for a minimum reading from the adapter right channel output. See Fig. 9 for test setup.

It should be noted that test steps 3c and d are performed with the stereo generator disconnected from the FM exciter. In step 3e the generator is reconnected to the exciter and the resultant measurements will indicate any interference from the exciter RF circuits. For a more comprehensive test for spillover or bleeding of one channel signal into the other, the 400-cps +10 DBM signal should be fed into the right channel of the stereo generator and steps 3b through e should be repeated with the distortion and noise meter connected to the left output channel of the stereo adapter.

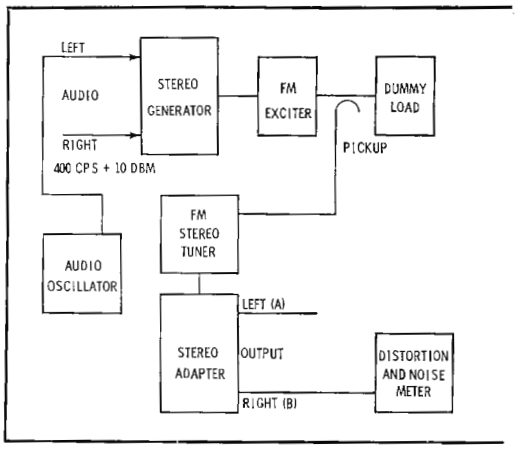


Fig. 9. Setup used to make test step 3e.

Performance of Stereo Plus SCA Modulation

With the combined transmission of the main carrier and multiplex programming (SCA) which originally produced excellent performance, it is of vital importance to the broadcaster that the addition of a stereo subcarrier will not lower this performance.

To prevent this problem, the FCC has provided definite requirements. One requirement details the permissible amount of spurious signal in the SCA program. The transmitter equipment should be designed so that the addition of the stereo subcarrier (38 kc ± 15 kc) will not produce a spurious signal in the SCA channel (67 kc ± 7.5 kc) of less than 60 db below the normal program level relative to +7.5 kc deviation.

Excessive Crosstalk

The NSRC has verified through appropriate field tests that crosstalk was a detrimental factor in composite performance of a stereo plus SCA system. Thus, the FCC has delineated appropriate signal specifications and standards to minimize the possibility of excessive crosstalk from the stereo subcarrier into the SCA subcarrier spectrum in multiplex operation.

It would appear that manufacturers of transmitting and receiving equipment should be expected to take steps in their technical design procedures to avoid adding serious annoying signal-to-noise disturbances which tend to impair the quality of reception.

Conclusion

The broadcast engineer, after completion of the above tests, will have available appropriate data for the full stereophonic proof-of-performance measurements required for audio frequency response, audio frequency harmonic distortion, output noise levels, balance, separation, and crosstalk. It is also possible to check the proper operation of a stereo system by using a regular station FM monitor (monophonic) and an FM stereo receiver. These measurements will provide a comparison of the FM monitor output signals versus the FM stereo receiver output, thus giving the broadcast engineer a true overall picture of performance. ▲

TV Interference

(Continued from page 15)

You know there's interference present because you have a pocketful of letters to prove it. The temptation arises to give the meter just a little more sensitivity—but DON'T. If you do, I will guarantee you will pick up something, but it won't be the signal that's blacking out the neighborhood.

Beginning at the exact geographic center of Edgewood Acres, I made two or three moves. At each location I would slowly tune the meter across channel 6 as I rotated the rabbit-ears in azimuth. My efforts were suddenly rewarded by the sound of a metallic "ping," caused by the needle on the meter making forceful contact with the pin at the top end of the scale. No music is sweeter. The tuning dial indicated 86 mc, so I took a bearing and made a mental note of the two possible directions from which I could be getting the signal (remember, rabbit-ears are **bi**-directional). I made a long move in location and took another bearing; I was hot on the trail now because of the happy phenomenon that two straight lines intersect only at one point. (A purist will argue that there is a second intersection on the opposite side of the earth, but I was interested solely in Edgewood Acres which is on **this** side of the world.)

Following several more measurements, each in a different location, the signal source appeared to be within a group of new houses on a nearby ridge. Taking the road serving this group of homes, I made a reading every few feet and found the strongest signal, 14 millivolts, in front of the house occupied by the H. family. Leaving the car on the public road I went to the door. After explaining my mission, I received Mrs. H.'s permission to drive to the rear of the house on their private drive.

So far, everything led to the actual location of the signal—this one house—and it was now my job to get into the house, find what was generating the signal, and correct it. At this point the engineer becomes The Ambassador, and enters into diplomatic negotiations. It's really not as formidable as it sounds, because most people are very cooperative. Also, it's fairly safe to assume that **their** reception isn't too hot either, so most of the time it doesn't take much persuasion to get permission to clear up the trouble. Although these people are regular viewers of your station, chances are you are the first flesh-and-blood member of the staff they have encountered — probably their first, and only, contact with the station.

Remember, you represent the station to this person, so when you leave the station's image should be improved over what it was when you arrived. However corny this may sound, if you deport yourself as a gentleman and observe a few little social graces, your status will change to that of a welcome, albeit uninvited, guest. Good rules to follow: (1) DON'T trespass, get permission to enter property; (2) DON'T smoke on private property; (3) DO remove your hat when indoors; (4) DO go through the motions of wiping your feet when entering a house.

Tally-Ho

Like most of the people you will contact, Mrs. H. was extremely cooperative. Within minutes I had the power in the house cut off, and

for the first time in a number of days there was NO interference on the channel. Power was restored and the process of pinpointing the trouble began by removing the branch circuit fuses one at a time.

When the house was built, a TV signal booster was installed between the lead-in and the antenna receptacle in the living-room. Mrs. H. had lived there only six weeks and didn't know the booster existed because it was between the first-floor joists at one end of the basement. Actually, she didn't need the booster for decent reception, so it was my pleasant duty to retire that one from service.

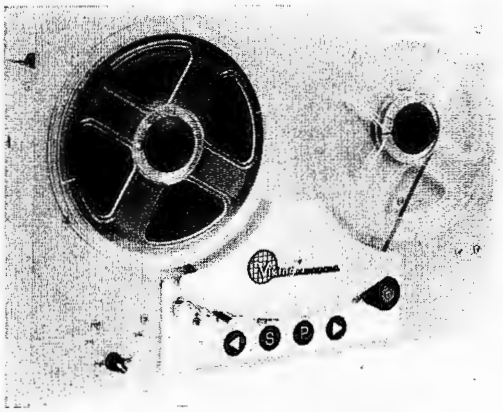
As a sequel to this trip to Greensburg, since the entire city of 6,000 was affected, we purchased an advertisement in the local newspaper announcing that the trouble had been found and corrected by station engineers, and thanking the viewers in that area for their patience, etc. In addition to the advertisement, we have another post-interference routine we feel is important. We composed a one-page memo explaining the trouble, what it was and how it was corrected, and sent copies to each TV serviceman in Greensburg. Assuming that they digested the information in the memo, there is a good possibility that future problems with boosters in that area may be headed off.

The Case of the Powerful FM Station

While on the subject of interference, it might be useful to some station engineers to have a case-history of interference caused by a powerful FM transmitter in another city. This city does not have local TV and relies on Indianapolis for its television; there are assorted AM and FM stations there, however. One of the FM stations got a whopping increase in power, and inasmuch as Channel 6 lays right up to the FM band, Channel 6 was clobbered. As far as I know, the FM was staying within its channel, but this strong signal so near to our carrier was beyond the rejection of the TV receivers due to inherently poor selectivity. What made matters even worse, the FM transmitter was on "our" side of town and virtually every TV antenna in town pointed to us "through" the FM transmitter site. Since the FM station operated only in prime-time, it came on the air just when we went into our Class AA time. Here was genuine trouble because this is not a village—it is a thriving industrial city with a population of about 45,000 people.

Bob Flanders, Director of Engineering for the WFBM Stations, prepared a letter which was sent to all servicemen and TV dealers in that city, explaining the situation and recommending that a quarter-wave stub be attached to the antenna terminals of the TV receiver. To be effective, it must be a shorted stub a quarter-wavelength of the FM station wavelength. The simplest way to make the stub was to use ordinary 300-ohm twin-lead. Mr. Flanders' letter included a sketch as a guide in making the stub, and if memory serves me correctly, the stub was 51 inches long for 97.9 mc, the frequency bothering us. Any letters on this subject from viewers were answered with the same form letter. It was a very effective campaign which began in February, 1962. Today, to our knowledge, all of the sets affected have been corrected. ▲

NEW PRODUCTS



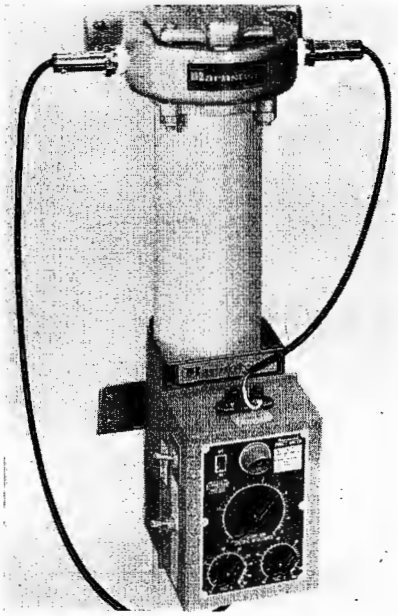
Tape Transport

Viking of Minneapolis has announced production of a new, reel-to-reel tape transport Model "230," designed for heavy duty application. This transport is entirely relay and solenoid controlled and push-button operated. All control circuits are designed for 24 volt DC power, and a full wave one ampere power supply is included in all standard models. Hyperbolic contour heads are mounted on unitized assembly blocks which may be readily interchanged to meet any specific requirement. The Model 230 employs two 4-pole induction reel drive motors with a single speed standard capstan motor; hysteresis and two speed capstan motors are optional. The new model features a remote control receptacle, plug in relays and such optional accessories as digital counter, mechanical or photo electric run out switches, remote control box, and rack mount panel. With head blocks, less heads, price is $303.95.

Circle Item 40 on Tech Data Card

Repurification Loop

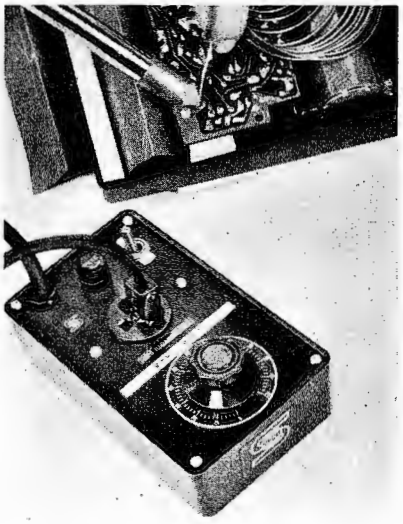
A compact bypass, wall mounting, repurification loop for coolant systems of U.H.F. Tubes is available from **Barnstead Still and Sterilizen Co.,** Boston, Mass. With a flow rate of 25 g.p.h., it consists of a combination cartridge holder and Submicron Filter with two B-23 conductivity cells and one PM-19X Purity Meter calibrated to 18 megohms. The device, complete with cell selector switch and purity meter bracket, measures 22" high x 12" high x 9½" deep and weighs (without cartridge) approx. 40 lbs. Now available is a larger unit having a flow rate of 40 g.p.h. and incorporating both demineralizer and oxygen removal cartridge holders, flow meter 0-60 gph, two B-20 conductivity cells with holders, PM-19X Purity Meter calibrated to 18 megohms with selector switch, temperature compensate to 212° F, and MF-45 Submicron Filter. The PL-1A measures 33" high x 30" wide x 15" deep and weighs (without cartridges) approximately 200 lbs.



Circle Item 41 on Tech Data Card

SCR Voltage Control

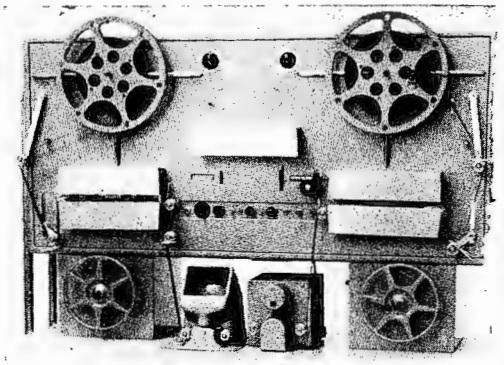
The new Vari-Volt developed by **Seco Electronics, Inc.,** of Minneapolis, controls voltage going to an AC/DC motor, incandescent light bulbs, or electrical tools to give an infinite range of speed, heat, or brightness. Complete and compact self-contained, the Vari-Volt operates on a silicon controlled rectifier rather than transformers. The unit controls the speed of all universal AC/DC motors up to ⅓ horsepower. It operates on standard 105-130 volt AC and is supplied with a three-wire input cord and output receptacle for using with a ground. To make a soldering iron more flexible, the user can dial the best heat for light or heavy work, thus facilitating work on printed circuit boards. Price, $19.95.



Circle Item 42 on Tech Data Card

Automatic Editing and Inspection Machine

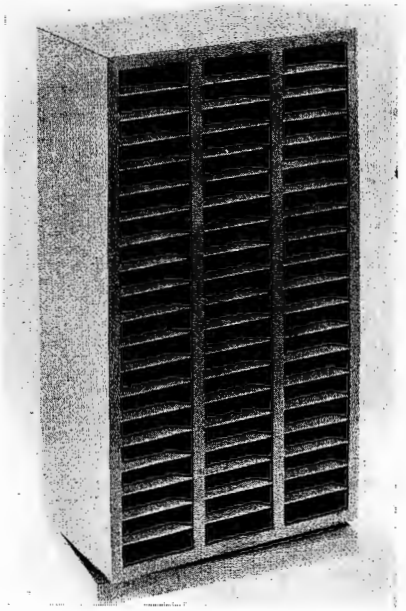
The **Harwald Co.,** Evanston, Ill., has introduced a 16mm film editing machine for the film room of a TV station, film library or film producer where its versatility and accuracy permit all release print editing and inspection functions to be performed quickly and reliably. This device incorporates the features of the popular earlier model Q, but has many improvements such as DC drive with transistorized control, elimination of all solenoids, reduction in the number of relays through the use of solid state circuitry, disc magnetic brakes and clutches, and use of only one belt. The "Editor" combines viewing and sound for previewing and editing with the basic Inspect-O-Film features: automatic defect detection, film cleaning, measuring and splice counting. The speed of the machine is adjustable from about one to 650 frames per second both forward and reverse. It is also equipped with an automatic rewind adjustable to about 2,000 feet per minute. The basic Model O Mark IV is priced at $5,450.00 f.o.b. Evanston, Ill.

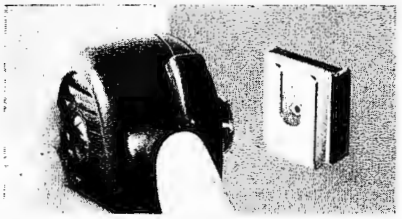


Circle Item 43 on Tech Data Card

Revolving Cartridge Rack

Available from **Sparta Electronic Corp.** is a revolving tape cartridge rack for providing convenient storage. The Sparta-Matic rack, which rotates on a noiseless ball bearing base, is available in two sizes. Model C-80 has the capacity for 80 cartridges, while model C-120 can hold 120 cartridges. Taking up a minimum of space, both racks are sturdily constructed and finished in dove grey plastic laminate to blend with other





professional equipment. Other colors are available on special order. Prices are: model C-80, $49.50; model C-120, $75.00.

Circle Item 44 on Tech Data Card

Magnetic Microphone Holder

GC Electronics of Rockford, Ill., recently announced the No. 65-525 Magnetic Microphone Holder as another addition to their line of 1963 products. The holder need not be permanently mounted, but may be relocated time and again on any metal surface. The magnet utilized in the holder, with holding capacity up to 12 pounds, gives a permanently mounted "feeling" when in use. Designed to be doubly functional, the unit may be used in a given position to hang a microphone near a broadcasting installation or clipped directly to the microphone. Price is 99¢.

Circle Item 45 on Tech Data Card

Heat Dissipators

IERC Div., International Electronic Research Corp., Burbank, Calif., announces new high power heat dissipators for power transistors, diodes and rectifiers. Largest of the series, HP3, is 3⅛" x 3⅛" x 1", and dissipates as much heat as standard extrusions with three times the mass, 2½ times the surface area, and 50% more volume. A second size, HP1, may be used separately or inserted

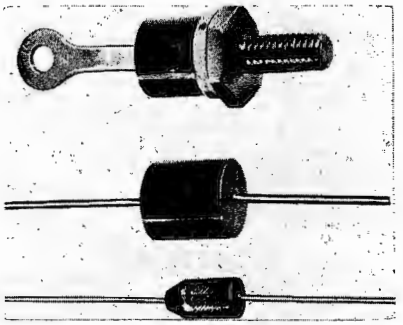
in the HP3 for increased performance. 2N1899 transistors have been tested at 100 watts dissipation when mounted in the HP1 and HP3 with 38 cfm of air. Size and weight economies are the result of staggered finger design. Another advantage is that the heat dissipators are efficient with forced air from any direction. Mounting is simplified since the mounting stud or screws for the semiconductor also secure the heat dissipator. Prices: $1.60 to $.70.

Circle Item 46 on Tech Data Card

Hermetically-Sealed Zener Diodes

Solitron Devices, Inc. Norwood, N. J., manufacturers of high-voltage silicon rectifier assemblies and test equipment, has announced the availability of a line of moderately priced hermetically-sealed zener diodes. The devices, with surface dassivated junctions, are sealed by the company's transfer-molded packaging method. The packages, illustrated, range in voltage ratings from 10 to 200 volts. Higher wattage units, to 50 kv, are produced in the Solidpack configuration. The zener diodes from 10 to 200 volts are of miniature size with insulated bodies, sharp knees, low dynamic impedance, high reliability, and excellent resistance to shock and vibration. The standard tolerances are 20%, 10%, and 5%; unit prices begin at $1.30 in 100 to 999 lots.

Circle Item 47 on Tech Data Card



ENGINEERS' TECH DATA SECTION

AUDIO & RECORDING EQUIPMENT

50. ALTEC—Folder contains information on line of speech input equipment for recording and broadcast studios.
51. AMERICAN CONCERTONE—Brochures cover line of portable professional tape recorder/reproducers.
52. AR—Catalog presents line of speakers, turntables, and audio accessories.
53. CROWN—Brochure covers seven distinct series of professional tape recorder/reproducers.
54. ELECTRO-VOICE.—Catalog lists products for broadcast, recording, commercial sound, and hi-fi applications.
55. FERRODYNAMICS—Catalog sheets cover line of magnetic tape products including tape, reels, leaders, mailers, and complete tape kits.
56. FOURJAY—Sheet covers line of slim wall-type speaker baffles for indoor or outdoor applications.
57. GOTHAM AUDIO—Reprints of article "Condenser Microphones" by Stephen F. Temmer, pres. of company, treats on the characteristics of condenser microphones and their comparison with units of the dynamic type.
58. RCA—Illustrated catalog describes line of broadcast and recording microphones and accessories; flyer lists physical and magnetic properties of recording tape.
59. REEVES—Professional products brochure includes low-print mastering tape, high output mastering tape, and duplicating tape.
60. SPARTA—Bulletin provides price schedule and information of tape cartridges and cartridge reloading.
61. TURNER—General catalog presents line of microphones, associated equipment, and accessories.

COMPONENTS & MATERIALS

62. ALPHA WIRE—Spec chart gives data on plastic jacket tinned copper wire.
63. DIALLIGHT—Catalog discusses the principles, design, and construction of subminiature transistorized indicator lights.
64. ENGLISH ELECTRIC—Application report explains specs and use of hydrogen thyratron assembly.
65. IERC—Short form catalog lists components for cooling and retention of electron tubes and semi-conductor devices.
66. INSTRUMENT SYSTEMS CORP.—Line of Hall effect products and Hall theory is covered 8-page catalog; included are probes, multipliers, modulators, tape heads, and other components.
67. KURMAN—Relay catalog presents specs and dimensional illustrations of approximately 200 relay models.
68. OAKTRON INDUSTRIES—1963 catalog shows complete line of loudspeakers, plus ceiling, corner, and wall baffles.
69. PAR-METAL—44-page catalog contains illustrations, specs, descriptions, and prices of modular cabinet racks and consoles.
70. STANCOR—48-page catalog lists replacement transformers and coils for TV, radio, hi-fi, and audio equipment.
71. STATHAM INSTRUMENTS—Hermetically sealed connectors for maximum resistance to radiation, high temperature, thermal shock, and corrosive environments are described in bulletin.
98. SYLVANIA—Booklet details line of pencil tubes, listing characteristics and operating information.

RADIO & CONTROL ROOM EQUIPMENT

72. AUTOMATIC TAPE CONTROL—Brochure describes portable cartridge player and recorder/reproducer.
73. BAUER—"Peak Master" limiting amplifier is described in brochure.
74. FAIRCHILD RECORDING EQUIP. — Automatic dynamic equalizer for creating apparent loudness is covered in data sheet.

99. MaCARTA—Catalog sheets and price lists cover line of tape cartridges, recorders, playback units, cartridge handlers, and accessories.
75. McMARTIN—Brochure describes RF amplifier for use with remote operated FM frequency and modulation monitors.
76. SORENSON—Complete line of power supplies, voltage regulators, frequency changers, and high voltage units is covered in catalog.

STUDIO & CAMERA EQUIPMENT

77. G.E.—Set of brochures cover remote cntl transistorized vidicon studio camera, viewfinder camera, UHF transmitters, UHF antennas, studio consoles, color film system, and color studio camera.
78. KLIEGL—Data sheets describe focusable spotflood light, twin flood light unit, and multiple-light strip.
79. TELEVISION ZOOMAR—Brochures describe line of lenses for image orthicon cameras and vidicon units.

TELEVISION EQUIPMENT

80. AMPEX—Six-part file contains information on television recording equipment for broadcast and cctv users.
81. CBS LABS—Bulletins cover video distribution amplifiers and mono/stereo test record.
82. 3M—Technical bulletin concerns video tape subjects of interest to engineers, vtr operators, and other TV station staff personnel.
83. RIKER—Illustrated brochure gives details on operation and application of company's modular special effects generator.
84. SPRAGUE—Bulletin gives information on line of RFI filters for audio lines and video circuits.
85. TELEMET—Brochures cover flying spot scanner, sync adder, phase corrector, video switching amplifier, transmission test generator, and a dot grating generator.

TEST EQUIPMENT & INSTRUMENTS

86. AMPLIFIER CORP. OF AMERICA—Booklet entitled, "Flutter: Its Nature, Cause, and Avoidance," presents a study of flutter and its associated disturbances.
87. ANALAB—Short form oscilloscope catalog lists single and dual trace main frames and a variety of plug-in units.
88. BLONDER-TONGUE—Catalog sheets describe transistorized field strength meter and RF switcher.
89. DELTA ELECTRONICS—Short form catalog and spec sheets list impedance bridges, monitor amplifier, high frequency antenna system, and voltage regulating inverter.
90. EICO—Catalog sheet describes combination IM/Harmonic distortion meter and AC VTVM.
91. HAMMARLUND—Bulletin presents features and specs of portable primary and/or secondary frequency standard.
92. WESTON—AC and DC portable electrical indicating instruments with taut-band suspension are described in bulletin.

TRANSMITTER & ANTENNA DEVICES

93. CO.EL—Catalogs describe broadband dipole antennas, UHF slot antennas, filters, and diplexers.
94. GENERAL ELECTRONIC LABS—Four-page booklet, containing timing chart, block diagram, strip chart, and specs, describes automatic logging equipment.
95. JAMPRO—Reprints of article, "Effects of FM Antenna System VSWR on Stereo Separation," include degradation chart.

POWER DEVICES

96. ONAN—Reprint of article serves as a practical guide to the selection of emergency electric generating equipment.
97. SECO—4-page catalog describes Vari-Volt units for control of lighting, heating elements, and AC/DC motors up to 15 amps.

Professional Services

Classified

Advertising rates in the Classified Section are ten cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra. Check or money order must be enclosed with ad.

The classified columns are not open to the advertising of any broadcast equipment or supplies regularly produced by manufacturers unless the equipment is used and no longer owned by the manufacturer. Display advertising must be purchased in such cases.

EQUIPMENT FOR SALE

Commercial Crystals and new or replacement crystals for RCA, Gates, W. E., Bliley and J-K holders; regrinding, repair, etc. BC-604 crystals. Also A. M. monitor service. Nationwide unsolicited testimonials praise our products and fast service. Eidson Electronic Company, Box 96, Temple, Texas. 9-61 tf

GOVERNMENT SURPLUS, NEW 10 CM. WEATHER RADAR SYSTEM—Raytheon, 275 KW peak output S band. Rotating yoke P.P.I. Weather Band 4, 20 and 80 mi. range. Price $975 complete. Has picked up clouds at 50 mi. Wt. 488 lbs. Radio Research Inst. Co., 550 5th Ave., New York, New York. 8-63 6t

Ampex Head Assemblies for 300 and 400 series recorders reconditioned. Service includes lapping and polishing all three head stacks, cleaning entire assembly, readjusting and replacement of guides, and realignment of stacks as to azimuth and zenith. Full track assemblies—$60.00. Taber Manufacturing & Engineering Co., 2619 Lincoln Ave., Alameda, California. 8-63 2t

Transmission line, styroflex, heliax, rigid with hardware and fittings. New at surplus prices. Write for stock list. Sierra Western Electric Cable Co., 1401 Middle Harbor Road, Oakland 20, California. 6-61 tf

TRANSMITTING TUBES FOR SALE — Immediate Delivery on 6076 Power Tetrodes, at $200 each. 3X2500F3 — $175, 4W20000A — $1815, 450TL — $25, 4-125A — $22.50, 872A — $5.25, 575A — $15.50. Many Others. Brand New. 1,000 hour warranty. Write or call Calvert Electronics, Inc., Dept. BE-8, 220 E. 23rd St., New York 10, N. Y., (212) OR 9-1340. 7-63 3t

Need AM Frequency Monitor, limiter, remote control equipment, console, turntables, 200-foot tower. KDEX, Dexter, Missouri. 8-63 1t

First phone, excellent electronics background. Need experience at TV level, hence your station can afford me. Age 35, will relocate. Dave Davis, 26 Central Ave., Shelby, Ohio. 8-63 2t

BROADCAST ENGINEER WANTED. Must have First Phone License and some experience. Send complete resume. WCHV Rosehill Drive, Charlottesville, Virginia. 8-63 2t

1 KW FM Transmitter General Electric 4 BT-1B includes GE Model 4 BT1B1 250 Watt Driver-Exciter. Excellent condition. $2,825. P. O. Box 2283, Newport Beach, California. 8-63 2t

Altec 639 B Microphone, as new, $125; RCA BA6A Limiter, with Shelf and Remote Meter, $400; Presto A93 Disc Recording Amplifier, $195; Gates CB500 Turntable with Grey Arm, $130. Commercial Recording Corporation, Dallas, Texas. 8-63 1t

Modulation Transformer, UTC Type 89864, 2KVA, 30-20,000 cps, 12/4 Kohms Pri/sec, $125.00 f.o.b. uncrated Los Angeles 45, TECMAR Box 833, Hawthorne, California. 8-63 1t

Advertisers' Index

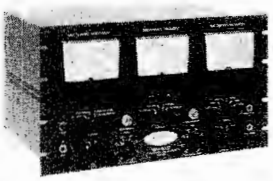
Memo To:

FM: *Station Managers*
Station Owners
Chief Engineers

McMartin

LOOK TO
FOR LEADERSHIP IN
MONITORS, MULTIPLEX AND RELAY RECEIVERS AND AUDIO

By outstanding performance, dependability and economy, McMartin built FM multiplex and audio products have earned a reputation for leadership. McMartin experience and engineering are continually at work developing new products and improving present ones to be of greater service to the industry.



TBM-4000 McMartin

FM/SCA MULTIPLEX MONITOR

The most versatile instrument of its kind for monitaring all moin channel modulation and SCA Multiplex operating characteristics. The only Monitor which directly reads crosstalk.

McMartin TBM-3000 and TBM-3500

TBM-3000 is a completely self-contained frequency monitor, and the TBM-3500 a self-contained modulation monitor. The 3000 used in conjunction with either the 3500 or 4000 fulfills the FCC requirements for station monitors.

McMartin

MULTIPLEX RECEIVERS

Proven performance and reliability . . .

More than 9,000 in use throughout the world.

McMartin

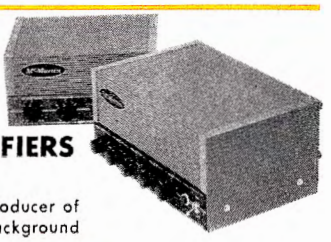
TBM-1000/2000 FM/SCA Multiplex Re-Broadcast Receivers

Ideal for area network relays . . .defense networks and off-air monitoring.

McMartin

8 & 32 watt
TRANSISTOR AMPLIFIERS
LT 80A & LT 300

McMartin is the world's largest producer of amplifiers for the commercial background music industry.



originality by

McMartin Industries, Inc.
605 North 13th Street Omaha, Nebraska
Code 402 — 342-2753

In Canada Sold By: Canadian Marconi Company, Montreal 16, P. Q.

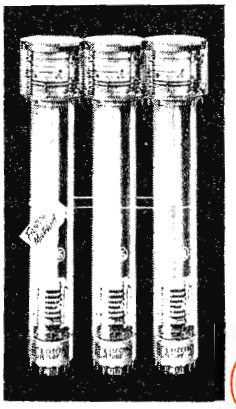
Circle Item 38 on Tech Data Card

Sponsor Preferred

Choose RCA-4415 & 4416 for Your Big Year in Color

Colorcast schedules are growing heavier. And heavier. And heavier. Get set now to deliver the sharp, true, bright pictures sponsors demand for their programs and commercials. Replace with RCA Image Orthicons 4415 & 4416. For RCA insists on highest quality performance in its color image orthicons. And has invested more to get it.

The RCA 3-tube factory-matched set in your camera produces exceptional pictures in color receivers, as well as high resolution pictures with normal tone rendition in black-and-white sets...at lighting levels available in black-and-white studios! There's no problem of high scene-lighting temperatures...no need for extra air-conditioning. And many lighting costs usually associated with highest quality indoor color pickup are avoided.



RCA precision construction, Field Mesh, plus finely matched tube characteristics assure you excellent picture registration and uniform color balance over the entire scanned area.

Also available is RCA-7513, an Image Orthicon for highest quality color pickup using conventional color TV lighting. Ask about RCA Image Orthicons locally. SEE YOUR AUTHORIZED DISTRIBUTOR OF RCA BROADCAST TUBES.

RCA Electronic Components and Devices, Harrison, N. J.

The Most Trusted Name in Television

For name and address of your local distributor write or call your nearest RCA Distributor Products Sales Office—New York, N. Y.: 36 W. 49th St., MUrray Hill 9-7200; **Needham Heights 94, Mass.:** 80 "A" St., Hillcrest 4-8480; **Washington 7, D. C.:** 1725 "K" St., S.W., FEderal 7-8500; **Atlanta, Ga.:** 134 Peachtree St., N.W., JAckson 4-7703; **Cleveland, Ohio:** 1621 Euclid Ave., CHerry 1-3450; **Chicago, Ill.:** Merchandise Mart, 467-5900; **Dallas 7, Texas:** 7901 Carpenter Freeway, MElrose 1-3050; **Kansas City 14, Mo.:** 7711 State Line, EMerson 1-6462; **Los Angeles 22, Cal.:** 6801 E. Washington Blvd., RAymond 3-8361.