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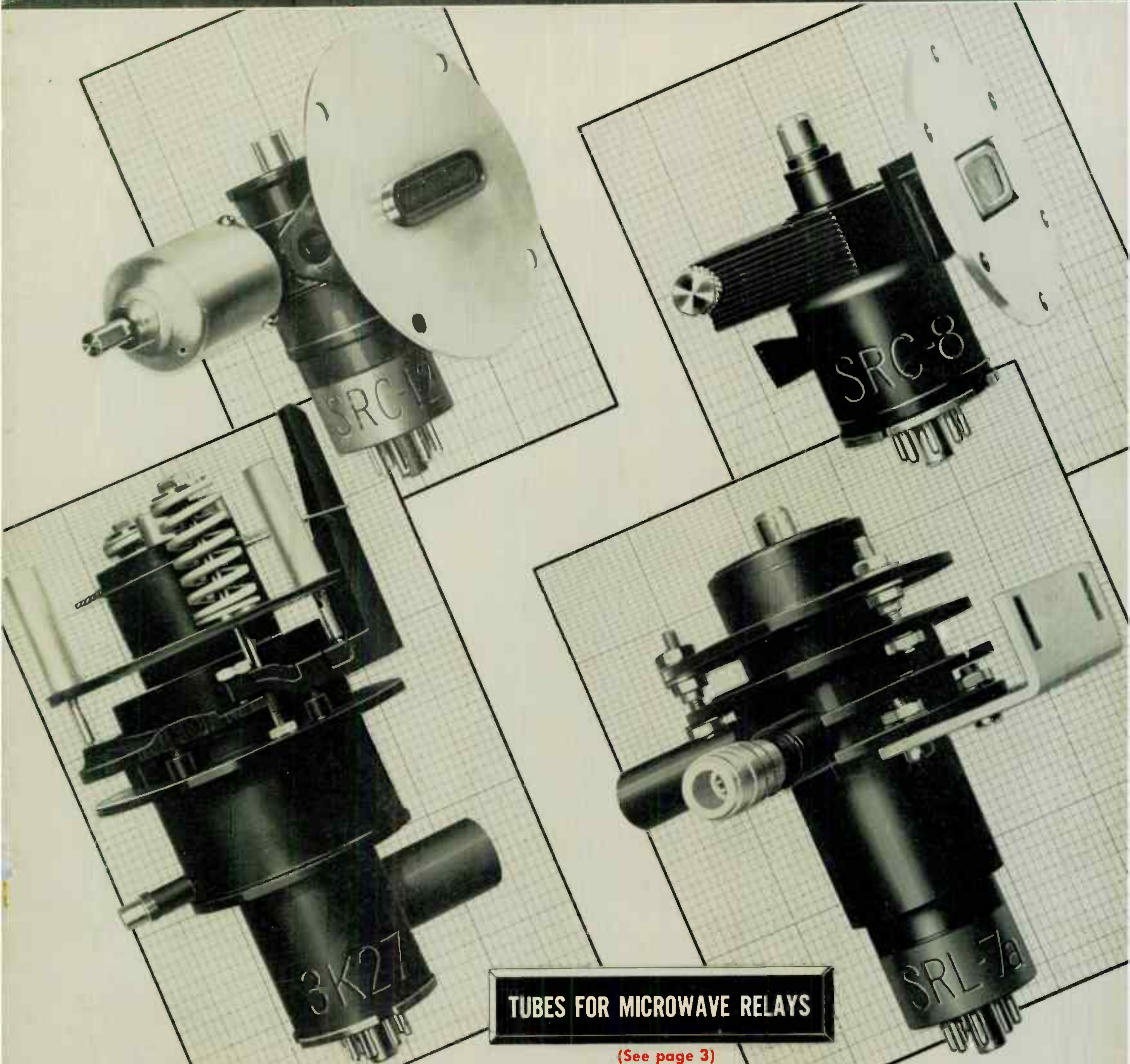
FM AND TELEVISION

Apr. 1948

★ ★ *Edited by Milton B. Sleeper* ★ ★



TUBES FOR MICROWAVE RELAYS

(See page 3)

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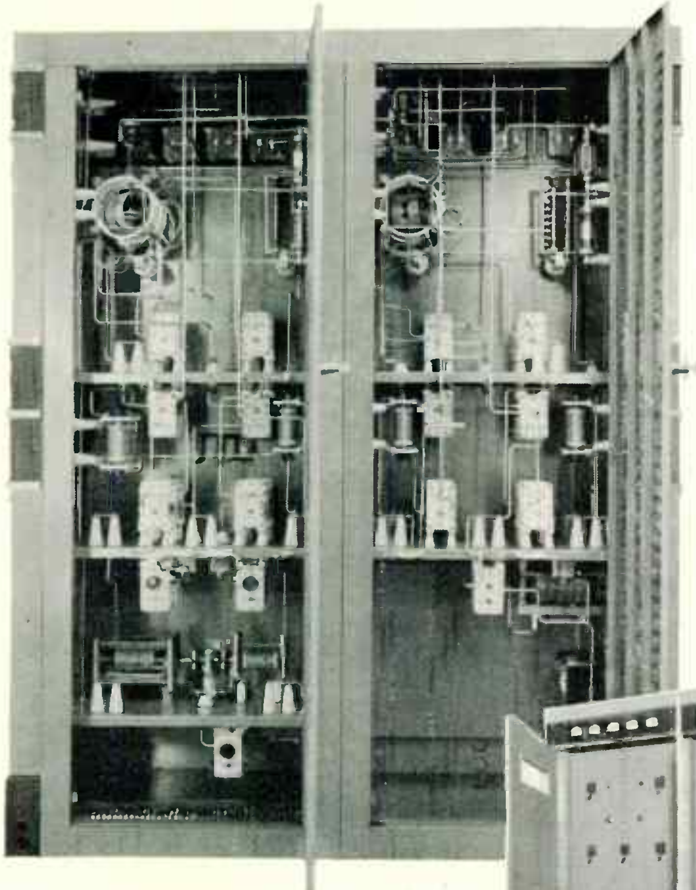
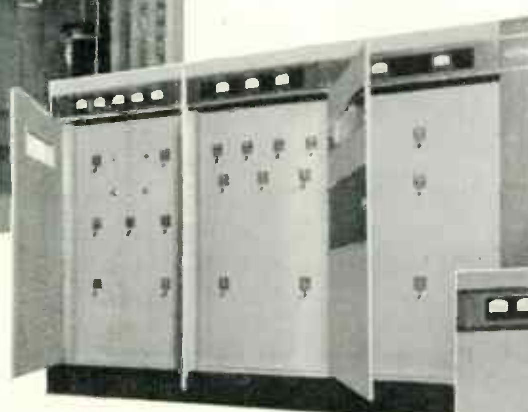


DOUBLE CUBICLE, 5 KW UNIT, rear view, showing the compact but uncrowded arrangement of components. Large rear doors are interlocked for safety, provide easy access for maintenance or adjustment.



TRIPLE CUBICLE, 10 KW UNIT shows convenient arrangement of power and phasing controls, line current and input meters. Counters and panel lights indicate the setting and directional pattern in use. Safety doors exclude unauthorized personnel. NOTE: Cabinet design and number of cubicles is determined by equipment required — not necessarily by KW output.

SINGLE CUBICLE, 1 KW UNIT illustrates the handsome appearance of the heavy gauge steel and channel iron cabinet. Modern two-tone chrome-trimmed design adds smart style to any station.

Raytheon's specialists, cooperating with your consultant and station engineers, are prepared to custom-build directional antenna phasing and tuning equipment that will produce optimum results with your proposed or existing transmitting equipment. Engineered for maximum efficiency and stability . . . designed for utmost ease, economy and safety of operation . . . styled for ultimate appearance, convenience and accessibility — in the size to suit the power and special characteristics of your installation.

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FM AND TELEVISION

★ ★ Edited by Milton B. Sleeper ★ ★

FORMERLY, *FM* MAGAZINE and *FM* RADIO-ELECTRONICS

VOL. 8 APRIL, 1948 NO. 4

CONTENTS

MILTON B. SLEEPER, *Editor and Publisher*

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THIS MONTH'S COVER

The Klystron tube, a wartime contribution of Sperry Gyroscope's tube-development group, was not immediately credited with having commercial, peacetime applications.

However, research on radio relay systems disclosed that Klystrons have features that give them certain advantages over other tubes for microwave transmission. Now, for example, they are employed in the AT & T relay system between New York and Boston.

The disadvantages of relatively high cost and short life are being overcome in the course of increased production. This month's cover shows four standard types of Klystrons.

Entered as second-class matter, August 22, 1945, at the Post Office, Great Barrington, Mass., under the Act of March 3 1879. Additional entry at the Post Office, Concord, N. H. Printed in the U. S. A.

MEMBER, AUDIT BUREAU OF CIRCULATIONS

WHAT'S NEW THIS MONTH

1. Set Production
2. The Coy Speech
3. FM-TV Competition

1. Production of home radio sets by RMA members in February shows up in this month's Production Barometer as previously predicted here.

Although FM and TV sets are at low levels compared to AM, the FM and TV production for January and February shows gains in 1948 over 1947, while AM sets are down considerably.

The actual figures for the two months put FM up 172,000 in '48 over '47, TV up 54,000, and AM down 463,000. While this represents a net loss of 137,000 units, it means substantial dollar gain.

It must be borne in mind, and this point should be emphasized, that the AM figure includes export, automobile, and portable receivers. Since there are no FM and TV sets in these categories, and since RMA's monthly figures do not disclose a breakdown of AM models, no adjustment can be made in the Production Barometer for purposes of more accurate comparison.

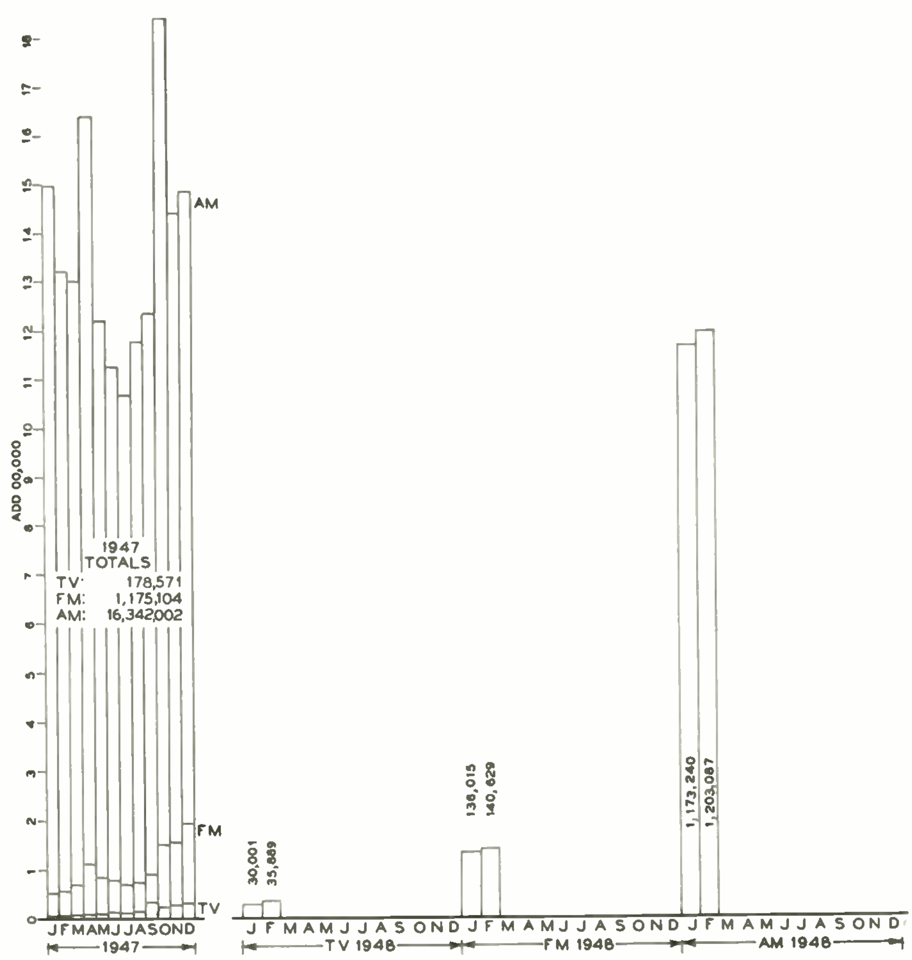
Incidentally, Delco has been working on an FM automobile set for over a year. Presumably, designs are ready for production whenever the sales department gives the signal. No doubt other manufacturers are making similar preparations.

FM tests made by Delco engineers in the Michigan area showed excellent results. That section is known for adverse AM receiving conditions. However, solid FM reception was obtained over surprisingly long distances, without the fading which characterizes AM reception on the highways and in the cities.

February RMA figures showed a preponderance of floor models in the FM category, amounting to 64% as against 36% table types. TV sets were divided between 29% floor models and 71% table types. While no exact figures are available, FM and TV dollar volume is now running well ahead of AM.

2. In the course of his speech during the March I.R.E. convention, FCC Chairman Coy [1] dwelt at length on a very touchy subject, that is, the limitations of the

(*Continued on Page 10*)



FM-AM-TV Set Production Barometer, based on montly figures released by the RMA

TELENOTES

WDTV Pittsburgh:

Construction has been started on the third DuMont television station, in Pittsburgh's Braslear Reservoir district. Effective radiation will be 14.25 kw. on video, and 9.45 kw. on audio. Test pattern transmission is scheduled to start in September, and programs in December.

TV Network Lineup:

As of April 1st, 161 stations affiliated with the four major networks have been granted TV construction permits or have applications pending. Here are the figures:

MBS 8 CP's	23 Applications pending
ABC 12 CP's	24 Applications pending
CBS 13 CP's	32 Applications pending
NBC 33 CP's	16 Applications pending

What realignment may take place before actual TV network operation starts is purely a matter of conjecture now.

Union Problem Settled:

Programwise, one of television's most serious problems was settled on March 18, when an agreement was signed by the American Federation of Musicians and the four major networks under which AFM members may perform on television shows. The agreement also covers the televising of shows also broadcast by FM and AM.

Upper-Band Television:

Major Edwin H. Armstrong has applied for an experimental television station to operate on 480 to 500 mc. with 50 kw. This action was taken in response to FCC Chairman Coy's insistence that work be started actively in the upper television band. Expectation is that FM will be used for both video and audio transmission.

TV in Boston:

Yankee Network is putting on public television shows to acquaint the Boston audience with TV, although their new station is not completed. Field television equipment, used for this purpose, has proved highly effective as advance promotion.

DuMont Affiliate:

Station WNHC-TV New Haven will operate as a member of the DuMont net when it goes on the air about May 1st. Manager of the Connecticut station is James T. Milne.

TV Receiving Antennas:

A forthcoming article in *FM and* TELEVISION will offer a practical antenna design for use where high-gain reception is required from stations in two or more different directions.

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ALTEC LANSING News

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ALTEC LANSING SCIENTISTS DISCLOSE BASIC IMPROVEMENTS IN HIGH QUALITY SOUND REPRODUCTION IN NEW SPEAKERS

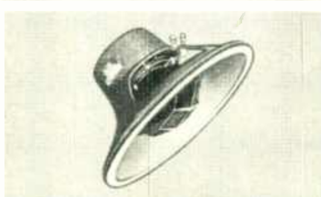
Altec Lansing Corporation, one of the world's largest makers of professional and theatre-type speaker systems, has announced a new, basically improved line of general purpose, high quality speakers. Altec scientists call attention to the fact that these new speakers,—constituting a complete new line — have been fundamentally re-engineered, and are the result of the application of new scientific discoveries resulting from intensive original research in Altec Lansing laboratories; they are *not*, it is emphasized, mere modifications or "re-working" of present models. The new line of speakers is offered "with the fullest conviction that never before has such a superb group of speakers been presented to a discriminating and quality-conscious public."

← NEW MODEL 604B DUPLEX SPEAKER SHOWS REMARKABLE EFFICIENCY AND PERFORMANCE

Authorities on sound quality—the experts in the broadcasting, recording, and motion picture industries—who considered the previous Altec Lansing Duplex speaker (the 604) as the finest two-way speaker unit that science has produced, were literally thunderstruck when they listened to "previews" of the new improved Model 604B. Among outstanding new features are: 1,000 cycle crossover frequency using the new N-1000B network with adjustable high frequency control; an exclusive Altec Lansing development used with the high frequency metal diaphragm to smooth the frequency response beyond belief from 1,000 cycles to 16,000 cycles.

SPECIFICATIONS

Angle of Horizontal Distribution ....60°
Angle of Vertical Distribution ....40°
Power Rating ....30 watts
Network Impedance ...16 ohms
Required Amplifier Output Impedance ...8-16 ohms
Diameter ....15-3/16"
Depth ....11⅛"
Weight ....40 lbs.



NEW 603B MULTICELL DIA-CONE SPEAKER

The new 603B Multicell Dia-cone speaker is as superior to the original 603 Model as the 603 was superior to its competitors. The new 603B has a 30% larger Alnico V permanent magnet; massive circular magnetic circuit; almost 100% increase in acoustic efficiency (2.5 db increase over the 603).

SPECIFICATIONS

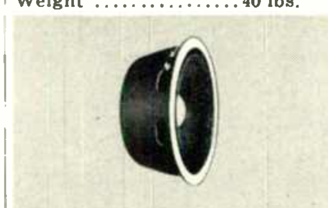
Angle of Horizontal Distribution ....60°
Angle of Vertical Distribution ....40°
Power Rating ....25 watts
Voice Coil Impedance..8 ohms
Required Amplifier Output Impedance....6-10 ohms
Voice Coil Diameter....3"
Weight ....18 lbs.
Speaker Diameter .....15-3/16"
Depth ....7"

NEW MODEL 600 B DIA-CONE SPEAKER

"Greater quality per dollar" describes the new low-priced high quality 600B Dia-cone speaker unit. Because of the high efficiency, small space requirements, light weight and superior quality of reproduction, the 600B is ideal for home use, sound reinforcement systems and industrial applications.

SPECIFICATIONS

Power Rating ....20 watts
Voice Coil Impedance..8 ohms
Required Amplifier Output Impedance ...6-10 ohms
Voice Coil Diameter....3"
Speaker Diameter .....12¼"
Depth ....5¼"
Weight ....12 lbs.



NEW 8" MODEL 400 B DIA-CONE SPEAKER

A low-priced high quality unit with a much higher efficiency than is found in ordinary 8" speakers: important in use with amplifier capable of delivering only from 5 or 6 watts. Exceptionally high power rating results from Altec Lansing design and use of a large Alnico V permanent magnet.

SPECIFICATIONS

Power Rating ....12 watts
Voice Coil Impedance..8 ohms
Required Amplifier Output Impedance ...4-8 ohms
Voice Coil Diameter....1¾"
Speaker Diameter .....8¼"
Speaker Depth ....3⅝"
Weight ....4 lbs.

FREQUENCY RESPONSE CURVES PUBLISHED IN ILLUSTRATED BROCHURE

With the announcement of the new line of speakers, Altec Lansing announces that frequency response curves will be published on all its speakers. These curves are guaranteed to be accurate, dependable and true reproductions, made on production run speakers with equipment used by Motion Picture Research Council for establishing speaker system standards in the motion picture industry.

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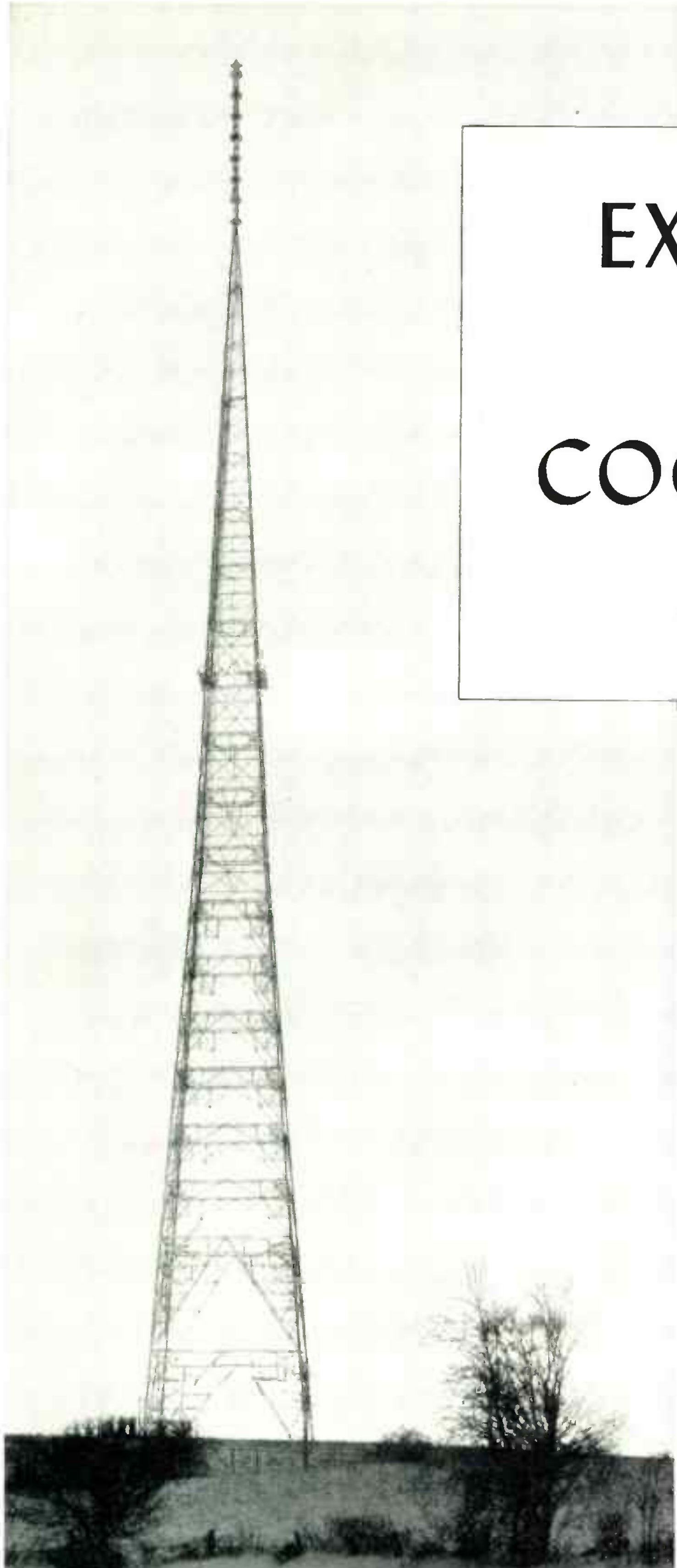

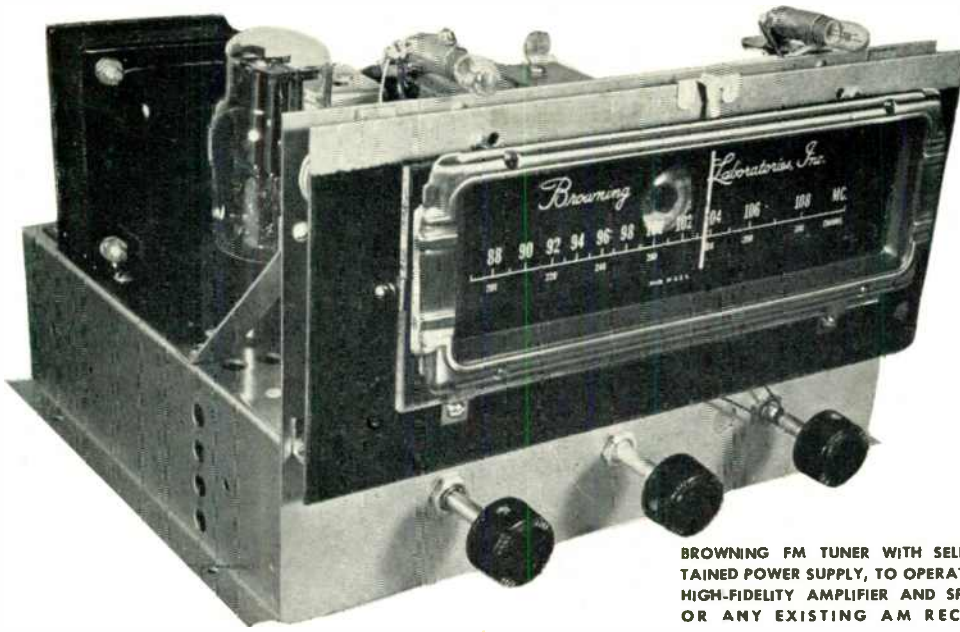

BROWNING FM TUNER WITH SELF-CONTAINED POWER SUPPLY, TO OPERATE ANY HIGH-FIDELITY AMPLIFIER AND SPEAKER OR ANY EXISTING AM RECEIVER

Performance Proves the Browning FM Tuner to Be Truly a

PRODUCT OF CONTINUING RESEARCH

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AUDIO OUTPUT: Flat within ±1½ db from 10 cycles to 15,000 cycles. Thus, the audio quality is limited only by the associated amplifier and loudspeaker.

DRIFT: Two minutes after the RV-10 is switched on, no further readjustment of tuning is required. BROWNING research has eliminated drift from this Tuner.

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We would like to emphasize that these are not merely the characteristics of one, special RV-10, but of every RV-10 Tuner when it passes final inspection at the BROWNING plant. For details and prices, address:

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WHAT'S NEW

(Continued from Page 4)

lower TV band, and the shift to the upper band.

Certainly, no one could do a more serious disservice to present television activities than to encourage the public to think that low-band operation will be shifted to higher frequencies at some time in the near future. On the other hand, television is expanding not at a slow and constant rate, but at a fast and accellerating pace that is hastening the day when added channels will be required.

In fact, if Chairman Coy's prediction that he expects to see "all television channels in the nation's 140 metropolitan districts assigned within the next 12 months" is realized, then television will be confronted in 1949 or 1950 with a limitation due to lack of low-band channels.

It now seems certain that this stopping point will be reached long before research and development can produce high-band transmitters and receivers.

Altogether, it is a delicate situation. There is a temptation to avoid the problem by refusing to acknowledge that it exists. But that is hardly a constructive attitude, particularly at a time when, as Chairman Coy pointed out, "television broadcasting service and the land mobile services each are competing for the use of the same band of frequency", and that "the Commission has pointed out the inadequacy of (low-band) channels."

Why was this subject brought out for discussion at the most important meeting of radio engineers held during the year? What is the background of FCC thinking on this subject? What basis has been laid by the Commission for any action that may be taken to accelerate the shift of television to the upper band? In short, was this frequency problem the only subject at hand for an address to IRE members, or was it a firm first step toward furthering a plan under development at the FCC?

Searching for background information that would give some clue to these questions, we came upon the transcript [2] of the press conference held in the New Post Office Building, Washington, D. C., on January 15, 1945, following the release of the FCC's proposed frequency allocations to non-Governmental services.

Former Commissioner E. K. Jett presided over the conference, assisted by Comdr. Paul D. Miles, chairman of the Interdepartment Radio Advisory Committee, IRAC members Dr. J. H. Dellinger, Capt. E. M. Webster, Col. A. G. Simpson, and Comdr. Budlong, with George P. Adair then FCC chief engineer, Charles R. Denny then FCC general counsel, and Dr. L. P. Wheeler then of the FCC Engineering Department.

In his greeting to the press, Mr. Jett said: "I notice that there is a public stenographer present. I suppose we will have to carefully weigh our words, because we are going to have a verbatim transcript." Here are some questions and answers from that transcript:

MR. SLEEPER: Is there any explanation available at this time as to why television is being put back to the 44-mc. band and up, when apparently it will be far more subject to interference than FM would be if it were left there?

COMR. JETT: . . . While we feel that television should go ahead promptly as soon as manpower and materials become available, under the existing standards which were adopted in 1941 for commercial television service, we nevertheless believe that 12 channels assigned for the 6-mc. operation are insufficient for a truly nation-wide competitive system of television.

Therefore, the report encourages the development of frequencies above 480 mc. for the so-called higher-definition and color systems of television. And we have reason to believe that those frequencies will be developed in due time, and that the industry will be able to recommend standards with respect to those frequencies.

. . . You might say to me: "Well, the interference problems, insofar as television is concerned, would be just as bad with FM." As an engineer, I will agree with that. However, FM is to be started and developed as a permanent broadcasting service for the future. Television may or may not be a permanent service in the bands below 225 mc. because we are encouraging the development of television above 480 mc. We fully expect, after a number of years, that the truly competitive operations in this Country will be in the bands above 480 mc. Therefore, of the two services, when you consider that we must select between one and the other, the 6-mc. television service will be of a temporary character. I admit, of course, that the temporary character may extend for some years. Therefore, the service that is temporary in character should take the interference, not the one that will be with the public throughout the entire future. Mr. Adair also reminds me that our television standards for primary service afford protection only to the 500 microvolt-per-meter contour.

MR. WOOD (Columbia News Bureau): "Does the report mean to imply that the higher frequencies will not be open to commercial television?"

COMR. JETT: . . . I can assure you that just as soon as the industry can demonstrate that frequencies above 480 mc. are ready to go on a commercial basis, the Commission will certainly adopt commercial rules and regulations and standards.

(Continued on Page 12)

[1] See page 32 for the complete text of Chairman Coy's remarks on television frequencies.

[2] Copies are probably available from Ward & Paul, 1760 Pennsylvania Avenue, Washington 6, D. C.

4 New Ways to put live quality into transcriptions...

G-E VARIABLE RELUCTANCE PICKUP NOW WITH DIAMOND STYLUS!

Virtually banishes Needle Scratch, Needle Talk, and Distortion! Rides lightly in the grooves—responds only to *lateral* motion. Rugged mechanically . . . built to stand abuse . . . practically unaffected by temperature or humidity. Available with the long-wearing Diamond Stylus with either of 2 Stylus radii—2.5 & 3 mil. (G-E Sapphire Stylus pickups are all 3 mil). Net to broadcasters............................$29.63.

G-E TRANSCRIPTION TONE ARM

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G-E EQUALIZED TRANSCRIPTION PRE-AMPLIFIER

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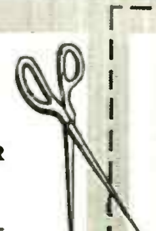

USE THIS CONVENIENT COUPON TO ORDER THIS G-E AUDIO EQUIPMENT TODAY!

If you want further information, consult your nearest General Electric transmitter representative, or write: *General Electric Company, Transmitter Division, Electronics Park, Syracuse, N. Y.*

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- ☐ G-E Tone Arm (Pickup not included)
- ☐ G-E Equalized Transcription Pre-Amplifier
  ☐ (set of tubes for Pre-Amp)
- ☐ G-E Transcription Equalizer
- ☐ Send me descriptive bulletins on all of these items
- ☐ Check or M.O. enclosed. ☐ Bill me.

NAME...

STATION............ADDRESS..........................

CITY..............................STATE.............

Mail this coupon today.

WHAT'S NEW

(*Continued from Page 10*)

and permit that service to proceed commercially."

Reviewing Chairman Coy's remarks in the light of statements by FCC officials who took part in setting up the existing allocations, it seems that either the Chairman used very poor judgment in making such a point of upper-band television on this particular occasion, at a time when present progress could be badly upset by any official threat of low-band obsolescence, or else he did it deliberately. In the latter case, it appears that the FCC is either undertaking to advance some ideology of its own, established perhaps prior to January, 1945, or is undertaking to implement the shift of television to the upper band in order to give communications the lower television band.

One thing is sure: Chairman Coy was not completely frank. This opinion is held by a considerable number of radio executives and engineers. In the best interests of both the public and the industry, he should issue a further statement to clarify the doubts he has created. FM managed to recover quickly from the shift in frequencies made during Paul Porter's administration. He promised that 10-kw. new-band transmitters would be "immediately available", but it took the industry two years to even start them in production.

There is every reason to expect that Chairman Coy has a better understanding of industry problems, and a more cooperative attitude in finding practical solutions. Surely, then, he must clear up the doubts created by his speech at the IRE Convention. If the FCC has already formulated plans for shifting television, a time schedule should be worked out between the Commission, the manufacturers, and the broadcasters — not in star chamber discussions by the Commission alone.

3. Proponents of television are predicting that they will soon take over the major part of the radio audience. Fact is that, before TV, the AM'ers were losing listeners at a rate they should have recognized as alarming.

Of course, claims of the TV broadcasters are based on the assumption that, by the time the novelty wears off, television programs will be good enough and sets will be cheap enough to build a mass-market audience.

Unless audio broadcasters start soon to adopt aggressive, forward-looking program policies such as appear to be shaping up in the TV group, they may lose their listeners by default.

The ease and low cost of putting phonograph records together and calling them shows or programs is lulling all too many AM broadcasters into a lethargy from

(*Concluded on Page 13*)

WHAT'S NEW

(*Continued from Page 12*)

which they may not awake until it is too late. We are sorry to hear that many FM stations are in that category, too.

We've noticed another angle to this situation lately. WQXR built its fame and success around the AM transmission of formal music on records. It used to be a real treat to hear them, when we were in New York City, particularly the programs which included recordings of selections seldom heard on other stations.

Out in Great Barrington, we can't get WQXR, but since *The Times* upped the power of WQXQ, the affiliated FM station, we get those programs once more. But what a difference now! What used to be delightful music before we got into FM listening habits sounds flat and dull and lifeless. It doesn't even compare with live talent shows coming from Hollywood on 5,000-cycle lines!

Our complaint is not against recorded programs, however, but against the use of low-quality records with high-quality FM transmission. We have heard transcriptions on such stations as WGFM Schenectady and WSFL Springfield, for example, that far surpass the live network shows. But deliver us, and the rest of the FM listeners, from those commercial pressings!

And this brings us back to a long-standing conviction. We still hold that most of the poor programming would be corrected quickly if station owners and their executive staffs spent a few hours a week together, listening critically to their own broadcasts on a radio receiver — not a studio monitor speaker.

The television broadcasters do that. We know, for example, that the most critical member of WABD's audience is Dr. Allen Du Mont. He doesn't do his looking at the studio monitor, either. He has a receiver built into his office, he has a set at home, and has even installed one at his country club. And we'll wager that every member of the WABD staff knows how closely he watches the programs from his station. We can't say that of any FM or AM station owner we know, and we know quite a number.

Maybe television will cut deeply into the present audio audience, but we believe that if the executive and engineering staffs at every FM station would listen to their programs as carefully as the TV men look at theirs, audio programs would soon improve and audiences would increase fast enough to offset the number lost to television.

If the industry is to show a net gain from the advent of television, there must be a substantial increase in the combined listening and looking audiences, and in the number of hours that sets are in use. A mere shift from audio to video will not benefit the industry.

REFERENCE DATA

Bound volumes of *FM* and TELEVISION contain a wealth of engineering and patent material. Each volume contains 6 issues, starting with January or July. They are available back to July 1941. Price $5.50. By mail, 25c extra.

THE FACTS ABOUT PHONEVISIO

ZENITH'S PHONEVISION SYSTEM IS SO SIMPLE THAT ITS PURPOSE AND OPERATION HAVE BEEN WIDELY MISUNDERSTOOD. HERE ARE THE FACTS—*By* MILTON B. SLEEPER

"SOMETHING must be done to bring up-to-date film features to the television audience." This statement was made by former FCC Commissioner E. K. Jett, in a recent address before the Baltimore Advertising Club. We know that FM progress was greatly retarded in 1947 because listeners could only hear their favorites on AM. Since FM-AM duplication was resumed, the demand for FM sets has increased enormously, and manufacturers have been encouraged to step up the production and sales promotion of receivers.

This experience seems to confirm Mr. Jett's opinion concerning the need for television broadcasting of feature motion pictures. Film shorts, essentially commercial as to script and scenes, worn out revivals such as the Perils of Pauline, or stage shows necessarily employing little-known talent, can hardly compete for long-term support against the featured heroes and heroines of the screen. Television must anticipate the time when the novelty wears off and even the most loyal members of its audience may begin to say: "I'd like to see a really good show tonight. Let's go to the movies." Unless this attitude is anticipated, we may find that, as radio nearly put the phonograph out of business and then brought it back to still greater popularity, television may create a greater number of movie fans than we have today.

Mr. Jett, now vice president in charge of radio for the Baltimore Sunpapers, has suggested that a cooperative plan might be worked out with the motion picture industry "so that certain feature-length films could be produced for both theatre and television audiences. The theatre shows may or may not carry advertising, but television programs must. Under this arrangement, a local television station would deal directly with the local moving picture distributor, and thereby avoid paying intercity network relay costs for this type of entertainment. The sponsor of the television programs, under such a plan, would pay part of the cost of producing the film, plus the station rate for each telecast."

It is certain that some arrangement between film producers and television stations must come about. It is vital to best interests of both groups. The need is recognized by the producers already. As the broadcasters get control of their initial operating problems, and have time to plan for a permanent future, their search for better programs will indicate that feature motion pictures are the obvious answer.

However, the controlling factor in working out any such solution is the matter of finding a television equivalent for the theatre box office. The interest of movie producers and theatre operators in television is not altruistic. It is no secret that producers have been exploring the possibility of television transmission over the telephone lines. Telephone officials have been very frank in admitting that they do not have any practical means for distributing programs over present wire facilities at rates the public would pay.

If it could be done, it would simplify transmission because no radio channels would be needed, and the use of telephone connections would provide a way to collect payment from each subscriber. However, radio channels are available for television broadcasting, and the Telephone Company can be tied into a film program setup to do the collecting. These provide the engineering and economic basis for the Phonevision system developed by Zenith Radio Corporation.

The surprising thing about Phonevision is its extreme simplicity, and the readiness with which it can be put into use. That may account for some of the misunderstandings that exist in the radio industry concerning its operation. Apparently, it is difficult to believe that there can be a simple answer to what has seemed such a complex problem.

Basically, the new Phonevision system employs standard television transmitting equipment and standard receivers such as are in use today. The Phonevision service can be cut in or out at the transmitter and at the receivers instantly, at the throw of a switch.

Suppose, for example, that a feature picture is to be broadcast by a Chicago station from 8:00 to 10:00 P.M.

Comdr. E. F. McDonald, right, and Dr. Alexander Ellett, head of Zenith Research, believe that Phonevision will provide the means to collect for television movie shows

At 8:00 P.M., the station will change over from free to PV transmission by cutting in an auxilliary modulating circuit. If you tune in on a set not equipped for PV, you will see the picture, but it will jump slightly from side to side at a rate that will permit you to get an idea of what is going on, but so fast that you will not attempt to follow the action.

If your set is equipped for PV, you will see the same jumpy effect unless you call your telephone operator, and ask her to give you a connection to the station. Thereupon, the picture will become perfectly steady, and you can watch the program to its conclusion.

On your monthly telephone bill, there will be a charge, perhaps $1.00, for PV service during that program. A part of that charge will be retained by the Telephone Company, and the balance paid to the broadcast station and the picture producer. This will furnish the revenue for the three service organizations involved, and the cost to you for enjoying the picture in the comfort and privacy of your home will be substantially less than taking your family and friends to see the same show at the movie theatre. Incidentally, PV eliminates the need of hiring a baby-sitter! That feature alone would win the enthusiastic support of many families.

As Commander McDonald, president of Zenith Radio, explained the use of Phonevision, this transmission would be only a part of a television station's programming. With two or more stations in an area, they would probably stagger their PV transmission so that there would be free programs on the air at all times during operating hours. Also, a schedule could be worked out so that PV movies would be available at different times of the day. Stage plays and concerts weren't discussed, but there seems to be no reason why they couldn't be transcribed by PV, too. With network operation, a play or concert could be carried far beyond the range from which people could attend in person. That would be an extra service to the television audience, and bring a large additional revenue to the management.

Now, let's go back to the details of operation. As explained, PV requires only an additional modulator at the transmitter, with a connection to one of the ordinary telephone lines running to the station. There's nothing expensive or complicated at that end.

A PV home receiver installation requires 1) a small unit connected to the existing telephone line, 2) a little 3-tube unit built into the television set, and 3) a switch to change from free to PV reception. The first would be installed by the Telephone Company. The second and third items would be wired into TV sets by the manufacturer. They could be added to regular TV receivers, but it would be more expensive. The factory installation would add about $10 to the retail price of standard models.

When Phonevision is in use, it does not interfere with incoming or outgoing telephone calls. There is no interruption of phone service during PV program reception.

The third consideration in this system is that of telephone office equipment. It would be a serious disadvantage if elaborate changes or additions were required in the central offices within the television service area. Fortunately, that is not the case. In fact, many Phonevision demonstrations were given from Zenith's Chicago transmitter for months before the Telephone Company ever heard of the

Phonevision reception, with and without the telephone connection to the station

system! No one, outside the Zenith engineering department, knew what was going on except that, when the PV modulator was in use, those who tuned their television sets to the station couldn't keep the pictures from wiggling back and forth.

Actually, to extend the Phonevision service to all telephone subscribers in a large area, some special central office connections will be needed, but telephone officials say that facilities are already available in standard switchboards. The cost of arranging to handle PV is, therefore, negligible. As for the bookkeeping involved, that would be done in a manner similar to the practice already established for handling telegrams phoned to Western Union offices.

Finally, there is the matter of unauthorized use. Many experimenters and radio engineers might find, in Phonevision, a challenge to their ingenuity. So the question arises: "Won't many people build their own PV units and put them on their television receivers?" That, you may remember, was the objection to the proposed subscription radio service that was to use a pig-squeal at the transmitter and a circuit to remove it at each subscriber's receiver.

In that respect, Phonevision is different. The PV modulator does not make the pictures jump at a fixed rate, but at a random frequency that cannot be duplicated at the receiver without direct connection through the telephone line to the transmitter. Even with a bootleg unit at the receiver and an unauthorized connection to the telephone line, it would be virtually impossible to receive PV without the cooperation of the telephone operator.

So these and other objections raised against PV, are answered in simple, practical, and inexpensive ways. There is, at this moment, one unknown quantity. That is the attitude of the FCC. Zenith has been transmitting Phonevision under an experimental license. So far, the question of commercial operation has not been raised. Some of the TV broadcasters have expressed indifference or opposition to PV, but it should be remembered that they are interested primarily in developing television, rather than in immediate profits from their operations. They will be a small, minority group within a year or two. All the movie executives who have seen PV are reported to have expressed great enthusiasm, and not one has objected to showing films on television if TV will pay for their use.

After all, television can only develop on a large scale as a profit-making enterprise. We aren't prepared to say that PV is the only answer to the basic need of revenue necessary to pay for better programming. However, after the experience of seeing it in operation and having a chance to ask questions of Commander McDonald, we must say that it seems to us a thoroughly sound and practical system. In fact, if we could get movie shows at home, we'd see many more than we do now. Why, Phonevision would even do away with the parking problem!

FM NETWORKS

At this time of writing, no decision has been reached concerning the final disposition of the band from 44 to 50 mc. Originally part of the low FM band, and subsequently allocated to but not used by TV, the FCC has proposed to assign it permanently to the communications services.

Extensive experience in FM radio network operation has shown conclusively that transmission over long distances is far more consistent and dependable than on 88 to 108 mc. For that reason, there has been strong sentiment in favor of keeping FM in the 44- to 50-mc. segment.

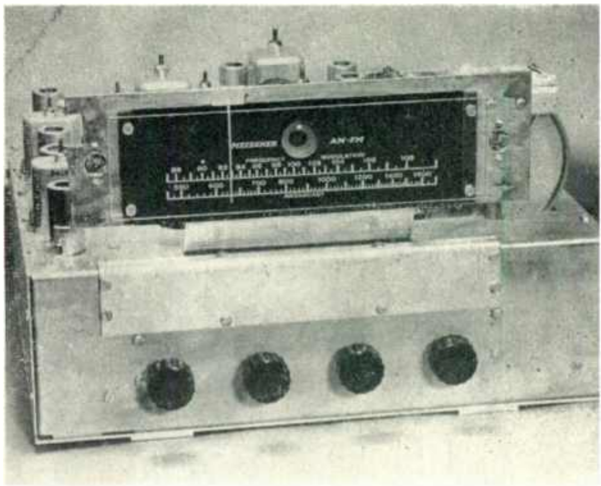
On the other hand, a number of broadcasters who are making plans for FM radio networks have recently expressed the feeling that FM S-T links have proved so successful in operation, and offer so much economy over telephone lines that the loss of 44 to 50 mc. would not be too serious. They will simply use FM microwave relays.

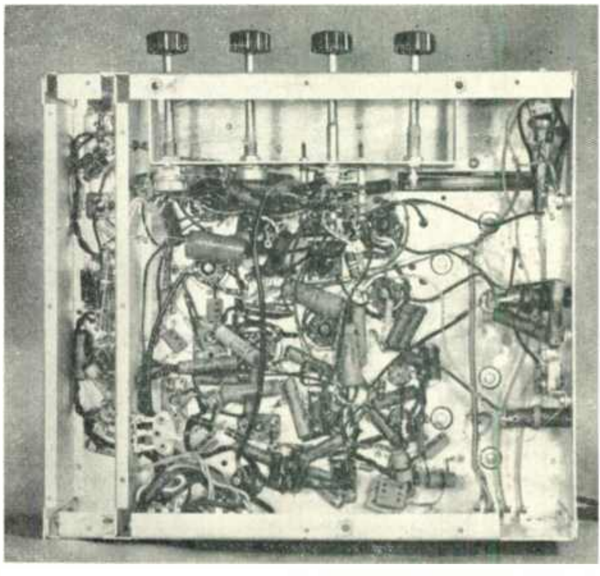
Several companies, including Federal, REL, Harvey Radio, GE, and RCA, are making FM transmitters for 920- to 980-mc. operation that meet with FCC performance specifications. This equipment appears to be admirably suited to networking. In fact, such a network setup would probably prove more flexible in some areas than the present system of rebroadcasting.

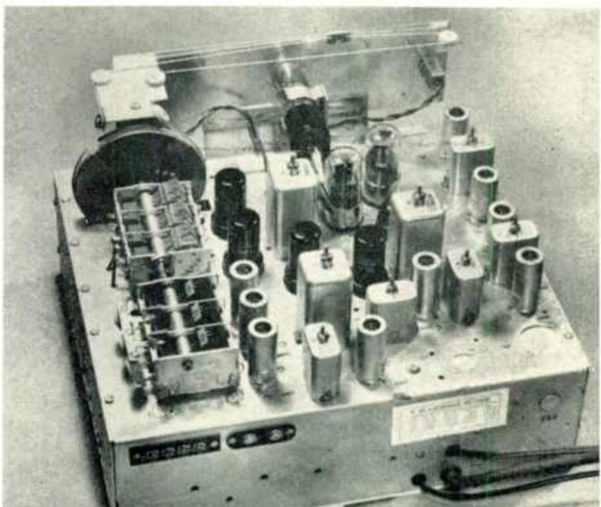
FM DOUBLE SUPERHET

MEISSNER SET HAS DOUBLE CONVERSION ON FM FOR EXTRA GAIN & SELECTIVITY—*By* WM. J. HARRISON*

FIG. 1. *Top: The Meissner FM-AM tuner employs double conversion in the FM section. Amplifier is mounted separately.* FIG. 2. *Center: A steel shield plate normally covers the under side of the chassis.* FIG. 3. *Bottom: Layout of the condensers, tubes, and transformers can be seen in this view*







WITH the AM broadcast band so loaded with stations that co-channel interference cannot be overcome by circuit design, receiver engineers can do little more than exercise ingenuity in mechanical design. However, the characteristics of FM broadcast transmission are such that the engineering skill entering into FM receiver design is immediately evident in what is heard from the loudspeaker. That applies to sensitivity, and the rejection of co-channel, adjacent-channel, and static interference. As the performance of the radio circuit is improved, further advantage can be taken of refinements in the audio circuits and loudspeaker design.

Double-Conversion FM:

The use of double conversion is not new. This system was employed in some of the finest prewar, low-band FM broadcast receivers. It is widely used today in FM communications receivers. Of course, design problems are somewhat simplified in the latter case, since the sets are fixed-frequency types, using crystal control.

It is not as easy to design double-conversion circuits for continuously variable tuning from 88 to 108 mc. However, it has been done, and very successfully in the Meissner model 9-1093 FM–AM tuner shown in the accompanying illustrations. Here is how it works:

The oscillator operates at one-half the signal frequency, minus one-half of the IF frequency. To take some actual values, with an IF of 10.7 mc., if the incoming signals are at 88 mc. the oscillator frequency is 88/2 − 10.7/2, or 44 − 5.35 mc. = 38.65 mc.

The 38.65-mc. signal is heterodyned against the incoming signal in the 1st converter to produce 49.35 mc. (88 − 38.65 = 49.35), the frequency to which the 1st converter plate circuit is tuned.

This 49.35-mc. signal, fed to the 2nd converter, is again heterodyned against the oscillator frequency. The difference frequency, 49.35 − 38.65 mc. = 10.7 mc., is selected in the plate circuit of the second converter for amplification in the IF stages.

To cover the FM broadcast band, the three tuning circuits of the double conversion superheterodyne are designed to give the following ranges:

Antenna . . . . 88 to 108 mc.
Oscillator . . . . 38.65 to 48.65
Converter Plate . . . . 49.35 to 59.35

*Chief Engineer, Meissner Manufacturing Company, Mt. Carmel, Ill.

The theoretical advantages of this design are amply confirmed in practice, and the performance justifies the extra development and design costs. There are four principal advantages in the double-conversion FM circuit:

1. Increased antenna gain and greater selectivity can be obtained than with the conventional superheterodyne because the input conductance of a converter stage is much lower than that of an RF amplifier stage.

2. Since the oscillator operates at a lower frequency (less than one-half the signal frequency) smoother and more consistent oscillator operation can be obtained.

3. No two circuits are tuned to the same frequency. Therefore, the system is less susceptible to regeneration caused by coupling from the common inductance represented by the frame of the gang condenser.

4. The image frequency is widely separated from the signal frequency. This results in a very high image ratio.

The complete circuit is shown in Fig. 4, with illustrations of the chassis details in Figs. 1, 2, and 3. In the entire FM–AM circuit there are 19 tubes, plus a tuning eye and two rectifiers. These are:

6SK7	RF	6AG5	2nd IF
6SA7	Converter	6AG5	3rd IF
6SK7	1st IF	9001	1st Limiter
6SK7	2nd IF	9001	2nd Limiter
6H6	Detector	6AL5	Discriminator
6J5	1st AF	6SN7G	Driver
6J5	2nd AF	6L6G	Output (2)
6AG5	1st Converter	5Y3G	Rectifier
6AG5	2nd Converter	5V4G	Rectifier
6C4	Oscillator	6U5/6G5	Eye
6AG5	1st IF		

Mechanical Details:

Because the model 9-1093 receiver was designed particularly for custom-built installations, the amplifier was not included on the tuning chassis. This facilitates installation in special cabinets that would not accommodate the bulk or the weight of a single unit, and is greatly preferred by custom set-builders for that reason.

Since the tuner weighs 18 pounds and the amplifier 27 lbs., it is obviously much easier to remove and replace either of two units than to handle one weighing 45 lbs.! All cables are terminated in separable connectors, as shown in Fig. 4.

Finally, with this type of construction it is possible to separate the amplifier

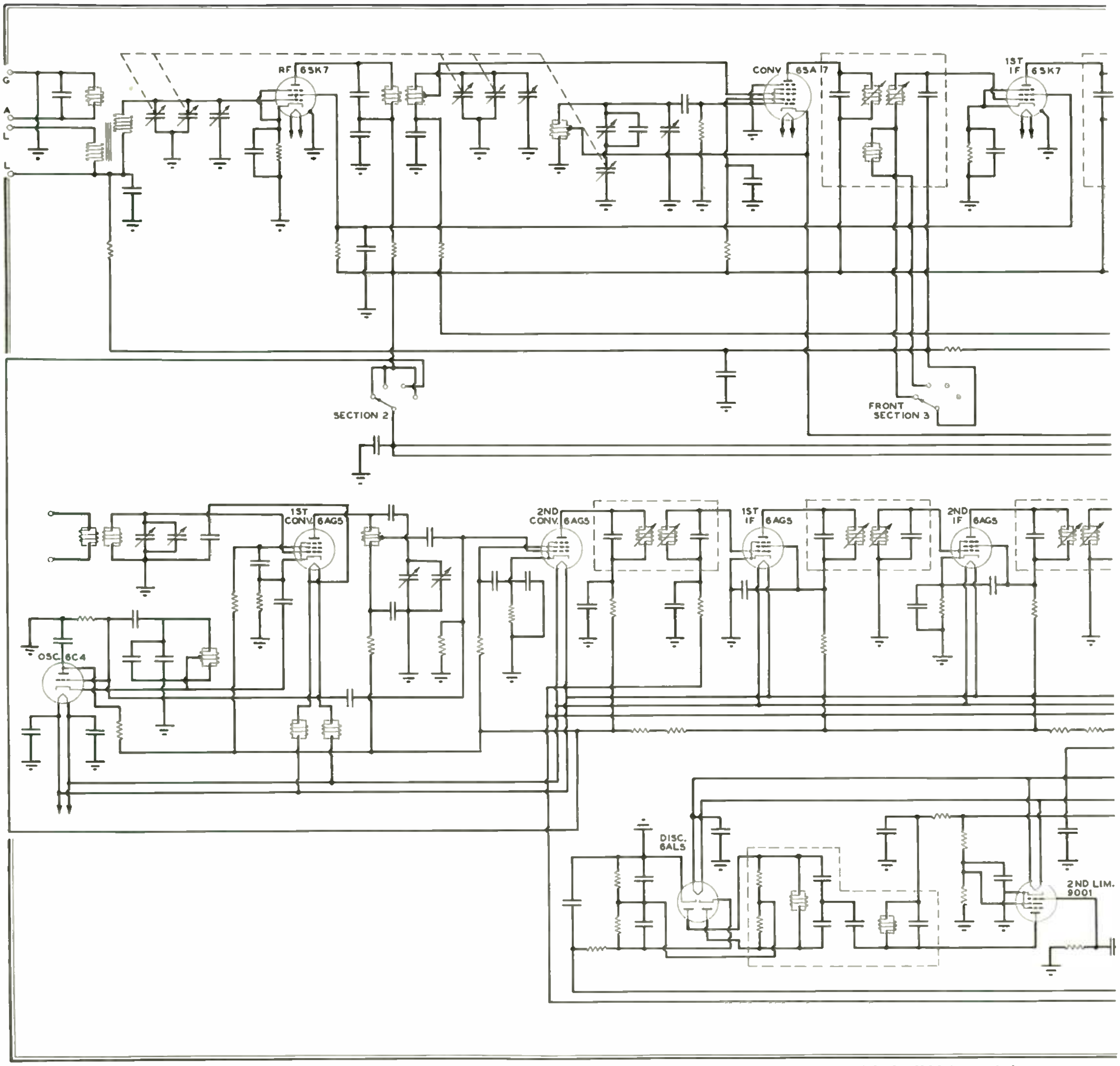


FIG. 4. *Schematic of the Meissner FM-AM tuner and power supply. Input to the AM circuits is at the left top, with the FM input below*

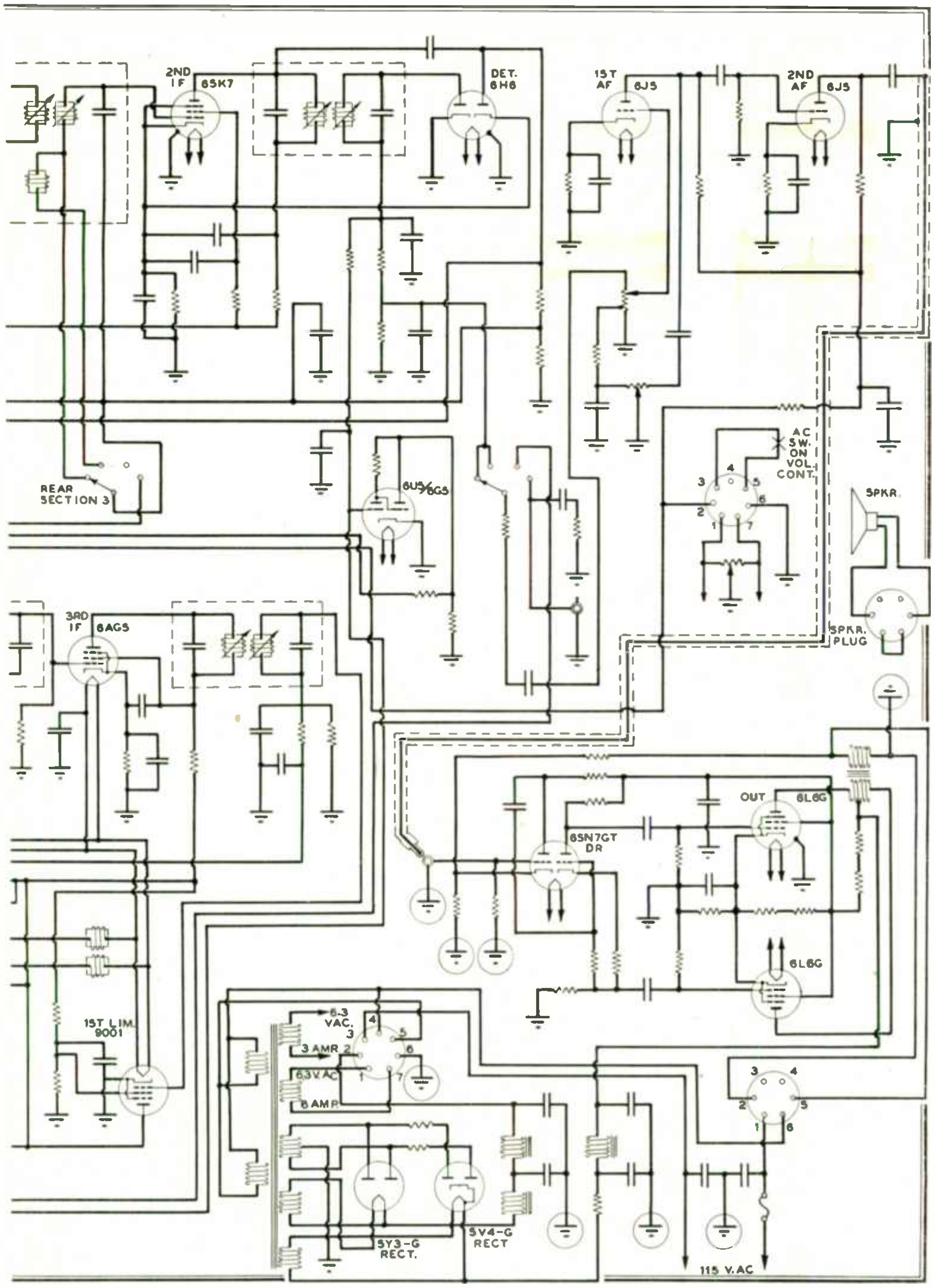
from the tuner to an extent that the former is not affected by the heat generated in the 18-watt amplifier.

Space required for the tuner is 15¾ ins. wide, 8⅜ ins. high, and 12¼ ins. deep. The amplifier actually measures 16¼ ins. wide, 7 ins. high, and 7⅛ ins. deep. However, generous clearance must be allowed for ventilation, and louvres should be provided in the cabinet to admit cool air and to allow the escape of heated air. This is particularly important where heat may affect a fine furniture piece.

Circuit Characteristics:

Following are the characteristics and ratings of the circuits:

TUNING RANGE: AM 535 to 1,620 kc.;



Amplifier has two 6L6G's, driven by a 6SN7GT. Note the arrangement of the power supply

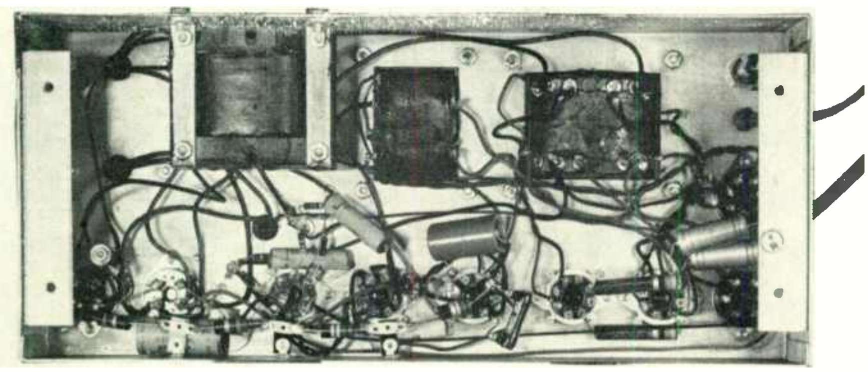


FIG. 5, *Left: Power supply and amplifier.* FIG. 6, *Above: Under side of amplifier chassis*

FM 88 to 108 mc.

FIDELITY: Flat within 2 db from 50 to 15,000 cycles.

HUM LEVEL: 65 db below full output.

POWER OUTPUT: 18 watts at less than 2% harmonic distortion.

AM SELECTIVITY: Two-position switch give choice of peaked selectivity for distant reception, or broader selectivity for local and clear-channel stations.

PHONO INPUT: Compensated for either high-level magnetic or crystal pickup.

ANTENNAS: Separate connections for outside FM and AM antennas, are provided, plus built-in antennas.

SPEAKER: The power amplifier is designed with an unusually large amount of negative feed back which, among other things, makes the amplifier relatively non-critical as to load impedance. A speaker of 8 to 15 ohms can be used. Slightly greater undistorted power output can be obtained by using a speaker impedance of 12 ohms.

POWER SUPPLY: 105 to 124 volts, 50 60 cycles. Power consumption, 190 watts.

Service Information:

Conventional alignment methods are applicable to the AM band. The IF frequency is 455 kc. Trimmers should be adjusted at 1,550 kc., and the oscillator padder at 580 kc.

To align the FM discriminator, remove the 2nd IF tube and apply 1 volt from an FM signal generator at 10.7 mc. with 200 kc. deviation to the 1st limiter grid through a .005 mfd. condenser. Adjust the bottom slug of the discriminator transformer so that the peaks of the curve, as seen in an oscilloscope, are symmetrical about the vertical axis. Adjust the top slug to give maximum amplitude to the peaks.

IF alignment requires removal of the second 9001 limiter from the socket. Insert a microammeter in series with the 47,000-ohm 1st limiter grid resistor to ground. With a 10.7 mc. signal input to the antenna, adjust each IF transformer for maximum limiter grid current.

Because of the double converter system in the RF section, the image frequency is so far from the signal frequency that it is not necessary under normal conditions to pay any particular attention to the image during the course of alignment. The trimmers should be adjusted for maximum limiter grid current with the signal generator set at 108 mc.

From this review of FM alignment procedure, it is clear that the use of double conversion does not add any complications to servicing.

To insure maximum FM performance from this set, it must be operated with a good outside antenna installation, particularly in metropolitan areas. Although an inside antenna will give excellent reception of local stations, long-distance, high-quality reception requires an outside antenna. Improved results will justify the small extra expense.

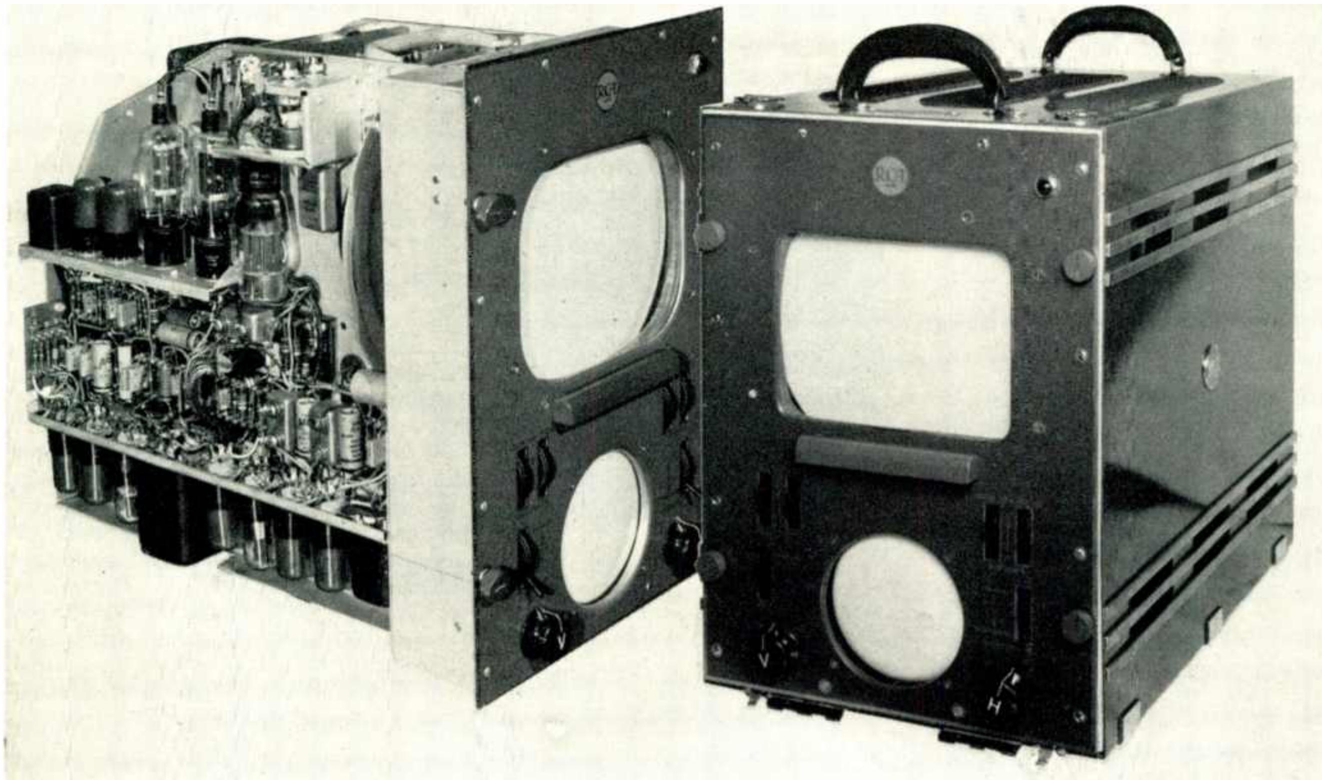


FIG. 27. *Interior and exterior views of the master monitor, provided with tubes which show both outgoing pictures and wave shapes*

same time, hear or originate instructions.

This is done by using double earphone headsets, to which a light-weight microphone is attached. One earphone carries the program sound, while the other reproduces the orders. For this purpose, dual plugs are employed, with 5-wire connections.

The cameramen and assistant production men plug their headphones and microphones into jacks underneath the cameras. A special jack at the switching unit gives the program director a direct line to his production assistants at the cameras.

Other jacks at the switching unit allow the engineer at the control position to speak to any cameraman by plugging in at the proper jack, to all the cameramen, or to tie them and himself into the production circuit.

Master Monitors:

For field use, the master monitor, Fig. 27, serves to reproduce the transmitted picture on a 10-in. tube. It also has a 5-in. tube for measuring signal levels and to monitor the wave shape.

Focus and brightness controls for the picture tube are at the upper right side, with similar oscilloscope controls at the upper left. In addition, there are vertical and horizontal lock-in controls for the picture tube, a "calibrate" control for the oscilloscope, and a switch for selecting horizontal or vertical waveshapes.

Picture Tube Circuits:

As Fig. 23 shows, the master monitor is used in conjunction with the switching unit, through which it can be shifted, if desired, to any camera. Low capacity video inputs to the picture and oscilloscope tubes are normally tied together, but they can be used separately.

The picture input signal is put through a 3-stage video amplifier, the final stage being a cathode follower which feeds the grid of the picture tube. An additional tube functions as a DC restorer, to maintain the picture black-level constant. The output of the video amplifier also feeds a clipper stage in which the synchronizing component of the composite signal is isolated by clipping off the picture signals, and the sync pulses retained.

Sync pulses are separated into horizontal and vertical components by the usual capacitor-resistor networks. Then the separate signals are fed to corresponding scanning generators. These generators are similar, but one works at 60 cycles, while the other works at 15,750 cycles. Horizontal and vertical pulses obtained from the picture signal are used to lock in blocking oscillators which generate the scanning frequencies. The pulses from the blocking oscillators trigger discharge circuits which, in each case, generate sawtooth waves at the desired frequency. Finally, in both the horizontal and vertical chains, this wave goes through a 3-stage amplifier, and is fed to the deflecting coils of the magnetic yoke on the picture tube.

There is a total of 29 tubes in this unit, most of which are miniature types.

Oscilloscope Circuits:

Video signals are fed to a separate 3-stage amplifier and applied to the vertical deflecting plates of the oscilloscope tube. The amplifier includes a DC restorer to hold the black level constant. It also has a calibrating stage, with a double clipper to develop a pulse whose peak-to-peak value is in direct ratio to the B supply. Since the latter is closely regulated, the pulse always has the same voltage amplitude. This can be preset to a convenient value, such as 2 volts. At any time during operation, the pulse can be switched on the oscilloscope to check the value of the peak-to-peak video signals by comparison of pattern heights.

Both one-half line and one-half field frequencies are needed to obtain waveshape patterns corresponding to lines and fields on the oscilloscope screen, and to have two complete pulses appear in either case. Therefore, a switch on the front panel is used to connect the oscilloscope scanning unit to either the vertical or the horizontal blocking oscillator. This input feeds a buffer stage driving a frequency-halving generator which, in turn, drives a discharge tube that produces sawtooth waves at one-half the input frequency. After amplification, these waves are applied to the horizontal deflection plates of the oscilloscope.

This completes the detailed description of the various elements of the RCA field equipment shown by block diagrams in Figs. 1, 17, and 23.

MICROWAVE HANDBOOK

CHAPTER 3 — PART 2: HOW WAVEGUIDES CARRY ENERGY AT MICROWAVE FREQUENCIES, AND HOW ENERGY IS INTRODUCED AND EXTRACTED — *By* SAMUEL FREEDMAN

3.3 Physical Concepts:

Coaxial cable transmission line decreases steadily in efficiency for frequencies approaching the microwave region. Performance finally becomes erratic and unpredictable due to phenomena of a type associated with waveguide behaviour.

The problem becomes appreciable as the lateral distance between the central conductor and the sheath begins to represent a distance appreciable with respect to the operating wavelength. Many of the effects described for simulated components in Chapter 2.4 start to manifest themselves. The problem is further complicated by the fact that the lateral distance between the inner conductor and the sheath in any coaxial cable is not likely to be uniform throughout the length.

Thus, radio-frequency energy, instead of traveling down the conductor, tries to take lateral or semi-lateral paths, as if the central conductor were the earth and the inner wall of the sheath were the ionosphere. Therefore, it becomes advisable or necessary to control this phenomenon by employing waveguides of correct dimensions to replace the coaxial cable.

Fig. 12 shows the physical theory of standard rectangular waveguide, most widely used for microwave communications. It is normally used in the dominant mode, that is, above the cutoff frequency, but below a dimension corresponding to twice that frequency. This is known as the TE_{01}, or TE_{10}, mode to be explained later.

The following steps explain the concept of such a waveguide.

Fig. 12A shows two parallel lines of any length. In Fig. 12B, two wires ¼-wave long are shorted. As explained in Chapter 2, a line shorted at a point of infinite impedance still presents an open circuit for AC, even though it would be a dead short to DC.

The shorted ¼-wave section at B is

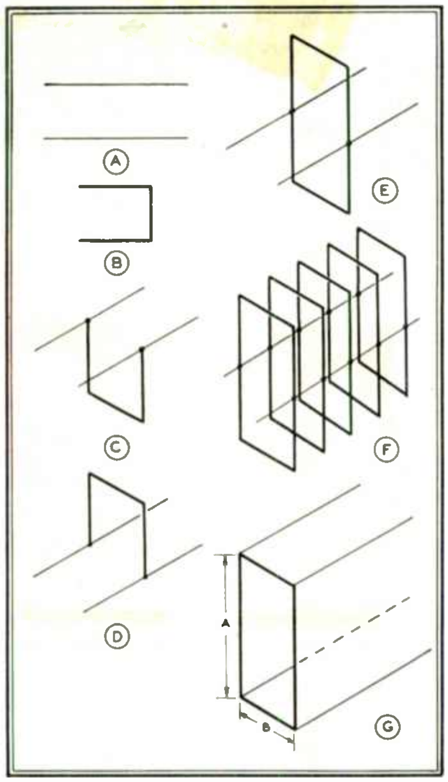


FIG. 12. *Two parallel lines shown at A are made into a waveguide by adding an infinite number of closed loops, G and F*

shown in Fig. 12C attached to the parallel wires, A, on one side. The same construction, on the opposite side, is illustrated at D.

Fig. 12E shows the equivalent closed metallic loop attached to the parallel wires in A. There is still no short-circuit for AC as long as the frequency is above cutoff. Similar loops are added at F.

Finally, an infinite number of loops are added so that they touch each other, and form a continuous tube. The equivalent of 2 parallel wires exists along the centers of the wide sides of the waveguide for the cutoff frequency.

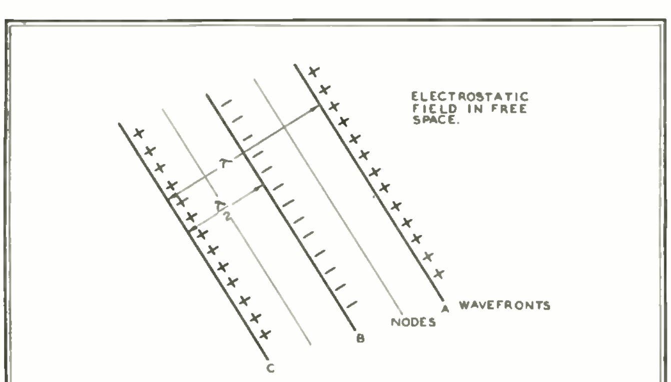
3.4 Electrical Concepts:

No person fully understands or is capable of analyzing mathematically all the phenomena that may exist in a waveguide. It would be a nightmare if one were to take into account all the relationships between adjacent and opposite walls at every angle, in addition to the lateral, longitudinal, and intermediate diagonal dimensions. Prior to waveguide development, no one ever dreamed that a simple pipe could give man such complex tasks.

However, such difficulties are not associated with a rectangular waveguide operating on the dominant mode to which the following explanation can be applied. An analysis of waveguide behaviour involves a three-dimensional, time-varying study, difficult to conceive by any single illustration alone.

A conducting pipe can only serve as a waveguide if the electric field is zero at the supporting sides (B dimension) of the two surfaces in the A dimension. This means that there must be zero electric field at the side walls with the electric field itself kept perpendicular to the top and bottom walls. How these fields are developed and the resultant electrical behaviour in any waveguide can be understood from the accompanying illustrations, developed by careful, combined thinking of the technical staff at DeMornay-Budd. Other versions of the phenomena have been presented in various publications from Sperry Gyroscope, the Bell System, Federal Telephone & Radio, Government publications, and elsewhere. The explanation presented here was chosen because it seems most easily understood by those who do not care to go too deeply into mathematical considerations.

Fig. 13 shows an electrostatic field as it may exist in free space. A, B and C are



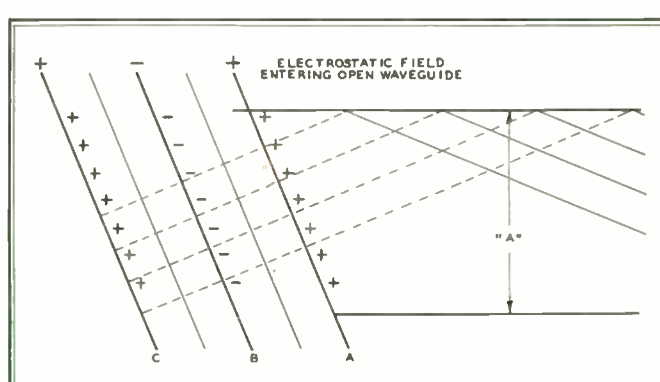
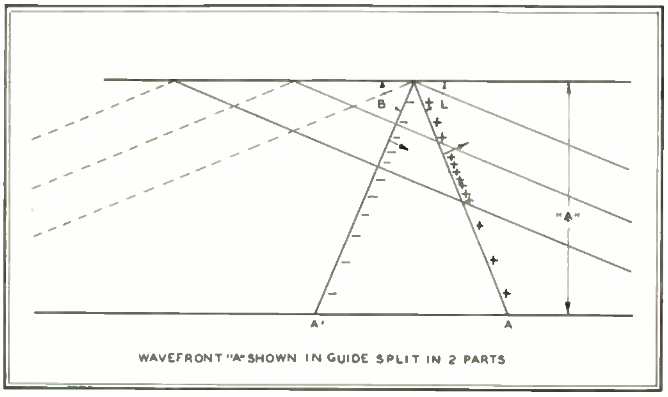


FIG. 13, *Left: Representation of an electrostatic field in free space.* FIG. 14, *Right: Action of the field upon entering a waveguide* wavefronts with the voltage distribution as indicated. The nodes between A and B, and between B and C are the zero points. The equivalent of sine wave distribution exists, since A is maximum positive, B is maximum negative, and C is maximum positive again. The distance from A to C equals the wavelength in free space. One-half wavelength is represented by the distance from A to B, or B to C. The direction of propagation is from C to A.



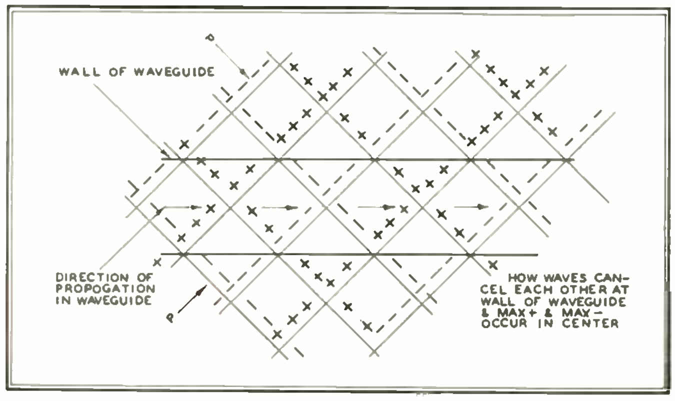
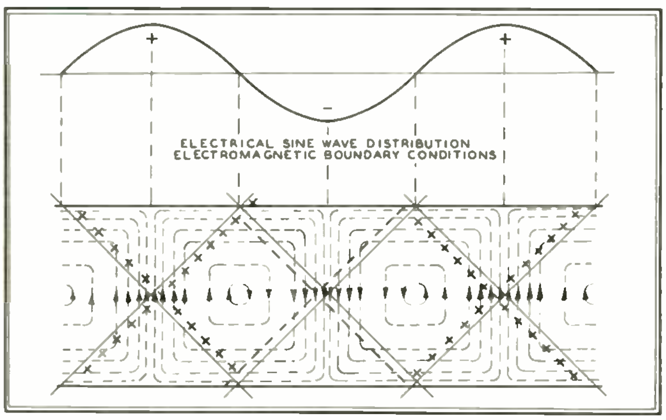


FIG. 15, *Left: Formation of a wavefront in a waveguide.* FIG. 16, *Right: Showing why voltage is zero at boundaries, maximum at center*

When the field shown at Fig. 13 encounters the open end of a waveguide, the result is as indicated in Fig. 14. The points illustrated in Figs. 13 and 14 then reform in the waveguide as wavefronts, Fig. 15, and are split into two parts, represented by lines A′ (negative) and A (positive).

This occurs because, as each charge of the wavefront strikes the wall of the guide and is reflected, it changes polarity. A condition exists where, as each wavefront is reflected, it reverses phase and reinforces the next wavefront of similar polarity. It is by this means that propagation in a waveguide is possible. Without the complex manner in which the charges of a wavefront reinforce each other, wave travel along a guide would not occur.



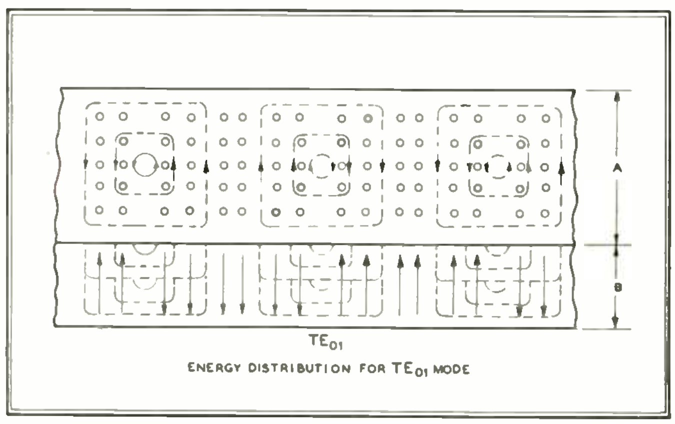


FIG. 17. *Left: How electric fields are cancelled at the walls.* FIG. 18, *Right: Fields are shown by views of A and B dimensions*

The boundary conditions portrayed in Fig. 15 create a voltage distribution of the charges in the wavefronts. The charges cannot exist at the boundaries of the A dimension because positive and negative charges occur simultaneously at the wall of the guide and cancel out. One charge is moving toward and the other away from the wall of the guide. Since there cannot be any voltage maximum at the boundaries, it must be maximum at the center, or between the boundaries. That is because the moving charges cancel and reinforce each other. The cancellation effect diminishes as the charges move away from the wall of the waveguide, until a maximum voltage condition exists at the center of the waveguide.

Since the angle of the wavefront in the waveguide is dependent on the A dimension, and since the wave which entered the waveguide is based on its wavelength in free space, angle B is changed with respect to the angle of the wavefront upon entering the waveguide, as shown in Fig. 13. Thus, the wavefront angle is based on the wavelength in the waveguide, and not in free space. Angle B is the angle of incidence while angle L is the angle of reflection. Thereafter, the wavefronts reflect between the walls at the same angle as they travel down the longitudinal axis of the waveguide.

Fig. 16, based on Maxwell's Equations, is another way of showing why the voltage is zero at the boundaries of a waveguide, and maximum at the center of the A dimension. Cancellation of positive and negative voltages occur at the walls, while positive values and negative values are reinforced at the center of the waveguide. A sine wave is thereby created down the center, but the zero boundary condition is maintained.

Further information is contributed by Fig. 17. This shows the cancellation of the electric fields at the walls of the waveguide, as in Fig. 16, and the magnetic field distribution. The magnetic field fills the entire B dimension of the waveguide with such a distribution pattern. One pattern corresponds to the electric field distribution in the center of the waveguide. This field is at right angles to the magnetic field.

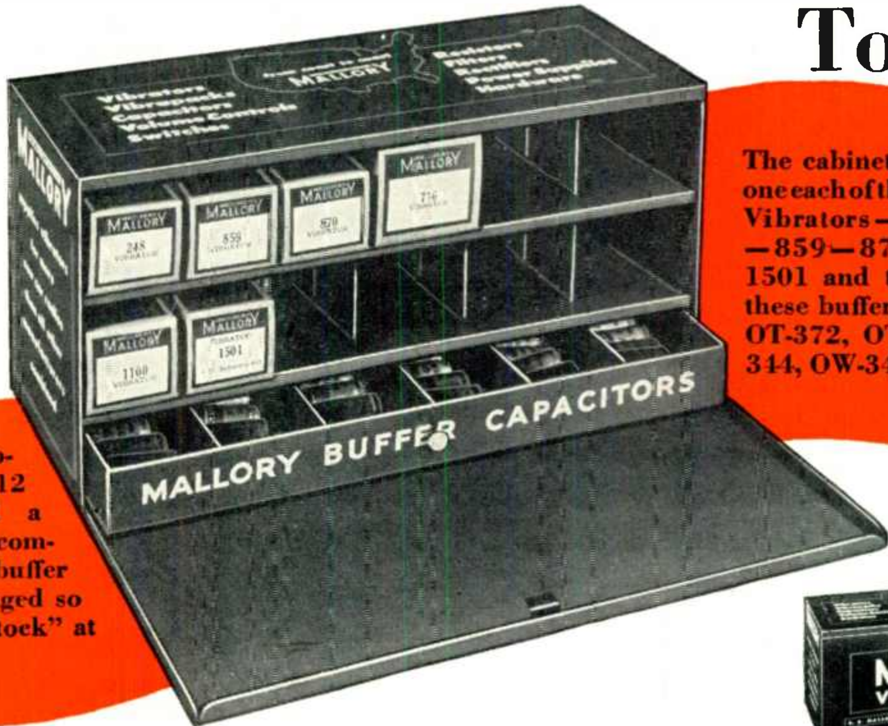
Both the electric and magnetic field distribution in a typical waveguide, operating in the TE_{01} mode, are shown in Fig. 18. Letters TE indicate the Transverse Electric mode of operation. That is, the electric field is perpendicular to the axis of the waveguide. The first numeral, 0, shows that zero half-wave patterns exist across the cross-section of the guide along one dimension. The second numeral, 1, shows that one half-wave pattern exists across the dimension at right angles to the first.

Now, to introduce or extract energy from the waveguide, it is necessary to insert a probe at a point along the longitudinal axis, at the center of the A dimension, where the electric field is concentrated. The same effect can be obtained by the use of a loop introduced in the center of the B dimension, where there is concentration of the magnetic field.

In the case of a bend in a waveguide, the conditions can be compared to a transmission line with two lumped reactances.

(*Continued on Page 29*)

Another Good Deal—From Mallory To You



The cabinet contains—one each of these Mallory Vibrators—248—716—859—870—1100—1501 and two each of these buffers—OT-371, OT-372, OT-373, OW-344, OW-345, OW-346.

The cabinet provides space for 12 vibrators and a drawer with 6 compartments for buffer capacitors, arranged so you can "take stock" at a glance.

The Fastest Selling Vibrators in the Finest Line Made—

The Mallory "2448 Vibrator Deal"

Mallory, first producer of the vibrator, builder of the sturdiest, most reliable vibrators made, offers you an attractive deal on this important replacement part. A fast moving selection of 6 vibrators, that will cover 75% of your requirements, together with an assortment of 12 buffer capacitors (2 each of 6 ratings), in an attractive metal cabinet at a net price of $24.48 to the serviceman.

This is the serviceman's regular price for these parts; no charge is made for the cabinet. You sell the parts for $40.80—make your full $16.32 profit.

Your Mallory Distributor has them in stock for immediate delivery. Place your order now, and get this handsome, convenient cabinet for *your* shop.

More Mallory Vibrators are in Use Than All Other Makes Combined

WHAT WILL MALLORY DO NEXT?

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P. R. MALLORY & CO. Inc.
MALLORY

CAPACITORS . . . CONTROLS . . . VIBRATORS . . .
SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
VIBRAPACK* POWER SUPPLIES . . . FILTERS

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APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

24 great newspapers select

Television by RCA

RCA has <u>everything</u> you need to get started <u>NOW!</u>

Overwhelming acceptance of RCA equipment marks the swift progress of television from coast to coast.

Already a substantial percentage of broadcasters and newspapers have ordered RCA transmitters. Most of these stations are being *completely* RCA equipped, from super-sensitive cameras to high-gain antennas.

Many of these telecasters are already on the air with regular programs—or on an experimental basis. Other stations are receiving shipments of RCA equipment that will put them on the air very soon. And by the end of 1948, high-definition *RCA television* should be within the reach of 49,000,000 people.

Why is *RCA television* so far in the lead? Here are a few of the reasons: (1) Everything needed to get on the air is in quantity production at RCA *now;* (2) All equipments embody the very latest technical advances in the art; (3) Designs are flexible . . . "add-a-unit" construction makes them equally applicable to the very small or the very large station; (4) Facilities can be gradually and *economically* expanded as television audiences grow . . . without obsolescence of original equipment; (5) Equipment is easy to operate and reliable.

As you know, television is moving fast. What are *your* plans? Will you be the first to bring this new public service to your community . . . utilize its tremendous audience impact for newscasting, advertising, and circulation building? We'll be glad to help you get started with complete planning information and cost data. Write Dept. 38-D.

TELEVISION BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

These would be at the beginning and at the end of the bent section. Reflections only occur at the junction plane between straight and bent waveguide sections.

Waveguide sections are terminated with flanges, as was illustrated in Fig. 8. The flanges may be either of the cover (flush) type or of the grooved (choke) type. The choke type has a quarter-wave circular groove at an average distance of a quarter-wave from the hollow guide area of maximum E field density. This prevents the exit of energy at the joint, due to discontinuity of the metal tube, because:

1. The quarter-wave groove is equivalent to 2-wire line shorted at its far end. Therefore, it must be of infinite impedance at the open end.

2. Since it is at infinite impedance a quarter wavelength from the hollow waveguide orifice, it must offer zero impedance at the latter point. Energy, therefore, tries to leave, but must return to the waveguide and continue its progress within the guide rather than escaping at the flanges. The usual practice is to connect a cover flange to a choke flange wherever two sections or components are joined together.

Fig. 8 shows various components terminated in smooth-surfaced or recessed flanges, *i.e.*, cover or choke flanges, respectively. Some choke flanges have an additional outer recess that bears no relationship to choke groove. This is only provided to seat a rubber gasket, necessary when pressurization is employed.

3.5 Waveguide Modes:

The pattern or patterns of the distribution of electric and magnetic fields which the energy will or can follow throughout a waveguide is defined as its mode or modes. Efficiency of energy transmission in a waveguide may be anything from virtually zero to nearly 100%, depending on the energy distribution and the point of coupling to the waveguide for introducing and extracting energy.

The mode or pattern which the energy follows throughout the waveguide is designed either as Transverse Electric, TE, or Transverse Magnetic, TM. Transverse Electric means that the electric field in the waveguide is perpendicular to the axis of the waveguide. It has no component along the longitudinal axis of the waveguide. Transverse Magnetic means that the closed loops of the magnetic field are in planes perpendicular to the axis of the guide. It has no component along the longitudinal axis of the guide.

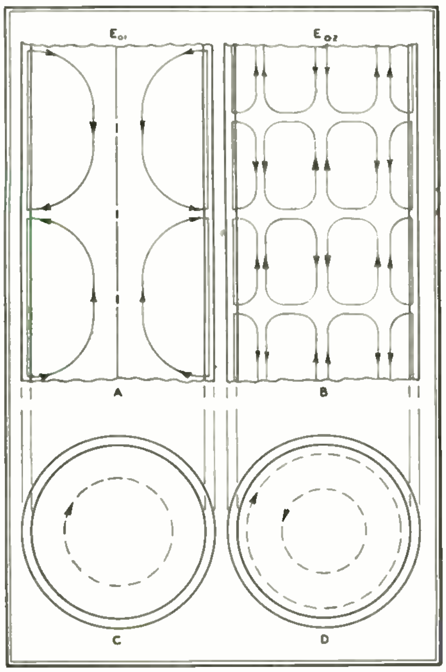


FIG. 19. *Fields in a round waveguide.*

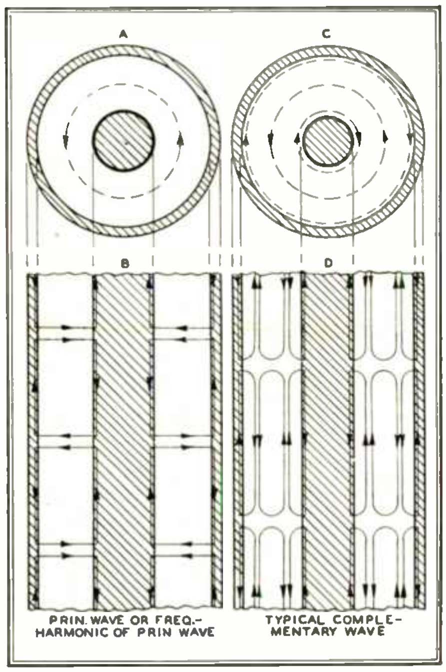


FIG. 20. *Fields in coaxial cable simulate waveguide*

TE and TM modes are further defined by two numerals determined by the shape and dimension of the waveguide with respect to the wavelength or frequency, as well as by the means of excitation. In the case of rectangular waveguides described in this Chapter, TE_{01} means that there is one half-wave pattern of electric field lines across the cross-section of the waveguide along one dimension, while there are zero patterns along the dimension at right angles to the first. TM_{01} would mean the same for the closed magnetic loops instead of the electric lines of force.

In the case of cylindrical waveguides (round pipe), the first number indicates the number of full-wave patterns of the electric component encountered in traversing the internal circumference of the cross section. The second number indicates the number of half-wave patterns that will be crossed on the diameter.

Doubling or tripling the frequency for a waveguide of given dimensions or doubling or tripling the waveguide dimensions for a given frequency or wavelength, will double or triple the number of patterns which may exist in the waveguide. This will change the mode of operation. Highest efficiency is obtained on the dominant mode, that is, the lowest frequency pattern which can be developed in the waveguide. It is above cut-off but below twice the cut-off frequency.

Fig. 19 shows the electric and magnetic patterns in a round pipe or cylindrical waveguide. The illustration shows a cross-section inside the pipe. Fig. 19A shows two E (electric field) patterns along the length of the pipe. Fig. 19C shows the corresponding H (or magnetic field) pattern that exists in the same pipe for that mode. Figs. 19B and 19D show double-moding, set up when the frequency is doubled for a waveguide of given diameter or when the diameter is doubled for a given frequency.

Fig. 20 shows the effect which occurs in a coaxial line, corresponding to the related illustrations in Fig. 19. Waveguide conditions exist inside the coaxial line because all dimensions are appreciable with respect to the wavelength at microwave frequencies. Coaxial lines with solid dielectric have conduction and dielectric losses, while hollow waveguides do not have any conduction loss or losses due to the presence of insulated spacing material. Therefore, coaxial lines are not used at microwave frequencies except in very short lengths, and only when manufactured to high standards of dimensional uniformity.

Chapter 3 will be concluded in the May issue. Chapters 4 and 5 will be devoted to the generation of microwaves with conventional tubes. New techniques not previously disclosed will be discussed. This is a subject of particularly timely interest.

OBSERVING CRYSTAL MODES

PROF. L. ROSENTHAL, Rutgers University, reports an interesting use of the Kay Mega-Sweep oscillator for observing crystal modes as a series of pips in an oscilloscope trace.

A recent application of the Mega-Sweep wide-range, sweeping oscillator makes possible the visual observation of crystal modes. Both the external pattern of crystal modes as a series of pips along frequency trace and the internal pattern of the individual pips can be observed.

In operation, the sawtooth sweep voltage of the sweeping oscillator is applied to the horizontal plates of an oscilloscope, providing a horizontal deflection which is proportional to frequency. The frequency-modulated output signal of the sweeping oscillator is applied across a quartz crystal. The voltage across the crystal, after rectification and filtering, is passed on to the vertical deflecting plates of the oscilloscope.

With the oscillator adjusted for maxi-

(*Concluded on Page 46*)

SPOT NEWS NOTES

ITEMS AND COMMENTS, PERSONAL AND OTHERWISE, ABOUT MANUFACTURING, BROADCASTING, COMMUNICATIONS, AND TELEVISION ACTIVITIES

Cost of Lost Time:

In view of UEW claims that excessively high profits should be reduced by wage increases, it is interesting to note from Western Electric's annual statement that this Company paid out $32,057,000 in nonproductive wages and salaries for vacations, holidays, sickness, and accident absences, compared to $27,000,000 in dividends. In other words, the employees received a dividend of 3.2% in the form of payments for time they didn't work, while the dividends to stockholders amounted to only 2.7% of the company's sales.

FM Communications for TVA:

Tennessee Valley Authority is installing 24 fixed stations and 130 mobile units for dispatching repair crews. This maintenance work extends over an area of 80,000 square miles, and 6,400 miles of transmission lines. Motorola equipment is used throughout the new system.

A. M. Skellett:

Director of research at National Union Radio Corporation, Orange, N. J., has been appointed vice president in charge of the Company's research division.

WHBC-FM Canton, Ohio:

ABC affiliate, operating on limited schedule since January 13, is now running 18½ hours a day. Frequency is 94.1 mc.

History Repeated:

Just as people with a little money and even less experience jumped into manufacturing radio sets back in the early 20's, hoping to make some quick profits, others with similar ambitions are trying to build television receivers. It's a bad situation. Not only are their customers disappointed, but radiation from these poorly-designed receivers interferes with the reception on good sets. It looks, though, as if the public will have to learn by sad experience to keep away from off-brand models.

Dr. Dale Pollack:

Appointed research associate in the department of applied mathematic of the Weizmann Institute of Science in Rehevoth, Palestine. He will supervise the establishment of a new laboratory, and make periodic visits to the Institute to direct the work there. During his absence, Aldo R. Miccioli will be in charge of the New London laboratory.

New FM Equipment:

REL sprung a surprise at the IRE Show by exhibiting a new FM broadcast modulator so simple and compact in design that an acquisitive visitor might have walked out with it under his coat. We hope to have an article on the new circuit in the near future. Also displayed by REL was a trim-looking microwave S-T transmitter and receiver installation.

2,000% Increase in Sales:

Many dealers selling FM sets have not even tried to sell good antenna installations, nor have they been willing to make the installations without charge, despite the high profit on FM consoles. In contrast, L. K. Ward, Los Angeles, has reported that, in a period of 90 days, free installation of electric stoves upped sales 2,000%. Looks as if FM set dealers are passing up a chance to increase their sales, too.

Microwave Progress:

Relay communications systems have already proved so successful that some contracts for rights of way along railroads, to accommodate poles and land lines, are being cancelled. Microwave relays are proving less expensive to install and maintain, and more dependable in bad weather.

FMA Is Growing:

Expansion of FM broadcasting and set production is reflected in the growth of the FM Association. On May 5 and 6 there will be a meeting at Hotel Statler, Washington, D. C., to organize FMA Region 4, comprising broadcasters and manufacturers in the District of Columbia, Delaware, Maryland, Virginia, and North Carolina. Ben Strouse, general manager of WWDC-FM, will be temporary chairman. Further details can be obtained from Bill Bailey, FM Association, 101 Munsey Building, Washington 4, D.C.

WBRC-FM Birmingham:

Eloise H. Hanna, one of the few women broadcasters in the USA, will have the most powerful FM station in the world when installation is completed on a 50-kw. RCA transmitter and 8-bay antenna. Authorized effective radiation is 546 kw. WBRC has also contracted for a 5-kw. RCA television transmitter.

Prize Winner:

Winner of the fishbowl prize at our IRE booth last month was G. W. Lockhart, of the Sexton Can Company, Marblehead, Mass. His name was drawn from the paid subscription blanks by Miss Esther Latterell, of our New York office.

New Use for Mobile Phone:

Probably the first radio dealer to use radiotelephone communication on his service trucks is Witte Radio & Television Company, Philadelphia. Installations were made by the Telephone Company, so that trucks can be reached through the regular telephone exchange system. Dollar savings in operating the trucks have paid the cost of the radiotelephone, with a big bonus of good will from television owners who want fast service when their sets require attention

15,000-Cycle Line Tests:

We haven't had any official information on the Continental Network tests between Washington and Alpine, using a 15,000-cycle telephone line, but we've noticed out in Great Barrington that the noise level is down considerably from what we heard at the beginning. It has been hard to judge accurately, because signals over this 90-mile path from W2XEA vary widely in strength from night to night at this time of year. We'd like to hear from readers who have been listening to Continental programs over W2XMN and W2XEA.

Five Years Ago:

In April, 1943 we published a description of the new Massachusetts State Police FM system. The equipment was furnished by Fred M. Link. Under "What's New This Month," we quoted the following from a statement by Major Armstrong: "It is not generally known that for well over a year a regional FM network has been set up and operated from Alpine to Mt. Washington several times a week . . . the quality on the far end of the link is superior to wire-line transmission. . . . Were I to make any predictions, however (and they would be made entirely on the basis of work carried out before the war), it would be that the ease with which relaying can be accomplished and the excellence of performance will be the next surprise." And finally: "within five postwar years the existing broadcast system will be largely superseded."

FM and TV Stations:

At the end of March, the status of FM and TV stations was as follows:

	FM	TV
On the air	444	19
Authorized	569	71
Applications	118	165
Total	1,131	255

Present estimates are that 1,000 FM stations and 25 to 30 TV stations will be in regular operation by the end of 1948.

New FM Transmitter:

We don't know any details yet, but Arnold Bailey, formerly of Bell Laboratories, has announced a new type of FM transmitter described as being of greatly simplified design. Principles employed are applicable to broadcasting and communications. Development is being carried out by the Arnold B. Bailey Corporation, Scotch Plains, N. J.




H. W. Pangborn, KNX Hollywood — Paul A. deMars, consultant — Frank L. Marx, ABC — Orin W. Towner, WHAS Louisville

NEWS PICTURES

The engineering conference to be held during the NAB Convention in Los Angeles will bring together the largest group of top-drawer broadcast engineers ever assembled. Through the cooperation of NAB's Charles Batson, we present here photographs of some of the outstanding engineers who will take part. Jack Poppele, Royal Howard, Frank Marx, Paul deMars, and Orin Towner, respectively, will preside at the following conferences:

May 20, morning: Comparison of propagation characteristics between Channels 4 and 7, E. C. Page; TV and FM transmitting plants, R. F. Guy; Small TV stations, James D. McLean; TV studio systems, M. A. Trainer; Light sources for TV studios, F. E. Carlson; Remote




Lester H. Bowman, CBS — David Packard, Hewlett-Packard, Inc. — Everett L. Dillard, WASH, KOZY — R. H. Ranger, Rangertone, Inc.

control TV lighting, Capt. W. C. Eddy.

May 20, afternoon: CBS TV studios, W. B. Lodge; TV field broadcasts and relays, Robert Clark; Facilities for audio and studio broadcasting, E. H. Schreiber; Installation and maintenance of TV receivers, Edward Edison; Absolute speed for magnetic tape, Col. R. H. Ranger; Tape editing device, H. W. Pangborn.

May 21, morning: Economics of FM coverage, Everett Dillard; S-T link radio system, W. G. Broughton; Transmitter measuring equipment and techniques, David Packard; Directional antennas, A. Earl Cullum; Measuring co-channel interference, A. Fox; Stereophonic sound, Dr. H. A. Leedy.

May 21, afternoon: Sound and relay equipment, J. L. Hathaway; Features of CBS studio facilities, L. H. Bowman; FCC-Industry roundtable.




Ernest H. Schreiber, Pacific Tel. & Tel. Co. — Capt. William C. Eddy, WBKB Chicago — Raymond F. Guy, NBC — William B. Lodge, CBS

FREQUENCY ALLOCATION PLANNING

FCC CALLS FOR IMPROVEMENTS IN ENGINEERING OF TELEVISION RECEIVERS AND TRANSMITTERS, AND ACCELERATED RESEARCH ON UPPER TV BAND—*By* WAYNE COY*

THE most significant factor affecting the second of the two[1] main problems that we face, that is, the fullest use of the radio spectrum above about 30 mc., is not international cooperation, but sound planning for the future domestically. Except for certain bands of frequencies that require international standardization because of their use by ships and aircraft, this upper spectrum constitutes essentially a national problem. This is because, in general, these frequencies have short range propagation characteristics. Those bands required for international aviation and marine purposes were standardized at Atlantic City, in accordance with our proposal to the Conference, and, therefore, need not be re examined for some years to come.

In 1944, the FCC conducted a comprehensive frequency allocation hearing and, in 1945, published a finding. This finding became not only the basis of the allocation proposal which the Department of State transmitted to the Atlantic City Radio Conference, but also became the blueprint for the Commission's postwar regulation of this upper spectrum. Now that we are certain that adjustments in this plan will not be required, at least for some years, for purposes of regional and world-wide standardization of aeronautical and maritime uses of radio, we must examine where we are and where we are going.

Many new uses of radio were provided for in the Commission's 1945 frequency plan.

One of these new uses, for example, was the Citizens Radio Service — a personal, short range two-way radio service in the 460- to 470 mc. band for use by the general public. The Commission has just given its type approval to the first transceiver for this new service. This means that as soon as this first type approved set gets into production, the public can start enjoying this new type of radio service. Having given type approval, the Commission will make it very simple to get a station license.

Many additional uses for radio have been suggested since 1945, so that it becomes increasingly evident that the most careful planning will have to be done on a continuous basis if the objectives of the Communications Act and the desires of the American people are to be met.

This may surprise you, since you probably assume that planning has been done and is being done. That is perfectly true, but the point I should like to stress is that we must, from time to time, readjust our sights and make as certain as it is possible for us to do that the next generation will be able to derive the maximum benefits from the public domain we call the ether.

It is quite easy for us to color our planning on the basis of expediency and temporary problems of the present. It is equally easy for us to assume, as accomplished facts, scientific developments and advances in the art that cannot be realized.

Either of these courses of action represents an extreme. Further, the extent to which these factors may be implicit in our planning determines, in part, the soundness of a service-allocation plan.

Yet it is apparent that we must have some plan, since uncontrolled experimentation in the upper spectrum would prevent the development of essential radio services that cannot begin operations in advance of reasonably certain knowledge that their frequency allocations are secure. Moreover, it is an axiom, in problems of this kind, that no one service can be allotted an expansion of its spectrum space except at the expense of other services.

So with a finite spectrum whose upper limit is determined at any given time by the state of the art, and with constantly expanding frequency requirements of the several services, as well as suggestions for new uses of radio, it is apparent we have a dynamic problem for which there is no static solution.

Now the Commission has certain powers under the Communications Act, but in the final analysis, the Commission is merely the sounding board of the desires of the public; therefore, the Commission must and does approach problems of this kind from the standpoint of what appears to be in the public interest, convenience and necessity.

The first consideration in appraising the future use of this upper spectrum is an evaluation of the principal services for which spectrum space has been provided.

Broadcasting, electronic aids to navigation, vehicular communication, radio relay systems and miscellaneous communication services, all are accorded bands of frequencies. By no means do the amounts of spectrum space, and the corresponding orders of frequency for each of these services, necessarily represent a complete satisfaction of their ultimate needs. No plan will do that. If only two services had to be accommodated, it is likely they each would wish the same bands. And we have many services and dozens of uses of radio to accommodate.

We facilitate the fullest use of the spectrum by adopting and adhering to certain technical principles, such as giving first priority to services that cannot use wire in lieu of radio and which are required for the protection of life and property. Also, we can support projects intended to result in the most economical use of the spectrum.

All these things we do, and more.

But anyone interested either in the future of television broadcasting or in providing mass vehicular communication service knows these measures do not, in themselves, assure the attainment of the full scope of the objectives in either of these fields.

We know the American public accepts television, and it is the duty of the Commission to provide allocations so all the people may receive this service.

I can be more explicit. A solution of the present sharing arrangements will not serve to make the available television frequencies any more adequate for "a truly nation-wide and competitive system of television" than they are now. If my predictions come true, I expect to see all television channels in the nation's 140 metropolitan areas assigned within the next twelve months.

Can we be satisfied with a metropolitan television system in the United States? I cannot conceive that anyone can answer that question in the affirmative. If we cannot devise plans for "a truly nation-wide, competitive system" of television for the next generation, we are not worth our salt.

But when are we going to get at the

(*Continued on Page 48*)

NOTICE TO READERS

In response to our announcement in the January issue concerning the demand for men to handle communications work, we have received a number of inquiries, and an indication of many more to come.

Accordingly, we have set up a classified advertising section in this issue. As the heading states, there is no charge to readers seeking employment.

We would like to call attention to the fact that there is a large and rapidly growing demand for microwave engineers and men to handle installation and maintenance, television installation experts, engineers and operators for FM and TV stations, and engineers and testers for FM and TV set development and production.

* Chairman, Federal Communications Commission, Washington, D. C. From an address at the I.R.E. President's Luncheon, Hotel Commodore, New York City, March 23, 1948.

[1] The first problem discussed by Chairman Coy was that of planning world-wide frequency allocations by international agreement.

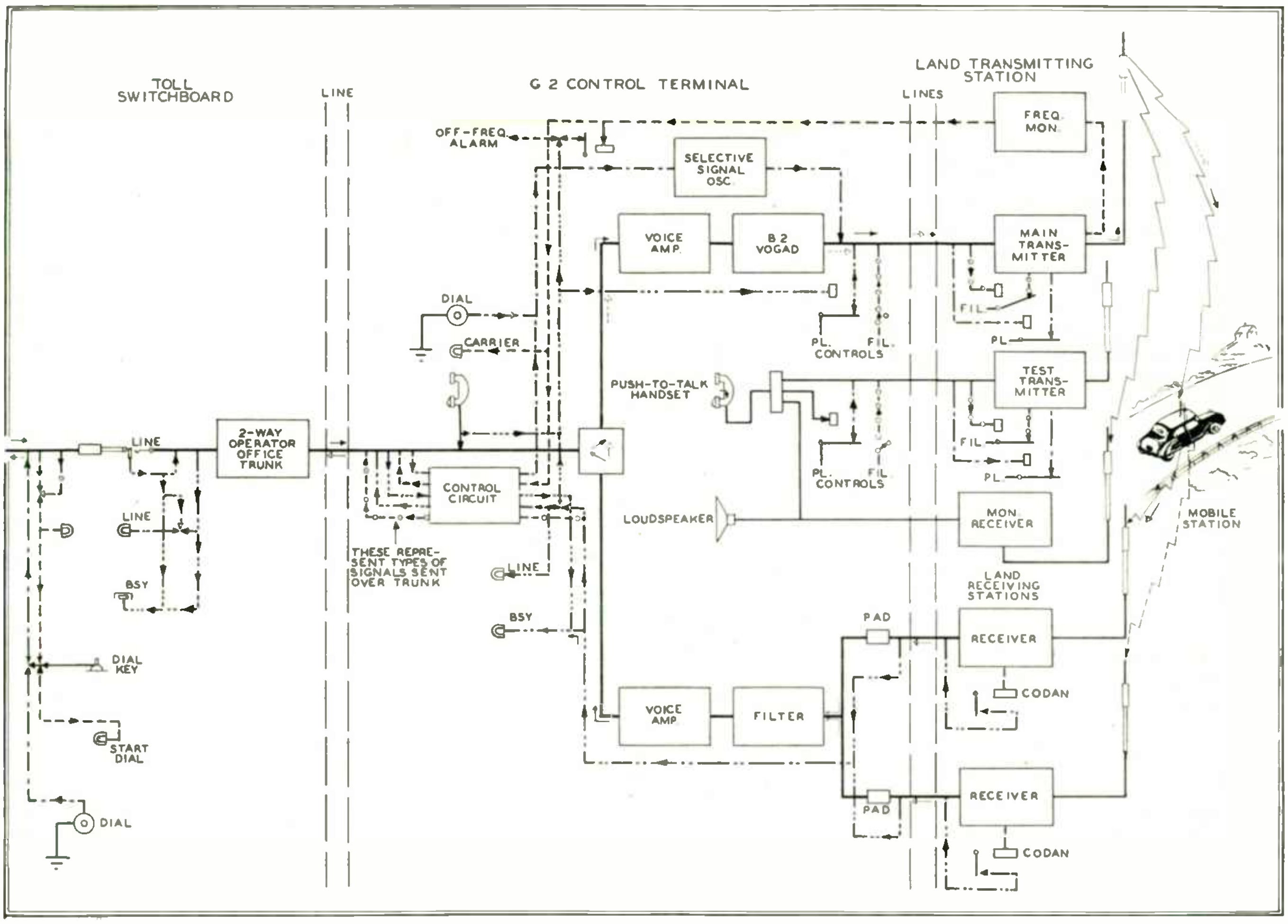


FIG. 1. The dotted lines and arrows identify the circuits and signal paths in this diagram of a G-2 control terminal installation

LAND-LINE MOBILE SERVICE

WESTERN ELECTRIC G-2 CONTROL EQUIPMENT INTEGRATES TELEPHONE SERVICE BETWEEN MOBILE UNITS AND LAND-LINE SUBSCRIBERS—*By* B. P. COTTRELL*

THE rapid expansion of mobile telephone service is reaching more and more into the daily lives and interests of the American public. This is due, in a large measure, to progress achieved in making service available between mobile installations and the established telephone system, through the exchange switchboards.

The use of mobile radiotelephone installations is no longer a novelty. However, the methods and equipment used to extend normal, efficient telephone service to private cars and trucks is still something of a mystery, even to many communications engineers.

Mobile telephone service in urban areas and along highways between principal cities has become more than a two-way system since the introduction of selective dial signalling and direct interconnection with land-line telephone subscribers. A typical setup is illustrated in Fig. 1. It comprises:

1. Main transmitter, installed at an advantageous point, and operated by remote control

2. A test transmitter, operated on the same frequency as the mobile transmitters, so that the technical attendant, listening on a monitor receiver tuned to the main transmitter frequency, can check the operation of the system. The test transmitter and monitor receiver are equivalent to a mobile station

3. One or more fixed receivers, located where signals from the cars can be picked up most efficiently, and connected to the telephone switchboard by land lines

4. The telephone switchboard

5. The G-2 control unit which integrates the various operating units of mobile and wire telephone service into a dependable and efficient system

G-2 Control Equipment:

Fig. 1 shows the circuit elements of the Western Electric G-2 control between the two pairs of dotted lines. Figs. 2 and 3 show an installation of four G-2's, one of which is in cabinet, while the other three are rack-mounted. In this particular installation, the unit at the left handles the Philadelphia link in the New York-Washington highway system. The adjacent rack-mounted control is for the Philadelphia urban channel, designated by the FCC as No. 11, while the next control is for the Philadelphia urban channel No. 9. At the extreme right is the control for New York-Washington rail phone.

The panels on each control, from the bottom up, carry the following circuits:

VOICE-FREQUENCY MONITOR AMPLIFIER, used if a receiver is located at some distance, to raise the volume

RECEIVER CONTROLS, to match the output of the receivers to the G-2 control

VOGAD, which regulates the speech level from land-line telephones

JACK FIELD, to facilitate the control and testing of the various circuits

* Mobile Radio Sales Engineer, Radio Division, Western Electric Company, 120 Broadway, New York 5, N. Y.

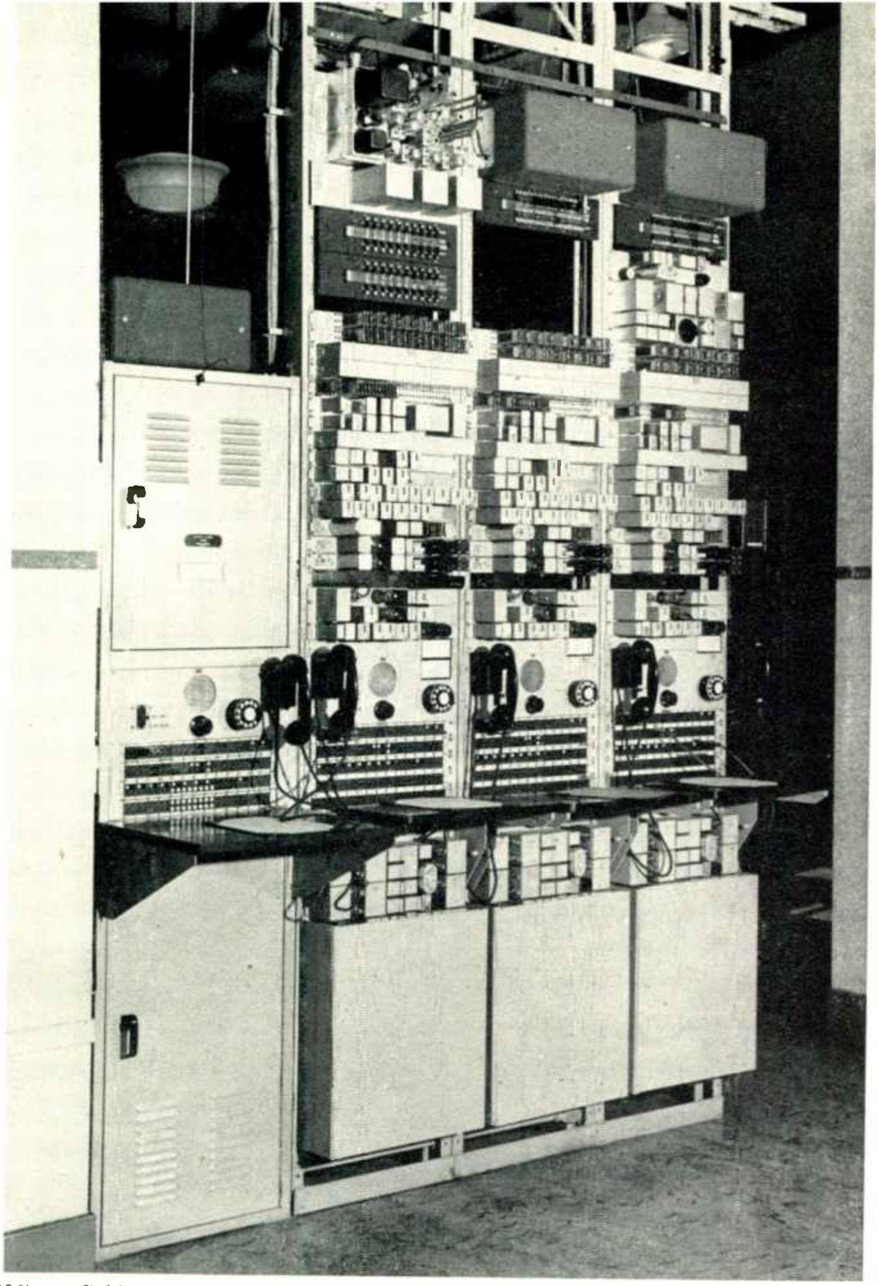


FIG. 2. Cabinet-mounted and rack-mounted G-2 controls used for mobile radio service

MONITOR SPEAKER PANEL, also carrying the telephone dial and handset

SELECTIVE SIGNALLING OSCILLATOR, supplying the two tones for selective dial signalling to mobile units

VOICE-FREQUENCY AMPLIFIER, compensating for wire lines and loss due to bridging several receiver lines.

VOICE-FREQUENCY AMPLIFIER, used to raise the level of speech fed into the Vogad

CONTROL EQUIPMENT, adapting the control terminal circuits for connection to the switchboard on a 2-wire basis, and for operation in the same manner as a community dial office

TRANSMITTER CONTROL, providing all the circuits and components for remote control of the main transmitter

TEST TRANSMITTER CONTROL, containing the circuits and components for remote control of the test transmitter

TERMINATING CIRCUIT PANEL, terminating the 4-wire radiotelephone circuit, and converting it into a 2-wire, 2-way circuit, and performing other functions.

Elements of the G-2 Control:

The block diagram in Fig. 1 shows the manner in which the various units of the control terminal are related, and the type of signals involved.

A particularly interesting unit is the Vogad (voice operated gain adjusting device), a circuit which automatically maintains a high average volume level of speech so that the most efficient use is made of the fixed station transmitter. Thus, a greater service area can be covered than would otherwise be possible. This is accomplished by means of a gain-increaser circuit and a gain-decreaser circuit acting on a variable gain amplifier. The Vogad is unique in its ability to deliver constant volume-level output of speech, even though the input level varies above or below normal. This is in contrast with volume-limiting amplifiers which can only reduce the gain when the input level is high.

The selective signalling oscillator unit in the G-2 makes selective calling possible to any appropriately equipped mobile unit operating on the given channel.[1] This oscillator unit is controlled by the switchboard operator's dial, and converts the dial pulses into alternate 600- and 1500-cycle tones to actuate the selector apparatus in the mobile receiver. For each dial pulse there is one interchange of tones. When received at the mobile equipment, the proper sequence of tones causes the code wheel of the selector apparatus in the particular receiver called to be advanced 23 steps, closing a contact which lights a lamp or rings a bell. In mobile receivers other than the one called, the selectors may advance a few steps, depending on their particular codes, but only the selector of the radiotelephone called will be advanced the full 23 steps. The actual dialing of a radiotelephone is as rapid as that of any other telephone inasmuch as a standard telephone type dial is used in both cases.

The circuits in the G-2 make it possible to employ a single pair of wires between the control terminal and the telephone switchboard. Over this single pair the voice passes in both directions as well as all the signals necessary for operation of the mobile telephone system. These signals include dial pulses from the switchboard to the terminal, incoming call indication, busy indication, land transmitter start, and transmitter ready indication.

Under normal operating conditions, the switchboard operator turns on the land transmitter by plugging into the line jack connecting to the control terminal, but for test and maintenance purposes facilities are provided whereby the techaical attendant can operate the system from the terminal itself. In addition to the plate and filament controls for the land transmitter, there are also controls for the operation of the test transmitter.

Four receiver control circuits are provided (four more can be added) so that a number of fixed receivers can be employed, depending on local conditions. The primary purpose of these receiver control circuits is to give the switchboard operator an indication of an incoming call whenever one or more of the fixed receivers picks up a carrier signal of adequate level from a mobile station. A lamp is provided at the terminal for each fixed receiver, indicating which fixed receivers are responding to a mobile station carrier. Faults occurring in a fixed receiver may contribute hum or noise to the circuit. For this reason facilities are provided whereby the technical attendant can monitor each of the fixed receivers, and disconnect any one from the terminal.

The outputs of all fixed receivers are combined in the control terminal, and the volume raised by a voice-frequency amplifier. A terminating circuit is provided for combining the transmitting and receiving paths into the two-way circuit to the switchboard. This terminating circuit provides full-volume re-radiation by the land transmitter of signals picked up by the fixed receivers, in order that calls can

[1] See "Selective Calling for Mobile Telephone Service," by B. P. Cottrell, *FM* AND TELEVISION, Jan. 1948.

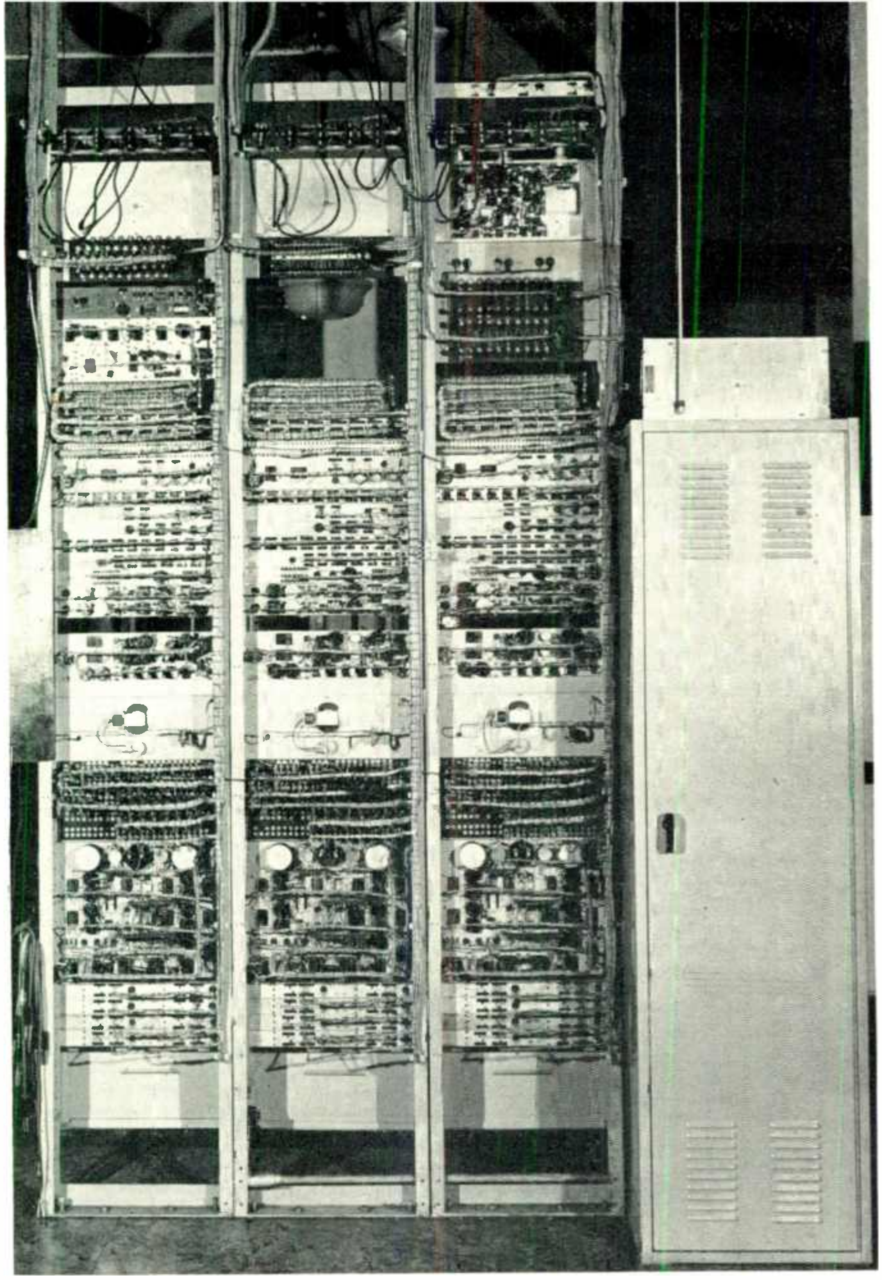


FIG. 3. Rear view of the G-2 control installation indicates the facilities required

be made between mobile radiotelephones.

A monitoring loudspeaker, used with a monitor receiver tuned to the land transmitter frequency, is mounted in the control terminal for continuous monitoring to comply with regulations. Failure and off-frequency alarm circuits, in addition to the monitoring speaker, make the technical attendant aware of the performance of the radio system at all times. The off-frequency alarm circuit is intended to be used with a Western Electric 2-A frequency monitor. This monitor is automatic in operation, and closes the alarm circuit if the land transmitter frequency drifts outside the prescribed tolerance.

The effective manner in which the G-2 performs makes it as simple for the switchboard operator to place a call to or accept a call from a vehicle as it is with a conventional telephone. Calls can be made from a fixed telephone to a mobile telephone, from a mobile telephone to a fixed telephone, or between two mobile units. In general, it is only necessary for the mobile service operator to plug into the line jack, thereby turning on the fixed transmitter carrier, and dial the number. When a user of a mobile unit wishes to reach the operator, he presses the push-to-talk button on his microphone for one or two seconds. This causes a lamp to light on the switchboard, making the operator aware of the incoming call. The operator then plugs into the line jack and answers the call.

Speech through the toll switchboard at the left of the block diagram passes through the resistance bridge and into the transmitting path where the Vogad regulates the volume to a practically constant level. It is sent out over the wire line to the main radio transmitter. Speech coming in from one or more of the several land radio receivers over the wire lines is combined at the input of the receiving path and passes up through the resistance bridge into the 2-wire line and through the toll switchboard. A portion of the received speech goes into the transmitting path and is re-radiated. Selective signaling tone pulses are fed into the transmitting path at a point beyond the Vogad.

Control Circuit Operation:

Although the individual control features are relatively simple relay circuits, the multitude of interconnection becomes complex. An outline of the sequence of events will serve to explain the functioning of the control circuit.

On a call to a mobile station, the control circuit:

1. Operates the BSY indication at the switchboard, lights the BSY lamp in the terminal, and starts the land radio transmitter.
2. Signals the selective signalling oscillator which, in turn, is connected to the transmitter in place of the voice-frequency line, and then after a short interval originates the equivalent of dialing the digit used as clearing pulse, after which it lights the START DIAL lamp or signals the key-pulsed sender at the toll switchboard.
3. After dialing, automatically times the ringing interval to 3 or 4 seconds, at which time it disconnects the circuit to the selective signaling oscillator which then sends another clearing pulse (an interchange of tone) before it is disconnected from the transmitter line.
4. Provides answering supervision on the toll switchboard cord lamp.

On a call from a mobile station, the control circuit:

1. Closes the LINE lamp circuit of both switchboard and the terminal.
2. Operates the BSY indication at the toll switchboard and lights the BSY lamp in the terminal.
3. Turns on the land radio transmitter and extinguishes the line lamps when the operator answers by inserting a cord in the LINE jack.

On a call from one mobile station to another mobile station operating on the same carrier frequency, the calling subscriber places the call with the toll switchboard operator and is told to stand by. The operator then pulls down the connection and originates a new call by dialing the called mobile subscriber whose answer can be heard by the calling subscriber and the conversation proceeds. The switchboard operator leaves one end of a cord plugged into the switchboard LINE jack to permit monitoring and to keep the land radio transmitter operating, since it must transmit the speech from each mobile subscriber to the other. That is, the conversation loops through the control terminal.

On a call from a mobile station operating on one carrier frequency to a mobile station operating on another carrier frequency, the toll switchboard operator uses both ends of the switchboard cord, since two land radio transmitters are involved. One cord plug is inserted into the LINE jack of the calling subscriber's channel, the call is acknowledged, and the calling subscriber is told to stand by. The other cord plug is inserted into the LINE jack of the called subscriber's channel, and the operator originates a call by dialing the called subscriber. When he answers, the calling subscriber can hear him

(*Continued on Page 42*)

TELEVISION HANDBOOK

CHAPTER 3: PRIMARY COMPONENTS OF EQUIPMENT — PART 3: DISCUSSION OF THE COMPOSITE TYPES OF PHOTO-ELECTRIC PICKUP TUBES — *By* MADISON CAWEIN

4. Composite Types and Derivations:

The two basic types of photo-electric pickup tubes have been described in the two preceding Sections. These tubes are basically different in several respects, principally as regards:

A. The type of photo surface
   a. Continuous photo cathode (Dissector)
   b. Mosaic photo cathode (Iconoscope)
B. Type of electrical image
   a. Extended electron image in space (Dissector)
   b. Latent-charge image stored on mosaic islands (Iconoscope)
C. The means of obtaining resolution
   a. The finite size of a mechanical aperture upon which the extended image is focussed (Dissector)
   b. The finite size of an electron beam which is focussed upon the mosaic (Iconoscope)

All types of television pickup tubes currently in use are variations, combinations, or derivations of the principles employed in the image dissector and the iconoscope. No further theoretical considerations in regard to the operation of photo-electric pickup tubes will be entered into here, other than a description of the essential classifications and a brief discussion of the manner in which these function.

(4.1) Image Iconoscope:

The image iconoscope (British Emitron) consists essentially of a marriage between the image dissector and the iconoscope. An optical image of the subject-scene to be transmitted electrically is focussed upon a translucent, continuous photo-cathode at one end of the tube, through a glass window. An extended electron image emanates from the opposite side of the cathode and is focussed by electrical means, (electro-magnetic and/or electrostatic fields) upon the mosaic. The mosaic is scanned by an electron beam, and the signal is taken off of the signal plate in the usual manner for an iconoscope.

The principal advantages of this tube are that the sensitivity is greater than that of the iconoscope by a factor of about 10:1, due to higher photo-sensitivity of the translucent cathode and secondary multiplication at the mosaic. Also, the redistribution is more uniform, resulting in a decrease in the shading signal, or spurious signal, over that which occurs in the iconoscope. Due to the storage effect of the mosaic islands in this tube, it is not subject to the same noise limitations which exist in regard to the instantaneous signal which is derived from the image dissector.

The disadvantages of this tube are that it is difficult to build, requires greater mechanical and circuit complexities than the basic types, it is not standardized as to arrangements, and it is not in general use at present.

(4.2) Orthicon:

The orthicon is a derivation of the iconoscope in which the photo-sensitive mosaic is translucent (as is the photo-sensitive cathode in the image iconoscope) so that the optical image can be projected on one side and the electrical image scanned off from the opposite side by means of a scanning beam, as shown diagrammatically in Fig. 55. The scanning beam in this case is a low-velocity beam which strikes the inside of the mosaic at such a low energy-level that no secondaries are emitted and no redistribution problem is created. The photo-electric charge on the mosaic islands is just neutralized by the action of the scanning beam. The excess electrons in the beam return to the region of the cathode, and the signal output is more linear with illumination than is that of the iconoscope. The action of the orthicon in general is more efficient than is that of the iconoscope.

The principal advantages of the orthicon are that the increase in efficiency results in a sensitivity about 10 times greater than that of the iconoscope, there is no shading signal, the contrast range is relatively linear, and no keystone correction is required.

The disadvantages are that the circuit complexity is increased, the mechanical and electrical adjustments are critical, and a certain amount of S-distortion is present as in the image dissector. In spite of these facts, the tube is commercially more desirable for direct pick-up than any of the other types of tubes so far discussed for medium light levels.

A small type of orthicon, called the vericon, has been developed by Remington-Rand. This tube is quite sensitive and lends itself admirably to the construction of a compact camera. Another type of small orthicon, developed by RCA, employs several stages of secondary multiplication to augment the output.

TV SERIES RESUMED

Last fall, pressure of his work as manager of Research at Farnsworth Television & Radio Corporation interrupted Madison Cawein in the preparation of the Television Handbook series.

Now Mr. Cawein has resumed his work on this very important contribution to television literature, and we are pleased to announce that he expects to carry it through to completion without further delay. This series, therefore, will again be a regular feature of FM AND TELEVISION Magazine.

For the benefit of those who missed any of the preceding parts, they were published in the following issues:

December, 1946	April, 1947
January, 1947	June
February	August
March	September

These back copies are available at 50¢ each, or $2.00 for the set of 8 copies. Of course, the supply is very limited.

(4.3) Image Amplifier:

The image amplifier represents a variation from conventional pickup tubes, including some of the principles of the iconoscope. This tube is not commercially available, and its discussion here is included to complete the picture of history, invention, and development, as this applies to the vast amount of ingenuity and thought which have been devoted to the present art of television.

This tube includes a mosaic type of photo-cathode similar to that in the iconoscope, but perforated with myriads of holes in a mosaic arrangement. The optical image is projected upon the photo-sensitive front of this cathode, and a scanning beam impinges upon the secondary-emissive back. A screen-grid collector is placed in front of the surface, maintained at sufficient potential to draw electrons emitted at the back of the perforated cathode surface through the perforations. The scanning beam creates a moving, secondary-emissive cathode spot. Electrons originating at this spot are drawn through the holes to the collector screen (the anode), their intensity being controlled by the positive, stored charge on the mosaic islands of the photo-cathode, in the region of the hole (control-grid action). Thus, each elementary area in the region of a hole constitutes a tiny triode amplifier (capable of extension to a pentode by insertion of extra grids). The cathode of the triode is commutated and caused to move from hole to hole in regular sequence by the scanning beam.

The advantages of this tube are its instantaneous response, internal amplifier action, linearity of contrast, and freedom from the shading signal and noise limitations of the iconoscope and dissector, respectively. Its disadvantages are the difficulty of construction, the shadow cast by the collector, and the limited resolution.

(4.4) Image Orthicon:

The image orthicon is the most advanced and most sensitive television pickup tube to come into commercial use up to the present time. This tube is an scene, and the charges are all positive.

A low-velocity electron beam is focussed upon and scanned across the back of the glass target plate by the rear portion of the coil system. The influence of the electrodes E and D, in conjunction with the coil system, is to cause the scanning beam to strike the back of the glass plate per-

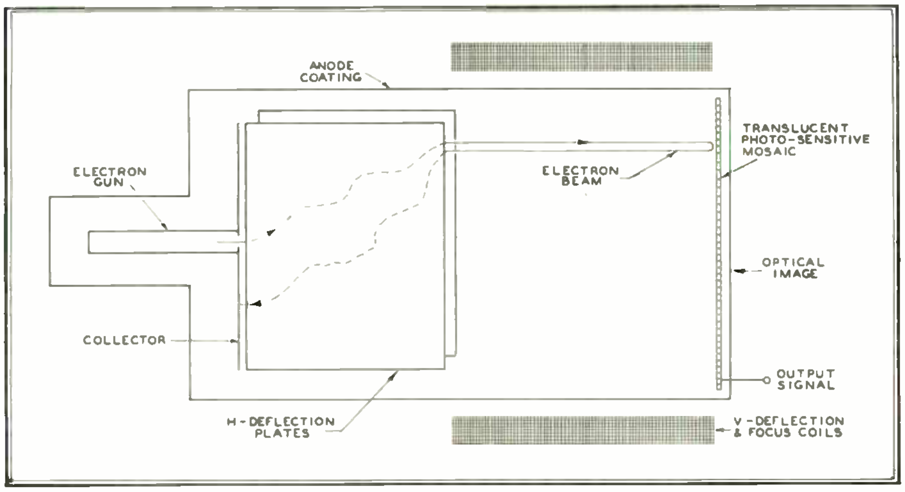


FIG. 55. *Construction of the orthicon pickup tube, a derivation of the iconoscope design*

outgrowth of the development of the image iconoscope and the orthicon. A diagrammatic arrangement of the principal elements of the image orthicon is shown in Fig. 56.

Since this tube bids fair to become the most popular television camera tube during the next few years, more space will be devoted to its description here than to the other tubes previously described. Because the development of the tube can be expected to progress, however, and because the underlying principles of the more basic types, as the iconoscope and image dissector, have been rather completely described, the functional operation of the image orthicon will not be detailed at as great length as for the image tubes of sections 1 and 2.

An optical image is focussed on the translucent photo-cathode, Fig. 56, and an extended electron image is focussed by the coil system, accelerated by means of the accelerating electrode, to strike the target in focus. The target consists of a very thin glass plate and a collector screen. Secondary electrons are emitted from the glass plate and flow to the collector, establishing a positive potential of about 1 volt average between the target and the collector screen. Actually, all the elementary areas of the glass plate become charged to various levels of potential corresponding to the levels of illumination in the original scene, augmented by secondary-emission action. The front side of the glass plate, or target, thus becomes a mosaic of charged areas, insulated from one another by virtue of the thinness of the glass (less than .0005 in. thick). These charged areas on the glass represent a latent electrical image of the televised

pendicularly and at substantially zero velocity. The glass plate must be operated at a temperature of approximately 50° C., under which conditions it becomes conductive along its thickness. The zero-velocity electrons from the beam accumulate on the rear of the glass in quantities proportional to the elementary charged areas on the front of the glass, and leak through the glass during the scanning

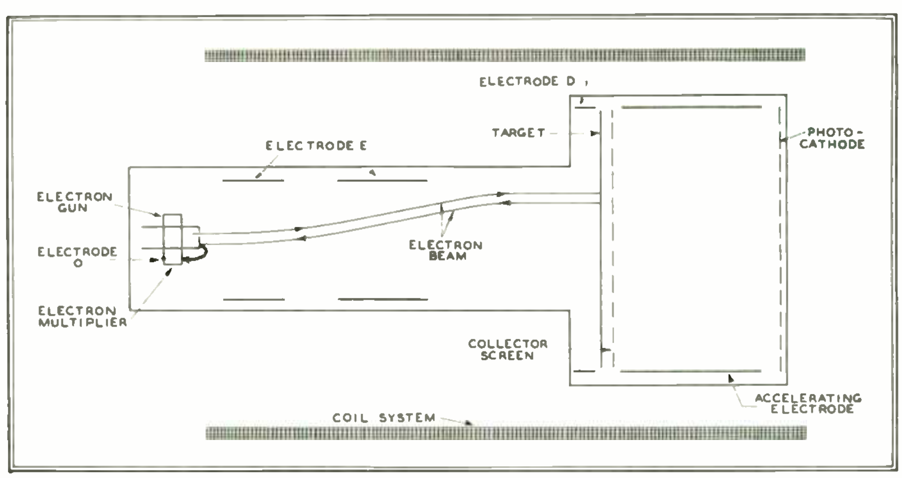


FIG. 56. *Diagrammatic representation of the extremely sensitive image orthicon pickup tube*

cycle to neutralize the positively charged areas of the latent electrical image. The excess of electrons in the scanning beam return, as shown in Fig. 56, along a parallel path to the incident beam and strike a secondary emissive area around the periphery of the gun, which surface serves as part of the electron multiplier. The return beam, modulated in accordance with the electrons removed by adherence to the glass plate, is amplified by secondary-emission activity in the multiplier, and serves to produce an output signal at the electrode O which is well above the noise level in the first stage of a thermionic amplifier and can, therefore, be amplified by conventional means from this point on.

The structure of the glass plate, its flatness, and its proximity to the screen are quite critical. The thickness of the glass must be small enough so that conduction occurs through the glass to a much greater extent than across its surface, otherwise the charged areas of the electrical image would serve to neutralize one another due to leakage across the surface. It is important that the electron beam be small enough in intensity to prevent overload of the multiplier, and large enough to insure complete neutralization of the positively charged areas on the front of the glass target.

The principal advantages of this tube are that the sensitivity is approximately 400 times that of the iconoscope, the threshold of the sensitivity approaches that of the human eye with good resolution, the peak output signal is 300 times above the noise level of the thermionic video amplifier, and the size of the tube is small enough to allow for a compact camera design.

Some of the disadvantages are that the circuits are complex, the adjustments are critical, the tube is expensive and fragile, proper operating temperatures must be maintained to prevent time lag (memory) between preceding and succeeding images, and the tube may be permanently damaged in a very short time by misadjustment or failure of operating potentials.

Nevertheless, the image orthicon is the only television pick-up tube which can be obtained commercially at the present time for indoor and outdoor pickup of sports events under adverse lighting conditions. For this reason it is rapidly replacing all other types of pick-up tubes for mobile service.

NOTE: Part 4, to appear next month, will discuss the performance and characteristics of relaxation oscillators used in camera deflection circuits.

STUDIO SPEECH INPUT SYSTEMS

PART 2: PLANNING A SPEECH INPUT SYSTEM GEARED TO THE PROGRAMMING AND STUDIO FACILITIES OF FM OR AM STATIONS OF MODERATE SIZE—*By* JOHN A. GREEN

In Part 1 of this series[1], we discussed a complete set of speech input equipment for use in the small to medium-sized FM or AM broadcast stations which are so numerous today. Facilities were provided to handle only one program and one audition channel. Of course, there are operations today which require a much greater degree of versatility, calling for two studios of moderate size, plus a small announce booth. In Part 2, therefore, we shall present the details of a more complete system, providing two program channels, or one program channel and one audition channel.

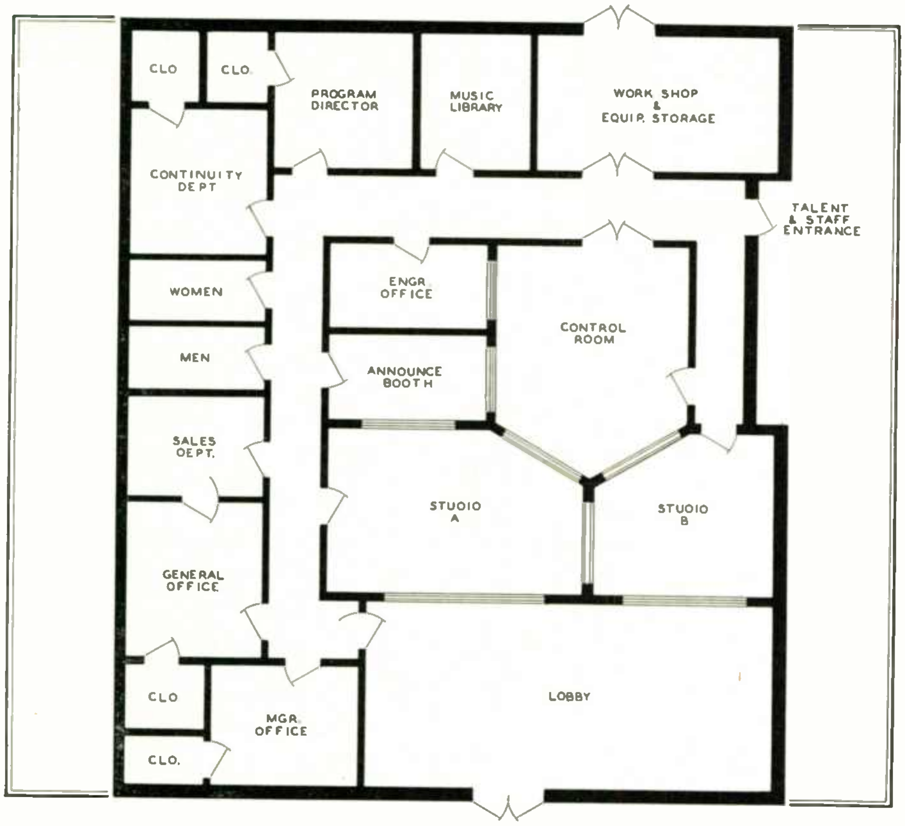


FIG. 11. *Layout for a station of moderate size includes two studios and announce booth*

General Considerations:

In designing a set of speech input equipment for any station, whether it be large or small, there are certain fundamental ideas that must always be considered. The first, perhaps, is the convenience of the complete layout. As a part of this, the ease with which operation and maintenance can be handled should be given careful consideration. The speech input system must be so designed that there is always not only enough equipment to allow operation in the normal manner, but to meet abnormal conditions, as well. If the budget cannot be stretched far enough to allow the installation of all the equipment desired, it is wise to provide for the addition of this equipment at a later date. In this way, rework of the entire layout at subsequent intervals when new equipment is purchased will be minimized. Competition as faced today in our scheme of radio broadcasting makes it wise for the station manager to allow his chief engineer to think ahead, and make plans for equipment that will do the many special jobs of all types and sorts which come up as station operations expand. Often the program department comes to the engineer and asks that a special job be handled not next week or next month, but this very afternoon. If suitable equipment is not available, it may be necessary to pass up a profitable show, or a valuable public-service feature. What makes these situations doubly serious is the fact that the program may then go to a competing station. However, if proper planning is done beforehand, and facilities are at hand, the engineering department will be in a position to do these jobs on short notice, and handle them more quickly and to better advantage than other stations in the area.

Basic Planning:

Logically, the layout of the studios depends on the program operations to be performed. Both of these considerations affect the design of the speech input system. Let us, therefore, set up a plan of program operations. Then we can provide suitable studio accommodations, and finally work out the speech input installation.

Since we have assumed a station of medium size, either FM or AM, in a city of perhaps 50,000 to 100,000, the following conditions will probably obtain:

1. The station will operate on an 18-hour schedule, 7 days a week.
2. The major part of the programs will be produced at the station. The remainder will be taken from a network or other remote originations.
3. A considerable number of rehearsals will be necessary for shows produced in the studios.
4. News and weather reports will be originated at the station, in addition to news commentaries over the network.
5. Part of the music will be from records and transcriptions, necessitating a music library of moderate size.
6. At times, while one show is on the air, another will be fed to a network, or will be recorded.

Studio Layout:

Fig. 11 presents a suggested floor plan to meet the requirements set forth above. It includes two studios and an announce booth, the control room, and all the offices for the station. You will see that the studios and control room are grouped as a single unit. This achieves economy of space and equipment, and simplifies installation and maintenance. By putting the speech input console against the control room window facing the larger studio, vision is afforded of both studios and the announce booth. This, of course, is an important operational advantage.

There is space in the control room for the equipment racks and recording apparatus. The engineers' office is handy, and the large window enables the Chief to see that things are coming along in the control room as they should.

An adequate workshop and storage room are always a good investment, chargeable against the engineering department. With a good bench and a few tools, many special pieces of equipment can be constructed by the staff to meet special needs. Also, such a shop is extremely useful in connection with routine

[1] Part 1 appeared in the issues of February and March, 1948.

View of truck cab showing driver "on the road" in communication with headquarters station.

The Lock-In Tube In Action

For Electric Department

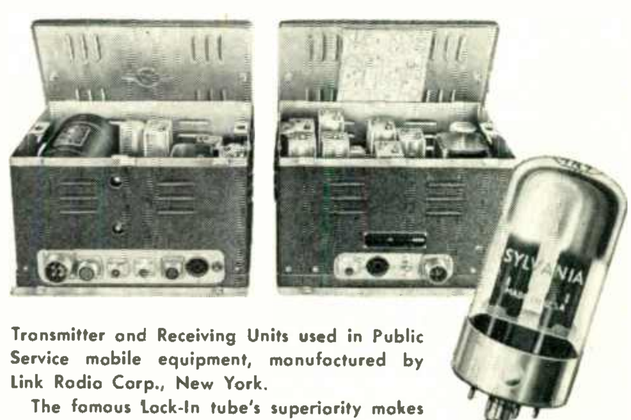
Public Service Electric and Gas Company

Headquarters station in communication with any of the many Public Service units ready for prompt trouble-shooting.

THROUGH an ingenious system of radio communication, the Electric Distribution Department of the Public Service Electric and Gas Company (New Jersey) is able to service a given area swiftly and efficiently.

With 153 vehicles in operation (at the present time), equipped with two-way radio units, Public Service can direct any one of these mobile units to the scene of an electrical breakdown in a matter of minutes!

This elaborate repair system can't afford to risk communication failures. Sylvania Lock-In tubes are used in these Link Radio Corporation sets because no matter how rough the way, they'll *stay* in their sockets. Tubes have few welded joints and *no* soldered ones—the elements can't warp or weave. Short, direct connections . . . less loss; getter located on top . . . leakage reduced by separation of getter material from leads. See Sylvania Distributors or write Radio Division, Emporium, Pa.



Transmitter and Receiving Units used in Public Service mobile equipment, manufactured by Link Radio Corp., New York.

The famous Lock-In tube's superiority makes it the ideal choice for equipment on the road, in the air, on the rails, marine radar, FM and television.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

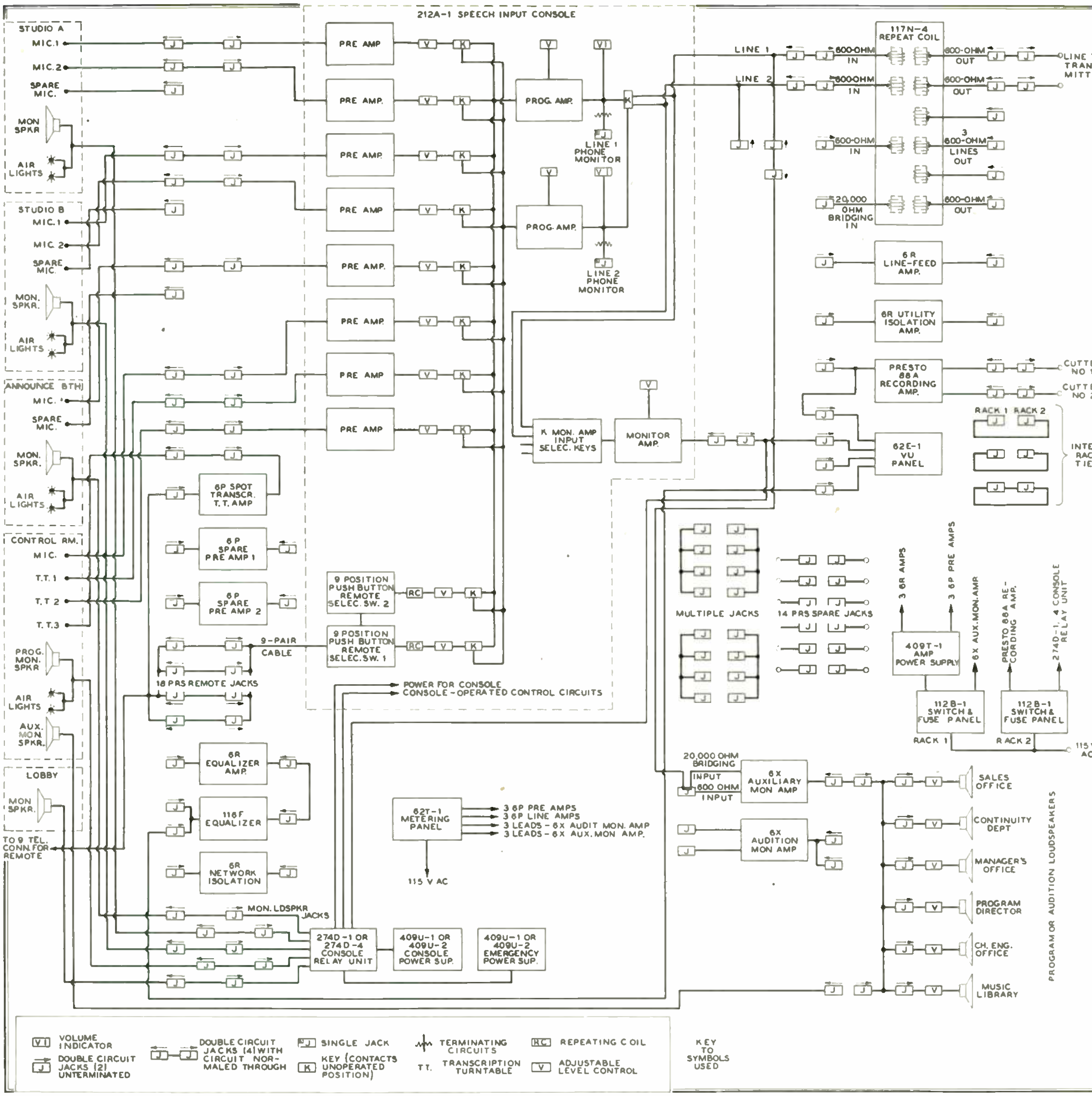


FIG. 12. *Block diagram of the equipment and control console for the studio facilities shown in Fig. 11. Three turntables are included*

maintenance and emergency repair work.

A lobby of generous proportions is arranged so that visitors to the station can sit or stand to watch the activities in the studios. The announce room and control room are also visible from the lobby. Thus, visitors can be handled without going through the section devoted to business offices.

In the business section, the managers' office is ideally located. Space is provided for the office force, sales department, continuity department, program director, and music library.

Of course, the plan of operations and the studio can be modified to fit specific needs. However, such changes will probably not alter the basic design of the speech input system, except in minor details.

Speech Input Equipment:

The 18-hour daily schedule puts a heavy load on the speech equipment, calling for extreme reliability in order that uninterrupted service will be assured over long periods of time. Of course, routine inspection and maintenance are required on all equipment, and thoroughness in this respect is essential at any station. Still, no matter how careful the maintenance, generous factors of safety must be built into the equipment to assure adequate reliability over a long period of years.

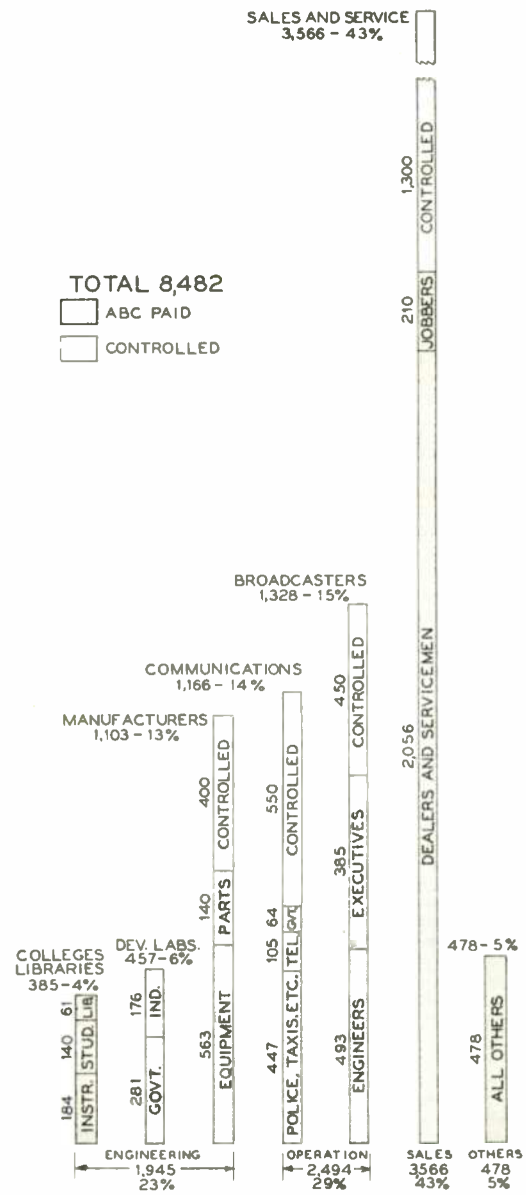
The control console is the nerve-center of the audio system. Therefor, it must provide means for handling all the varied present and future program activities.

For example, since our plan calls for producing many shows locally, the console design must provide for frequent rehearsals and auditions. They must be handled on schedule, without interfering with programs on the air, and without putting an undue load on the operating personnel.

Since there will be numerous remotes

(Continued on page 46)

PICTURE OF COVERAGE THAT MAKES ADVERTISING PROFITABLE*



* In 1948, the readership of FM AND TELEVISION will place orders totalling more than $1 billion for FM and TV broadcast equipment, FM communications equipment, and FM-TV home receivers, test instruments, and replacement parts.

Are There Eagles or Homing Pigeons on Your Advertising Dollars?

Do your advertising dollars still have eagles carrying olive branches and arrows? If so, maybe it's time for you to change the design to homing pigeons with orders in their claws.

Time was when advertising's job was to fly high and wide. Like the eagle, it was sent out to soar around, and collect quantities of letters asking: "Please send me your free literature." Advertising wasn't expected, then, to pay its own way with immediate results.

Now, times have changed. Advertising dollars must be sent out, like homing pigeons, to bring back orders.

Advertising in FM AND TELEVISION, like the homing pigeon, travels in a straight line between your plant and radio's great, new FM and TV markets. This is the only publication that has concentrated over the years in the fields of FM-TV engineering and production, operation, and sales.

If you want to shift the pattern of your advertising from eagles to homing pigeons, study the concentrated coverage illustrated in the chart above. It represents the groups whose orders will total over $1 billion this year for FM and TV broadcast equipment, FM communications equipment, and FM-TV home receivers, test instruments, and replacement parts.

Note how ABC circulation is reinforced by hand-picked, extra coverage. And the cost? It's the lowest rate of any radio publication: $160 per page, 12 times! If you're after orders, FM AND TELEVISION will give you the highest return per dollar spent.

Ask for Detailed Information on Market Coverage for Your Specific Products

MOBILE SERVICE

(*Continued from Page 35*)

and the conversation proceeds, the switchboard operator leaving both ends of the cord plugged into the Line jacks so as to monitor the call and to keep both land radio transmitters operating. Here the conversation is looped through the two control terminals, there being one control terminal for each mobile service channel. In short, the system provides exactly the same degree of flexibility for mobile communications as for regular telephones.

Details of the Vogad:

In the G-2 control terminal, the Vogad is operated from DC power supplies. With no input, its normal gain is 20 db. Its controls are set so that, for average speech input volume, this amount of gain will give a satisfactory output volume. Over a speech range of +8 to −37 vu, the Vogad gain is automatically decreased or increased through its 45-db range in such a manner as to maintain the output speech volume within ± 2vu of the desired volume. The Vogad consists essentially of a varioamplifier whose two vacuum tubes are arranged in push-pull and the grid bias of which (and therefore the amplifier gain) is regulated by a syllabic-gain increaser and a gain decreaser. Patching jacks are provided in the control terminal so that the Vogad can be removed from the circuit and tested as a unit.

Transmitter Control Circuit:

The normal function of the transmitter control circuit is to start the land radio transmitter whenever the toll switchboard operator plugs into the Line jack or when the technical operator at the control terminal plugs into the BL jacks. In either case, the terminal relay is operated and applies battery voltage to the transmitter control circuit relay. With the control key in its normal position, positive 130-volt telegraph battery is applied to one of the two composite circuits on the transmitting line to the land radio transmitting station, where it operates a control relay. It transfers a connection of the alarm circuit; supplies ground to light its associated red signal lamp; and applies 130-volt battery to the other composite circuit on the transmitting line to the land transmitting station where it operates a control relay to apply plate power to the radio transmitter.

If the transmitter radiates its correct carrier frequency, the frequency monitor at the land transmitter applies ground to the transmitter control circuit relay. This relay applies battery to light the local green Carrier On lamp; transfers a battery connection of the alarm circuit; and applies battery to the trunk control circuit which lights the Start Dial lamp at the toll switchboard.

Receiver Control Circuit:

Jacks are provided for patching and testing purposes. By means of optional wiring, the incoming line from the land radio receiving station can be poled as required to give the best combination of the several incoming signals from the other land radio receiving stations. One end of the winding of a relay is connected to the midpoint of the line side of a repeating coil. At the receiving station, a similar connection is made from the line to the contact of the radio receiver codan relay. When an incoming signal is detected by the land radio receiver, ground from its codan relay is connected over the 2-wire line to the receiver control relay. This applies battery to the white signal lamp and ground.

Selective Signalling:

Each Western Electric mobile station includes a selector set as part of the receiver. Mobile stations of other manufacture can be equipped with a 106 selector set as a separate unit.

At the toll switchboard, the operator dials directly on the trunk or sends key pulses to a sender that transmits the pulses over the trunk to the control circuit of the terminal. When ground is applied to the selective signalling oscillator, the terminal relay is operated from the oscillator and connects the oscillator output over the transmitting line to the land radio transmitter. The oscillator sends alternate pulses of 600 and 1,500 cycles.

(*Concluded on Page 44*)

MOBILE SERVICE

(*Continued from Page 42*)

Talking and Monitoring:

In addition to the voice channels and operating control circuits, the G-2 includes adequate facilities for measuring and testing, and alarm circuits are provided to indicate abnormal conditions.

Many variations of the basic circuits can be arranged to suit individual conditions. This description, however, serves as a basic review of the control equipment necessary to provide telephone service to all types of mobile vehicles.

COMMUNICATION DIRECTORY

The revised Communications Directory, Part 1, will appear in the July issue of *FM* AND TELEVISION. It will list all municipal, county, and state police, fire, forestry and railroad radio systems, with additions and changes made during the past twelve months. Listings will show the call letters, address of control point for each main station, number of associated mobile units, frequency, type of modulation, and the manufacturer of the principal equipment. This information is available from no other source. Part 2 of the Directory was published in January 1948, and will be revised again in January 1949.

EDUCATIONAL FM

* Operating under special temporary authority.

** Construction permit.

† Application pending.

		MC
ALABAMA		
TUSCALOOSA		
WUOA*	University of Alabama	91.7
CALIFORNIA		
LOS ANGELES		
KUSC**	University of So. Calif.	91.5
†	Bible Inst. of Los Angeles	
†	Intl. Evgl. Christ. Church	
SAN DIEGO		
KSDS*	Unified School District	91.7
SAN FRANCISCO		
KALW	Unified School District	91.7
SANTA MONICA		
KCRW	School Board	89.9
STOCKTON		
KCVN**	College of the Pacific	91.3
COLORADO		
DENVER		
†	Denver Bible College	
FLORIDA		
MIAMI		
WTHS*	Tech. High School	91.7
GEORGIA		
ATLANTA		
WABE*	Bd. of Education	90.1
ILLINOIS		
CHICAGO		
WCTF*	Chicago Theo. Seminary	89.9
WBEZ	Chicago Bd. of Education	91.5
URBANA		
WIUC	Univ. of Illinois	91.7
INDIANA		
BLOOMINGTON		
WFIU*	Indiana University	90.9
GREENCASTLE		
†	DePauw University	

(*Concluded on Page 45*)

EDUCATIONAL FM

(*Continued from Page 44*)

IOWA

AMES
WOI-FM* Iowa State College 91.3

BOONE
† Boone Biblical College

IOWA CITY
KSUI State Univ. of Iowa 91.7

KENTUCKY

LEXINGTON MC
WBKY Univ. of Kentucky 91.3

LOUISIANA

BATON ROUGE
WLSU** Louisiana State Univ. 91.7

MICHIGAN

ANN ARBOR
WUOM* University of Michigan 91.7

DETROIT
WDTR** Board of Education 90.9

E. LANSING
WKAR-FM* Mich. State College 90.5

MISSOURI

ST. LOUIS
KSLH* Board of Education 91.5

NEW JERSEY

NEWARK
WBGO Bd. of Education 91.1

SO. ORANGE
WSOU* Seton Hall College 89.5

NEW YORK

FLORAL PARK
WSHS Sewanhaka High School 90.3

NEW YORK
WCUV* Columbia University 89.9
WNYE* Board of Education 91.5
WFUV Fordham University 90.7

SYRACUSE
† Syracuse University

TROY
† Veterans Vocational School

OHIO

CLEVELAND
WBOE Board of Education 90.3

TOLEDO
WTDS* Board of Education 91.3

OKLAHOMA

NORMAN
KOKU* State University 90.9

OKLA. CITY
KOKH* Board of Education 90.1

STILLWATER
KOAG-FM* Agr. & Mech. College 91.7

TULSA
KWGS** University of Tulsa 90.5

OREGON

EUGENE
KRVM** School District No. 4 90.1

PENNSYLVANIA

PHILADELPHIA
WJUN* Junto, Inc. 91.7

STATE COLLEGE
WEHR* Penn State College 90.9

W. CHESTER
WWCH* State Teachers College 91.3

RHODE ISLAND

PROVIDENCE
WPTL* Providence Bible Inst. 91.5

TEXAS

HOUSTON
KUHF* University of Houston 91.7

WISCONSIN

CHILTON
WHKW* State Radio Council 89.9

DELAFIELD
WHAD* Same 90.7

MADISON
WHA-FM Same 91.5

WAUSAU
WHSF* Same 89.1

OBSERVING CRYSTAL MODES

(*Continued from Page 29*)

mum sweep, the oscilloscope pattern shows those crystal modes lying within the sweep width. The maximum sweep of the Mega-Sweep, usually about 30 mc., can, with some loss of linearity, be brought up to about 70 mc. As the sweeping frequency passes through the crystal frequency or one of its odd harmonics, the crystal impedance and the rectified voltage across it become minimum. Since this absorption occurs periodically at the sweep rate, a stationary pattern is seen on the oscilloscope with pips corresponding to the series-resonant modes of the crystal. As the center frequency of the sweep is shifted, higher modes can be seen to appear on the pattern. With the sweeping oscillator adjusted for narrow sweep, the pattern of an individual pip occupies a large area on the oscilloscope and can be studied in detail.

In a typical test, using a 10-mc. fundamental crystal, the modes were traced up to the 11th, or a frequency of 110 mc. The size of the pips was noticeably different, the variation being due either to different mode strengths or amplitude modulation in the output. Using the wave meter incorporated in the Mega-Sweep, the frequencies of the modes were found to be 20 mc. apart.

SPEECH INPUT SYSTEMS

(*Continued from Page 40*)

plus the network, provisions are required in the console for connecting such circuits into the audio equipment. Also, the console must be capable to handle two shows simultaneously — one on the air and the other either being recorded for subsequent transmission or sent out over a local network. This degree of flexibility simplifies programming and makes the recording equipment available to the sales department on short notice.

Fig. 12 shows the block diagram of a speech input system which meets the specifications set forth in the preceding paragraphs. From this diagram it is easy to determine the equipment that will be needed to make the installation. Some of the equipment specified may be considered as extra, but it has been included to permit completely flexible operation.

Facilities are provided at the left in Fig. 12 for two microphones in studios A and B, for regular use. In addition, an extra microphone receptacle is shown, terminated in the jack field. This makes it possible to connect an additional microphone easily when special program situations arise in either studio. There are circuits to each studio for a monitor speaker and on-off air lights.

The announce booth has a normal

(*Concluded on Page 47*)

SPEECH INPUT SYSTEMS

(*Continued from Page 46*)

circuit for one microphone, for a monitor speaker and air lights, and a spare microphone receptacle terminated in the jack field.

In the control room there is one microphone circuit. This mike is used for on-the-air announcements as well as for talkback to the studios and remote lines. Circuits are provided for three transcription turntables, two monitoring speakers, and air lights.

Finally, Fig. 12 shows a circuit for a monitor speaker in the lobby.

Going from left to right in the diagram, three preamplifiers will be seen. One of these is normally used for the third transcription turntable, while the other two are provided so that special circuits can be set up quickly in the different studios, without disturbing the other equipment, when they are needed.

Eighteen pairs of jacks are used for the input circuits to the remote positions or high level positions on the console. Nine of these are normally connected to the input of the console, eight normals to the telephone circuit, and one normal to the third transcription position.

There are two isolation amplifiers and one equalizer. One isolation amplifier compensates for the insertion loss of the equalizer. The other can be used for network isolation or for utility purposes.

The console specified is a 212A Collins 10-position, 2-program-channel design. Eight of the inputs are for low-level circuits, and two for high level circuits. Two complete programs can be handled simultaneously through the unit, since it contains two program amplifiers. There is only one monitor amplifier, but connections are provided for an external monitor amplifier to be used on the second program channel. Switching facilities permit talkback to all the studios and the remote lines.

In the conclusion of Part 2, next month, the audio equipment for this installation will be described and illustrated.

TAXI RADIO SYSTEMS

ALTHOUGH the data in the Communications Directory published in our January issue was taken from FCC records, we have been advised that the equipment manufacturers' names were not shown correctly in certain instances.

L. B. Williams of the Yellow Cab Company, Atlanta, informs us that they are using the original equipment supplied by Communications Company, Coral Gables. This, by the way, was probably the first taxi fleet system to be installed.

J. Robert Hamaker, of Mobile Communications Company, Long Beach 2,

(*Concluded on Page 48*)

FREQUENCY ALLOCATIONS

(*Continued from Page 49*)

dent that many present broadcast receivers in particular are deficient in regard to the suppression of oscillator radiations and in selectivity. Perhaps your efforts and ingenuity will result in simpler and more effective methods than are now available.

Ladies and gentlemen, radio is still new; let us continue to try as hard as we can to establish a well-balanced plan for using this great natural resource, and of assuring ourselves that both the next generation as well as our own will be able to enjoy this heritage. I know I speak for the entire Commission when I say that we will need all the help we can get from the radio engineers.

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COMMUNICATIONS ENGINEER now maintaining 25-car mobile FM system is prepared to handle additional work in the vicinity of East St. Louis, Ill. Box 47, *FM* AND TELEVISION.

CHIEF ENGINEER now in charge of 150 mobile FM units, 3 land stations, desires advantageous change. Only interested in permanent position with commercial or state police system. Require living quarters for 3. Will also consider return to broadcast engineering. Box 82, *FM* AND TELEVISION.

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SALES ENGINEERS wanted, capable of handling sale, planning, installation of mobile FM systems in the New York territory. Excellent opportunity for men with experience in operating and maintaining FM systems. Box 60, *FM* AND TELEVISION.

MANUFACTURER of mobile FM equipment for police, taxis, public utilities has territories open in the middle west and south. Franchises available to established sales organizations or parts jobbers employing experienced sales engineers. Box 14, *FM* AND TELEVISION.

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MECHANICALLY RUGGED . . . bellows, bearings and adjusting mechanism designed to withstand excessive use and provide long life.

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	Capacity	R-F Peak Voltage	Maximum RMS Current
VVC 60-20	10-60 mmf.	20-KV	40 amp.
VVC2-60-20 Parallel Split-stator	20-120 mmf. 5-30 mmf.	20-KV 40-KV	80 amp. 40 amp.
VVC4-60-20 Parallel Split-stator	40-240 mmf. 10-60 mmf.	20-KV 40-KV	160 amp. 80 amp.

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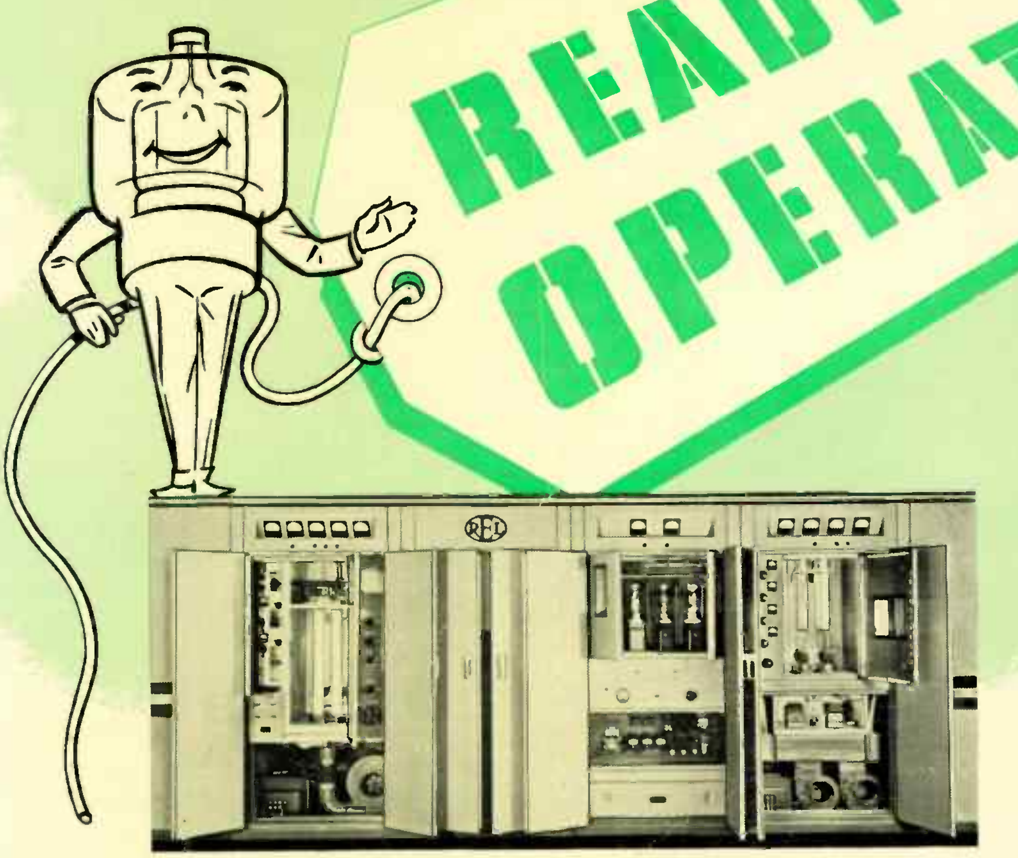

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