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FM-TV

★ *Edited by* ★
Milton B. Sleeper

850 LOUDSPEAKERS FOR MUSICAL-CEILING EFFECT

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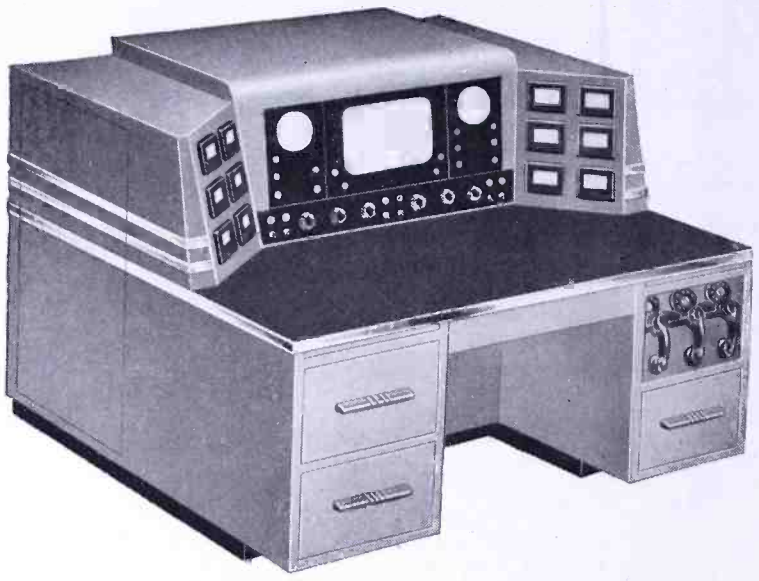
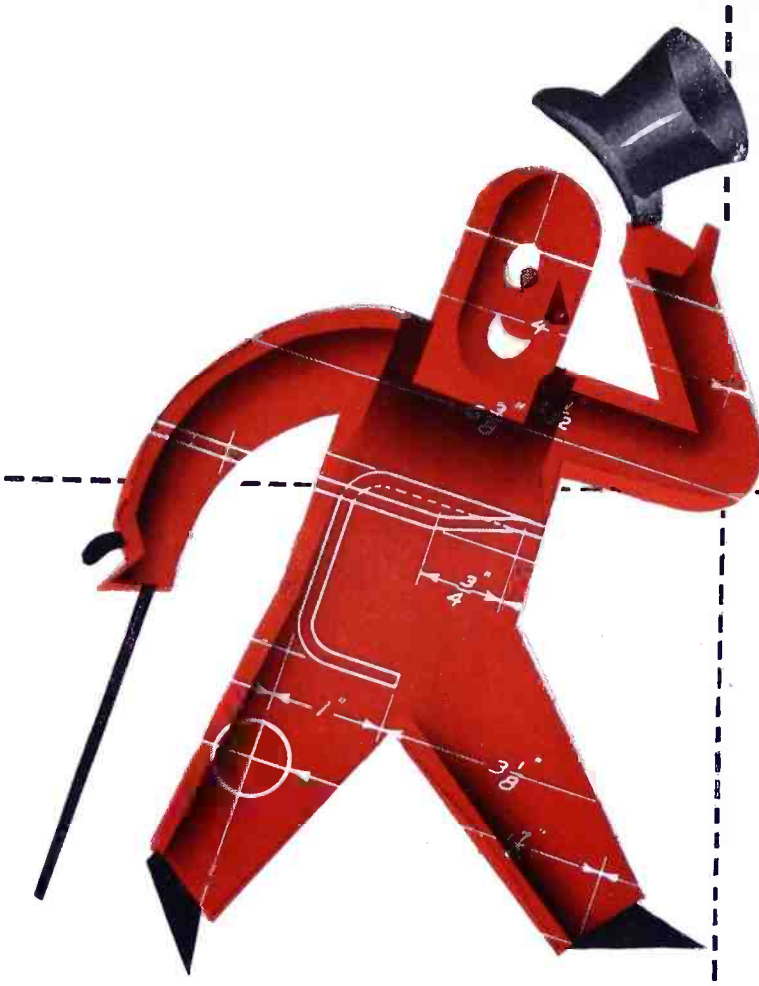
Our Hat Is Off to Television Engineers





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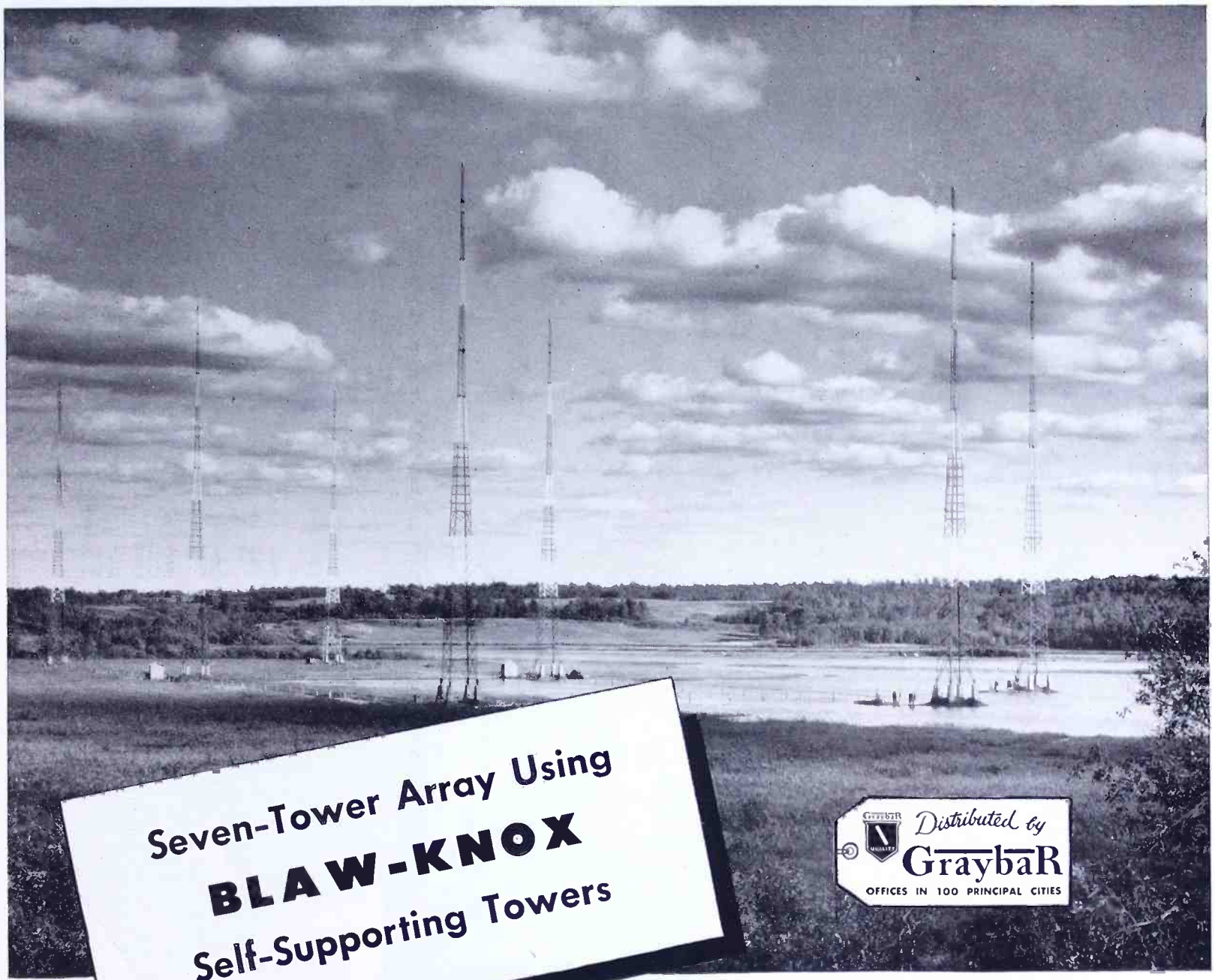
Custom Craftsmen in Sheet Metal



This seven-tower directional array was designed to protect several stations operating on the same frequency. Six towers are used during the night and the seventh, with two night pattern towers, give excellent daytime coverage. Due to the location it was necessary to place gravel fills through the ice to a depth of over 30 ft. before pile foundations could be driven to solid ground. Towers are Blaw-Knox Type CN, base insulated 225 ft. high.

BLAW-KNOX DIVISION of Blaw-Knox Company
2046 FARMERS BANK BUILDING
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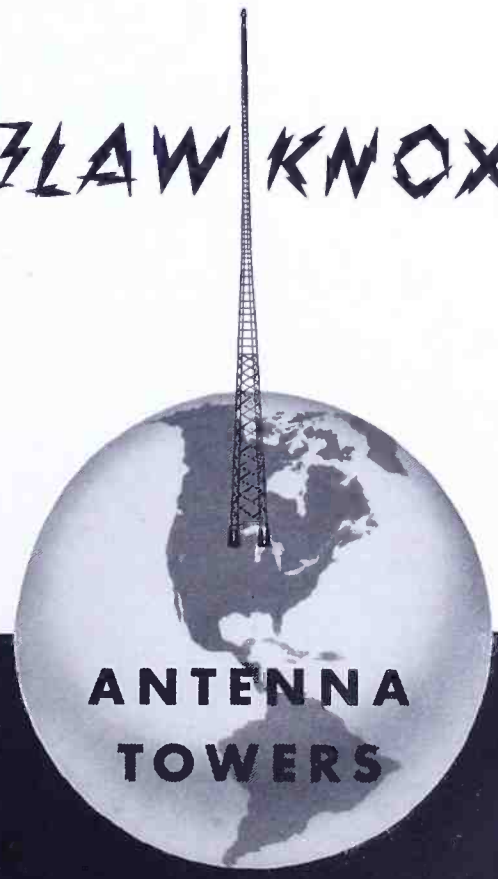
BLAW KNOX



BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY

FM-TV

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

VOL. 8 DECEMBER, 1948 NO. 12

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SPECIAL DEPARTMENTS

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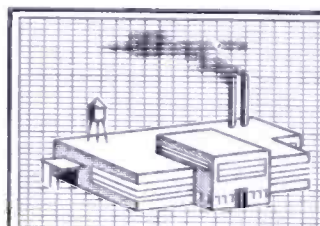


Set Production

LAST January, we said in this column: "Probability is that AM production will hover around 1,000,000 sets per month in the first half of 1948, and may drop considerably below that figure in June and July."

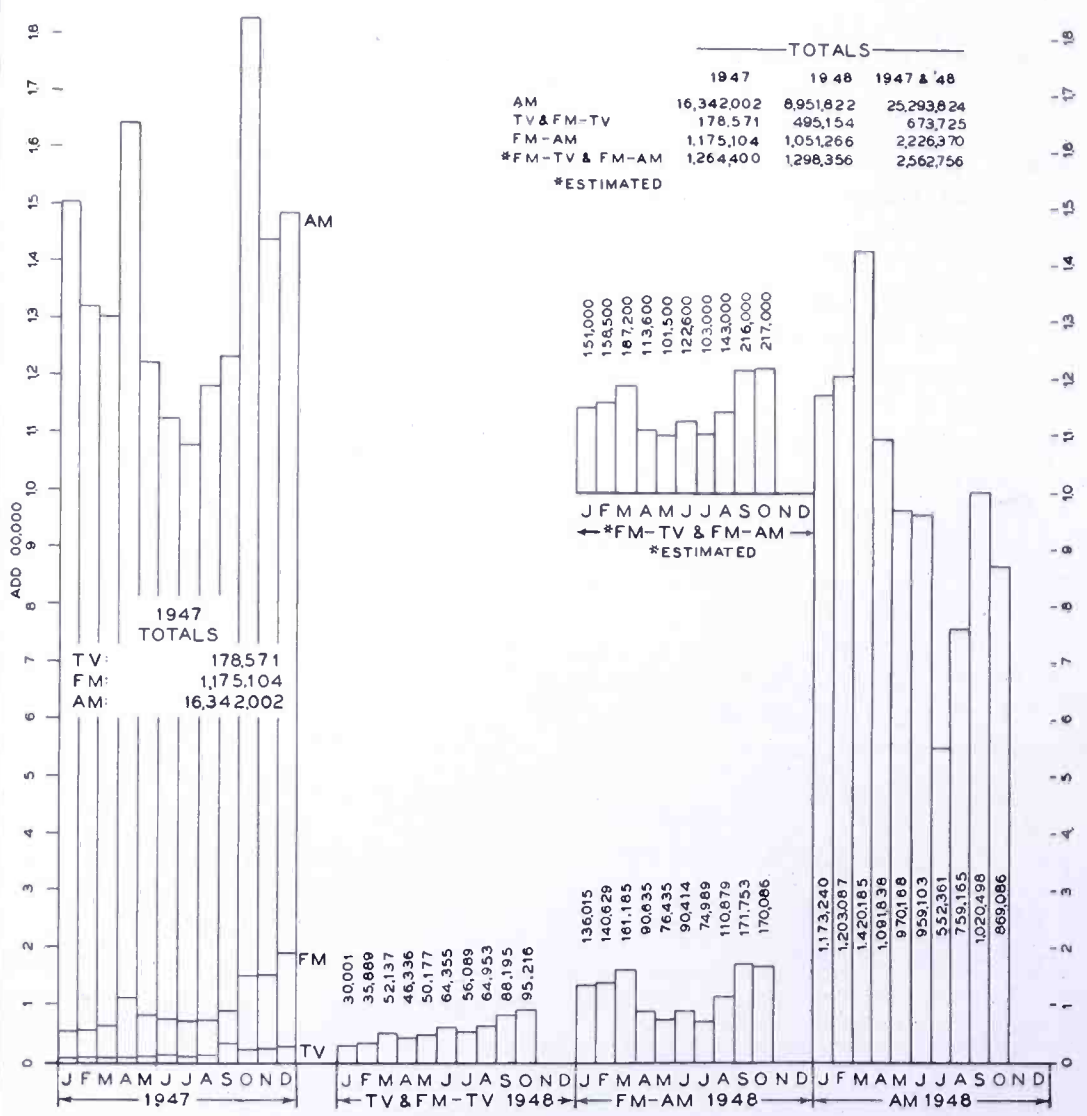
Following a spurt in the 5-week month of September, AM sets fell off to make October the third lowest month of this year. Compared to October 1947 AM production of 1,827,366 units, October 1948 is down 52%. AM sets manufactured through October '48 are 26% below the same period in '47.

TV sets were up 7,021 in October over September, and FM sets down 1,667. Actually the weekly production rate was up substantially in October for both FM and TV, because September figures were for 5 weeks.

Total TV sets produced since the beginning of last year have now passed the ¾ million mark, and FM sets are almost up to 2¼ million. From the sponsors' and the broadcasters' points of view, these represent a very considerable chunk taken out of the AM listening audience. Production of AM sets, however, represents a very small increment in AM listening. Most of those sold in the domestic market replace old sets that have been discarded, or go into homes where there are one or two AM models already.

All FM and TV sets are console or table models designed for home use, and are sold in the U. S. A. The RMA figures on AM types lump portable, automobile, and export models together with those for home use. If the latter were shown separately, the figure would be startlingly low.

Next year, another record will be presented on this page. Each new month's production figures will be represented as a per cent increase or decrease over the average monthly FM, AM, and TV production in 1948. We couldn't make such a comparison this year against 1947, because FM and TV were just starting.



FM-AM-TV Set Production Barometer, based on monthly figures compiled by the RMA

Motorola 2-way FM keeps plows on the road in constant communication with central dispatcher's office (lower right). The famous Lock-In Tube's superiority makes it the ideal choice for equipment on the road, in the air, on the rails—for marine radar, FM and television.

Motorola FM and Sylvania Lock-Ins help man the husky plows!

BATTLING through giant drifts, the snow-plows of the State of Washington's Department of Highways force their way through high, remote mountain passes to open the roads for traffic. Automotive equipment couldn't have a tougher assignment.

To keep the plows in constant touch with Department Headquarters, Washington counts on Motorola 2-way FM. And for tubes that will stand up under the most severe conditions, Motorola counts on Sylvania Lock-Ins in its mobile units. These tubes stay firmly in place, no matter how rough the going. There's no warping or weaving of elements. Connections are short and direct; there are few welded joints, no soldered ones. Top location of getters cuts down losses...separation of getter material from leads reduces leakage.

See Sylvania Distributors, or write Radio Tube Division, Emporium, Pa.

SYLVANIA ELECTRIC

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

The 1304 is *TOPS!*

TOPS in Reproduction quality—operating convenience

REPRODUCTION QUALITY? The Western Electric 1304 Set combines the 109 Type Reproducer Group with its extremely low intermodulation distortion and a unique new driving mechanism (shown in Fig. 1) that cuts flutter to a value lower than many standard recording equipments.

Even the small amount of flutter originating in the mechanism's simple gearing is damped in the novel filter of Fig. 2. Result: a flutter level, *including wow,* of less than 1/10 of 1% *at both 78 and 33-1/3 rpm.*

The platter has been isolated from the sources of rumble by means of the drive isolation coupling (Fig. 4), the fabric belt, and by mounting the entire drive mechanism on rubber vibration mounts (Fig. 3). The large drive pulleys, the use of large belt wrap around, and an adjustable spring loaded idler pulley prevent belt slippage problems.

OPERATING CONVENIENCE? Speed change-over at the throw of a switch. Acceleration to 33-1/3 rpm in *1/9 revolution*—to 78 rpm in *less than 1/2 revolution.* Rapid slowdown — no overdrive — convenient flange on platter for quick stopping.

And playing time variation is *less than ± 2 seconds in 15 minutes!*

Scientific placement of elements facilitates operation. An annular groove in the platter makes it easy to grasp edge of 10- or 12-inch records. 706A Guard provides automatic arm rest, keeps stylus from dropping on panel, catching in turntable felt, or striking edge of revolving platter.

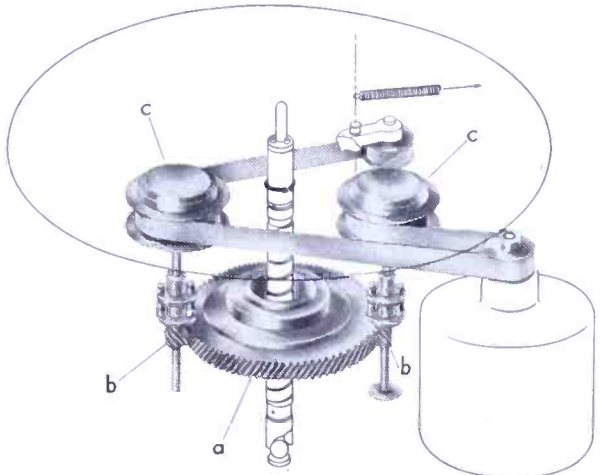


FIG. 1

A single helical ring gear (a), is permanently meshed with two pinion gears (b), each driven by an overriding clutch (c). Reversing direction of motor rotation disengages one overriding clutch, engages the other to change platter speed. Permanently meshed gears eliminate possibility of flutter caused by wear of engaging and disengaging.

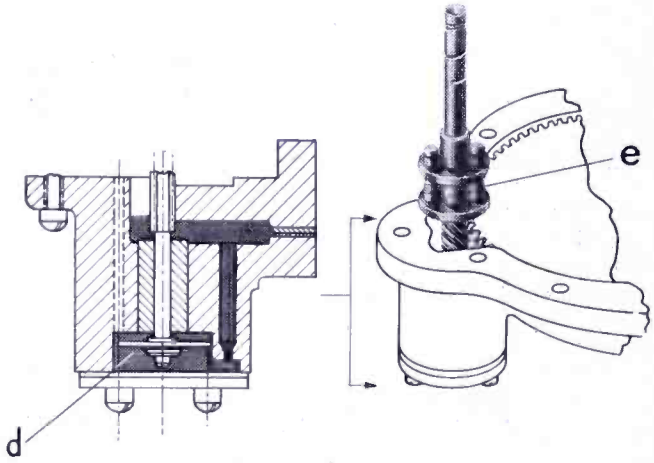


FIG. 2

As shown in cut-away view, a coupling (e) allows each pinion and associated shaft to move a short distance along its axis. The bottom of each pinion shaft projects into an oil-filled chamber (d) for damping axial motion. Because of the helical gearing and the high inertia of the turntable platter, irregularities in the drive tending to cause flutter are taken up and damped in axial motion of the driving pinion.

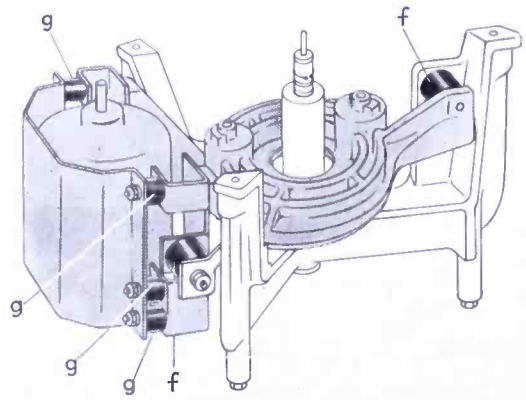


FIG. 3

The entire mechanism, including motor, floats separately from frame and platter shaft on three large rubber mountings (f). Motor, in turn, is isolated from the gear system by smaller rubber mountings (g) and the use of belt drive.

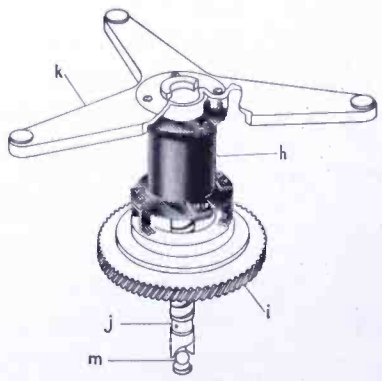


FIG. 4

Drive isolation coupling (h), provides the only connection between driving gear (i), platter shaft (j) and platter support (k), completing the separation of drive mechanism from platter. This coupling—very rigid in rotational plane, highly flexible in all others—transmits the driving motion, but isolates the rumble-causing motion. Platter and support ride on a hardened single ball thrust bearing (m).

TOPS in flexibility of installation

THE WESTERN ELECTRIC 1304 Type Reproducer Set is a single compact unit, readily adaptable to a wide range of installation requirements. It is available in a variety of cabinet arrangements to permit the greatest possible flexibility in installation.

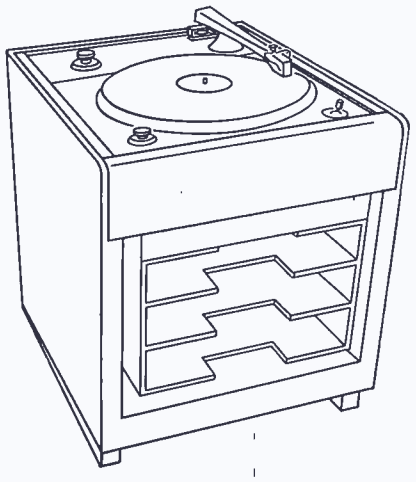


FIG. 5

The 1304 Reproducer Set. includes a floor type cabinet with or without a removable door. The 701A Shelf is available which provides record storage space (Fig. 5), or the cabinet may be arranged for mounting standard amplifying equipment (Fig. 6). In either case, additional space for equipment is available at the rear of the cabinet.

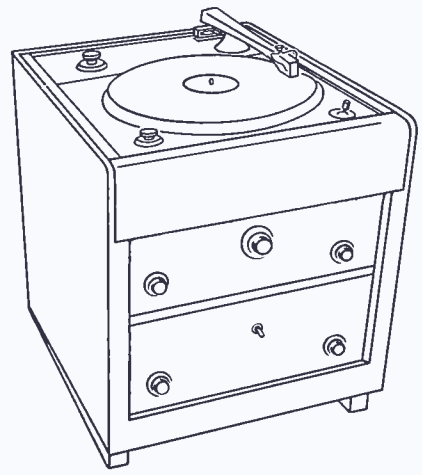


FIG. 6

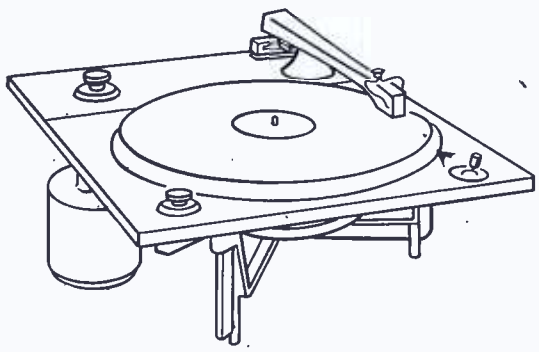


FIG. 7

If you want the superb reproduction and the operating convenience of the 1304—but prefer to use an existing table or a specially built cabinet—just specify the 304 Type Reproducer Panel. This is a complete panel unit, all ready to install, with exactly the same drive mechanism used in the 1304. The 109 Group with 706A Guard, on-off and speed-change switches and platter are all included.

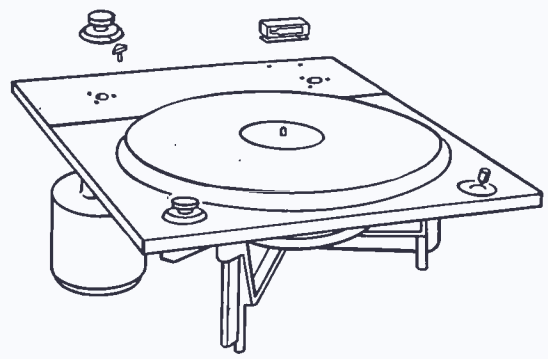


FIG. 8

You can also use the drive mechanism of the 1304 with your own reproducer group. The 305A Panel is drilled to take the 109 Type Group, and is furnished with 706A Guard, equalizer knob and the required hardware for mounting the 109 Type Group. The 305B Panel can be drilled in the field to mount reproducer groups other than the 109. (706A Guard and equalizer knob not included.)

For complete information on the 1304 Reproducer or Reproducer Group — or on the 304, 305A or 305B Panels — call your nearest Graybar Broadcast Representative. Or write Graybar Electric Company, 420 Lexington Avenue, New York 17, N. Y.

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—QUALITY COUNTS—

TELEVISION NEWS

FCC Chairman Coy: Addressing TBA conference in New York on December 8: "The achievements of the past year are made all the more impressive when we consider the hard work, ingenuity, and zeal with which the men on the firing line have overcome countless handicaps. . . . The enthusiasm, energy, and imagination thrown into their work by the men behind the scenes prove that television is not only a science and an art. It is also a cult."

TV Tax on Taverns: Pennsylvania Supreme Court has ruled that taverns showing television must pay the same fee as those showing movies since, the Court holds, TV and movies are essentially the same thing.

WMCT Memphis: Now operating on channel 4, this new Tennessee station has joined the CBS-TV net, making the seventeenth affiliate.

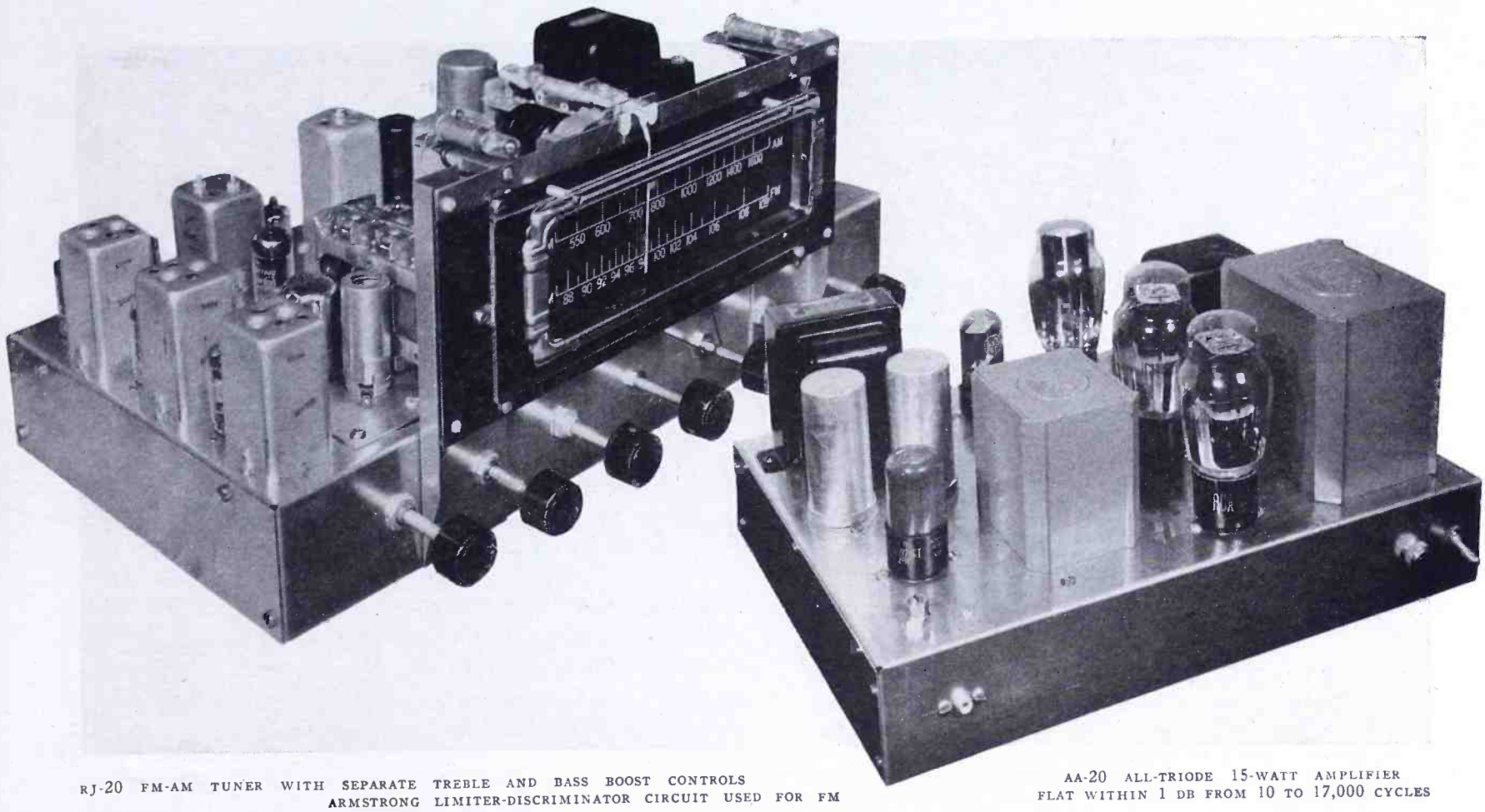
Television Data Book: Issued as an aid to DuMont dealers. Loose-leaf binder contains information on the DuMont line, tips on sales methods, typical customers' questions and the right answers, and a glossary of terms.

Better Pictures on Big Tubes: Motorola has announced the perfection of anastigmatic direct-view pictures on 16-in. tubes. Credited to Motorola research engineer Dr. Kurt Schlesinger, this invention employs a magnetic yoke outside the neck of the tube.

Manual on Projection TV: A large book of 96 pages, plus diagram inserts, has been prepared by Television Assembly Company, 540 Bushwick Ave., Brooklyn 6. Data on the model P-520 projection receiver is presented in great detail. Price is $2.50.

NBC Network Operation: When the eastern and mid-west coaxial cable network goes into operation on January 12, the "Kula, Fran, and Ollie" show sponsored by RCA at WBKB Chicago will be carried by eight east-coast stations, plus seven from St. Louis to Buffalo.

Window-Type Antenna: A very rugged TV dipole and reflector assembly for window mounting has been brought out by JFD Manufacturing Company, 4117 Ft. Hamilton Parkway, Brooklyn 19. This should be excellent at favorably-located apartment houses.



RJ-20 FM-AM TUNER WITH SEPARATE TREBLE AND BASS BOOST CONTROLS
ARMSTRONG LIMITER-DISCRIMINATOR CIRCUIT USED FOR FM

AA-20 ALL-TRIODE 15-WATT AMPLIFIER
FLAT WITHIN 1 DB FROM 10 TO 17,000 CYCLES

HEAR THE NEW BROWNING TEAM FOR HIGH FIDELITY ON FM, AM & RECORDS

Spend five minutes listening to the RJ-20 FM-AM tuner working into the AA-20 all-triode amplifier and then you'll know why we are so very proud of this BROWNING team.

Hook them up to your favorite loudspeaker and record-player. Then check the operation on your pet stations and test recordings.

Go over the FM and AM tuning: Try the variable IF bandwidth on AM. Listen to the effects of the independent treble and bass boosts. Run up as much volume as your speaker will take.

We invite you to be super-critical of the new BROWNING tuner-amplifier combination because its performance will win your unstinted praise.

If you have a sharp ear for audio quality, you are sure to be pleased with the treble and bass controls. Operating with a 2-stage amplifier on the tuner chassis, they permit completely flexible adjustment to suit your individual taste.

Each unit has its own power supply, requiring only the addition of a speaker and record-player. Data sheets FMT-12, giving complete data on this equipment, are ready for mailing now. Write for your copy TODAY.

AA-20 AMPLIFIER DATA

While the AA-20 Amplifier was designed specifically for the RJ-20 Tuner, it is ideal for use with the RJ-12A FM-AM Tuner or the RV-10 straight FM tuner. A unique feature is the power takeoff for adaptation of an external noise-suppressor and reluctance pickup preamplifier.

Life-like reproduction and minimum distortion are obtained from the use of triodes throughout. The two halves of a 6SN7GT are connected in cascade, and feed the push-pull input transformer. This feeds the push-pull class AB1 6B46 power amplifiers. Fixed bias for the output stage is developed in a bias rectifier circuit. The high-quality output transformer has adjustable impedance to match any voice coil from 1.2 to 30 ohms.

Data sheet FMT-12 shows frequency response within 1 db from 10 to 17,000 cycles. Total harmonic distortion is less than 1½%; intermodulation distortion within the amplifier is held to approximately 2½%.

BROWNING
LABORATORIES, INC.
WINCHESTER, MASS.
ENGINEERED FOR ENGINEERS

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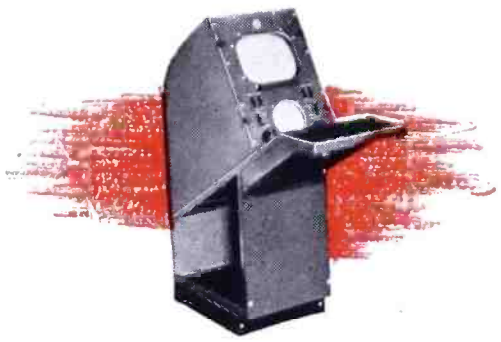
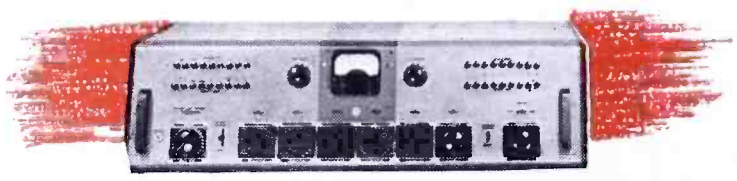
Everything for TV...

RCA De Luxe Video Console. Everything you need to monitor, control, and switch camera pictures. "Add-a-unit" design enables you to expand these facilities as your station grows.



RCA Camera Control Type TK-10A. Makes it practical to watch and control the picture quality of station camera. Same size and appearance as RCA's switching units, film camera control, and preview- and line-monitoring units. These units can be grouped in any combination to form a video console (shown above).



RCA Studio Consolette Type 76-C4. This flexible and easy-to-operate control unit performs all the audio amplifying, monitoring, and control functions of a TV station—large or small. Can be used for single- or two-studio operation, and for two transcription turntables.

THAT PICTURE you see over there is a studio control room for a medium-size television station—complete by RCA, from sight to sound.

This room virtually puts entire programming under "push-button" supervision. From here you control and monitor studio programs . . . sound and picture . . . switch between *all* cameras, switch to network or remote programs, control and monitor recorded sound, monitor the programs on the air.

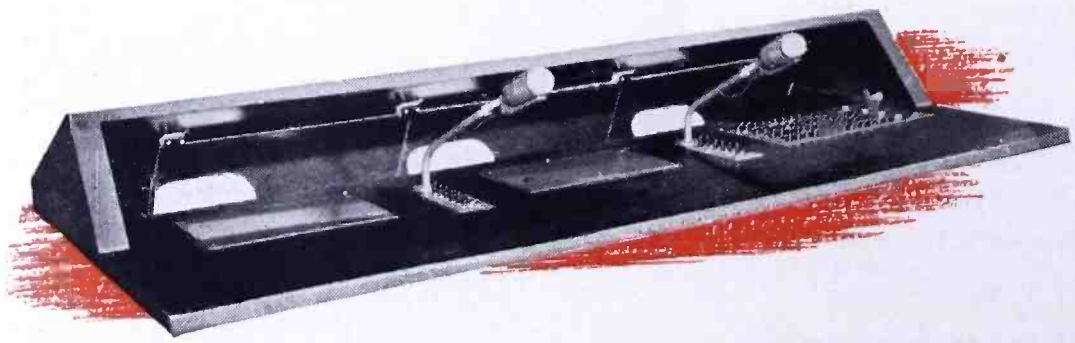
In this room are large picture monitors for previewing signals from remotes or networks and from the studio cameras. In this room also is an audio consolette that controls all program sound lines—from the studio microphones, network audio line, studio and announce microphones, and from the turntables shown in the foreground. A program console . . . with its picture monitor for viewing the studio line and the on-the-air picture . . . co-ordinates the programming. Nothing included in this room that should not be there. Nothing omitted that should be included.

Why do most TV stations go RCA all the way on studio control-room equipment?

Because RCA control-room equipment has design flexibility to meet every station's need and budget. Because RCA control-room equipment is *unit-built* . . . permits easy and economical addition of extra units without a worry about discarding the original equipment. Because a single company makes the entire line . . . *and backs it up!*

For professional assistance in planning your television station, call in an RCA Specialist. Or write Dept. 38L, RCA Engineering Products, Camden, N. J.

The One Source for Everything in TV—is RCA



RCA Program Directors Console Type TC-5A. Television's most up-to-date directors' control. Includes large-size picture monitors for the studio outgoing line, for previewing, and for "on-the-air" monitoring. All switching under finger-tip control. Low height for full studio visibility. Recessed monitors for maximum image brightness in a fully-lighted control room.

entire studio control rooms,

for instance—

Typical RCA Control Room for a TV Station
—one of more than 20 possible layouts to meet any station requirement, large or small.

1. Audio Consolette—for separate channel
2. Audio Consolette
3. Program Directors' Console
4. Video Console
5. Transcription Turntables
6. Audio Operator Position
7. Program Director Position
8. Technical Director Position
9. Video Operator Position

TELEVISION BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

THIS MONTH'S COVER

Sometimes new trends in our industry develop so quietly that they reach substantial proportions before their progress is generally realized. This is true of Stanley Joseloff's Storecast Corporation, and of the extensive use of radio reception in retail establishments. It's astonishing to think that in one store—Hess Brothers in Allentown—there are 850 speakers that bring low-level speech and music from "musical ceilings." This month's cover shows one of the six shopping floors where speakers are built into the ceilings on 16-ft. centers. More details will be found on page 33.

WHAT'S NEW THIS MONTH

1. Confusion in Terminology 2. Limiter-Discriminator vs. Ratio Detector 3. The Bankers' View of Research as an Investment

1. We'd like to contribute toward eliminating confusion in a situation where confusion is becoming worse confounded. Consider, for example, the statement: "Compared to a radio wave, a television wave is extremely short in length." This was written by our highly esteemed contemporary Jack Gould, in *The New York Times* of October 3. On the same page there was a piece by Sidney Lohman entitled "About TV and Radio." In its excellent article on "R. C. A.'s Television," *Fortune* introduced a new twist in referring to "another striking difference between video and radio.

These examples are quoted to point up the increasing misuse of common radio terms by those who seek to differentiate between the two methods of broadcasting.

Webster's New International Dictionary defines the noun "radio" as *the transmission and reception of signals by means of electric waves without a connecting wire.*

In broadcasting images, speech, or music, "radio" transmission is employed. Television is just one method of transmitting information by radio.

Imagine an article entitled "McIntosh Reds and Apples," or reading that, "Compared to chickens, Plymouth Rocks are hard to raise." Sounds silly, doesn't it?

All breeds of chickens are still chickens. A Plymouth Rock is just a particular breed. Similarly all radio signal transmission of any type is still radio. Television is just a particular kind of radio transmission.

However, we do need to differentiate between sound programs with and without images, and we need some short-form terms.

Perhaps the most convenient are "video and audio." Jack Gould would have been technically correct if he had said that waves used for video broadcasting are extremely short as compared with those used for audio broadcasting. The word "broadcasting" is used because speech relay systems and relays handling both video and audio programs are operated at wavelengths much shorter than those in the TV broadcast band.

Sidney Lohman's story might have been entitled "About Video and Audio" without causing anyone to raise a protesting eyebrow. Again, *Fortune's* story would have conveyed a more accurate idea as to exactly what things differ strikingly if they had been identified as video and audio, instead of video and radio.

If this terminology isn't nailed down now, it may get completely out of hand. Our good friend Sol Taishoff, editorializing in his *Broadcasting Telecasting*, suggests that NAB change its name to National Association of Broadcasters and Telecasters. The adoption of such a name might be gratifying to Sol Taishoff, but the correct terminology would be: National Association of Video and Audio Broadcasters. If the operator of a television station isn't a broadcaster, he must be engaged in point-to-point service, and we're sure that isn't what Sol meant!

The importance of accurate terminology was discussed at length by Duane Roller of Wabash College in the *American Journal of Physics*, March-April, 1947. He wrote:

"The role of language in a science is of the utmost importance; for not only is communication of ideas indispensable if we are to have any science, but the symbology and framework of language used in this communication are also the very tools with which we *think*. We do not think first, and then afterwards

WHAT'S NEW THIS MONTH

(Continued from page 12)

translate the results into words. Instead, clear thinking and the correct use of words are essentially the same process."

Let's clear up our thinking about television terminology, so that what we say and write will be precisely what we mean.

2. At the November 19th meeting of the Radio Club of America, Major Armstrong delivered a paper on the ratio detector. By way of introduction, he showed a diagram of the old Ultraudio circuit to illustrate how, by merely redrawing it, it becomes the familiar regenerative circuit. The difference, he explained, lay not in the circuit functions, but in failure to comprehend those functions years ago when they were the subject of the lengthy deForest-Armstrong litigation.

Then, possibly looking toward court action in his suit against RCA, Major Armstrong showed a succession of circuits to illustrate how, by redrawing the conventional diagram of the ratio detector, it can be made to appear equivalent to the limiter-discriminator circuit. He also illustrated the similarity of circuit functions with an oscilloscope demonstration.

The outcome of patent litigation is hardly a subject for speculation here, but we do have the uneasy feeling that the fact of the Armstrong-RCA suit is holding up wholehearted, industry-wide effort to produce sets that afford the full capabilities of FM reception. It may well be that this litigation is the one last source of resistance that FM must overcome in its progress toward supplanting AM for audio broadcasting.

3. Not so many years ago, bankers looked upon engineering and research, more often called "experimenting" then, as a wasteful frittering away of capital. Before the war, some radio manufacturers shared that point of view, disdainfully rating engineers as window-dressing, to be locked up behind a door marked "Engineering Department," where they would be out of the way of productive effort.

The accelerated progress of radio has changed that attitude, and competitive urgency has put a premium on engineering and research. Today, radio manufacturers employ more engineers than ever in the history of the industry.

And how do the bankers feel now? Well, the First National Bank of Boston probably expressed the current attitude of that group in its recent *New England Letter*, from which we quote the following comment:

With some of the more fundamental elements of costs such as wage rates and

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taxes virtually frozen on a high plateau, there is urgent need for relief. This can best be brought about by effective research on an extensive scale. In its broadest sense, research means "Yankee ingenuity gone scientific." Research in its scope covers all forms of activities that have to do with the discovery of new products and the improvement of old products as well as the devising of better methods, processes, and procedures.

Research covers both theory and practice. The academic institutions carry on most of the fundamental research, as this field is primarily concerned with the discovery of new theories, the extension of knowledge, and the training of men and women in scientific methods. Without fundamental research, far-reaching technical development would not be possible. While industrial firms find it necessary to do a certain amount of fundamental research, the preponderant part of their work is confined to applying research to the solution of practical problems. In many phases there is no sharp line of demarcation between the two classes of investigation because they often intermingle when pure science serves as a guide for experiments and regions to be explored for utilitarian results.

Since private concerns have payrolls and taxes to meet and materials to buy, research must pay its way, and the dollar results must be rung up on the cash register. When well organized and directed under able management, research pays large dividends. Some firms report that every dollar invested in research brings a return of fifteen dollars.

A noted scientist of a foremost American firm gives unqualified endorsement to research investment in the following words: "Because the methods which science uses, both fundamental and applied, are so powerful and certain in achieving the ends sought, money spent through well-organized research and development departments is the least risky and potentially the most profitable of all the expenditures in which industry ventures capital."

The best evidence of the profitableness of effective research is found in the record of American business enterprise. This record shows that industries which applied scientific methods and adopted modern appliances—such as the petroleum, automobile, chemical, and electrical industries—have without exception made the greatest progress and they are in the best position to deal with difficult problems in a keenly competitive age. Research has been termed the "elixir of life of industry, ever renewing its youth and vigor" which makes possible flexible adjustments. It is not a question as to

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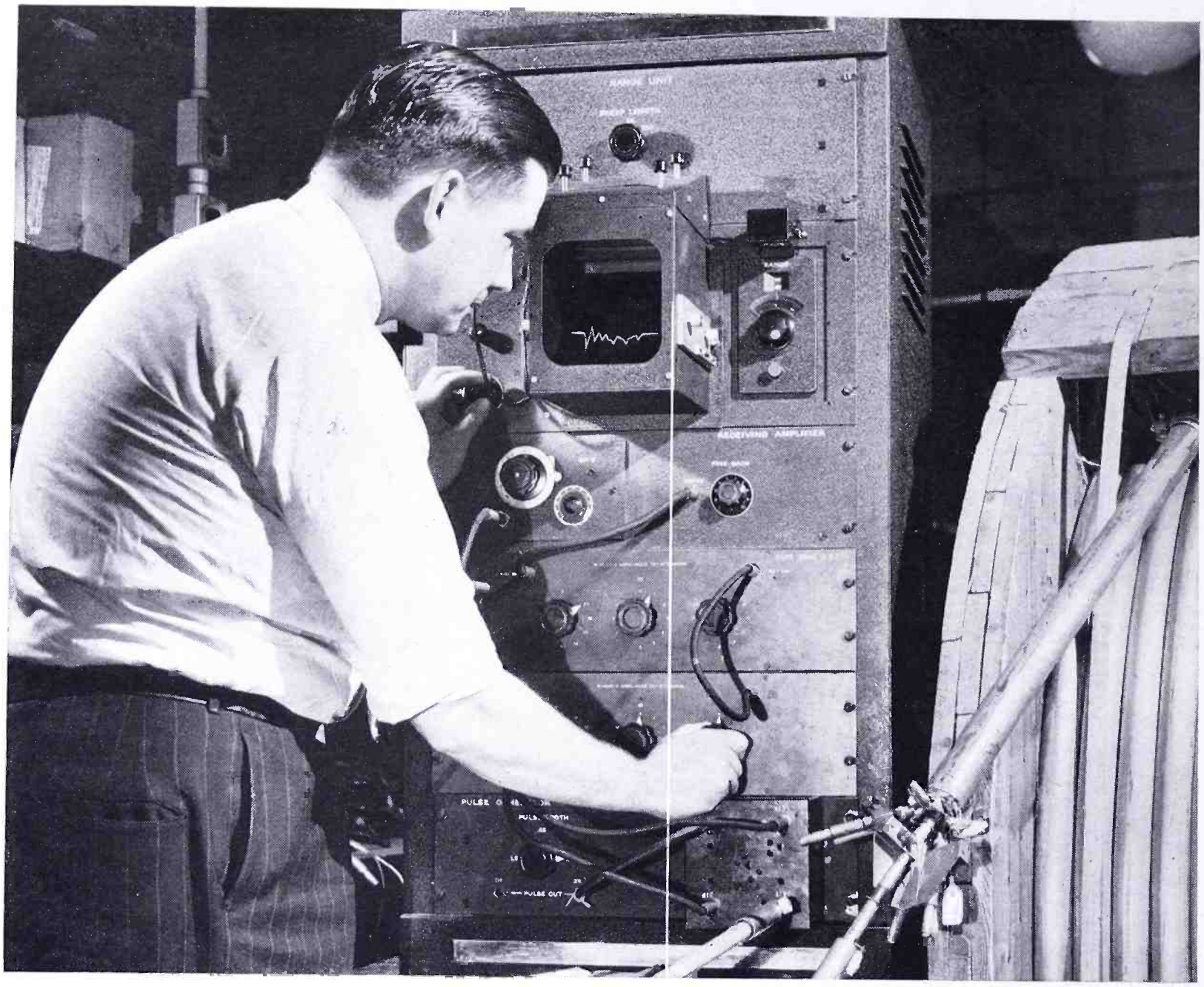
whether a firm can afford to carry on research work. Not to do so, on the contrary, is to gamble with survival.

There is a growing realization by business enterprise of the importance of research, as is shown by its phenomenal growth. During the past quarter of a century, the number of firms engaged in industrial research has multiplied eightfold, while expenditures for this purpose have increased fifteen-fold. Industry is spending currently around $750 million annually on research developments, an amount more than twice as much as during 1940. Total expenditures for research of all kinds, including the amount spent by colleges, foundations, and the Government, are in the neighborhood of $2 billion. While this seems like a huge sum, it is less than 1% of the aggregate value of our gross national product.

Great as are our scientific achievements, it is well to realize that results do not come overnight. Patience, definite objectives, careful planning and checking, as well as the selection of thoroughly trained personnel are required. It is estimated that it takes about seven years, on the average, from the test tube to commercial use of a new product. In addition to the development of new products, the principles of research can be effectively applied to all phases of business operation such as cutting production costs through new processes and methods, increasing manufacturing output, marketing, and the like. In other words, research represents better ways of doing things and, in the final analysis, reflects the strength or weakness of management.

The benefits of research are shared not alone by industry but by all workers and consumers. Technical progress is the foundation of modern civilization and largely accounts for the difference between living conditions in America and in most of the rest of the world. This development, slow at first, was accelerated with the passage of time, since scientific advances are cumulative, and took place in a spectacular manner during the last quarter of a century. Not only has research over the decades provided "more goods for more people at lower costs," but it has been the chief source in creating new jobs. In 1939, it is estimated, about one third of the total number employed had jobs that were based upon inventions, scientific discoveries, and developments. Into the relatively short period of the war there were compressed more scientific developments than ordinarily take place in decades, and these in consequence have so expanded the opportunities for work that it is reported that now "possibly 50% of all the employment in the United States is based on products which come from the research laboratories."



He asks an echo

Radar sends out pulses of electric waves which, reflected from a target, return to reveal the target's location.

Likewise, the apparatus pictured above sends electric waves over a coaxial telephone cable. Minute irregularities reflect the waves back to their origin; the echo makes a trace on an oscilloscope screen and so tells where to look for the trouble.

Telephone messages need smooth "highways" over which to travel across country: circuits able to transmit every talking frequency, without distortion. Television needs even smoother highways and at many more frequencies. So Bell Laboratories devised this method of spot-testing the cable over the entire frequency band needed for telephone or television. It is so delicate that any possible interference with transmission is detected at once. Its use makes sure that every inch of highway is clear.

This is another important example of how Bell Telephone Laboratories constantly develop finer communications for the nation.

BELL TELEPHONE LABORATORIES

Pioneers in the research of FM radio and television, and active in developing improvements in both fields today

HOW STORECAST OPERATES BY FM

A PIONEER IN SELLING CAPTIVE AUDIENCES EXPLAINS THE PART OF SUCCESSFUL STORECAST OPERATIONS THAT CUSTOMERS DON'T HEAR - *By* STANLEY JOSE LOFF*

FM broadcasters can play an important part in the development of storecasting as a new, different, and powerful medium, an all-inclusive advertising, merchandising, and sales promotion service that has come into existence because of the great advantages FM has to offer. In performing this service, storecasting will also contribute greatly toward creating public demand for the kind of radio reception that only FM can give.

It is the business of my company, Storecast Corporation of America, to perform a broad liaison service for broadcasters, sponsors, and retail stores. Public acceptance of storecasting has become known throughout the industry. The principal question put to us by broadcasters is: "How can storecast tie in with my FM operation and what's the payout likely to be?"

The best way I know to answer that is to put the facts before you, so that you can relate them to your particular situation. I'd like to give you a quick run-through on our experience up to the present time.

The Start of Storecasting:

We started operations close to three years ago in fifteen super markets in Hartford, Connecticut. We worked with a local Muzak franchiser, and piped music and transcribed announcements to the markets over leased telephone lines.

Our purpose was to reach the very substantial captive audiences the super markets offered, in the belief that here was an unusual opportunity to sell food products right at the point of sale.

We had noted the phenomenon of the super market, and how it was absorbing so many of the little grocery stores. The little store had been warm and cordial, with a friendly manager who did a lot of personal selling. The big super market was cold and impersonal, and its manager was much too busy administering his operation to have a chance to meet and know his customers.

The customers were pretty much on their own, and the merchandise, especially the outside stuff that didn't have the store's private label on it, was waging a feeble battle against anonymity, crowded by so many other items on the super market shelves.

It was pretty tough sledding at first, because we had all kinds of problems with equipment. It took a lot of doing before we knew how and where and with what to distribute our sound to get the right music and voice penetration through the strident noises of a busy super market. Further, it was tough sledding because we found we were doing only a small part of the job.

More Than Programs Needed:

To achieve real success, we had to do a whale of a lot more than merely pipe in music and announcements. That by itself didn't begin to take full advantage of the great and peculiar possibilities of this unique point-of-sale medium. We virtually had to go into the grocery business ourselves. We had to build an organization that knew intimately the fine points of super market operation, along with problems at the super market headquarters level. We had to train manpower and evolve our own methods for merchandising our sponsors' products, and evaluating space and shelf position. We had to acquire a complete knowledge of the nature and movement of each of our products and the full exploitation of tie-in possibilities—all these and a thousand other details inherent in grocery advertising, merchandising, and sales promotion.

Further, our operation differed importantly from any other medium because of the significant—and nerve-wracking—fact that our sponsors knew our results and could check them almost down to the last package. You can't inventory the grocery store on Monday morning to find out how many cans of Chase & Sanborn coffee Charlie McCarthy sold the night before. But store-by-store results of storecasting *can* be isolated.

That's why so many other attempts at this type of business had failed. The advertisers can hold us under a continuous and ruthless microscope. This situation called for setting up inventory and research methods peculiar to this type of operation, and a highly detailed system of auditing.

All of these facets of our operation took time to perfect, but ultimately we built the kind of operation and organization we needed. We set up a complete merchandising service with trained field men who became the deputies of each one of our sponsors in the super markets. It was they who saw to it that merchandise was kept in good supply at all times, that it was stacked on the shelves and not buried in the stock rooms, and that it was placed strategically in positions where it could be promoted to best advantage. In addition, they had to attend to the countless other details that go into the complete servicing of accounts.

It took plenty of blood, sweat, and tears to do all that had to be done, but I'll spare you the details.

Our basic premise proved to be right. You can do a good job of selling on captive audiences at the point of sale if—and I can't over emphasize the "If"—you are equipped with the thorough knowledge and the trained manpower necessary to work closely and intelligently with the merchants handling the products you are trying to sell.

Some Present Sponsors:

Our Company is now working with some mighty important merchants. Among them are the Country's 4th, 5th, and 6th largest grocery chains: American Stores Company, First National Stores, and National Tea Company.

Equally gratifying is the fact that there are quite a few more big and important merchants who are eager to take on our service. Our clients include some of the best names in the food industry, such as Libby, Swift, Wilson, Illinois Meat, General Foods, Coca Cola, and some 60 other national and regional accounts. And very significant is the fact that our record of renewals is excellent, understandably so, I think, because we've increased average sales of all our accounts by 60%.

FM Storecasting in Chicago:

Now for the FM part of the story, currently unfolding in Chicago. You see, we had previously operated storecasting from special studios via telephone lines. It had been our intention to do the same thing here but, tough as line availabilities are in other cities, we found conditions even worse in Chicago.

Well, as it develops now, the lack of available lines was just about the best piece of tough luck we could have had, because FM has opened up new possibilities that could never have been dreamed of with telephone lines.

Our FM operation in Chicago is set up with WEHS, Richard Hoffman's station located on top of the Banker's Building in the downtown section. We have 100 installations in National Food Stores already. Our plan is to continue to add stores in this chain as well as competitive stores in the area.

It's a deal I think Richard Hoffman will have reason to be happy about, because the programs we use for the stores will be equally acceptable in homes. In

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* President, Storecast Corporation of America, 100 Fifth Avenue, New York, N. Y.

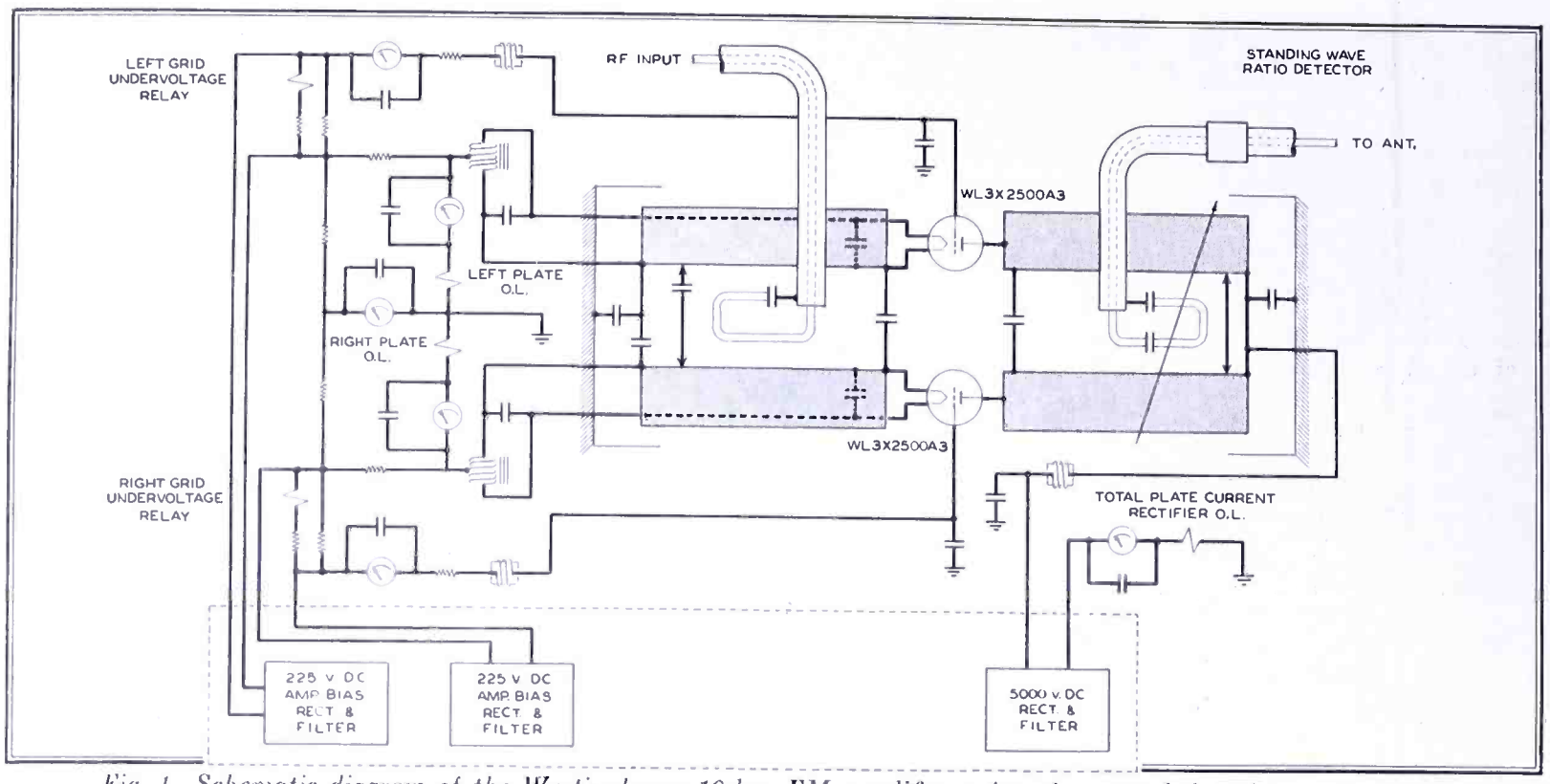


Fig. 1. Schematic diagram of the Westinghouse 10-kw. FM amplifier, using the grounded-grid type of circuit

10-KW. FM BROADCAST AMPLIFIER

DESIGN OF THE GROUNDED GRID WESTINGHOUSE UNIT, WITH TWO WL3X2500A-3'S, OPERATED AT ONLY 3,700 VOLTS ON THE PLATES—*By* J. R. BOYKIN*

AN ideal amplifier for the FM broadcast band, if such an amplifier could be designed, would include all the following characteristics:

The plate voltage would be very low. Indeed, it would be advantageous to use 115 volts as the plate supply. Such a low potential on the plate would reduce the hazard to life; it would greatly minimize design problems concerned with arc-over; and it would even make the amplifier much easier to keep clean, since high-voltage DC acts to attract and collect dust. Low-voltage wiring is much simpler, and can be run in conduit or metal-covered cable without going to excessive sizes.

This ideal amplifier would be extremely stable. It should be possible to tune it as simply and casually as one would tune a well-neutralized amplifier operating in the AM broadcast band. High stability would be realized without sacrificing gain in the stage.

The efficiency of the amplifier should be kept high. While the cost of power that is changed to heat is an important factor, the cost and trouble of getting rid of the heat is even more important. This is much more pronounced in amplifiers of 10- or 50-kw. than in smaller units. For a given power output, an amplifier having 50% plate efficiency has three times the plate dissipation of an amplifier running at 75% efficiency. Low efficiency requires a much larger cooling system. In general, the physical size of tubes is more dependent on plate dissipation than on any other factor, so if the efficiency can be kept high, the tubes will be smaller, the distributed capacities will be lower, and overall circuit design will be simplified.

The tubes in the ideal transmitter should be easy to change, and light enough to be handled conveniently by one operator. The tubes should not run at such a high temperature that they must be allowed to cool before handling. Most important is that the design of the tank circuits must be such that the tubes can be replaced without dismantling the tank circuit.

Servicing the transmitter must be easy. While it may be necessary, in some cases, to have the transmitter of very small size and compact construction, it should be roomy enough to allow easy access to all the parts.

Adequate metering, interlocks, and overload protection are needed, but gadgets should be avoided.

Incompatible Design Factors:

Unfortunately, not all of these ideals are compatible. For a given tube type and power output, lowering plate voltage below a certain point is almost certain to reduce efficiency. This is natural, because the plate current must increase to give the same power. This, in turn, causes greater tube drop and consequently more losses. High stability does not go with high gain. The very fact that the stage has high gain means that its operation is more likely to be disturbed if a portion of the output is inadvertently fed back to the input. Any design of tank circuits and tuning that is good electrically is apt to be poor mechanically. To put the tuning elements in their proper position for best electrical results usually means an awkward panel arrangement or a multitude of flexible shafts or cables. And some compromise has to be made between best electrical performance and best mechanical arrangement. This situation is further complicated by the necessity of being able to get at the tubes easily.

A Method of Compromise:

These incompatibilities can often be alleviated by introducing or altering a third factor. Even though it is impossible to attain an ideal design, by taking advantage of newer approaches to the problems the conflicts can be resolved.

In the 10-kw. Westinghouse amplifier shown here, many of the problems were solved in just that manner. In the past, 10-kw. amplifiers have usually operated with 8,000 volts or more, even at low frequency This was considered necessary to keep the efficiency high. In this grounded-grid amplifier, the plate volt-

* Section Engineer, FM Transmitter Section, Westinghouse Electric Corporation, Baltimore.

Below: door in tank compartment provides access to tubes

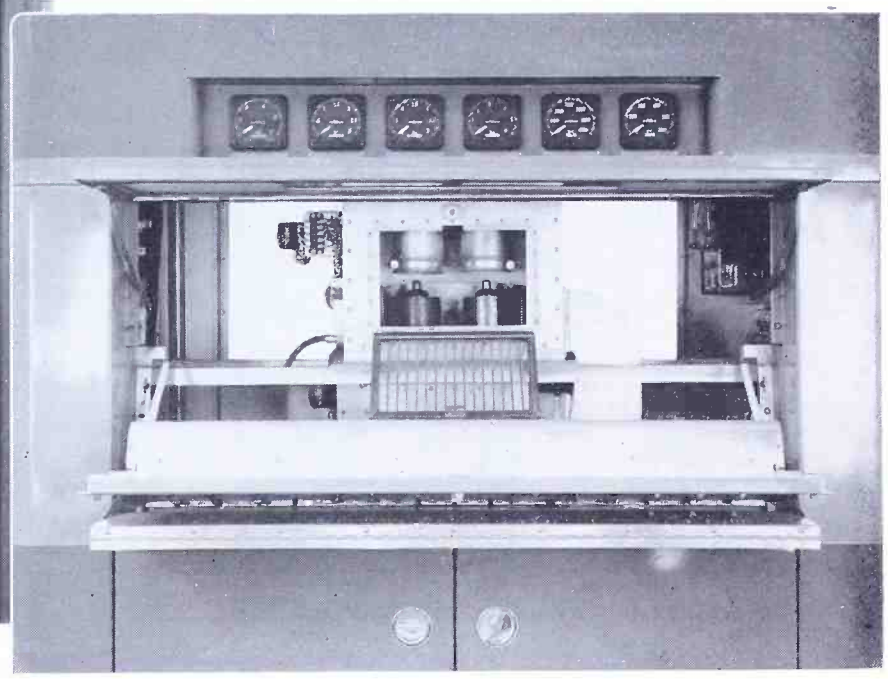


Fig. 2. Complete driver, rectifier, and 10-kw. amplifier

age is only 3,700 volts, yet an apparent efficiency of 100% is realized in the band of 88 to 108 mc. The next factor varied in this case was the transconductance of the tubes. The tubes used are type WL3X2500A-3 triodes, which have very high Gm. The use of such low plate voltage and high plate current requires that the design of the tank circuit have low-impedance elements in order to keep the kva.-to-kw. ratio high enough to have good wave form and consequently good efficiency in the stage. Another factor which makes it important to keep the tank circuit elements low in impedance when distributed constants are used is the necessity of having the physical length of the tank lines sufficient to provide a good circuit for coupling. Of course, there is a low limit to the impedance of the lines where side-band clipping takes place. However, the maximum band width is less than .3%, and it is unlikely that the kva.-to-kw. ratio would be high enough to cause any appreciable distortion with a reasonable configuration of tank lines.

The plate tank lines, Fig. 3, are of 4-in. pipe, spaced slightly less than 2 ins. apart. The lines are enclosed in a metal box with the walls less than 4 ins. away, further lowering the surge impedance. It will be noted that the diameter of the pipe is the same as the diameter of the radiator of the amplifier tubes, thus causing the radiator to be a continuation of the transmission line. The use of such a low-impedance line keeps the waveform near enough sinusoidal for good efficiency, and makes the tank lines long enough for good coupling. For 88 to 108 mc., the length of the plate tank, including the tube radiators, varies from 18½ down to 12½ ins.

Naturally, the use of a low-impedance tank causes high circulating current. The amplifier was designed for series feed so that this current would not be passed through coupling capacitors. The shorting bar is used only for setting the approximate frequency, and the fingers are then clamped tightly to the lines. Tuning is then accomplished by a variable capacitor which serves as a trimmer.

Coupling to the output transmission line is accomplished by a pickup loop positioned by an electric motor drive, as shown in Fig. 4. This pickup is unique in that there are no sliding connections to wear or burn. The actual high-frequency connections to this loop are made capacitively at both ends. This is a very important point, since the position of this loop may be varied often to compensate for changes in load impedance with weather conditions.

The cathode tank is of similar construction to the plate tank. A movable shorting bar sets the approximate frequency, and final tuning is accomplished by means of a motor-driven capacitor.

In the matter of stability versus gain, it was felt that the high stability and smooth operation of a grounded-grid amplifier was more important than high gain. This is especially true when one considers the status of allocations in the FM broadcast band. At least temporarily, it is necessary to use a building-block scheme, because a station may go on the air initially with less than full authorized power. Since the standard ratings set by the FCC are 250 watts, 1 kw., 3 kw., 10 kw., and 50 kw., it is almost necessary that any transmitter, except in the low power ratings, be capable of conversion to the next higher rating by the addition of an amplifier stage. This requires a power gain of 3 to 5 per stage, and is easily realized in a grounded-grid amplifier. The amplifier described here requires 3-kw. drive for 10-kw. output.

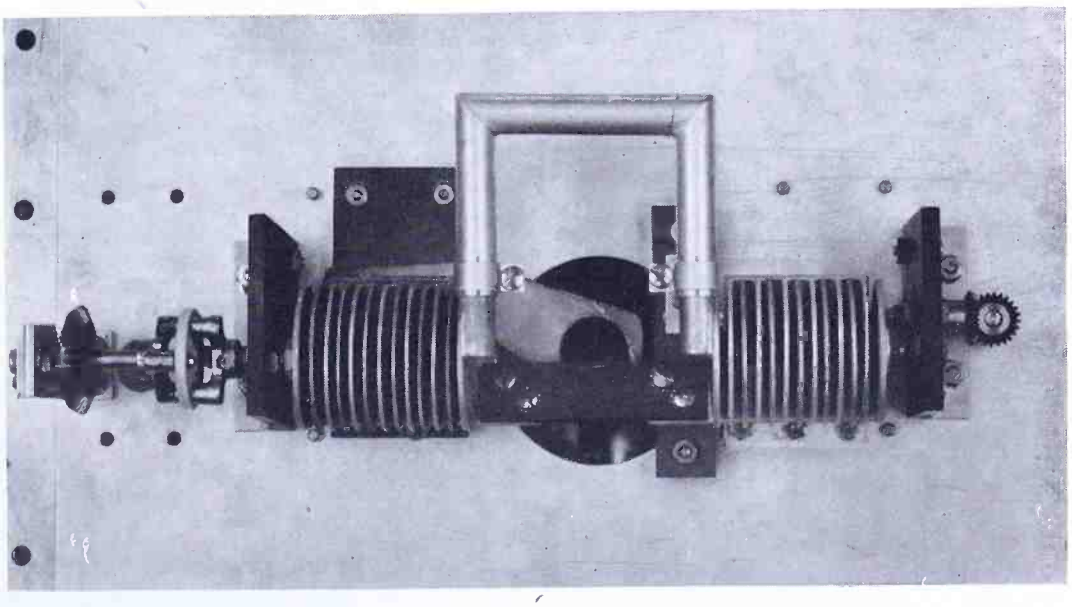


Fig. 4. Unique motor-driven pickup loop has no sliding connections to wear or burn

The inherent stability of the grounded-grid amplifier is enhanced by the use of tubes having a ring grid connection. This type of tube construction allows the grid to be by-passed to ground effectively, and

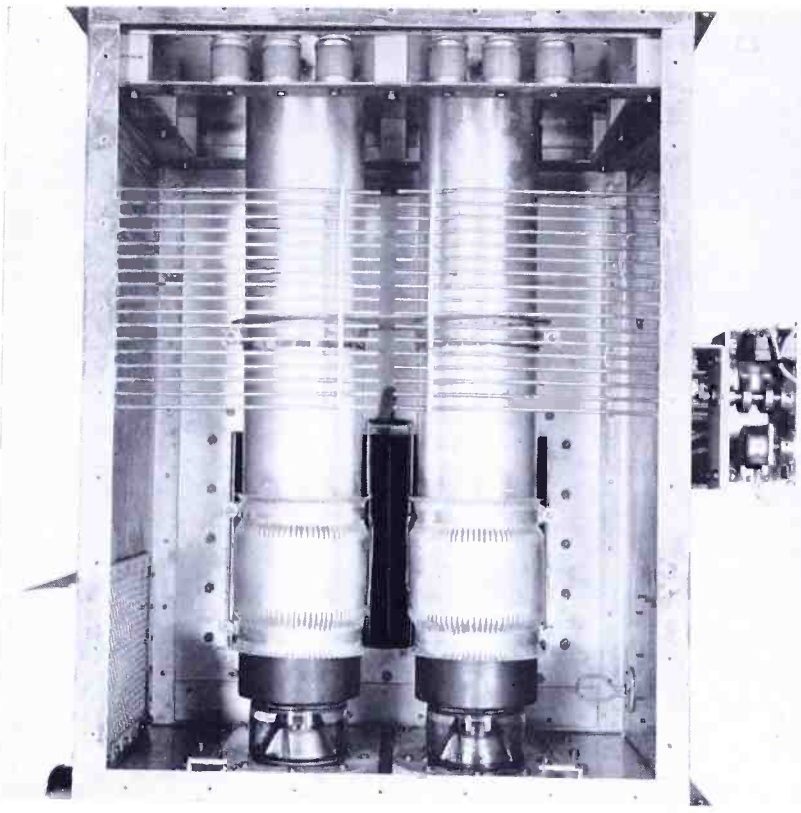


Fig. 3. Surge impedance is lowered by careful tank line design

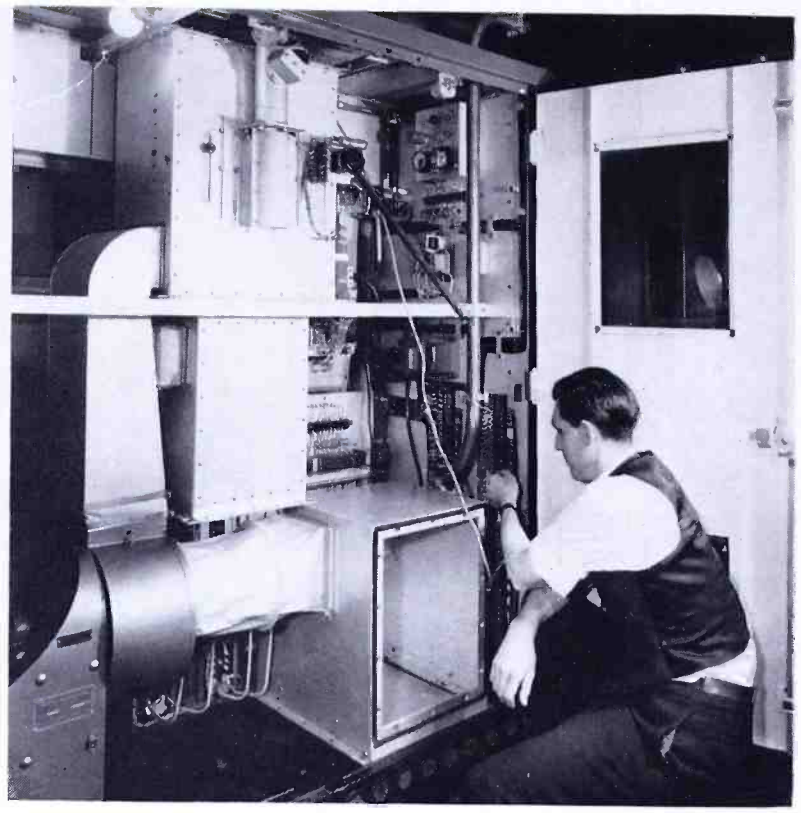


Fig. 5. Full-width doors give entrance to the rear of cubicle

obviates the need for neutralizing. With the amplifier so constructed and mounted in the shield box, the overall stability is comparable to that of an amplifier operating in the AM broadcast band.

The problem of mechanical versus electrical arrangement has been solved by using motor drives on all tuning elements and variable couplings. This allowed placement of the tuning elements for optimum electrical performance, and the controls in the logical position from the operating standpoint. Each control is located on the front panel where it can be adjusted while the operator observes the meters. Position indicators, mounted directly over the controls, consist of a small voltmeter calibrated in arbitrary units 0-100. A potentiometer on the tuning element causes the voltmeter to indicate relative position.

Access to the tubes is gained through a door in the plate tank compartment, as shown in Fig. 2. The tubes are light in weight and easily handled. Due to the high efficiency of the amplifier, the tubes run so cool that they can be handled with the bare hands as soon as the power is turned off. It is not necessary to wait for them to cool.

Servicing a transmitter of this construction is very simple. Large doors, Fig. 5, give entrance to the rear of the cubicle, while a window and drop-down control panel give access to the front. Another advantage of the drop-down control panel is the ease with which the control switches can be cleaned.

Large 270° meters are provided at the top of the amplifier. These include a reflectometer which serves to show the voltage standing wave ratio on the output transmission line.

Fig. 2, at the left, shows a complete transmitter installation, comprising a 3-kw. driver on the left, the main rectifier for the final amplifier in the center, and the 10-kw. amplifier at the right.

STORECASTING

(Continued from page 17)

the first place, he will receive substantial advertising revenues through storecasting. In the second place, I think he is going to find many rich rewards above and beyond the revenue he gets from storecasting

WEHS will reach very substantial audiences in the market—close to a million people a week in the initial 100 stores, with more to come as we complete additional installations. The station will have on its roster some of the greatest names in the food industry. A lot of agency time-buyers are going to get to know WEHS very well, and a lot of people in the metropolitan Chicago area are going to be very familiar with the 97.9-mc. spot on their receivers.

As a result of Storecast programs, I sincerely believe this station will sell a substantial amount of time in the evening hours and in other periods not devoted to our advertisers.

Moreover, I think the best interests of FM generally will be served by this effort. I daresay that plenty of women are hearing FM for the first time while they are buying their groceries, and we're not missing any chances of letting them know they're listening to the new and better kind of broadcasting.

We shall reach the distaff audience principally, for storecasting will run from 10:00 a.m. to 1:00 p.m., and 2:00 to 6:00 p.m.

Programs are mostly music with news, weather reports, and occasional recipes and household hints. Music is good, middle-ground fare, largely instrumental, neither too jivey nor too formal.

Over the years we've evolved quite a successful formula for effective 20-second announcements. We don't use jingles, sound effects, or trick attention-getting devices. They are forthright, point-of-sale reminders that many customers appreciate as a service. Further, we use a related-selling technique, grouping compatible products. This has proved effective for tie-in sales. It's also a swell way, incidentally, to sell 3 separate products in a 1-minute commercial.

Plans for Expansion:

Now there, as briefly as I could tell them, are the salient facts. As to future plans, we intend to convert all of our present operations to FM within the near future. We have concluded arrangements with FM station WMMW Meriden, Ct., and will have one in Philadelphia shortly. The New York area will probably be the next new development, with others to follow.

We are ready to discuss operations in other metropolitan areas. I have to stress *metropolitan* areas because, as we see it, this type of operation will pay out best in areas where there is a heavy concentration of markets. You will note I say markets, not merely super markets, because I believe storecasting can work successfully in any large stores where there is substantial traffic and where customers spend an appreciable amount of time. Storecast can work successfully if—and here comes that "if" again—the basic premise of our super market experience is followed.

WHAT HAPPENED TO FM FACSIMILE

HOW THE DEVELOPMENT OF BROADCAST FACSIMILE WAS STOPPED BY THE FCC'S ESTABLISHMENT OF 8-IN. TRANSMISSION STANDARDS—*By* MILTON B. SLEEPER

OF all the strange actions by the FCC in recent years, one of the most amazing has to do with facsimile broadcast service. The preliminaries excited only limited interest, the action was given little attention in the public press, but the end result was to bury facsimile under six feet of sod.

The background story can be found in past issues of this Magazine. Facsimile has been called the poor man's television because instruments had been developed and prepared for manufacture that could be retailed for $100. To be sure, such equipment could not deliver the equivalent of rotogravured bathing beauties, but it could convey important news, information, line drawings, and cartoons.

The instruments were designed for connection to any FM receiver delivering 3 to 5 watts from a 500-ohm output. Now, the paper width for these home facsimile recorders was arrived at as an optimum compromise of recording-signal frequency, which is a controlling factor in the cost of the operating circuits, the characteristics of low-priced home FM receivers, operating power available to actuate the recorder, paper cost, and the manufacturing cost of the recorder itself and particularly the driving motor.

These factors added up to the use of 4-in. recording paper. Months of testing and experimenting with programs planned in the public interest showed that the 4-in. recorder could perform an important service, particularly in rural areas where, incidentally, FM broadcasting has won particular favor.

This work was done by Milton Alden of Alden Products Company, in Brockton. An aspect of this situation that must be borne in mind is the fact that Alden Products, a long-established manufacturing concern had tooled up for the $100 4-in. recorder, and had complete production facilities available.

Very complete details of the Alden recorder were presented in a booklet entitled "Questions and Answers about Facsimile." One of the interesting points brought out concerns the very narrow frequency band employed to operate the recorders. Only 3,000 cycles wide, using double side bands, the facsimile modulation can be added to FM broadcast signals at the upper audio range, and transmitted simultaneously with audio programs. The circuits employed for duplexing are simple and inexpensive. Operation in this manner was demonstrated at the NAB convention in Atlantic City, September, 1947, using transmission from station WCAU-FM Philadelphia.

A threshold limiter was also developed to prevent small random noises from interfering with the recorder on very weak signals.

In short, the 4-in. Alden recorder was a highly-perfected, commercial product, ready to be marketed.

Meanwhile, attention of the newspapers was called to facsimile as a potential competitor in the distribution of news and pictures, as well as cartoons. An organization called Newspaper Publishers' Facsimile Service was formed, financed by contributions from interested newspapers, and headed by John V. L. Hogan whose station WQXR is now owned by *The New York Times*.

NPFS undertook the development of its own facsimile recorder. Lacking either the organization or the facilities for manufacturing, the NPFS equipment was of purely developmental design. A few scanners and recorders were built at very great expense. They were obviously not intended for sale to the general public, but suited only to demonstration purposes.

The recorders were designed to use 8-in. paper, and to reproduce photographs with a degree of detail substantially superior to newspaper printing. With the same relation of information to recorder cost that applied to the Alden design, the indicated retail price of the NPFS model was in the neighborhood of $600.

At such a price, it is obvious that it could not be sold for home use. Practical marketing experience in the radio field indicates that a facsimile recorder must be priced substantially below the smaller television sets. That is out of the question with an 8-in. design.

Moreover, the NPFS type cannot be operated from the output of the average FM broadcast receiver. NPFS has never given out specifications for a suitable receiver, but repeated efforts to find out did, eventually, elicit the information that "The mark obtained from any but the very best sets is apt to fall short of the optimum density of blackness, since to produce an adequate black mark an output of about 15 watts is necessary. . . . The audio characteristics of some sets fail in the high frequencies, and so produce the inferior copy that is characteristic of a low-frequency subcarrier."

From this it can be inferred that most FM sets will not operate the NPFS recorder, and the cost of a special amplifier must be added to the recorder itself.

All this information was available to the FCC when it was asked to set transmission standards for commercial facsimile broadcasting. The score for the two types of machines can be set up in this fashion:

	4-in.	8-in.
1. Is it priced for popular sale?	Yes	No
2. Can it be operated directly from the average home FM set?	Yes	No
3. Can it convey enough information to perform important public services?	Yes	Yes
4. Can it transmit photos?	No	Yes
5. Can it transmit type and line drawings?	Yes	Yes
6. Can it be duplexed with sound programs?	Yes	Yes
7. Can it operate on very weak signals?	Yes	No
8. Can it be started by a special signal from the broadcast station?	Yes	Yes

On the basis of this information, the FCC established the 8-in. paper width as standard. To understand the end result of this decision, it is necessary to ask and answer two other questions: 1) What advantage does the 8-in. recorder offer to the public over the 4-in. type? 2) What decision on the part of the FCC would eliminate facsimile as a potential competitor to the newspapers?

Whatever the process of reasoning, the FCC settled on the 8-in. width as standard. There was some explanation that 8-in. transmission could be received on 4-in. recorders. To anyone experienced with facsimile, that would mean reception of type on the 4-in. machine so small it couldn't be read.

That's the story of home facsimile at the present writing. It's the end of the story, unless the Commission has a change of heart. Maybe the FCC thought that facsimile couldn't be a success if it didn't reproduce photographs of bathing beauties. It hardly made sense to choose a system priced beyond public buying power, proposed by a group with neither production facilities nor any plan for having the recorders manufactured. But that is exactly what the FCC did. Certainly, if the Commissioners wanted to do the newspapers a favor, and stop facsimile before it ever started as a commercial enterprise, they couldn't have adopted a more effective method than to standardize on 8-in. recording.

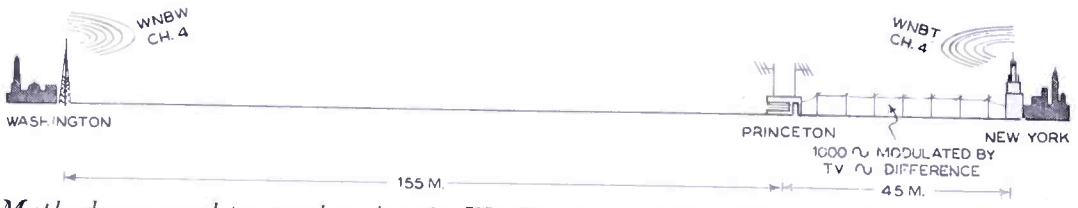
Anyway, there are the facts. You can draw your own conclusions.

SPOT NEWS NOTES

NOTES AND COMMENTS ABOUT SIGNIFICANT ACTIVITIES OF PEOPLE & COMPANIES

WNBT-WNBW Synchronized:

To eliminate horizontal bars on TV screens caused by co-channel interference between WNBT New York and WNBW Washington, RCA has set up a highly successful synchronizing system. As illustrated here, the stations are picked up at Princeton on separate receivers. The difference frequeny is used to modulate 1,000 cycles transmitted by wire to WNBT. This is applied to a frequency discriminator circuit, from which a DC voltage is applied to a reactance-tube frequency control on the WNBT transmitter. At present, for test purposes, the synchronizing control is cut off for 1 minute at the beginning of each 15-minute period.



Method now used to synchronize the Washington and New York stations on channel 4

So successful is this method that RCA expects that co-channel stations can be operated with 150-mile separation and still provide interference-free reception over their full, assigned coverage areas. Similar controls can be used for a string of stations on the same channel. Idea was conceived by Ray D. Kell, head of the TV section of RCA Laboratories.

Dr. Harold A. Zahl:

Named by Brig. General F. H. Lanahan, acting for Chief Signal Officer Major General Spencer Akin, to fill the newly-created position of Director of Research at the Signal Corps Engineering Laboratories, Ft. Monmouth, N. J.

Frank M. Folsom:

Elected president of RCA, succeeding Gen. Sarnoff, who will continue to serve as chairman of the board. John G. Wilson was elected executive vice president in charge of the RCA Victor division, the post formerly held by Mr. Folsom.

English Licensee:

Six English companies manufacturing phonographs and records, all subsidiaries of E.M.I., will use the H. H. Scott Dynamic Noise Suppressor under a license agreement signed recently in London.

The Salesman Has an Answer:

A little while back, dealers were selling FM-AM sets with the promise: "If you buy an FM-AM model now, you'll be ready for FM when we have service here. Now we find that some dealers in rural sections are saying: "Get a TV-FM set now. Then you'll be ready for TV when there's a station in this area."

Full Time for WGHF:

Finch station in New York has gone on full-time schedule. Added feature is facsimile transmission of weather maps at 5:55 A.M. and 9:35 P.M., originating at the U. S. Weather Bureau.

FCC Chairman Coy Predicts:

"Most of the 74 TV stations now under construction will be completed during the coming year. That will give us a total of more than 100 stations actually in operation by the end of 1949."

More TV Production:

Freed-Eisemann is readying a line of TV-FM-phono models for introduction early in '49. Designs using 12- and 16-in. tubes have been developed under the direction of Joshua Sieger.

New Speaker Plant:

James B. Lansing Sound, Inc., has moved to a larger factory building at 1801 Haywenhurst Avenue, Van Nuys, Calif.

WLRD Joins Continental:

Rangertone tape equipment has been installed at the 13-kw. Miami Beach station to handle 15,000-cycle programs recorded at Washington. WLRD will serve as a key station for a regional radio net carrying Continental programs.

"'M' boy, your father produced the finest pictures shown on television today!"

Leonard Mautner:

Former chief transmitter engineer at Du Mont is vice president of newly-organized Television Equipment Corporation, 238 William Street, New York. First equipment to be produced is a low-cost TV camera. Chief engineer of the company is William Brown, formerly of RCA Laboratories.

Transcription Facilities Bought:

K. R. Smith, former vice president of Muzak, has purchased the manufacturing facilities of World Broadcast System. The new concern, to be known as K. R. Smith Company, Inc., is located at 619 W. 54th Street, New York.

FM Program Deal:

Stanley Rosensweig, of long-established Sun Radio Company in Washington, has contracted with WASH for 52-week, 5-hour Sunday Musical Festival program. This treat for FM listeners will be tied in with promotion of Capehart instruments.

Robert W. Galvin:

Son of Motorola's president Paul V. Galvin, has been appointed executive vice president, filling a post left vacant since the death of co-founder Joseph E. Galvin in 1944.

FM Time-Block Sold:

Rice's Fashion Corner has purchased 6 hours a day, Monday through Saturday, beginning at 5:00 P.M., on WLOW-FM. Sale was made two weeks after station went on the air, and puts this FM operation in the solid black.

Export Representation Wanted:

Fairchild Camera & Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, N. Y., is seeking additional export market representation for their studio recording and amplifier equipment. Inquiries should be addressed to L. F. Hovey.

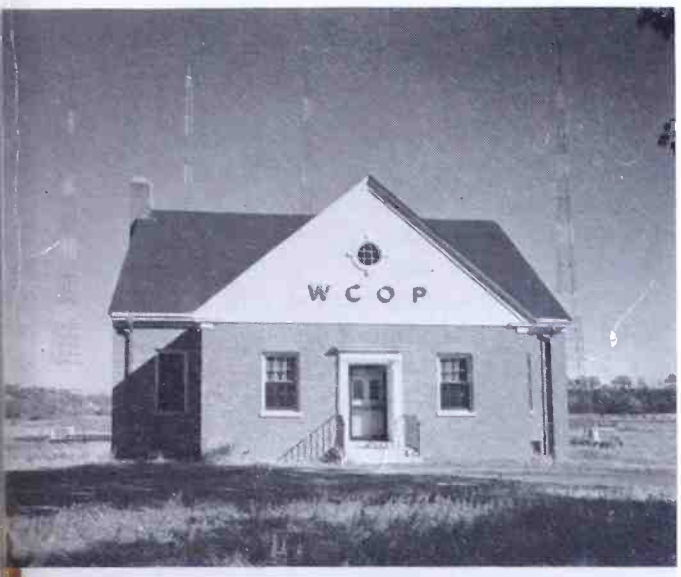
Dr. Wilfred Roth:

Former chief physicist of Rieber Research Laboratory has joined Harvey Radio Laboratories, Cambridge, Mass., as development division group leader.

New Address for FMA:

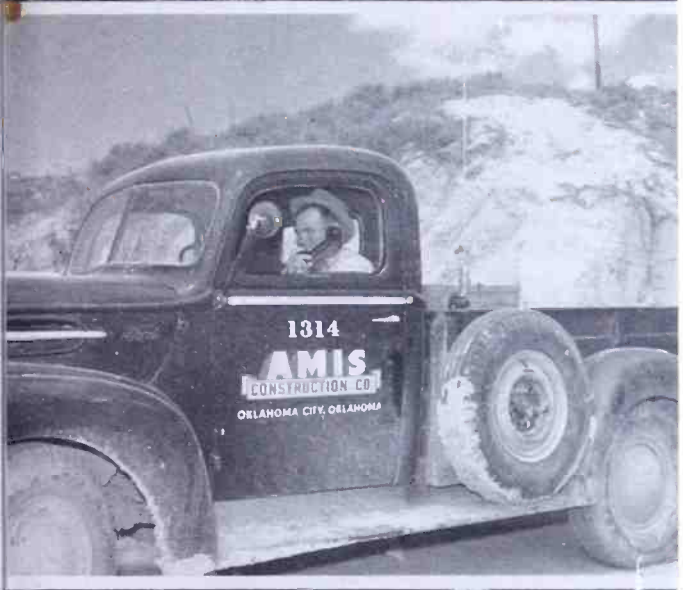
Offices of the FM Association have been moved to 526 Dupont Circle Building, Washington 6, D. C. Phone is Hudson 7170.

NEWS PICTURES



LEFT: The Cowles FM installation at Lexington, Mass., represents an investment of $100,000. It is on the air with 20-kw. radiation from 6:00 A. M. to 1:00 A. M. The solid coverage range is about 65 miles.

Two-way FM saved lives and dollars when a flash flood suddenly raised the water level at the Medicine Dam project on Republican River, Nebraska. Radio calls quickly brought men to protect cofferdams and to move equipment to high ground. System uses eight G. E. fixed and mobile units.



Meridith-Syracuse Television Corporation is rushing completion of a G. E. transmitter to operate on channel 8. Capt. Bill Eddy, right, director of operations, is working with G. E. executives T. F. Bost, Paul Chamberlain, and WJTV chief engineer Gene Crow, standing.

Citizens Radio Corporation, Cleveland, is now in production on this UHF transmitter-receiver. Total weight, including batteries, is only 2½ lbs. It provides phone communication over a range of several miles.

RIGHT: REL's Serrasoid modulator was introduced officially to consultants and FCC engineers at Washington last month. This picture shows inventor James Day, chief engineer at REL, answering questions from pipe-smokers Stuart Bailey, FCC's FM Section Chief Cy Braum, and Everett Dillard.

Pittsburgh Plate Glass has evolved new techniques and special glass for sealing flat face-plates on 10- and 12-in. cathode-ray tubes. Result is described as greatly reducing labor and simplifying production.

KRON-FM San Francisco will carry a 5-hour daily program for Philco and its dealers. Signing the contrac are, l. to r., R. E. Crane of Thompson & Holmes; Norman Louvau, KRON-FM; C. S. Bettinger, Philco; Standing, T. W. Kirby, Philco; N. J. Etienne, T. & H.; and Al Constant, KRON-FM.

Antenna rotator selling under $40 has been announced by Alliance Mfg. Company, Alliance, Ohio. Operating on 110 volts, 60-cycles, this unit is designed to carry a weight of 20 lbs. Approximately 1 minute is required for a complete rotation.

Zenith's first TV models are now in production. Particularly interesting feature is the "Giant Circle" tube mounting, in place of the conventional rectangular opening. All models have a connection for Phonevision. Prices range from $389 to $1,150.

The use of dual speakers gives considerable improvement in the tone quality

TV RECEIVER DESIGN

DESCRIPTION OF THE CIRCUITS IN THE NATIONAL NC-TV7 TELEVISION RECEIVER — *By* JACK IVERS*

THE development and manufacture of television receivers is something of a departure from long-established precedent at the National Company, for our organization has always been devoted to communications equipment, as distinct from sets intended primarily for home entertainment.

On the other hand, our particular experience with circuits and design refinements has taught us many tricks. Moreover, we are old hands in working with frequencies in the television band.

Our first TV model, type NC-TV7, is illustrated here. The chassis drawing enumerates the complement of 22 tubes, including a 7-in. picture tube and 3 rectifiers. Each group of tubes is marked off and identified as to function.

In this receiver, the heterodyne frequencies on channels 1 through 6 are 37.3 and 32.8 mc. for picture and sound respectively, but on channels 7 through 13 they are 34.0 and 38.5 mc. Automatic gain control voltage is normally applied to the grid of the RF tube. It can be removed by opening a link switch if increased sensitivity is required.

Two 6AU6 tubes are used for the video amplifier, DC restorer, and sync clipper. A sync-negative signal from the video detector is applied to the grid of the video amplifier, so that noise pulses with an amplitude greater than that of the signal will have a negative polarity. The amplifier is designed so that, with a full-contrast picture, the top of the sync signal is at about cutoff and noise signals above that level are clipped off.

The contrast control, in the cathode of the video amplifier tube, controls the gain of the video stage. Bias for the video amplifiers is approximately constant at 1.5 volts, and is independent of the contrast control.

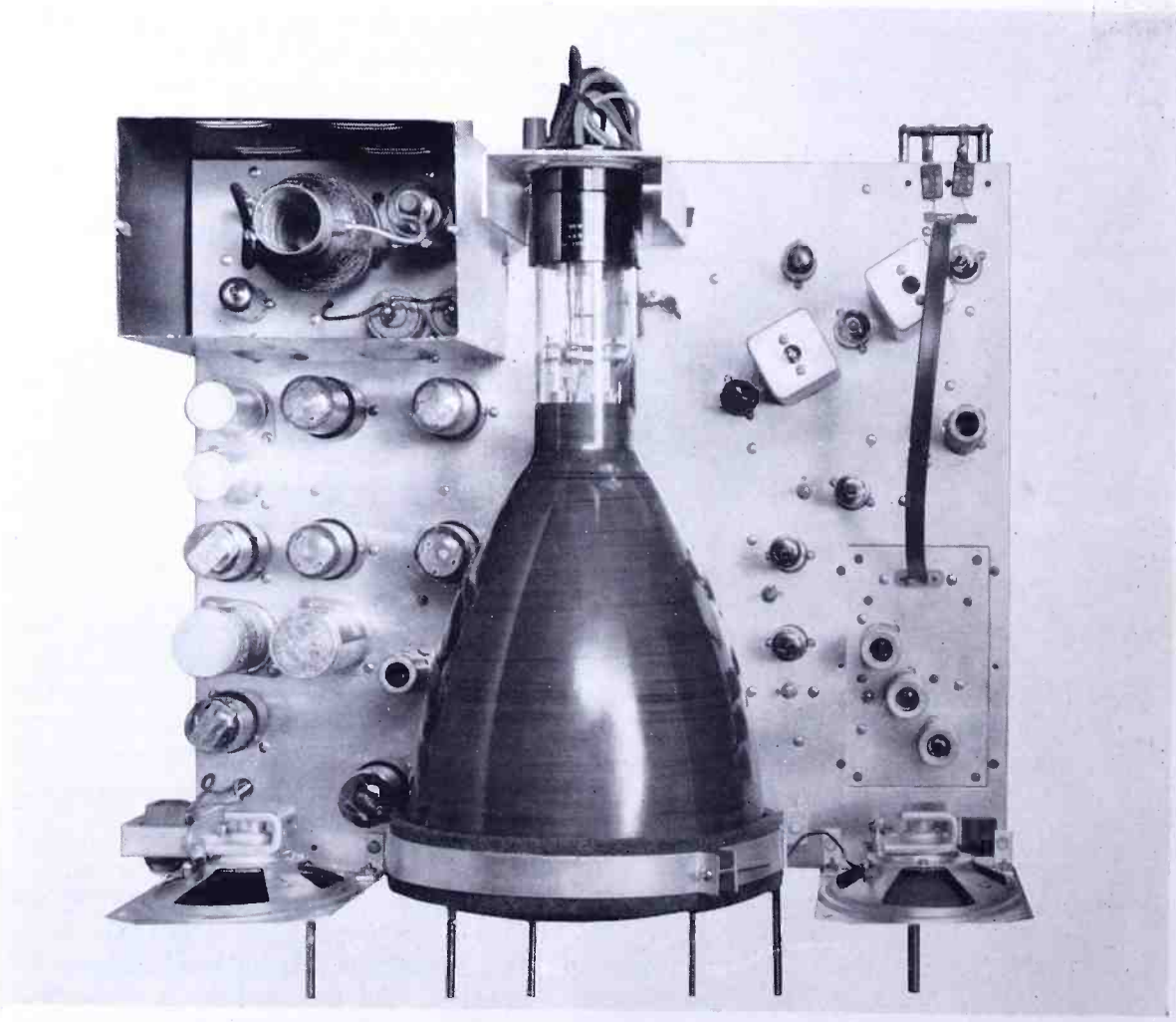
Peaking coils, in the plate of the tube, maintain the output relatively flat to 3.5 mc.

The second 6AU6 serves to restore the DC component, clip the sync from the composite signal, and then clip the sync on the other side. A DC voltage, developed across the cathode resistor and proportional to the average value of the input signal, is applied to the grid of the picture tube to reinsert the DC component. Since all picture information is beyond the tube cutoff, only sync pulses appear in the plate. They are clipped on both sides and then fed through a voltage divider network to obtain the desired voltage for application to the horizontal and vertical sweep oscillators.

For the sweep oscillator, a 12SN7GT is used in a Potter-type cathode-coupled multivibrator circuit. In the initial adjustment, the horizontal size-control is set for the largest possible picture size consistent with good linearity. Then the anode voltage on the picture tube is adjusted to produce the proper picture size.

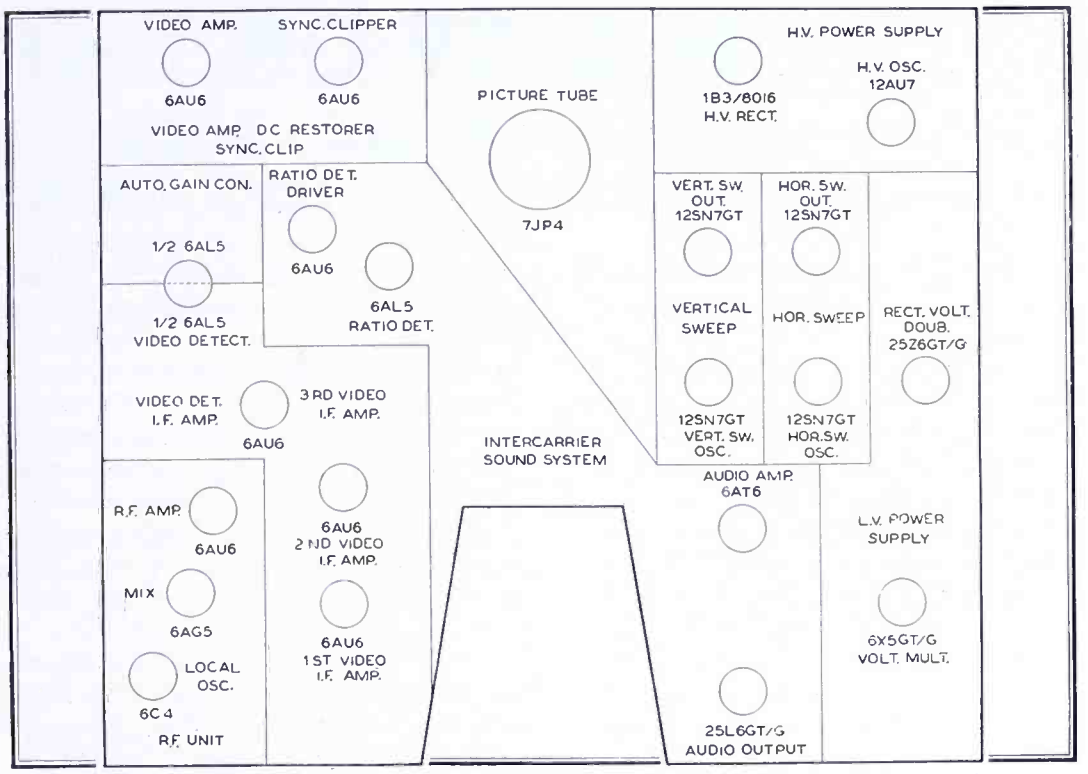
The sawtooth output of the sweep oscillator is applied to one grid of the push-pull horizontal sweep output tube. Phase reversal is obtained by capacity coupling between the plate of the first triode and the grid of the other.

A circuit similar to that of the horizontal sweep oscillator is employed for the vertical sweep. The output is applied to one grid of the push-pull vertical



This top view of the chassis shows the interior of the high-voltage power supply

* Chief Electrical Engineer, National Company, Inc., Malden, Mass.



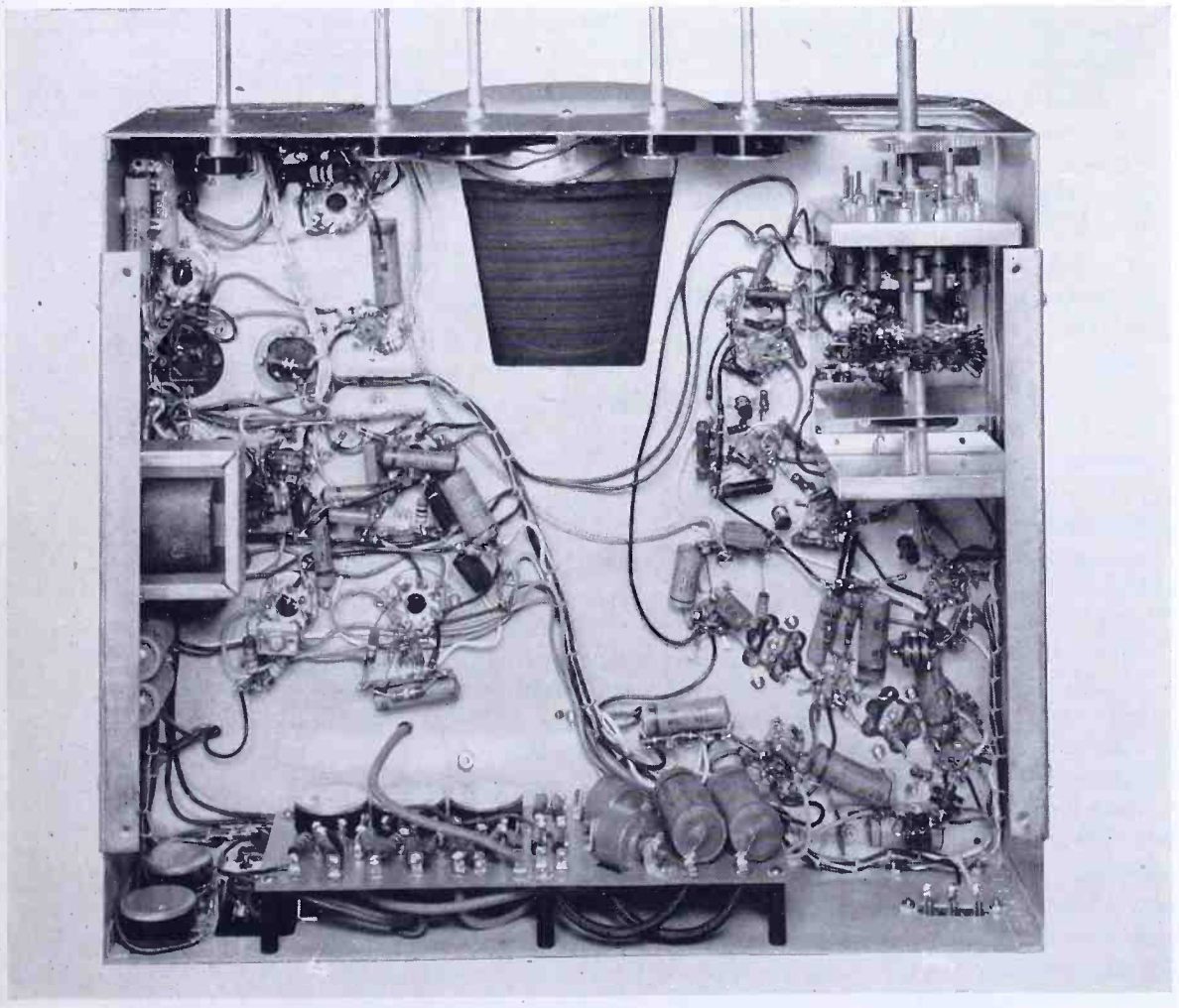
Circuit elements of the NC-TV 7 receiver, with tube types and functions indicated

sweep output tube. Phase reversal is obtained by driving the same grid from a resistive voltage divider from the plate of the first triode to ground.

In the intercarrier sound system, coupling from the video amplifier to the sound system is accomplished through a 1-mmf. capacitor. This minimizes any possible effect on the gain of the video amplifier below 4.5 mc. A trap inductance with an adjustable iron core, resonant at 4.5 mc., provides maximum transfer of the AF signals.

The ratio detector is of the conventional type. Audio output of 2 volts RMS for 25-kc. deviation at the detector requires a stage of audio ahead of the output. Audio quality is improved by the use of degeneration in the AF output stage.

Details of the mechanical design are shown in the accompanying illustrations.



This bottom view of the chassis corresponds to the tube layout drawing above

STATUS OF TV FREEZE

THE latest report on the television freeze was delivered by FCC Chairman Coy in an address at the TBA conference at New York City. He said:

Last week some 100 of the nation's outstanding television and wave propagation engineers met for a conference. I am glad to report that that conference produced some highly encouraging evidence of progress on the interference problem. Actually, the freeze has been productive of some stimulating activity.

It developed that the research that has been going on during the freeze has produced some promising results in the way of new approaches to this problem. RCA, for example, believes it now can roll up the "Venetian blind" effect of co-channel interference. The method it is experimenting with would link co-channel stations by telephone wire or by radio to synchronize the carrier currents. If it should prove practicable, it could be employed to improve television 1) by adding more stations at the present rate of 150 miles separation between co-channel stations, 2) by keeping the present number of stations but improving the picture and 3) by a combination of both measures.

On the other hand, it now seems that if some method of synchronization is not used, we will have to move the co-channel stations farther apart than 150 miles or we will have to settle for a much smaller service area for the stations.

I was also very much interested in a report on the polycasting technique for the ultra high band. This technique would locate several low-powered stations in a given area to do the work of one high-powered station. Use of FM as the carrier for the picture is also suggested.

I am gratified with the assistance the Commission is receiving from the industry in tackling this problem of troposphere interference. The work is going forward. A new committee was set up to evaluate the results of the Engineering Conference. They call it an *Ad Hoc* Committee. Why the engineers had to select a Latin name for the committee, I don't know. Probably jealous of the lawyers. Our future progress will depend in large part on the progress that can be made by this *Ad Hoc* Committee.

When the freeze was announced, I expressed the hope that it would not last longer than six months. From where I look now, it appears that this estimate will not be too far off. I say this with full knowledge that I am accused of being an optimist.

This problem of interference, together with the increasing demand for additional television channels, re-emphasizes the need for continued experimentation by the industry.

POLYCAST SYSTEM FOR TV ON UHF

PROPOSING UNIFORM COVERAGE BY "ILLUMINATION" FROM A NUMBER OF LOW-POWER TRANSMITTERS—*By* RAYMOND M. WILMOTTE & PAUL A. DEMARS*

THE Federal Communications Commission has recently found it necessary to suspend action on applications for new television facilities pending revision of the Rules, Regulations and Standards concerning television broadcasting service. The need for this revision is the realization that the engineering data on which the present television alocation was based is inadequate. The present difficulty results from the fact that the Commission, in the past, adopted theoretical calculations for the radio propagation characteristics of this service. This theoretical treatment failed to take into proper account all factors affecting coverage and mutual interference between stations. The principal factors ignored or not properly evaluated are terrain irregularities which affect coverage mainly, and tropospheric transmission which affects interference.

Predicted Coverage Not Attained:

Correct evaluation of all known propagation characteristics in the TV broadcast band has resulted in the recognition that the size of the service areas of individual stations or the total service areas of all stations combined are, under the Commission's allocation plan, far less than had been foretold. Also, the conclusion is inescapable that realization of the predicted size of service areas for individual stations or the total service area of all stations under any allocations plan is not attainable on the present 12 channels authorized for this service.

Paul A. de Mars of our firm was the first, in March, 1940, to present to the Commission all the essential factors affecting radio propagation in the VHF band in substantially correct quantitative relationship. At that time, he was technical director of the Yankee Network, and appeared as chief technical witness on behalf of FM Broadcasters, Inc., at the FM hearing, Docket No. 5805. Subsequently, on numerous occasions, de Mars has testified before the Commission in company with a few who have pointed out that neither the VHF propagation charts nor the procedures outlined in the Standards for estimating service and interference ranges therefrom yield correct results, and that their accuracy decreases in proportion to the irregularities of terrain encountered, and with both distance and frequency.

Under the direction of Mr. de Mars, our firm has analyzed all available data, including field intensity measurements made by the Commission, which we had collected from various sources. The results were published in a paper by de Mars in the April and May, 1947, issues of *FM* AND TELEVISION Magazine. This paper was used by the American Broadcasting Company in a hearing before the Federal Communications Commission in July, 1948, to support its claim that the television allocation plan did not in fact provide the interference-free service area to the facilities it had been authorized to construct as predicted by the Commission's Rules and Standards. The engineers for the American Broadcasting Company used the tropospheric curves of the de Mars paper to substantiate their allegations. At this time, the qualitative accuracy of the de Mars propagation curves was acknowledged by the Commission's engineering staff.

THE number of TV stations that can be operated on the lower band is totally inadequate to furnish programs for all the people who want to buy receivers. In other words, manufacturers and broadcasters face a limitation imposed not by the potential market for receivers, but by the relatively small number of stations that can be accommodated on the lower band.

This makes the utilization of the upper band a matter of immediate industry concern. If action is deferred too long, set sales are going to be stopped off at a point representing a fraction of the potential volume.

Upper-band tests indicate the need of an entirely new approach to TV broadcasting above 475 mc., and perhaps in the top channels of the low band. Experience reveals that increased power will not provide adequate service from conventional installations over large areas. What then?

The first realistic answer to that question is presented here in the Wilmotte-deMars proposal to employ what they call Polycasting. Offered by two of the leading engineering consultants, their proposal deserves immediate and careful consideration by manufacturers and broadcasters alike.

If 200-watt transmitters can do the job, no time should be lost in setting up experimental installations. Transmitters and receivers can't be designed for production until standards are set, and work on establishing standards can't be started until a practical method of using the upper band has been determined. There's no doubt but what the upper-band propagation problem will be solved. It's quite possible that Messrs. Wilmotte and deMars have done it already.

There has resulted a series of engineering conferences and hearings with more scheduled for the future. The purpose of these conferences and hearings is to establish the facts, and make such amendments to the Rules, Regulations and Standards as are necessary.

Having for a long time recognized the inadequacy of the present 12 TV channels in the VHF band to provide a satisfactory service to the United States, our firm has studied the technical and economic feasibility of providing television service in the so-called high band in the UHF portion of the radio spectrum, between 475 and 890 mc. The conclusion was reached that a television service under the present concept of a single high-powered station for an area comprised of a large city of metropolitan area is neither technically nor economically feasible.

This conclusion has been clearly sustained by testimony presented at the hearing on September 20, 1948, in the matter of utilizing the high band for television service, by RCA and the Joint Technical Advisory Committee. Consideration of the RCA testimony and the JTAC report leads to the conclusion that acceptable service in this UHF band under the known techniques would require stupendous powers of the order of 5,000 kw. and more. Such power is not now available or foreseeable of attainment in the near future. Furthermore, not only would the development of such a system require millions of dollars and take years to develop, but the cost of establishing and operating such transmitting facilities would be a great many times the cost of present practice. In addition, the use of these high powers would develop intolerable interference problems which could be dealt with only in a manner that would further restrict the service possible in the UHF band.

"Polycasting" Proposed for UHF:

For a number of years, we have studied the problem of economical and effective

* Raymond M. Wilmotte, Inc., 1469 Church Street, Washington 6, D. C. This proposal was filed with the FCC on Nov. 30, 1948.

operation in the UHF band. As a result of these studies, we now propose the use of a system based on a new concept. This system employs the very characteristics of the UHF band which makes effective utilization by present practices technically and economically unfeasible. The new system that has been evolved is termed, for convenience: "Polycasting."

Polycasting is a system making use of a relatively large number of low-powered stations. Our organization believes this system, to be discussed here in detail, can be put into operation economically, that the service provided will be better than that attainable on the present VHF channels, and that commercial equipment can be made available in a relatively short time.

This opinion is supported by leading engineers and manufacturers to whom the Polycasting system has been disclosed. Without exception, they reported it technically sound and economically feasible.

It is predicted that a program of experimentation will be undertaken soon to establish the technical feasibility of Polycasting, and the Commission is urged to avoid any action that would restrict the development of this new method for TV broadcasting in the UHF band.

In order to evaluate properly a comparison between present television concepts and the proposed Polycasting system, it is desirable to review here the principal characteristics of UHF propagation, and their effect on service and mutual interference between stations.

We do not believe that the common concept of the use of "satellites" will prove satisfactory for television at UHF. Attention is called to the distinction between the concept of satellite stations to augment or fill in vacancies in the coverage of main high-powered stations, and the Polycast system which utilizes low-power transmitting units exclusively.

Old and New Concepts of UHF:

In the past, under the leadership of the FCC, practically all predictions of the service ranges of broadcasting stations in the VHF and UHF bands have been made from theoretical calculations based on the assumption of a smooth earth, uniform ground constants, and a standard atmosphere. Atmospheric refraction is disposed of by assuming the earth's radius to be four-thirds of the actual radius. It has now been established that estimates based on these assumptions are grossly in error. The error arose from the fact that, in practice, the earth is not a perfect sphere, and terrain irregularities, buildings, trees, overhead wire distribution systems, and other objects introduce additional attenuation. These causes of attenuation are particularly severe where people live—the very areas where service is required.

The effect from these disturbing factors increases as the frequency increases. As a result, the actual signal intensities in the UHF band are far less than predicted by classical theory which, after being translated into engineering terms by the excellent treatment of K. A. Norton, was adopted by the FCC. Actually, much higher powers are required in the UHF band than in the VHF band because terrain and building shadows are blacker. In addition, greater signal intensities are required as the frequency is increased. This increase is based on the fact that the effective heights of UHF receiving antennas are smaller, the transmission line losses higher, and the noise inherent in UHF receivers greater than on the presently-used VHF channels, particularly the lower frequencies of the 45- to 216-mc. bands, which are customarily used as the standard for comparison of performance.

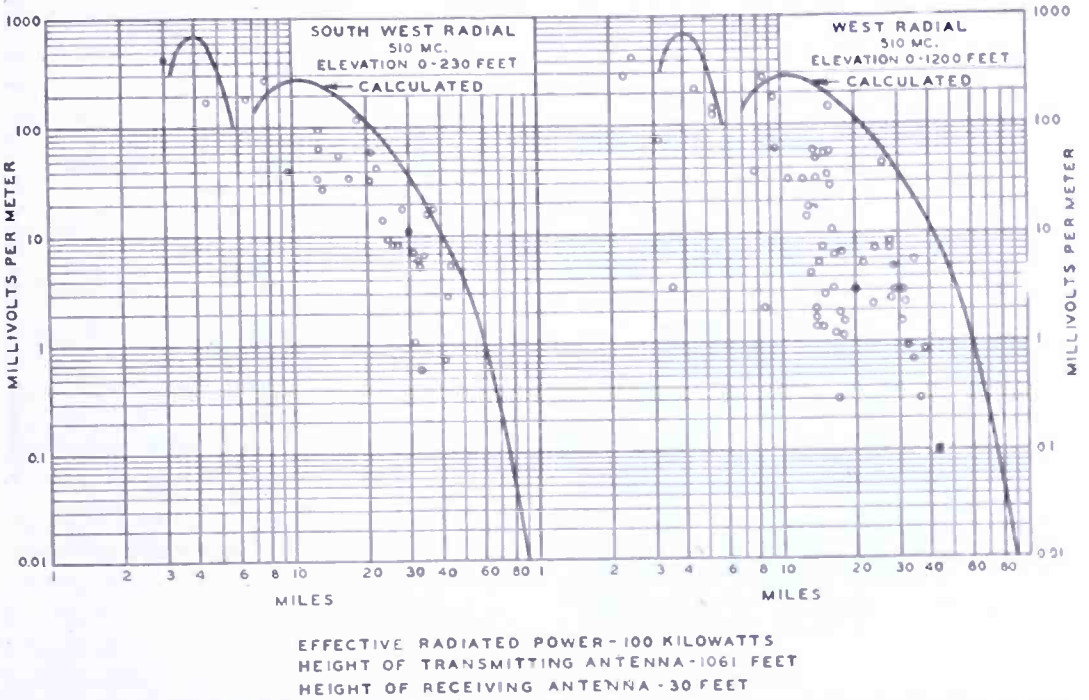


Fig. 1. Measured field intensities on 510 mc. along the southwest and west radials

UHF-VHF Power Ratios:

A measure of the power required is furnished by RCA in an article entitled "Comparative Propagation Measurements: Television Transmitters at 67.25, 288, 510 and 910 Megacycles," by C. H. Brown, J. Epstein and D. U. Peterson.[1] It is convenient to accept the treatment used in this article which estimates the power required versus frequency in terms of the ratio with respect to the power used at 67.25 mc. In this article the data has been assembled to compare the power required to produce a signal on the receiver transmission line for a given frequency at 50 per cent and 70 per cent of the receiver locations that will be at least as great as the signal enjoyed by 50 per cent and 70 per cent respectively, of the receiver locations when the frequency is 67.25 mc.

The data in this article shows that at 510 mc. the power ratio is 200 and 550 for 50 per cent and 70 per cent of the receiver locations, respectively, and at 910 mc. power ratio is of the order of 2,000 to 5,000 for 50 per cent and 70 per cent of the receiver locations respectively when it is assumed that half-wave dipoles are used. The use of receiving antennas with high power gains would reduce these ratios, but the article reports that in many cases it was found that directional receiving sets failed to improve the signal. These were mainly locations where the signal was weak and the gain was badly needed. It is reasonable to concur with the conclusion of the authors that the needed power ratio versus frequency at best lies somewhere between the figures quoted, the average being a reasonable choice.

G. H. Brown presented details of the RCA-NBC high-band experiments in Washington, D. C., duplicating on 510 mc. the WNBW channel 4 (66 to 72 mc.) transmissions. He stated that on the basis of measurements at 42 receiver locations, radiated power of 1,200 kw. on 510 mc. would be required to produce a signal strength at 50 per cent of the locations equal to that being received on 66 to 72 mc. Radiation at 5,000 kw. would be necessary for 70 per cent of the locations on the same basis, he said. The radiated power of WNBW is estimated at about 30 kw., making the power-vs.-frequency ratio 400 and 1,670 for the 50 and 70 per cent receiver locations, respectively.

It is interesting to speculate on the fantastic power in the 475- to 890-mc. band that would be required to insure that at 100 per cent of the receiver locations the signal on the transmission line be at least as great as the signal enjoyed

[1] RCA Review, June, 1948. Published by the Radio Corporation of America, RCA Laboratories Division, Princeton, N. J.

by 100 per cent of the receivers when the frequency is 67.25 mc.

In view of the foregoing, and for the purpose of later comparisons, it is felt that the use of power ratios of at least 400 and 1,670 as determined earlier are justifiable minimum values. Since the low-band (54 to 216 mc.) television allocation assumes radiated powers of 50 kw., it must be concluded that radiated power of 2,000 to 10,000 kw. is required for 475 to 890 mc. to insure usable signal intensities at say 70 per cent of the predicted low-band service area. This is normally considered as about a 40-mile radius for 50 kw. from a 500-ft. antenna.

Transmitting antenna gain is more easily attainable in the UHF than in the VHF band, but the practical, usable limit is probably close to 20 fold. Assuming that this gain of 20 is technically feasible, transmitter powers of at least 100 to 500 kw. and more must be employed if greater proportionate coverage is to be attained.

High-Power Problems on UHF:

Efforts to provide a usable signal intensity on UHF over areas comparable to those credited to the present band by means of a single transmitter do not, therefore, appear to be economically feasible. Assuming that it is technically practical to provide radiated powers of the magnitude required, disregarding cost considerations, the single station concept encounters further difficulties.

One is with respect to mutual interference between stations on the same and adjacent channels. All evidence to date indicates that UHF propagation via the troposphere is at least equal in intensity and frequency of occurrence for a given power and antenna height to that in the VHF band. There is, in fact, evidence of the probability that interference via the troposphere increases with frequency. In any case, the enormous radiated powers required to serve large cities or metropolitan areas by a single station will produce strong interfering signals.

On the basis of the frequency-vs.-power ratios adopted for this discussion, mutual interference will be increased in the UHF band from 20 to 40 times that in the VHF band. Although the interference difficulties seem to make consideration of single high-powered stations for wide coverage an absurdity, a further difficulty merits passing mention. Present low-band television transmitters employing radiated powers of less than 50 kw. are encountering troublesome blanketing and cross-modulation problems. With radiated powers of the order of magnitude of 2,000 to 10,000 kw., this problem might well become insoluble for a distance of some miles from the transmitter.

Illumination by Polycasting:

The Polycast system which we propose is based upon the concept of "radio illumination" of a service area by means of a multiplicity of low-powered transmitters. It is proposed to locate the units of this system in such manner that, in general, service from any given unit to its area will not be shadowed by terrain irregularities or other obstacles. The system will be tailored to fit the area to be served with respect to population, distribution, propagation factors, and the type of receiving conditions encountered, such as in business district, apartment house, or single-family residence zoning classifications. The use of a number of transmitters permits a flexibility in dealing with these factors that is not possible with a single transmitter, for they will reduce propagation losses enormously, particularly those due to shadows. Shadowed areas, when encountered, will be filled in without the use of large powers by so situating the transmitting units that an area shadowed with respect to transmission from one station will be illuminated by one of the others. Considered on the smooth earth concept, it appears that there will be large overlapping areas. In practice, however, the total effective service will be substantially equivalent to that calculated on the ideal smooth-earth condition, and will be substantially free from shadows.

The effect of such an arrangement is that at many points in the service area good service will be received from several directions. In the present VHF band with present type of operation, these would produce ghosts. In the UHF band, operating on the proposed system, these ghosts will be eliminated by using direct-receiving antennas or by separation on the basis of intensity-differentiation if FM modulation is used. Both these means are available at UHF, the first because directional antennas can be made small, and the second because the signal intensity will be sufficiently high that the differentiation characteristic of FM can be used to the full. In any case, the rules can be made to specify FM if, after careful and unbiased comparison, it appears to be most satisfactory form of modulation.

It can be seen that the engineering required in designing a Polycast system is exactly opposite to that required for a satellite operation under present-day techniques. At present, a satellite is located so that its service will interfere to a minimum with that of other satellites or of the parent station. In the Polycast system, the potential service areas would be deliberately designed to overlap.

Theory predicts that, over a smooth earth, signal attenuation in the 475- to 890-mc. band will be about inversly proportional to the distance up to approximately 10 miles from transmitting antenna heights of 200 feet or more. Measurements support this prediction over relatively smooth terrain. At greater distances, the signal intensity decreases rapidly both in theory and practice. This behavior of the UHF band favors the use of a number of low-powered transmitters, each serving a portion of a given service area.

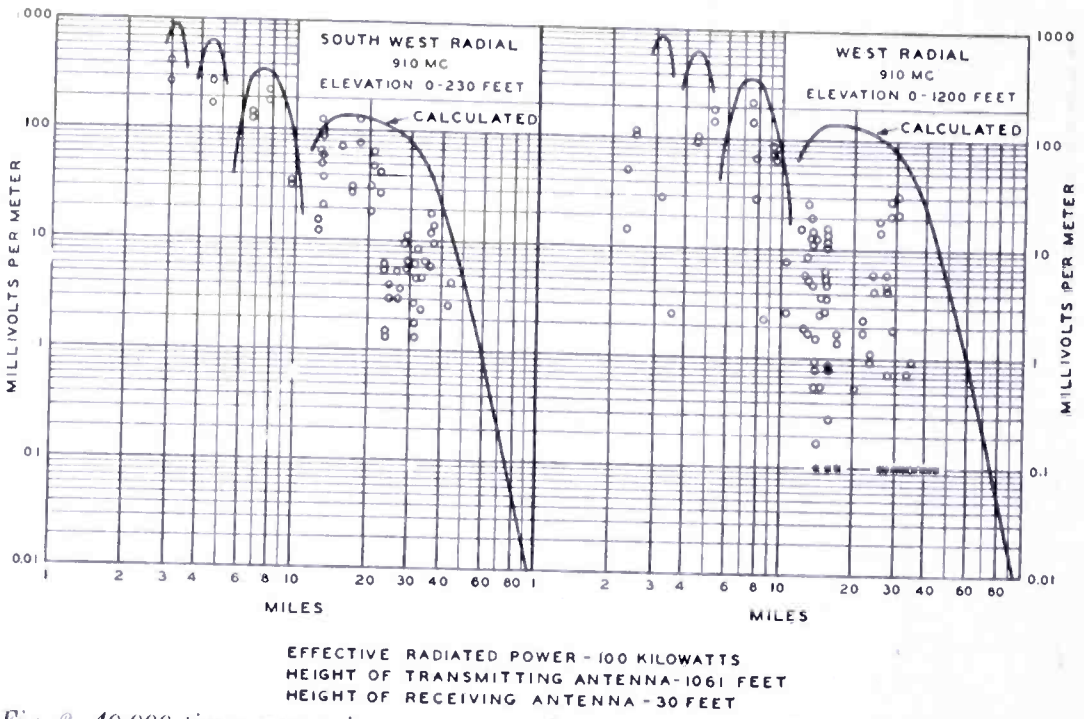


Fig. 2. 40,000-times power increase required to maintain signal intensity on 910 mc.

Application of RCA Data:

The advantage of the practical application of the Polycast system is best illustrated by presenting a typical case in which comparison is made with the single high-powered station method. In order to avoid dependence on theoretical assumptions which have misled others in the past, use will be made of actual measured data. The source of information will be the RCA's New York tests previously referred to. It will be assumed that coverage of an area included within a 30-mile radius is desired.

(Continued on page 32)

HOW G. R. PLANS NEW PRODUCTS

GENERAL RADIO'S UNIQUE POSITION IS PARTLY EXPLAINED BY THIS ACCOUNT OF THE PROCESSING OF NEW PRODUCT DEVELOPMENTS—*By* CHARLES T. BURKE*

THE General Radio Company was established in 1915 for the purpose of manufacturing, on a production basis, measuring and testing equipment for the communications field of that time. In the years since, the Company has expanded its activities in step with the increasing application in science and industry of techniques which have their roots in the communications art. Its field of interest now embraces all measurement methods based on vacuum tubes and alternating current circuits.

The rapid development of electronic devices and methods, particularly during the last twenty-five years, has opened continually widening fields for measurement applications. New product development has been from the first a major Company activity. Thus, new product development absorbs an unusually large part of the Company's budget, currently about 15 per cent.

Influence of Employment Policy: In pursuing its objectives, the Company has sought products which can be made on a production basis, and has avoided projects aimed at the manufacture of a single instrument. On the other hand, the volume of demand for measuring instruments does not permit large-quantity production. This has made it necessary to perfect methods suited to the manufacture of small lots on a standard production basis. A Company policy which exerts controlling influence on the new products program is that of continuity of employment, and the avoidance of expansion and contraction with business cycles. It has always been the policy of the Company to consider each employee, after a trial period, as a permanent employee. This means that it is not Company policy to discharge employees in times of reduced business activity. A corollary policy is not to hire employees if there does not seem a reasonable chance of giving them permanent employment. Plant expansion is avoided at peaks of business cycles. As a matter of fact, new buildings have generally been constructed in times of subnormal activity in general business.

It is a major Company need, therefore, to have a sufficient and steady supply of new devices to maintain factory employment on a full-time basis. In a field where obsolescence is rapid, a large part of the activity must be devoted to keeping instruments in the line up to date. It has been our experience that an accelerated engineering program is the best method of offsetting declining business on older instruments.

Administration by Committees: With a factory of substantial proportions to keep occupied, it is essential that engineering projects embarked upon be selected intelligently, and pursued at a rate which will bring them to fruition at a time when they will provide

H. B. Richmond, chairman of the board, is also chairman of the New Products Committee

needed shop employment. The administrative organization of product development and engineering to bring this about consists of a group of committees supplemented by direct personal responsibilities. An earlier experience with conventional committee setups demonstrated that a program cannot be administered by a committee, since the division of responsibility may on occasion be used as an evasion of responsibility, with the resulting tendency to postpone difficult decisions. Committees were found subject to the further disadvantage that responsibility could not be determined.

The committees to be described are, therefore, set up as advisory committees, with the chairman responsible to management for the performance of the committee function. To meet this responsibility the chairman is authorized to act without, or even against, the agreement of the rest of the committee. Naturally, this is a power rarely or never exercised, but without it we have found that committees cannot function effectively in executive capacities.

Inception of a New Product: Ordinarily, a new product receives its first formal consideration by the New Products Committee. The function of this committee is to determine the suitability of the product for the General Radio Company's engineering, manufacturing and marketing facilities; its salability; its relative importance with respect to other projects under development or consideration; and the amount of money which the Company might reasonably spend in developing it. Patent policy and possible infringement are considered at this point by a separate group, all of whom are members of the New Products Committee.

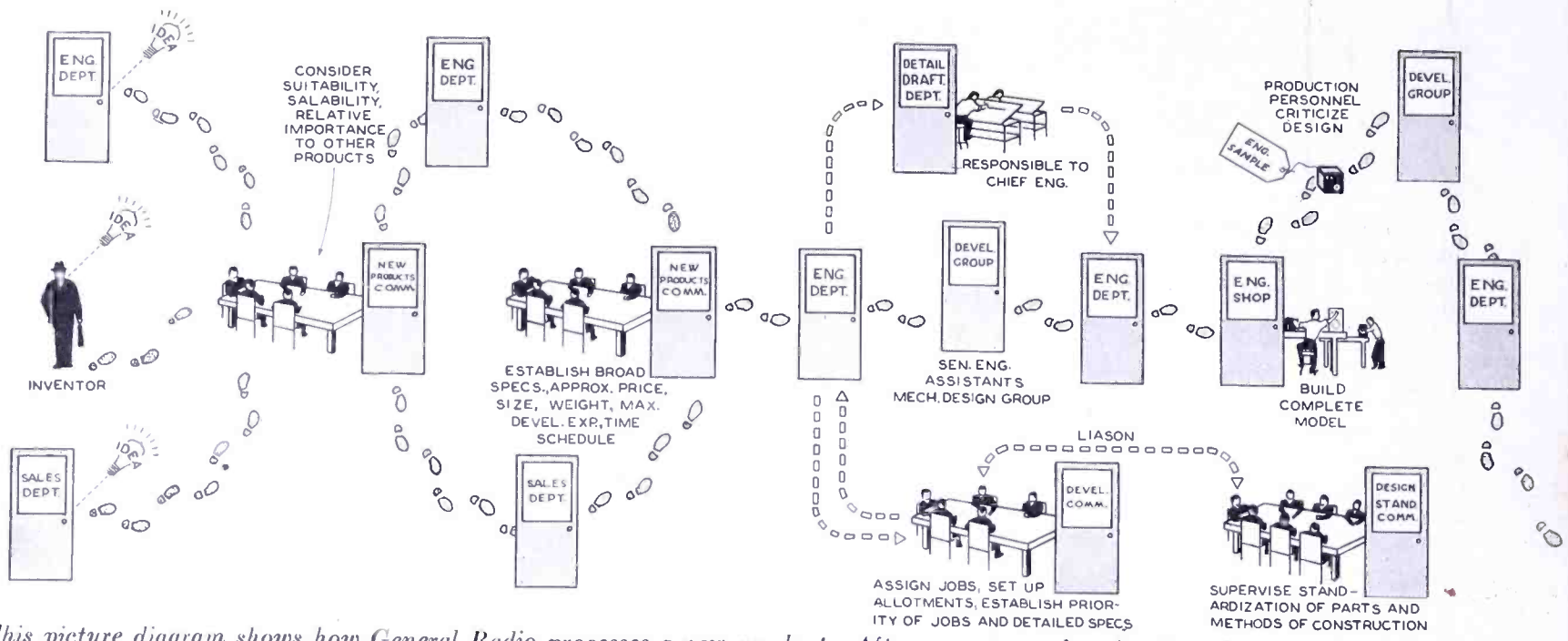
The New Products Committee personnel, as would be expected, is representative of the functional activities outlined above. Its chairman is the Chairman of the Board of Directors and its members represent engineering and sales.[1] Manufacturing is not directly represented on the committee since its activities are primarily related to engineering, marketing and finance, but members of the committee are sufficiently well-acquainted with the manufacturing facilities to judge whether or not a new proposal is suitable for General Radio Company to manufacture.

New product proposals come to the New Products Committee from many sources. A good many of them are presented after some preliminary consideration by Engineering. Others are proposed by the Sales Department as a result either of suggestions from field offices or correspondence with customers. Another occasional source is the individual inventor who seeks to have a device manufactured under license. It is unusual to authorize a development following the first discussion of an entirely new project in the New Products Committee unless there has been considerable informal discussion before the meeting. If the proposal seems to have merit, the Sales and Engineering Departments are usually requested to look into the question further, frequently with specific questions to be answered, and the matter is then discussed further at a future meeting.

If the New Products Committee de-

* Director of Planning, General Radio Company, Cambridge 39, Mass.

[1] The present New Products Committee comprises Chairman H. B. Richmond, Chairman of the Board of Directors; C. T. Burke, Secretary of the Committee; Melville Eastham, Chief Engineer; A. E. Thiessen, Vice President, Sales; D. B. Sinclair, Assistant Chief Engineer.



This picture diagram shows how General Radio processes a new product. After acceptance by the New Products Committee,

cides that a project should be undertaken, specifications are set up. These specifications are usually quite broad, including only those items which the Committee feels are essential requirements. These might include certain basic performance specifications, general magnitude of selling price, and possibly special items such as size and weight. Experience shows that it is most unwise to set up detailed specifications at this time. The New Products Committee may also establish the maximum engineering expenditure for the job. This amount may not be exceeded without reconsideration by the New Products Committee. A time schedule may also be specified if timing is of particular importance.

When a development has been determined upon by the New Products Committee, it is carried out by the Engineering Department, which is organized under Mr. Melville Eastham as Chief Engineer, and Mr. D. B. Sinclair as Assistant Chief Engineer. Acting with them is the Development Committee consisting of Messrs. Eastham, Sinclair, Burke, Karplus, and McElroy. Now, the function of this committee is to assign jobs, to set up allotments within the maximum determined by the New Products Committee, to establish priority of jobs, to discuss and establish detailed specifications, to review projects and, finally, to approve an instrument as completed in Engineering and ready for manufacture.

Development Group Takes Over:

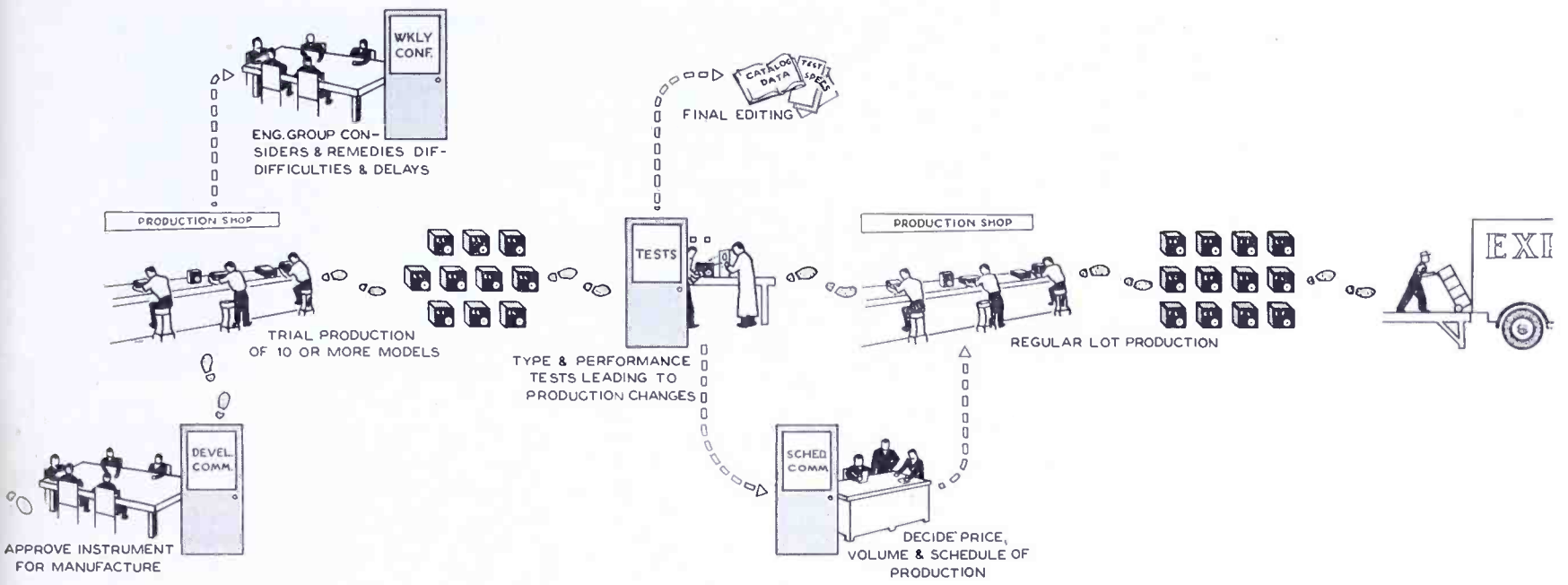
The Engineering Department is organized into several development groups, each consisting of a senior engineer with several assistants, and a mechanical design group. The senior engineer is responsible for the project and has great latitude within the price and performance specifications laid down. Broadly speaking, his responsibility is to produce a box with terminals which, for example, produces some form of energy having the characteristics set up by the New Products and Development Committees, which can be readily manufactured, and which will sell at a price that will permit profitable marketing. The details by which these objectives are met are pretty much up to the individual engineer.

The engineer obviously has very great latitude and correspondingly great responsibility in the development of the instrument. A particular engineer's projects are generally along more or less related lines, and he is expected to keep abreast of the art in those lines, to suggest new developments or necessary changes in current instruments to keep them up to date, and to assist in the preparation of catalog material and publicity articles.

Engineers are encouraged to participate in activities of professional societies, particularly to attend meetings and to give papers. It is through these activities that the engineer is expected to keep himself informed on progress and to pick up new ideas.

Perhaps it should be pointed out that the General Radio Company's engineering work is of the type directed to the development of particular devices, and that general research is not undertaken. Thus, the engineers are always working on fairly concrete problems. Each development group has assigned to it a design engineer responsible for layout of instruments and mechanical details, subassemblies and parts and, in general, for the mechanical embodiment of the device. These men work very closely with the development engineers throughout the life of their respective projects. They also work with drafting and manufacturing groups in preparation for quantity production.

The present New Products Committee comprises, l. to r., Charles Burke, Melville Eastham, Donald Sinclair, Arthur Thiessen, and Harold Richmond, chairman



it is given to a Development Group. Coordinated contributions from other committees and departments guide it through the plant

General standardization of parts and methods of construction is the responsibility of the Design Standards Committee, consisting of the chief draftsman and the engineers particularly responsible for mechanical design. This group, meeting as often as necessary, determines standardization policies. Mr. P. K. McElroy, who is chairman, is also a member of the Development Committee, and provides liaison between the two committees.

Detail drafting is a separate department, reporting to the Chief Engineer. Here, detailed working drawings are made from the preliminary sketches and layouts supplied by the design engineer.

When drawings are completed, the project moves into a transition stage before finally being released for quantity production. At this point, as at most others in the chain of progress, there may be considerable variation in the routine to meet the requirements of a particular case. This may result from peculiar production requirements or requirements of time and personnel. The normal procedure, however, is to build a complete model from drawings in the engineering shop, thereby detecting drafting errors before tools are made. An opportunity is given for the production personnel to criticize the design. It is certainly not expected that there will be important design changes as a result of this criticism, but it is hoped that no serious difficulty in manufacturing will arise which will not be known and considered at this time. Also, minor changes may be made to facilitate manufacture.

Trial Production Runs:

After the model has been completed and checked by Engineering, tools are made and the trial production run is started. On laboratory instruments, this quantity is usually ten. On parts, it would be considerably larger. In any case, the number is large enough to show up production variations, and small enough that changes can be made without too much difficulty if they are required. Usually some are!

The trial production lot is handled in the production shop, with regular production personnel. However, it receives special attention from a group whose responsibility is to work out manufacturing methods and iron out difficulties as the production proceeds.

Upon reaching the production calibration laboratory, very extensive tests are made on the trial lot. These are of the nature of type tests rather than the normal inspection and calibration tests to be made on successive lots. Behavior under extreme temperatures and humidity conditions is determined and, from the performance data, the final catalog specifications are established. Testing specifications are also checked and edited by experience. Not infrequently, this intensive test in the production laboratory brings to light features of design or manufacture which should be changed. If these are at all important, the changes are actually made on the trial lot and they are then retested.

An important means of liaison in the trial production stage and in the stages immediately preceding is a weekly conference which includes the assistant chief engineer, the head draftsman, and engineers responsible for mechanical design and for following the trial lot. At this conference, difficulties and delays are discussed and agreement reached as to the proper course to be followed.

Testing specifications and catalog data are engineering responsibilities, as is usually an article describing the new device and its application for the General Radio *Experimenter*. These items are carried along during the later stages of development, and should be complete before the test on the trial lot.

The Development Committee in session. L. to r., C. T. Burke, P. K. McElroy, secretary E. Karplus, chairman M. Eastham, and vice chairman D. B. Sinclair

Final Determinations:

When the trial production lot has finally passed all its tests, the new product is at last ready to move into regular production. There are, however, decisions still to be made: the important one of price, the less important ones of quantity to be manufactured and delivery schedules. These matters are the responsibility of the Scheduling Committee comprising C. T. Burke, chairman; C. C. Carey, vice president for manufacturing; and A. E. Thiessen, vice president for sales. Costs are made up by the factory Cost Department, and a price is determined on the basis of manufacturing costs, engineering expense, and probable market. The quantity to be ordered is established by balancing against one another such factors as rate of sale, manufacturing economy, pressure of shop facilities, and customer demand. Sales and advertising releases are prepared to co-ordinate with the completion of the first production lot.

Notes on the K Plan:

Probably no discussion of the operations of the General Radio Company would be complete without touching on the rather unusual pay plan which affects not only engineering but all executive and administrative personnel.

The Company objective of steady employment referred to in opening paragraphs of this paper requires adjustments in times of reduced activity, since we have not always been able in the past to maintain sales at a level to take our full factory output. Under such conditions the working hours are reduced for the factory, but full personnel is employed. Certainly for engineering personnel and to a degree for other administrative personnel, a reduction of working hours is highly undesirable in times of reduced sales, since the best way of restoring full operation is the development and manufacture of new products. On the other hand, the disparity between short hours and reduced income in the factory and full income in the salary groups not only seems inequitable, but the overhead involved becomes increasingly difficult to carry under limited operations.

To meet this condition, the pay plan familiarly known as the "K" system was established in June 1933. Under this pay plan, monthly salary rates are set at what is considered to be approximately the average going level for individuals of comparable training, experience and responsibility. This base rate is subject to multiplication by a factor K which has given its name to the plan. K may be a number greater or less than unity, depending upon the operating conditions of the Company. With everything on an even keel, the factory working normal hours but no overtime, and the Company making a nominal profit, K equals unity. As working hours drop, K is adjusted downward according to a set table which is established from time to time on the basis of current overhead costs and break-even points. Likewise, as the scale of activity rises and overtime work becomes available and profits increase, K rises above unity.

Individuals on monthly payroll are expected to work full time, even during periods when K is below one, and it is essential to the success of the plan that they do so. The result of the plan is to adjust overhead costs to operating rate to a surprisingly effective degree, so that the Company's financial existence is not threatened when operating far below its nominal break-even point, even for considerable periods. It is obvious, of course, that the effect on personnel of prolonged periods of greatly reduced income would be disastrous to the Company unless general business conditions were such that the rest of the industrial community were similarly situated.

The plan has a great advantage over the more common one of reducing overhead by cutting base rates, in that the reduced pay is automatically restored as soon as emergency conditions improve. Over a business cycle, not only is there no loss of base rate, but added income in periods of above-average activity pays back the loss over the period of reduced income. As a matter of fact, during the fifteen years that the system has been in existence, K has averaged considerably above unity. Thus, the loss of income experienced during the early 1930's has been made up long since. It is also fair to point out, however, that most of the fifteen-year period has been one of very great activity, and this experience is perhaps not an entirely valid guide for the future.

In view of the rather great responsibility of individual engineers for carrying through their projects, and the direct relationship between the development of salable instruments and the manufacturing rate, it is felt that this method of compensation is eminently fair for the Engineering Department. It provides full engineering employment at all times, but also provides both for reduction in overhead when necessary and for automatic compensation in periods of abnormal activity. It is supplemented by a general profit-sharing bonus which applies to all Company employees.

Design Standards Committee, l. to r., H. M. Wilson, chairman P. K. McElroy, secretary F. W. Williams, H. S. Wilkins, G. X. Smiley, H. C. Littlejohn, and R. C. Crosby

POLYCASTING

(Continued from page 28)

Figs. 1 and 2 presented here[2] show the measured field intensities on 510 mc. and 910 mc., respectively, corrected to an effective radiated power of 100 kw. These figures show the measurements along two radials. The first, called the southwest radial, is over relatively smooth terrain with a range of elevation from 0 to 230 feet. The second, called the west radial, is over hilly terrain with a range of elevation from 0 to 1,200 feet.

Examination of these figures yields the following approximate results: At 510 mc. the ratio of median signal intensity at 10 miles to that at 30 miles is about 10 to 1 on the southwest radial. The corresponding ratio from the west radial is about 100 to 1. At 910 mc. the corresponding ratios for the southwest and west radials are about 25 to 1 and 200 to 1, respectively. From these ratios, an estimate of the increase in power required to extend a given signal intensity from 10

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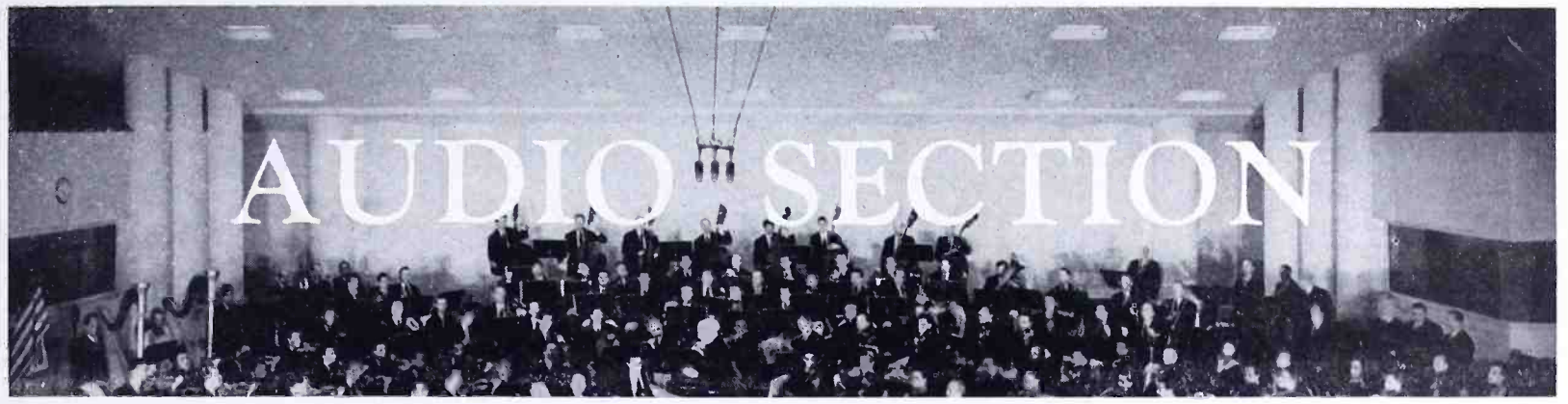
[2] From Figs. 13 and 14 of the Brown-Epstein-Peterson paper referred to in Footnote 1. Reproduced by permission of RCA Review.



AUDIO DEVELOPMENTS

DEVOTED TO THE INTERESTS OF THOSE WHO WORK WITH AUDIO FACILITIES — *Edited by* LAWRENCE OLDS *

HERE are the results of press-time efforts to find out about RCA's new records:

Is it true that the new records will run at 45 RPM? No answer.

Will they have an over-size spindle so they can't be put on any ordinary turntable? No comment.

Why are you making them only 7 ins. in diameter? Complete silence.

What is their advantage if they only run 5 minutes? Quick look at ceiling.

If the first releases are only popular tunes, what will people do about classical music? Eyebrows raised twice.

Is the difference between an .8-mil stylus for the new records and 1-mil for the Columbia LP stylus really important? Shift of weight to right foot.

With three different speeds, stylus types, pickups, and record diameters in use, do you anticipate that manufacturers of record changers will bring out inter-mix models? Slow scratching of left ear.

Have the record manufacturers no regard for women and children? Harrumph!

Not having time to inquire of Columbia in person, we phoned Mr. Paley. "Mr. Paley is in consultation with the doctors."

"Is he ill?" "No, it's his $2,500,000 antique. They are trying to find out if rigor mortis has set in."

WE can all agree with Gerald King, president of Standard Radio Transcription Services, as to the "horrible quality of sound on films which are telecast," and that "it is only short of criminal that this type of sound is allowed to go out over TV stations." Some of the sound engineers on the movie lots shrug off such complaints by saying that the audio channel is bound to be bad, because TV only gets films made before modern equipment was developed.

That's not the way we hear it from people who own television sets. When they break away for an evening at the movies, they complain: "The sound was just like what I hear at home when they have a movie film on television."

Gerald King explains: "The optical system of recording makes it an impossibility to record frequencies on 16-mm. film at the present rate of speed much in excess of 4,000 cycles. Not only is the quality bad, but the flutter is worse."

Then along comes J. A. Maurer to say that he is producing 16-mm. sound-on-film recording equipment "capable of handling the frequency range of 30 to 10,000 cycles with low distortion and a signal to noise ratio in excess of 45 db."

Well, it's a healthy sign when such matters get out into the open for discussion. It means that something will begin to happen pretty soon.

THE first portable equipment we've seen for microgroove recording is being reproduced by Presto. It is a modification of Presto's standard K-8 equipment. The new job handles both regular and LP recording, and has dual-purpose pickups. Using a 13¼-in. disc, a 30-minute program can be recorded on one side. A removable cover carries the loudspeaker.

In addition to conventional use for program recordings, the long-playing feature is a great convenience for speakers, music students, and dramatic groups who want to hear themselves as others heard them.

Presto has also brought out a new series of turntables intended primarily for LP records, but also available with 2-speed drive. They come in plain chassis form, or mounted in a cabinet, and fitted with a pickup.

THE storecasting idea is really sweeping the Country. Installations range from FM table models in drug stores to automatically - controlled, high - power equipment in the super markets. Down in Allentown, Pa., though, Hess Brothers' department store has done a job that takes the lead position in storecast engineering.

This is no prewar type of public address system, with speakers blaring and shouting down normal conversation. Such a setup would not only kill the whole effectiveness of storecasting, but would interfere with the essential business of making sales. Rather, this layout was planned as an aid to store operation.

Accordingly, the Hess Brothers' installation uses 850 speakers distributed over the ceilings on 16-foot centers, and operated at low level. The result might be called "musical ceilings," for that is the effect obtained. There are six shopping floors, each of 42,000 square feet, so equipped, with a total of 800 speakers. Fifty more are located strategically in an adjoining 9-story building devoted to storage and service departments.

At the control center, there are an REL receiver, transcription turntable, telephone connections for broadcast studio or wired-music programs, and an announce microphone, in addition to microphones at various points in the store. This installation, by the way, was made by R. S. Collmus, Western Electric's sound system dealer in Baltimore.

You are probably wondering: how can a store make use of such a system to an extent sufficient to justify the cost? Experience already gained at Hess Brothers' shows that the variety of uses is only limited by the imagination of the management. Some of the material for transmission which has proved to have the greatest functional value in the operation of the store are:

1. In-the-store advertising, to draw attention to sales, clearances, and special items.

2. Messages of immediate or long-range interest from the store to customers or co-workers.

3. Material of recreational interest to co-workers, or forming a part of the store's co-worker relations program.

4. Musical programs arranged to lift the emotional tone of customers and co-workers. On its own merits, this use justified the installation of the system.

5. Programs in connection with store

(Continued on page 46)

* North Plain Road, Housatonic, Mass.

HOW TO IMPROVE PROGRAM PICKUPS

STUDIO PRACTICES REQUIRED FOR FM IMPROVE AM, TOO. HERE ARE IDEAS THAT CAN BE EMPLOYED WITH FACILITIES AVAILABLE AT ANY STATION — *By* HAROLD E. ENNES*

PART 2 -- CONCLUSION

How Many Microphones?

In an approach to the study of specific types of program setups, the question of the number of mikes will invariably arise, especially on a large show. Keep always in mind the previous discussion on the monaural character of the system and the lack of focusing power unless deliberately used as a means of concentrating the attention.

The greatest weakness in mike setups for large shows has always been the use of too many microphones. There is bound to be some distortion, however slight, in multiple-mike setups due to time lag of sound waves which create phase additions and subtractions at the various pickup positions. This source of distortion, however, is only minor compared to the other faults of this technique. Aside from the operational difficulties of handling a large number of channels on the mixing panel, with greatly increased chances of error, the control man and his board take the place of the conductor. All the dramatic interest, the emotional pattern written into the original score, plus even the conductor's interpretation, is placed in the ratio of fader adjustments and the reactions and psychological temperament of the operator. In other words, too many variables are injected between the performers and the listeners.

Let's establish a foundation upon which we can build a workable structure to determine the correct number of microphones for a given show. Let's also be practical, and realize that many operators have neither the very latest studios nor an adequate amount of rehearsal time.

1. Whenever it is possible in the time allotted for setting up, arrange your performers about a single microphone (following suggestions given later for each type of show) so that the overall balance is correct. If you do this, you achieve balance by proper positioning, rather than by mixing various sources on the control board.

2. Perhaps your time is running out, and you are still having trouble with a particular section in obtaining balance. This is more apt to occur in a dead studio than in one which is acoustically live. Another mike will have to be used on the troublesome section. However, use of the second pickup can probably be limited to particular spots in the show, such as rhythm-section accentuation of an orchestra as required by the score.

3. Some of the more complex shows do require more than one microphone. Take, for example, a variety show consisting of a drama cast, a chorus, and an orchestra. Remember that the microphone does not

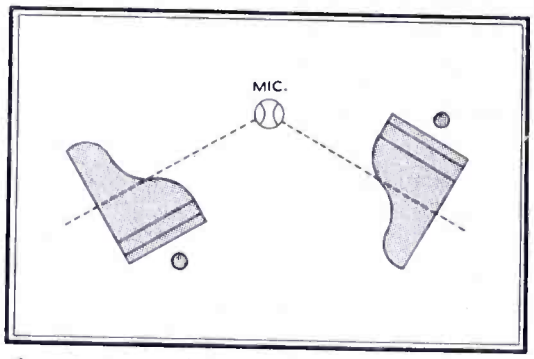


Fig. 6. Orientation for a two piano-team

focus attention as your ears do in the studio. Of course, it is likely that a program of this type will originate at one of the larger stations, having modern studios. The more rehearsal time you have, the less the number of microphones necessary, to the point where the absolute minimum is reached. So much for the basic theory of microphone technique. Let's go on with more specific program setups.

Picking up the Piano:

The single piano pickup is the simplest setup, since it is perhaps the least affected by acoustical nature of the room. No matter how softly the pianist plays, as long as he is unaccompanied by other instruments, the microphone should not be placed up under the lid. The distortion arising from the close proximity of large physical objects to the microphone is well known. It should then be obvious that a pickup under the lid and close to the sounding board will not allow natural transmission of the piano tones. Close-miking almost any instrument makes it necessary to hold down the volume, with great loss of musical brilliance. It is true that many operators have become so accustomed to this type of piano setup that, as is the case with the close-talking announcer, the sound may be familiar, but it is not natural reproduction. We must remember that it is the business of the broadcaster to transmit the natural sound of the original program content.

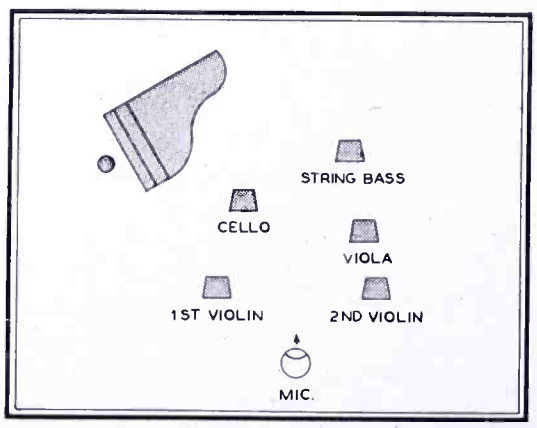


Fig. 7. Orientation for a salon orchestra

Here is the best method of determining ing the setup for a single piano: Start with a distance of 20 ft., head high. In a dead studio, this distance will probably result in a thin response, especially on low passage. In live studios, the sound may be too reverberant for clear-cut transmission. Move the microphone in on a line drawn through the center of the sounding board until the tones are full-bodied, with just the right amount of reverberation. This distance is seldom less than 8 ft., and will allow tonal brilliance and balance between lows and highs that is sacrificed in close-up technique

Now comes the final check for balance between bass and treble, in other words, the check of the player's left and right hand pressures. If the pianist has a heavy right hand, and bass response is somewhat weak in relation to the highs, keep the mike at the same distance, but swing it toward the tail of the piano. This method increases the response from the bass strings. If the pianist has a heavy left hand, with a relative loss of highs (this lack of highs is also apt to occur in dead studios), the mike should be moved toward an imaginary extension of the keyboard. This will increase response to the treble strings and decrease that from the bass strings.

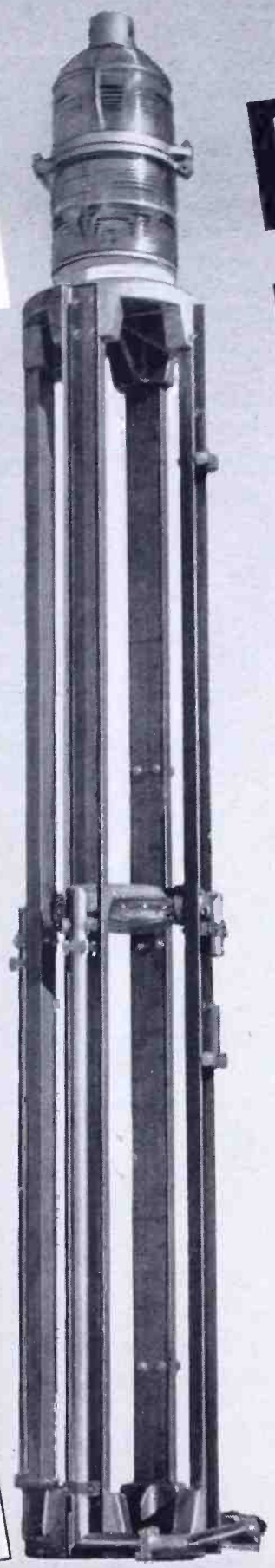
The twin piano team imposes only slight additional requirements. Fig 6 illustrates the most satisfactory orientation. The temperaments of the pianists must, of course, be considered and the lead piano given prominence by moving the mike closer to that piano if the accompanist is heavy-handed. The procedure for bass and treble balance should be followed not by moving the microphone, but the piano itself.

Vocalist and Piano:

The distance of the vocalist from the mike, the distance of the mike from the piano, and the distance of the vocalist from the piano must be considered in this setup. There is no excuse for using more than one microphone unless the time allowed for rehearsal is zero.

* Engineer, Station WIRE Indianapolis Broadcasting, Inc., Indianapolis, Ind., author of "Broadcast Operator's Handbook" published by John F. Rider, N. Y. C.

PROVED
In the Winter of '47-'48



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The first requirement is to listen to the vocalist in the studio. Does he or she sing out with the chest muscles, using a large volume and dynamic range? Or is the vocalist the crooner type, using only the larynx and throat for emphasis? Every vocalist is in one or the other general category.

One who sings out with full volume should be placed 12 to 6 ft. from the microphone when a piano alone is used as background. On rehearsal, always start with the greatest distance. The goal is to use the lowest volume and the highest volume without having to ride gain on the fader control. This part of the balance can always be achieved by careful rehearsal checks. The balance between vocalist and piano accompaniment is not always so simple. A good pianist or one familiar with a particular vocalist's style will automatically adjust his volume to the pianissimo and crescendo of the singer.

A bi-directional mike should be placed about 8 ft. from the piano, with the vocalist on the opposite side at the distance determined by trial. It is well to point out here that a very common error is in taking a vocal solo too literally. The presence of the piano must always be there, with only slight emphasis on the voice. It should be a blend with, of course, the voice always a little predominant, but not with a weak background of piano tones, as is often heard.

When the pianist insists on playing so loudly that the accompaniment smothers the vocalist, (some pianists cannot alter their volume and still play well) the dead side of the vocalist's microphone must be turned toward the piano. This is almost always the only adjustment necessary from the 8-ft. distance between mike and piano. If the studio is very live and the piano tones are still too prominent, turn the piano around so that the lid opens toward a wall of the studio. Don't, at any time, move the vocalist closer to the mike if it is necessary to ride gain on the natural dynamic range of the voice.

Setup for Small String Groups:

Small salon groups, string quartettes, or hill-billy groups, playing in intimate style, require good instrumental definition. This calls for comparatively close mike setups, but not too close! The author is always hesitant about using the word "close" since the reader is apt to take it as meaning directly into the face of the instrument.

Consider a small salon orchestra, generally consisting of several violins, a viola, a cello, a string bass and sometimes a piano. Due to their comparative volume they are usually placed in that order from the microphone. Fig. 7 illustrates the general orientation of such a group with the mike.

Now assume that the approximate distances are violins 4 ft., viola 6 ft., cello 8 ft., and string bass 10 ft., with piano somewhat off-mike at 10 ft. If the violins are too predominant for proper sectional balance, usual practice is to move the violins further back or to one side in a less sensitive zone, or else to bring the other instruments in closer.

However, remembering the focusing-power principle, it is clear that quite a range of sectional balance can be obtained by the simple expedient of adjusting the microphone height and tilt, as

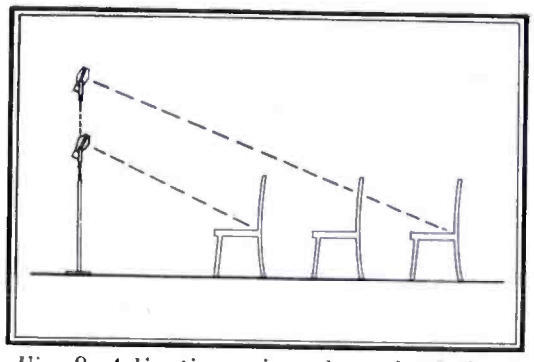

Fig. 8. Adjusting microphone for balance

shown in Fig. 8. If the violins are too predominant, raise the mike and focus on the other instruments. If the violins are weak, the mike should be lower and focused on them. This is a better method than moving the predominating instruments to one side in a less sensitive area of the mike, since the higher frequencies containing the over-tones are very important for wide-range pickups.

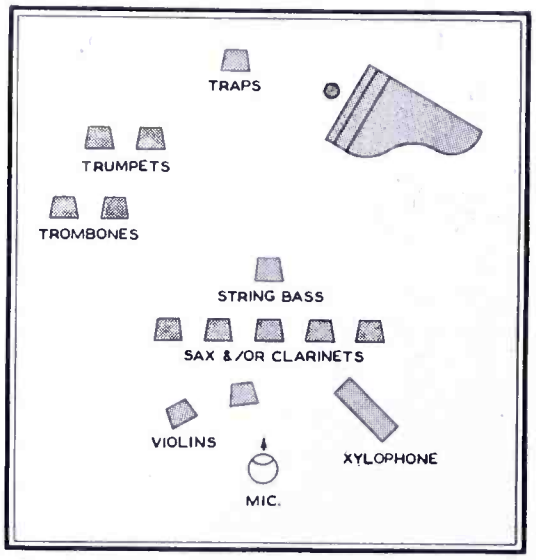

Fig. 9. Conventional one-microphone plan

There is little difference in pickup for this type of musical organization between dead and live studios, since the setup must be intimate in character, with high direct-to-reflected sound ratio, minimizing the effect of the acoustical nature of the studio.

Small Orchestra Setups:

A large number of organizations presenting popular, serious, or variety music comes within the small-orchestra category. There may be a combination of brass, strings, and reeds, numbering anywhere from 4 to 15 musicians.

Again the first step is to visualize the instruments in comparative power output. From softest to loudest, they are:

1. Violins, trumpets or trombones (muted), guitar.
2. Clarinets, saxophones, xylophone, vibraphone.
3. String bass.
4. Piano.
5. Trombone (open belled), trumpets (open belled).
6. Traps, bass drums, guitar (electrically amplified).

These are the most likely instruments to be encountered in such a setup. As before, the conventional approach is to arrange them in the order listed from the single microphone.

Look now at Fig. 9. This is a live-studio practice, starting with the violins at about 8 ft. When initially checking the balance of sections, remember the height and tilt adjustment for focusing power to obtain proper blend. Then, and not until then, try moving a troublesome section.

If you think it necessary to move instruments, keep these principles in mind: A predominating section may be too loud not because the relative distances between instruments is incorrect, but because the microphone is too close to the entire outfit. Move the mike back.

A weak section may be too soft not because it is too far from the mike, but because all instruments are too close to the microphone. Move the mike back.

In other words, the farther back a microphone is placed (within the limits of acoustically allowable distance) the better the chance of a good balance between all sections.

Another very important item is the treatment afforded muted trumpets or trombones. When their bells are muted, the instruments must be very close to the microphone. This means really close, about 2 ft. If the players cannot or will not step from their regular positions to one immediately in front of the mike, a separate microphone must be spotted just in front of that section. Obviously it is to be used only when they are muted.

Now consider a studio of older design, with dead characteristics. When the musicians number around 12 to 15, it is often difficult to get good sectional balance with the plan shown in Fig. 9. Even though the farther instruments may contribute about the same number of volume units, the pickup may be thin, because the dead studio does not reinforce the harmonics and overtones. Also the mike must be a little closer in a dead studio, emphasizing the discrepancy in sectional presence.

In nearly every case, however, best results are obtained with one mike, and by using the setup illustrated in Fig. 10. The

mike is a bi-directional ribbon type. The instruments must be more nearly on beam, due to the narrower angle of response in comparison to the uni-directional mike employed in Fig. 9 and to the dead acoustics of the studio. More time and movement of players will be necessary to get this setup exactly right, but it is far better than the usual procedure of using additional microphones.

How to Add a Vocalist:

A vocalist with the type of musical program just described imposes special problems unless the organization is thoroughly trained in prior broadcast production technique.

The ideal arrangement would be for the vocalist to stand in front of the orchestra, facing the mike at a distance of several feet. This arrangement, however, is often not practical as, for instance, when the mike is raised and slanted so as to obtain proper balance of instrumental tones.

Where such a situation occurs, there is no alternative but to use a second microphone for the vocalist, preferably a uni-directional type, with dead side toward orchestra. This mike can be used for the announcer, also.

Fig. 10. Improved pickup location

Symphony Orchestras:

The large symphony orchestra setup should be based upon exactly the same principles as heretofore discussed, except that the grouping of instruments, the use of a chorus, and the type of musical score make the problems much broader in scope. Fortunately, such programs are not usually attempted in an inadequately-designed studio.

Generally, the usual physical arrangement of the orchestra for regular audience listening will be satisfactory for broadcast purposes. On the initial trial of the main orchestra microphone, several mikes should be suspended at the most likely pickup positions in order to avoid the confusion of moving mikes. The general area for these microphones is 15 to 20 ft. high, and 15 to 25 ft. in front of the violin section. Fig. 11 illustrates a typical grouping of a large symphony orchestra.

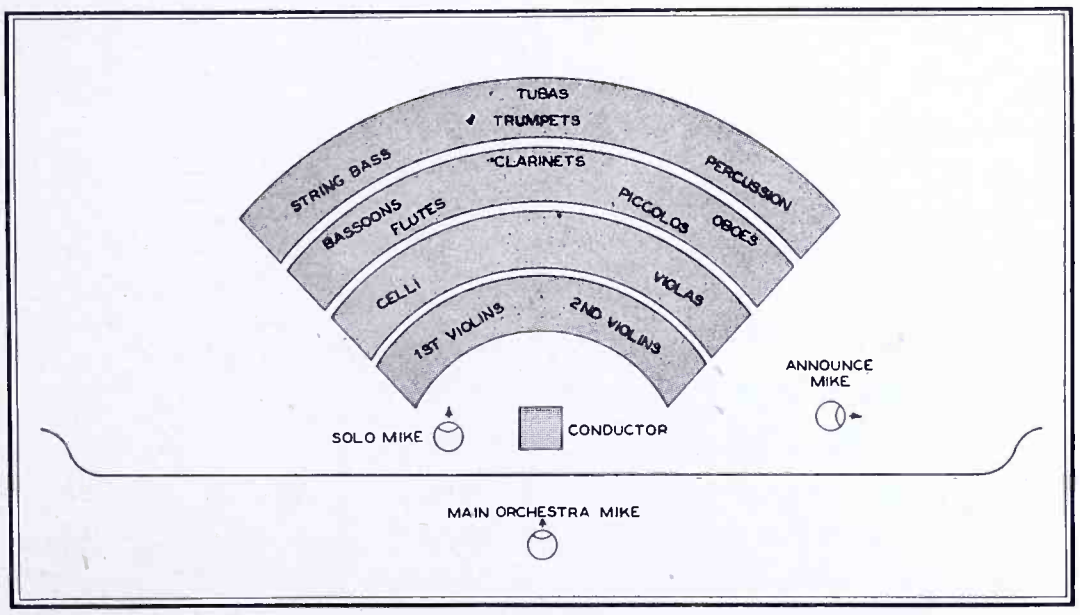

Fig. 11. Symphony orchestras may require solo and section mikes for highest fidelity

If a vocalist or instrumental solo is called for, it is almost always necessary to use a second mike to achieve proper sound perspective. Remember that vocal or instrumental solos are *not* to be entirely predominant; the orchestral accompaniment must be very much present. Always try to get the conductor to listen to a monitor speaker for a final check on balance, or get some responsible member of the organization to pass on it. The very best control and production men do this simply because every symphony organization has its own arrangement of score or possibly a distinct interpretation of the original score. This individuality must be conveyed to the listeners. Thus, many times, a slight rearrangement of instruments in relation to the microphone is found necessary.

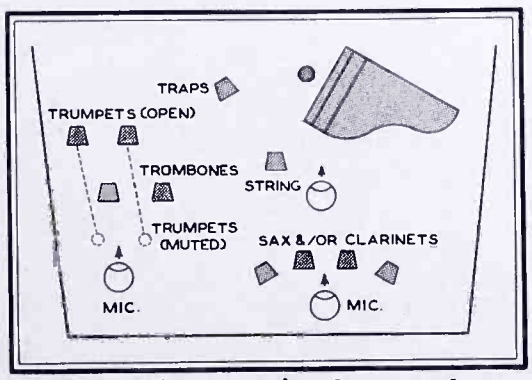

Fig. 12. Mike setup for dance orchestra

In spite of the usually superior results obtained with a single, well-orientated microphone, it is often necessary to deviate from this practice for true high-fidelity pickup. The main orchestra microphone, back far enough to obtain the proper blend of all instrumental tones, will faithfully pick up the delicate, distant tonal beauty of the violin passages in *Clair de Lune,* for example. Most music lovers, however, criticize this same microphone setup for such numbers as the Strauss waltzes, where the tonal perspective of the strings should be closer and more strident in quality.

Many leading conductors and producers of symphony broadcasts insist on an added mike suspended directly over the strings or other sections, to be turned up only on cue. This procedure supplies the missing psychological factor of microphone-to-sound perspective. When a choir is used with a symphony orchestra, it is also necessary to use a separate mike due to the spread of the total combination, in order to obtain focusing power.

Notes on Field Setups:

Field setups are an entirely different matter. The musical instruments must usually be placed more in a straight line due to lack of depth of the platform. Added to this is the inevitable noise and confusion about the point of origin. It may be argued that really high-fidelity transmission is impossible from such a broadcast, and this is true. But FM listeners especially will appreciate any pains taken to improve the pickup.

Multiple microphone arrangements are absolutely necessary for such an orchestra of even medium size.

Fig. 12 illustrates a 3-microphone treatment of a typical dance orchestra playing in the open. Always strive to obtain a good balance with the minimum number of mikes, taking into consideration the usually heavy background noise. It is almost always necessary to use a microphone for each group of instruments, as shown in Fig. 12, to give the section playing the lead or melody at any particular time the highest intensity. But remember that the presence of the other sections is important.

Conclusion:

It is apparent to the experienced broadcast man that many types of pro-

(Continued on page 44)

Note to Broadcasters: Machlett Laboratories now produce for the Western Electric Company its line of high power transmitting tubes —so well known and respected by all broadcasting engineers. Made by Machlett Laboratories in close collaboration with Bell Telephone Laboratories, these tubes will continue to set the highest standard of performance in broadcast service. These tubes are distributed exclusively for Western Electric by the Graybar Electric Company in the U.S.A., and by the Northern Electric Company in Canada and Newfoundland.

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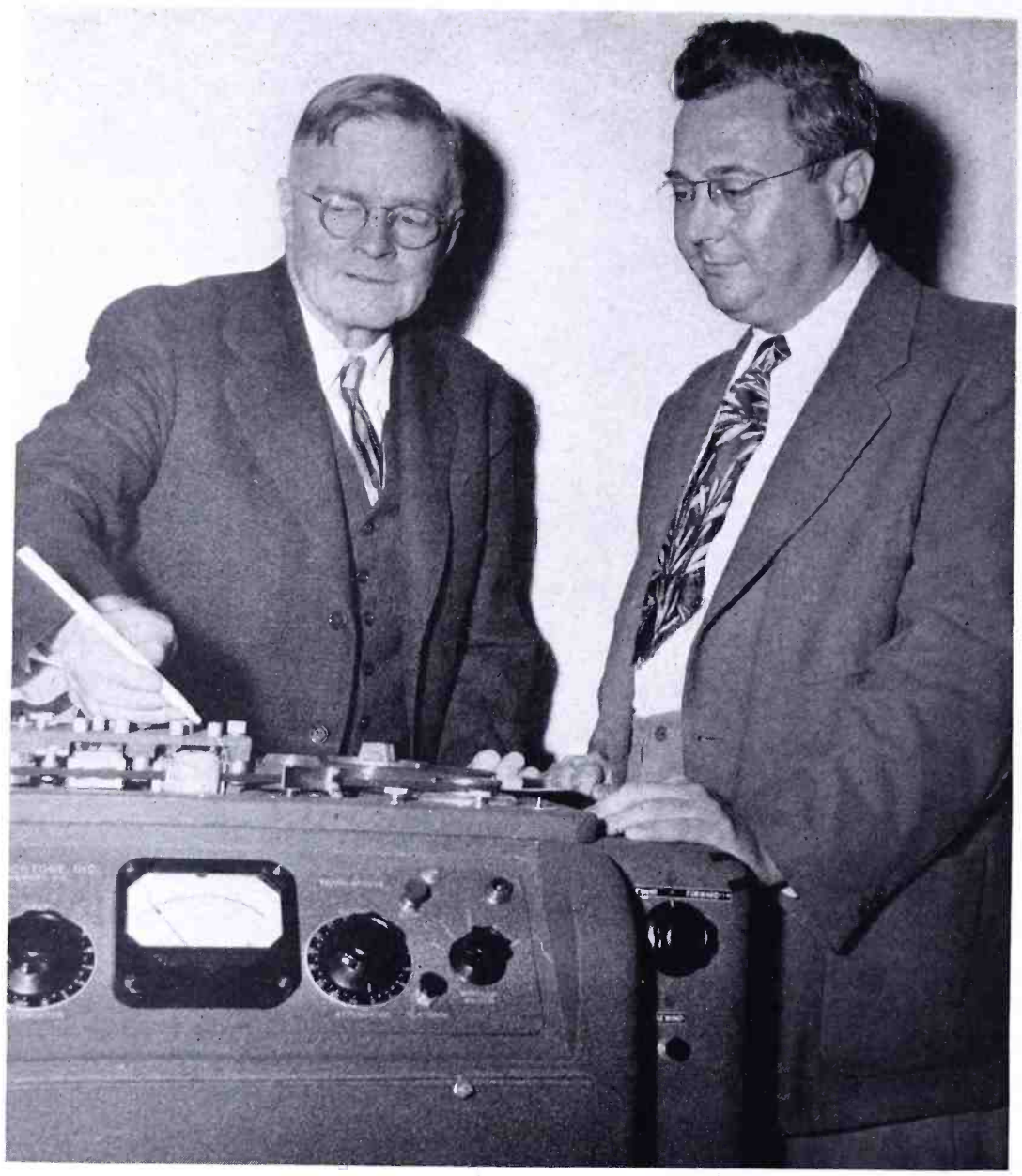


The author, left, and Everett Dillard at WASH, key station of the Continental Network, where programs are recorded on Rangertone machines and sent to affiliates

NEW TAPE TECHNIQUES

NOTES ON THE PROGRESS BEING MADE IN THE STUDIO USE OF TAPE RECORDINGS — *By* COL. R. H. RANGER*

"WHY can't we have more high-fidelity programs for FM stations?" With the advent of fine FM receivers, amplifiers, and speakers, the demand for better program quality, is mounting rapidly. To many listeners, this is the most important potential advantage of FM, but the majority of stations are programmed with records or network originations that hardly do justice to FM's audio capabilities.

The broadcasters' problem is one of expense. If an FM station is owned by a network affiliate, the least expensive way is to use the net programs for both AM and FM. This, unfortunately, limits FM to 5,000 cycles. The only 15,000-cycle telephone line extant is that between WASH, Continental Network's key station in Washington, and W2XEA at Alpine, N. J.

Most independent FM stations use records and transcriptions, as these are the cheapest program sources available to them. Phonograph records do well to reach 7,000 cycles. Transcriptions do a little better. Both introduce the problem of needle scratch.

The refinements that have been made in tape recording promise to answer the economic limitations on FM quality. This has proved to be the case with Rangertone equipment that have undergone extensive operational tests at WASH, Washington and at KSBR, San Bruno. The following table shows the frequency range and running time at three standard tape speeds:

Ins. per Second	Response in Cycles	Running Time
30	30-15,000	34 min.
15	40-12,500	68 min.
7½	50- 7,500	136 min.

For top performance, the 30-in. speed satisfies every requirement. It is completely satisfactory to music lovers who want the full audio and dynamic range required for the perfect reproduction of music. Moreover, full half-hour programs can be handled at this tape speed. At some sacrifice of quality, a one-hour program can be recorded at 15 ins. per second.

On sports events, where the action may continue for still longer periods, the 7½-in. speed is excellent. In such cases, the limitation on audio range is not a disadvantage, since the material recorded is almost entirely concerned with speech frequencies.

Wide frequency response is by no means the only outstanding operational advantage of tape recording. As someone aptly put it, there are no little flags on the frequencies which make them say: "Here I am." Of equal importance is the overall smoothness and ease of handling that comes from the non-mechanical functioning of the entire recording and playback process.

Work on tape recording is still going forward. The establishment of standards is a must for top performance. Moreover, it is essential that a tape made on one machine should be playable on another. Aggressive steps in this direction are being taken by committees of RMA, NAB, and ASA. They are holding regular meetings, and many of the basic standards have been established already. Meanwhile, Rangertone equipment is being supplied with adapters to make operation interchangeable with other makes.

As a part of the continuing development program, a monthly quality check has been instituted. Cooperating stations send to our laboratory a test tape recorded at program level, up in 2-db steps to 4 db, and down in 2-db steps to —10 db, all at 200 cycles. Also, a frequency check is made on this test tape, starting at 30 cycles and going up to the top range at each speed in convenient intervals. This tape is tested at our laboratory for response and harmonic distortion, and a report is sent back to the station. If modifications are necessary, they can be made quite readily by controls on the recorder.

Use of Tape at KSBR:

As to the practical aspects of studio use, here is a report from Franklin Evans, program director at Radio Diablo station KSBR:

Of the many uses for tape at KSBR, one of the most interesting is in connection with a weekly half-hour drama which we produce and record on a Rangertone machine.

As soon as the script has been approved, multiple copies are run off and distributed to each member of the cast.

* Rangertone, Inc., 73 Winthrop, St., Newark.

We use sound effects from the Standard Sound Effects Library, combined with any home-made effects that may be called for in the script. Since the program director writes, narrates, and produces these programs, any effects impossible for use are held at a minimum. Our bridge music is from the Tempo Library of Music Bridges, mingled with passages from our library of classical music. As a rule, we use three mikes for this production, one of which may be a filter mike.

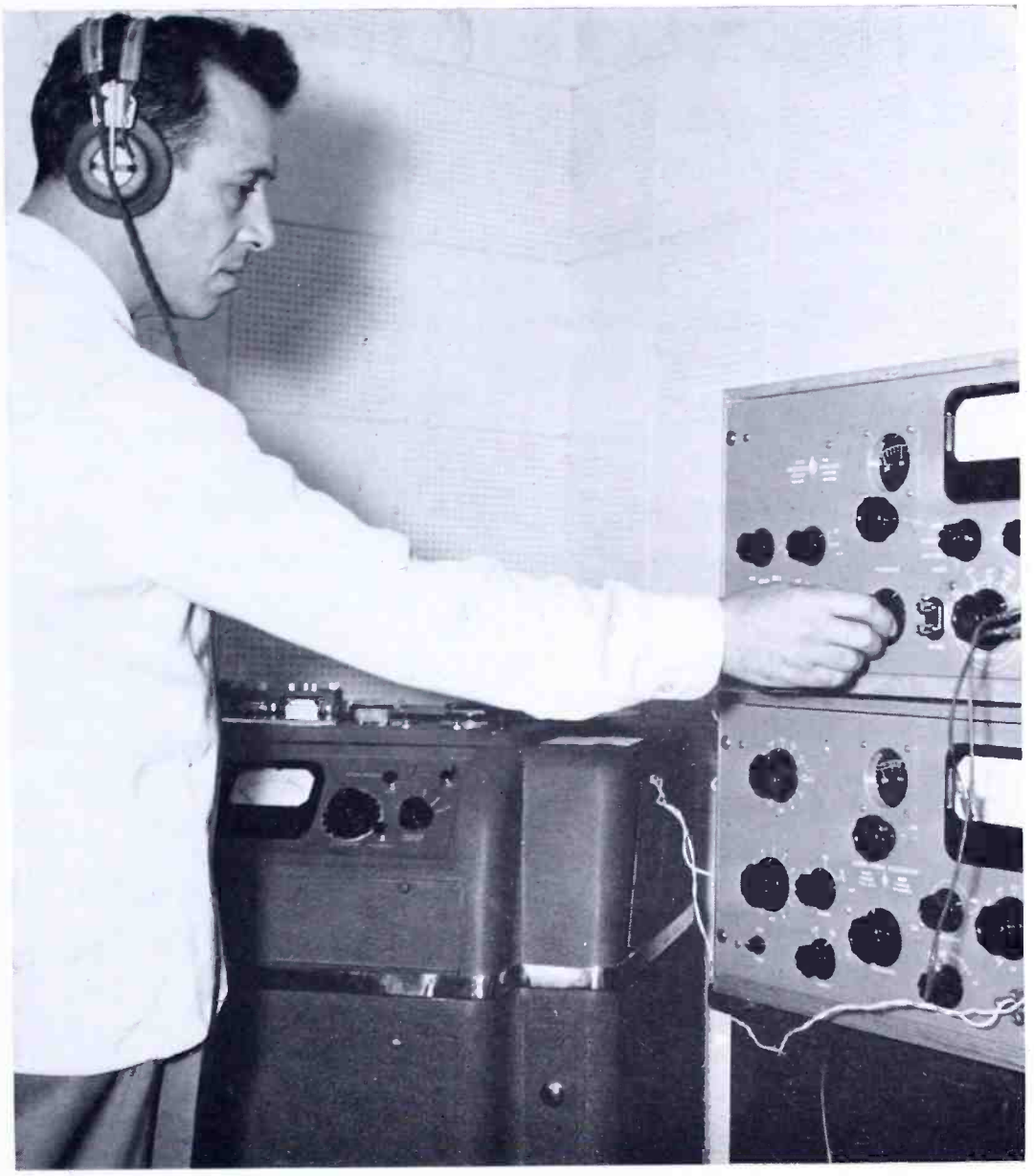
The first reading of the script is usually cut on the tape so that, when it is played back, we can pick out not only the obvious mistakes but also spots that do not show up on the script such as poor timing, interpretation, and characterization. The cast also has the opportunity of observing their mistakes in this first reading, and of improving their characterizations. During this playback the director follows the script, marks all mistakes, and suggests corrections. The cast is then given a review of the first take and the scripts are revised.

Sometimes the producer decides that one or two of the scenes on the first run are good enough to print, and he may decide to work around them. Usually this first run of tape is removed from the machine and a fresh reel of tape is installed for the second and, generally, final cutting.

Working as we do with a limited cast and production facilities, one of the actors may have to move about the studio, and possibly go to the control room to relieve one of the other men who has a scene coming up. When this situation occurs, the director, who is usually in the studio, waits about 3 or 4 seconds and then calls "Cut." The operator of the Rangertone presses the stop button and the change is made. While the cast is getting ready for the next scene, the Rangertone operator backs up the tape to where the last scene was ended. He, or she, inserts a tiny slip of paper at this place on the tape so that it protrudes above the reel. He also makes a check on his copy of the script, indicating where the scene ended and that there is a spot of dead tape to be edited out.

This method of production, we have found, expedites the cutting of a half-hour drama immensely. If a scene is not good, we simply back up the tape and cut it over. If a particular scene is good on the first take, we skip it on the second go-through. The operator simply marks the tape with a slip of paper to indicate that he will have to splice in a scene from the first tape.

Another advantage of tape over any other means of transcription is that the actor understands that if he makes a mistake, stumbles over a word, or reads a line improperly, or two lines are given at the same time, he simply



Arthur Arrigoni checks the performance of the Rangertone tape recorder at KSBR

pauses for 1 or 2 seconds and then repeats the lines that were not given correctly. The Rangertone operator hears this, flags the tape where the mistake occurred, and marks his copy of the script accordingly. The error is then as good as out of the show, for it will be clipped when the recording is over.

There is another advantage of using tape over any other means of transcribing. Using the 30-in. tape speed, we have found it possible not only to snip out words, but even to take out syllables, or even one letter of a word. In one instance, an actor read the word "horse" as "horses." This ruined the sense of the scene. So the operator took out the "s" from the end of the word. However, in so doing, he found he had also removed the final "s" sound. This put an even worse connotation on the sentence, as you can well imagine. Then the operator put back the last bit of sibilance, and the final sound of the word was, as intended, "horse."

After the complete show is cut onto tape, the cast is excused. The director and the operator then edit the tape, cutting and splicing out the errors, and tightening up the entire production. If the show is long, portions of it are removed to bring it down to time. The running time of the program can be set exactly by using a live introduction and close, with the cast credits as a pad. This gives a very positive advantage over either live work on the air and/or the conventional transcriptions.

On occasions we have been confronted with difficult sound effect problems. One that comes to mind was where two men were riding horseback. One man dismounted and the other remained mounted. In the scene, the man who was still on his horse shot the other man, and then had his horse rear up and trample the man to death. It was a gruesome scene, and a very difficult effect to get. We cut the entire show except for this one part. Then the cast worked on the effect, and we recorded it 7 or 8 times, until it was perfect. The effect was then spliced into the tape of the program.

This procedure, approaching the method used by the motion picture industry, has evolved into a set production pattern which, in our experience, works extremely well. In fact, it is much better than the old method of multitudinous rehearsals with cast, sound, and music, and then a final dress prior to air time.

INDEX OF ARTICLES

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PROGRAM PICKUPS

(Continued from page 37)

gram setups have not been treated in this article. Indeed, such a treatment would require a full-size book. The author has attempted to take up only those situations most commonly encountered.

There will, no doubt, be some who have honest disagreements with parts of this paper. The author extends an invitation of correspondence to any reader who may care to offer comment or criticism. Progress in any line of endeavor can be achieved only by the inquisitive mind, and earnest doubts of traditional practices. Microphone setup techniques in particular, and operational engineering in general are in need of exhaustive, wide-open discussion.

POLYCASTING

(Continued from page 32)

to 30 miles can be determined readily for the conditions stated. At 510 mc. the power must be increased from 100 to 10,000 times and at 910 mc. from 625 to 40,000 times on the southwest and west radials, respectively. These ratios are for median values of signal intensities which, according to Figs. 1 and 2, show a tremendous scattering.

To simplify this illustration, an average of the above ratios will be adopted. Since the terrain over which the tests were made is typical of that in the more populated sections of the United States, this assumption appears justified, and a ratio of 10,000 will be used. Due to the scattering of field intensities, particularly at distances beyond 10 miles, even this value does not assure 100 per cent coverage. For this example, the radiated power for the single transmitter to cover the area in question is assumed to be the average of the 2,000 to 10,000 kw. previously determined, or 6,000 kilowatts. An antenna height of 500 feet above average terrain elevation is assumed with this power. It then follows that a radiated power of .6 kw. will provide at least as satisfactory coverage of the area within a radius of 10 miles if the same antenna height is employed. It is felt that a more reasonable assumption would be to consider Polycast system antenna heights as 200 feet. To provide the same signal intensities from the lower antennas will require more power in inverse ratio to to height squared, or about 6.25 times. The radiated power of the Polycast system units then becomes about 4 kw. If a transmitting antenna gain of 20 is assumed, as in the case of the high-power station, the transmitter output power required is about 200 watts. While this estimated service area of 10-mile radius

(Continued on page 45)

POLYCAST SYSTEM

(Continued from page 44)

may change with conditions, greater knowledge, and different receivers and receiving installations, it can be used at present as a rough estimate.

The area assumed to be served by the single 6,000 kw. transmitter is 2,830 square miles. To serve this area by Polycasting, a minimum of 10 low-power units as described above would be needed. In order to provide the elimination of shadows under conditions of overlapping coverage, it is probable that, with careful design, some 15 units would suffice. Since service areas are not generally circular, the Polycast system would serve a city or metropolitan area more efficiently than a single high power source. But even if the area to be served were circular, the average signal over the area would be much stronger with the Polycast system, the shadows would be far less, and the interference greatly reduced.

As to equipment, with the low powers required, relatively little development work is needed after the FCC establishes the standards. Receivers have been developed and could be sold if there were transmitters providing attractive programs.

Conclusions:

In the foregoing, an attempt has been made to present the technical and economic difficulties that confront television broadcasting in the 475- to 890-mc. band, and to show how our concept of Polycasting presents a technically and economically sound solution.

The estimate of 6,000 kw. power required for the conventional system to serve to a distance of 30 miles is consistent with the JTAC report to the FCC. JTAC concludes from the RCA tests that 5,000 to 20,000 kw. would be required from the Empire State transmitter to produce a usable signal (5,000 microvolts per meter) at 40 miles.

There can hardly be disagreement with the conclusion that the super-power transmitter presents technical and econnomic problems that eliminate it from further consideration. On the other hand, the components of the Polycast system do not present difficult technical or economic problems, and can be produced in the foreseeable future.

The JTAC report to the FCC on September 20, 1948, in general supports the facts and opinions presented in the foregoing. A conclusion of this report is that television on the 475- to 890-mc. band cannot hope to provide the same quality of service over the same areas as is possible with the present assignments on 54 to 216 mc. unless a new concept is adopted.

The foregoing has only touched on the

(Continued on page 46)

AUDIO DEVELOPMENTS

(Continued from page 33)

promotions, such as the arrival of Santa Claus and the Easter bunny at the store, and appearances of authors in the book department, or sports champions in the sporting goods department.

6. Various types of paging, and announcements of lost children.

7. "Inquiring-microphone" interviews with celebreties visiting the store.

The work of installing the equipment, particularly the loudspeakers, was made easy by timing this job with a store-wide modernization program. In areas where new ceilings were built, the speakers were simply flush-mounted. Each was set into an enclosed baffle box 24 by 24 by 6 ins. The shallow depth is made possible by the fact that the 8-in. Western Electric 755A speaker is only 3⅛ ins. deep. Where new ceilings were not put in, baffle boxes were attached to the ceiling surface and painted a matching color.

The speakers are connected in seven groups, Each group, driven by a 75-watt W.E. type 143 amplifier, is handled as a separate programming unit. Each program source feeds a preamplifier, the output of which can be switched to any one of three channels. Inputs to the 75-watt main amplifiers can be connected to any one of the three channels. A spare amplifier, available for emergencies, can be switched to any speaker circuit. All switching of this very flexible system is centered at a console located at the control center.

Probably you are waiting to ask the $64 question: Now the system is in, how do they like it? One of the officials at Hess Brothers' gave the answer in this way: "It's hard to see how we ever got along without our sound system."

POLYCAST SYSTEM

(Continued from page 45)

problem of multipath transmission in the Polycasting system which, on first appraisal, may appear to be greater than under present techniques. Multipath effects are a problem in any band, and have to be dealt with at the majority of receiver locations. The solution of this difficulty is found in receiving antenna directivity and location. Given the high signal intensities inherent in the Polycast system, the higher-frequency ghosts can be dealt with practically more readily than on the lower band since, for a given degree of directivity required, the physical dimensions decrease with frequency. We believe that investigation may disclose the desirability of employing frequency modulation to provide inherent rejection of undesired signals, either by multipath sources or from other stations located at a distance.

The Polycasting system overcomes the technically and economically unsurmountable difficulty of radiating sufficiently high signal intensities over a large area by the present single-station method. The foreseeable difficulties under the Polycasting system can, in our opinion, be dealt with effectively and economically by familiar engineering methods.

Our petition to the FCC was made as the firm of Raymond M. Wilmotte, Inc., and as two individual engineers. In this connection we have no affiliations with either manufacturers or operators, nor are we influenced by special interests. It is our honest desire to see a good and stable television service developed to the best advantage of the American public.

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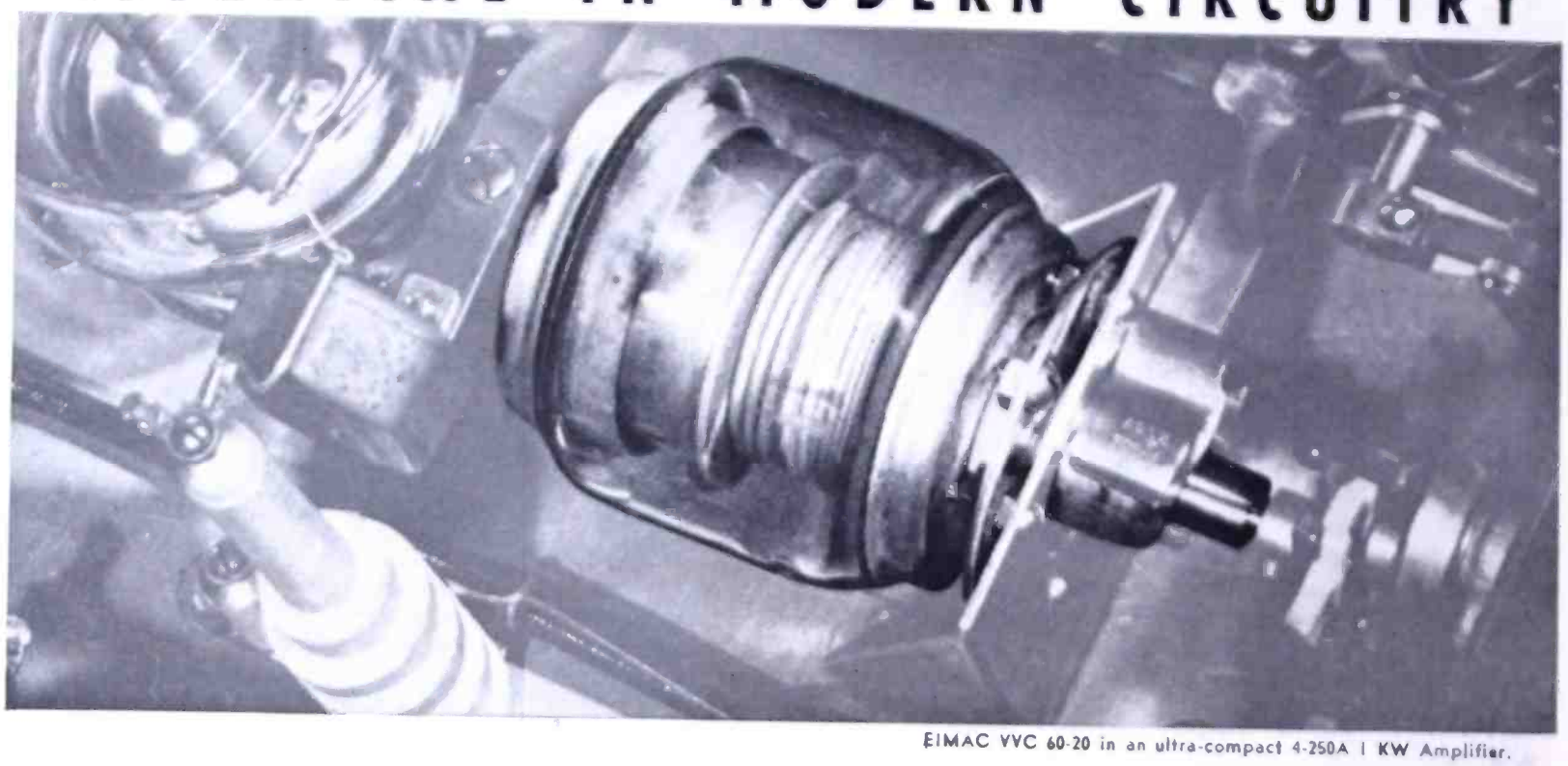

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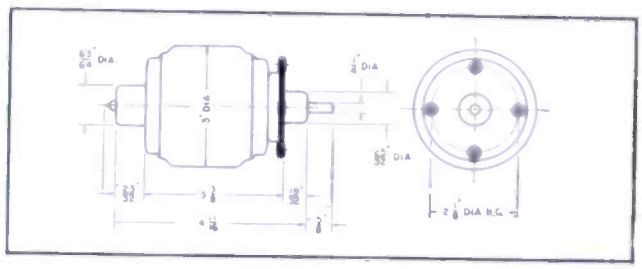

- Structural rigidity eliminates electro-mechanical vibration.
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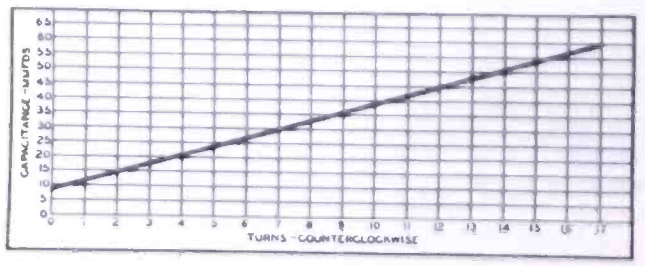

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Eimac variable vacuum capacitors are immediately available. In addition to the type VVC 60-20 illustrated here, there are types VVC2 60-20 and VVC4 60-20.

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Parallel	20-120 mmf.	20-KV	80 amp.
Split-stator	5-30 mmf.	40-KV	40 amp.
VVC4-60-20			
Parallel	40-240 mmf.	20-KV	160 amp.
Split-stator	10-60 mmf.	40-KV	80 amp.

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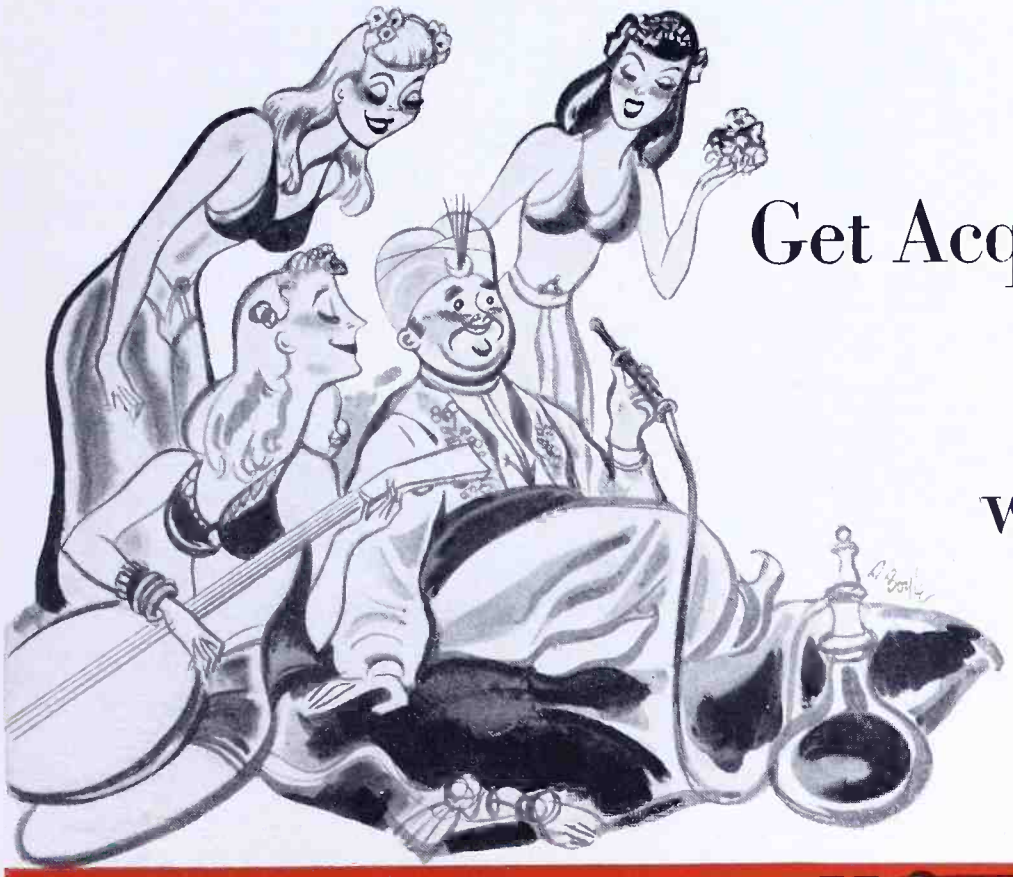

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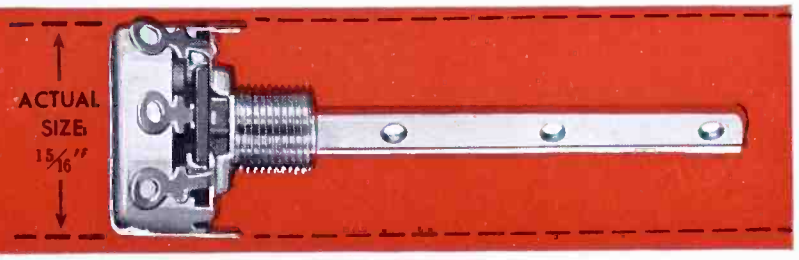

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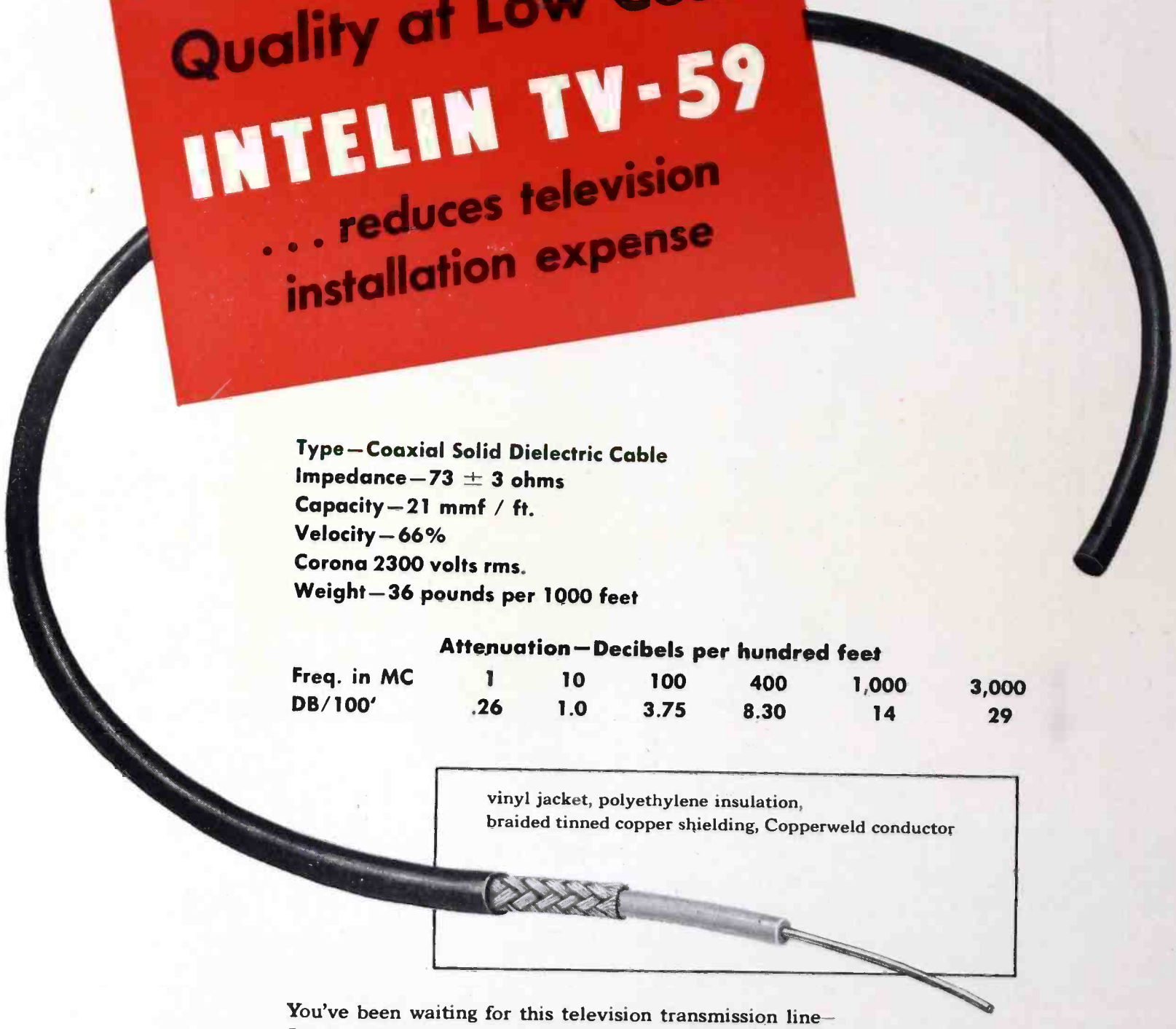

Type—Coaxial Solid Dielectric Cable
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Capacity—21 mmf / ft.
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