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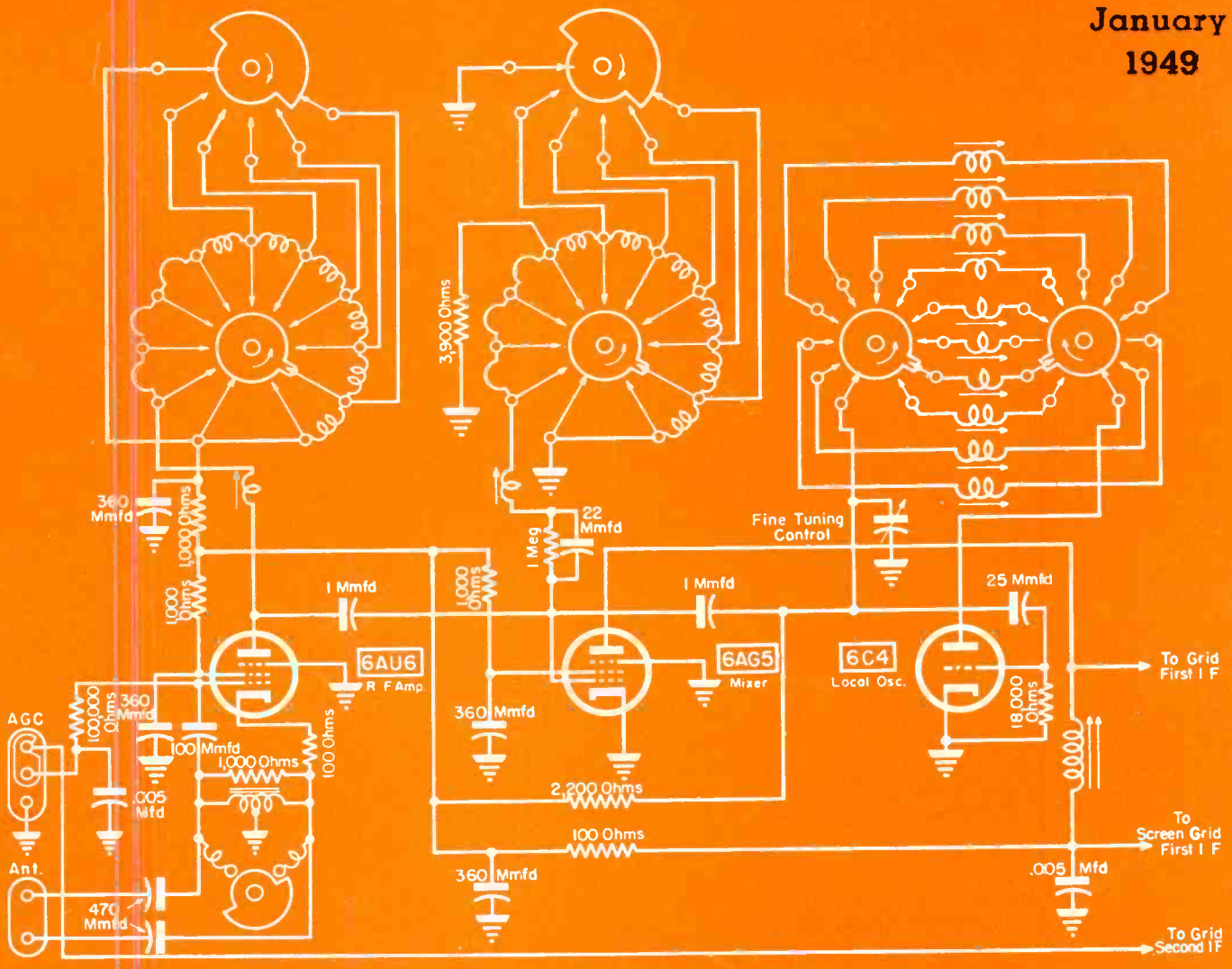
SERVICE

January
1949



Front end of a 7" direct-view twin-speaker TV receiver featuring the intercarrier-sound system.

[See page 2]

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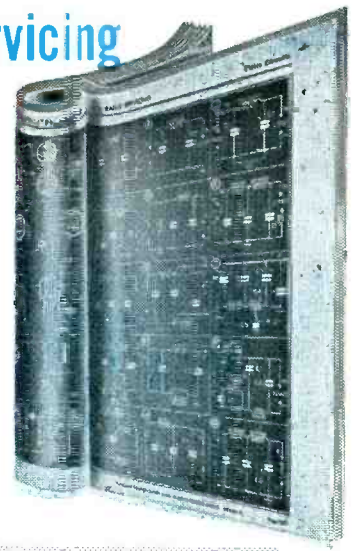

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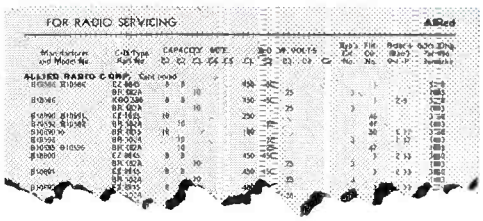

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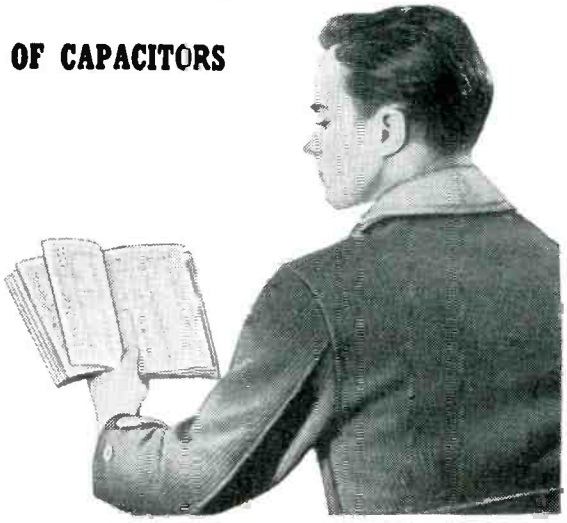

Vol. 18, No. 1

RADIO · TELEVISION · ELECTRONIC
SERVICE

January, 1949

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Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.

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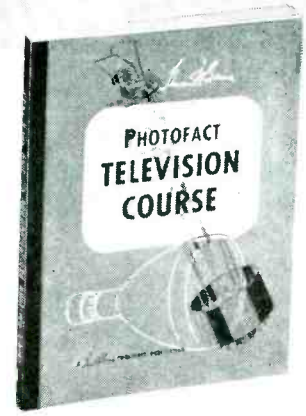

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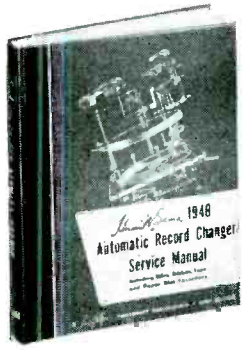

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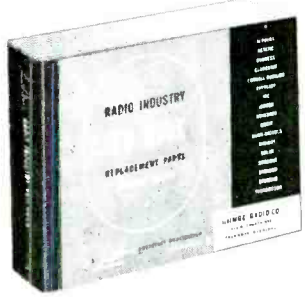

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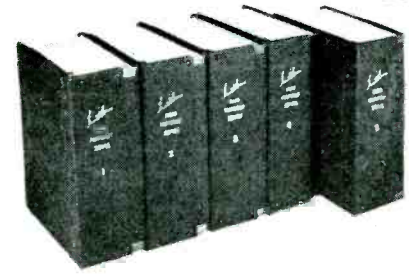

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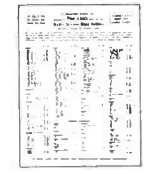

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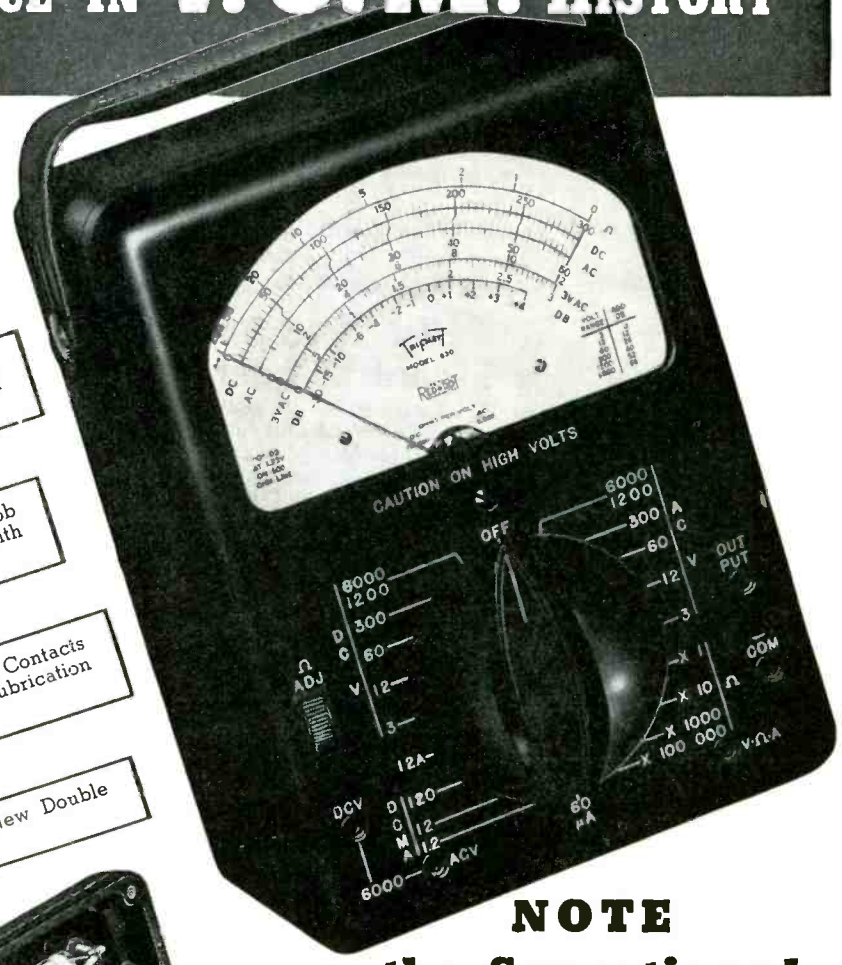

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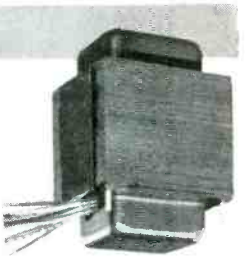

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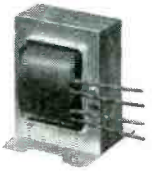
Exact equivalent to R. C. A. Type No. 211T1. List Price, $11.25



TSO-1

Vertical Scanning Output Transformer No. TSO-1. Couples vertical output tubes to picture tube deflection yoke.

Pri. Impedance: 19,000 ohms at 30 v., 60 cycles, 13 ma d-c
Ratio, Primary to Secondary: 10 to 1

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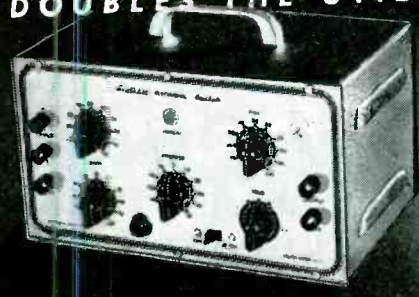

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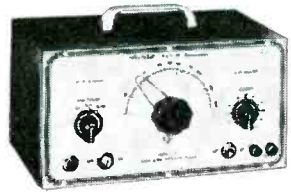

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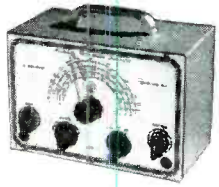

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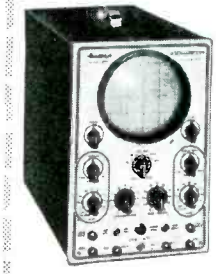

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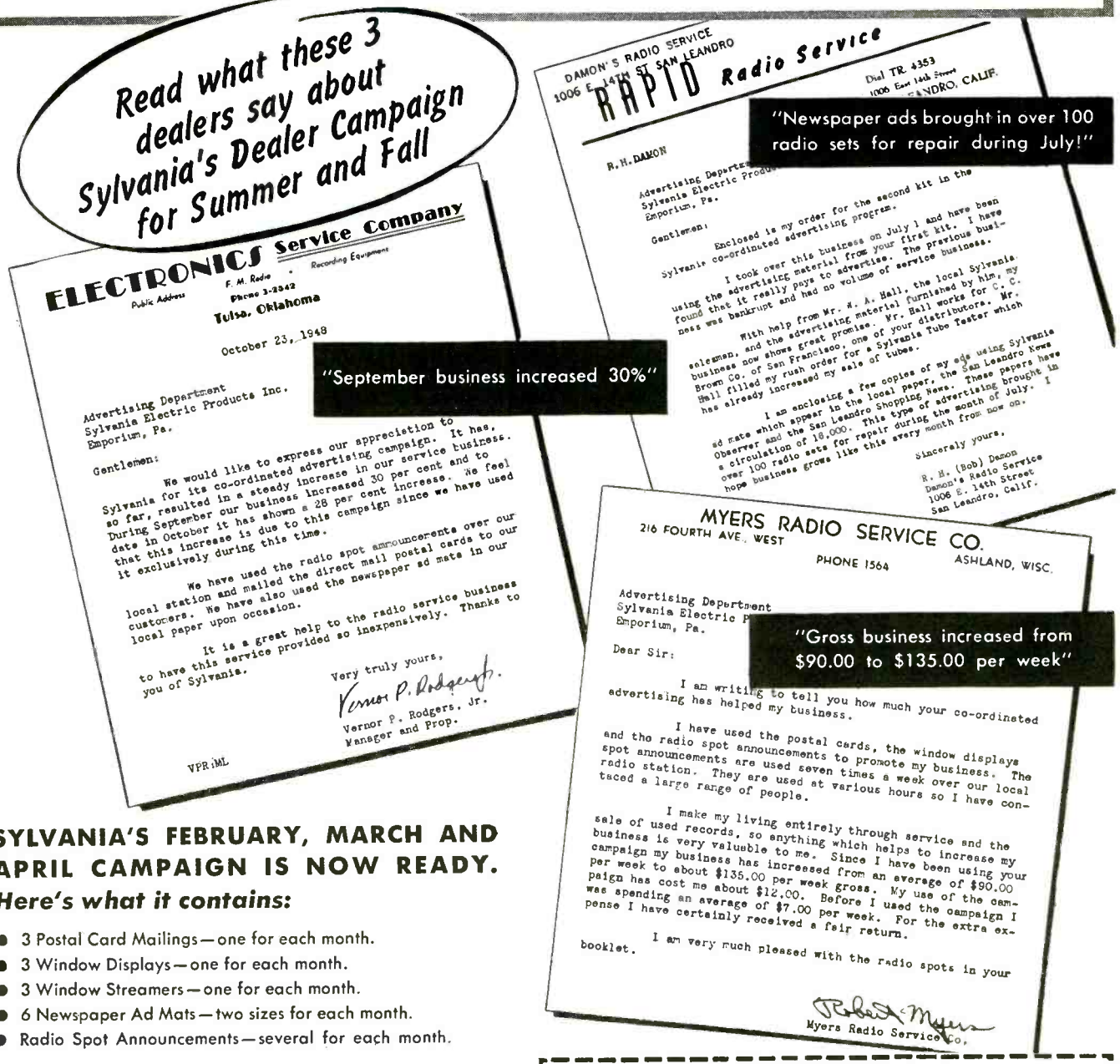
"September business increased 30%"

"Gross business increased from $90.00 to $135.00 per week"



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RAPID Radio Service
Dial TR. 4353
1006 East 14th Street
SAN LEANDRO, CALIF.

R. H. DAMON

Advertising Department
Sylvania Electric Products
Emporium, Pa.

Gentlemen:

Enclosed is my order for the second kit in the Sylvania co-ordinated advertising program.

I took over this business on July 1 and have been using the advertising material from your first kit. I have found that it really pays to advertise. The previous business was bankrupt and had no volume of service business.

With help from Mr. W. A. Hall, the local Sylvania salesman, and the advertising material furnished by him, my business now shows great promise. Mr. Hall works for C. C. Brown Co. of San Francisco, one of your distributors. Mr. Hall filled my rush order for a Sylvania Tube Tester which has already increased my sale of tubes.

I am enclosing a few copies of my ads using Sylvania ad mats which appear in the local paper, the San Leandro News Observer and the San Leandro Shopping News. These papers have a circulation of 18,000. This type of advertising brought in over 100 radio sets for repair during the month of July. I hope business grows like this every month from now on.

Sincerely yours,

R. H. (Bob) Damon
Damon's Radio Service
1006 E. 14th Street
San Leandro, Calif.

ELECTRONICS Service Company
Public Address · F. M. Radio · Recording Equipment
Phone 3-2242
Tulsa, Oklahoma

October 23, 1948

Advertising Department
Sylvania Electric Products Inc.
Emporium, Pa.

Gentlemen:

We would like to express our appreciation to Sylvania for its co-ordinated advertising campaign. It has, so far, resulted in a steady increase in our service business. During September our business increased 30 per cent and to date in October it has shown a 28 per cent increase. We feel that this increase is due to this campaign since we have used it exclusively during this time.

We have used the radio spot announcements over our local station and mailed the direct mail postal cards to our customers. We have also used the newspaper ad mats in our local paper upon occasion.

It is a great help to the radio service business to have this service provided so inexpensively. Thanks to you of Sylvania.

Very truly yours,
Vernor P. Rodgers
Vernor P. Rodgers, Jr.
Manager and Prop.

VPR:ML

MYERS RADIO SERVICE CO.
216 FOURTH AVE. WEST
PHONE 1564
ASHLAND, WISC.

Advertising Department
Sylvania Electric P
Emporium, Pa.

Dear Sir:

I am writing to tell you how much your co-ordinated advertising has helped my business.

I have used the postal cards, the window displays and the radio spot announcements to promote my business. The spot announcements are used seven times a week over our local radio station. They are used at various hours so I have contacted a large range of people.

I make my living entirely through service and the sale of used records, so anything which helps to increase my business is very valuable to me. Since I have been using your campaign my business has increased from an average of $90.00 per week to about $135.00 per week gross. My use of the campaign has cost me about $12.00. Before I used the campaign I was spending an average of $7.00 per week. For the extra expense I have certainly received a fair return.

I am very much pleased with the radio spots in your booklet.

Robert Myers
Myers Radio Service Co.

SYLVANIA'S FEBRUARY, MARCH AND APRIL CAMPAIGN IS NOW READY.

Here's what it contains:

- 3 Postal Card Mailings—one for each month.
- 3 Window Displays—one for each month.
- 3 Window Streamers—one for each month.
- 6 Newspaper Ad Mats—two sizes for each month.
- Radio Spot Announcements—several for each month.

SEND FOR FULL INFORMATION NOW!

Remember, this campaign designed for your use ties up directly with Sylvania's ad campaigns on a national scale. You pay only the postage on the government postal cards you mail. Sylvania supplies everything else *free!* Mail coupon today!

Sylvania Electric Products Inc.
Advertising Department
Room R-1901
Emporium, Pa.

Gentlemen: Please send me full details on your February, March and April Service Dealer Campaigns.

Name_____

Company_____

Address_____

City_____ Zone_____

State_____

SYLVANIA ELECTRIC

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

RADIO · TELEVISION · ELECTRONIC
SERVICE

TV, FM and Sound

THE TWO EXTREMELY IMPORTANT factors in the radio art, *FM and Sound,* have unfortunately received a vacillating type of attention from too many Service Men. The FM receiver has been dismissed as an attachment and a gadget by scores of Service Men and the sound system, particularly in the FM set, has been overlooked completely. It seems to have taken the television receiver to project the importance of the frequency-modulation system of reception and the audio end, too. For in the television set, there is quite an elaborate FM set feeding into an audio system, which is not always too elaborate or even acceptable. In capitalizing on the full capabilities of the audio end of the TV set, a thorough acquaintance with the FM and audio section are *must* factors. The circuit of the FM portion of the TV set, which is similar to that used in most standard FM and AM/FM receivers, must be studied as carefully as the video receiver itself. Every design feature should become familiar ground to facilitate servicing and, most important, provide a quality signal to the audio end.

Because of the importance of the FM phase of the TV set as well as the virtues of the system for receiving purposes only, complete coverage of the field will continue to be emphasized in every issue of SERVICE. Incidentally, there's a book which has just come off the press, directed entirely to *Frequency Modulation* which will undoubtedly become a bible with every Service Man. Written by Nathan Marchand, who has authored a score of articles for us, and published by Murray Hill Books, it contains over 400 pages of well-illustrated copy detailing every phase of FM in receiving and transmitting, fixed and mobile, and particularly the servicing of modern sets. This book is a *must* for reading and study.

As indicated, the sound portion of the TV set also merits careful consideration from the Service Man. In most sets, the full capabilities of the system are far from achieved, because of a limited output amplifier and particularly small speaker, two items dictated by production and, often, economic problems. Many Service Men have found on many occasions that the use of a special speaker cabinet can provide concert-grand-type reception, much to the customers surprise. To demonstrate, portable cabinets with small and large type speakers have been constructed, and connected to a switching system operating into an impedance matching transformer as well as an additional high fidelity amplifier to further demonstrate how improved quality can be provided. Some Service Men have found these demonstrations so successful that they have set up special departments to promote, sell and install these *TV Sound Systems,* as they are called by the Service Men. It's become quite a profitable business and seems to be booming daily.

Just how some of the boys have set up these *TV Sound Systems* will be described in an early issue of SERVICE. Watch for this extremely interesting discussion.

Taxicab Radio

LAST MONTH Samuel Freedman offered an informative analysis of the features of 2-way taxicab radios and just where troubles occur in them.

We have received some additional information from Mr. Freedman covering another very important phase of servicing of taxicab radios, the type of servicing practiced today. There appear to be three types: (*1*) Servicing only when required, where the Service Man charges only the actual labor and parts on occasion; (*2*) preventive maintenance and routing service, where a Service Man or service organization handles a fleet on a contract basis involving a certain charge per vehicle per month plus the cost of parts. The amount of this charge determines whether the parts shall be at list, net or halfway between these two extremes; and (*3*) fleet owner operation of his own servicing depot with full-time maintenance employees.

On a contract basis the usual charge per car is $5.00 per month, with extra for parts. However, there are servicing contracts in force in various parts of the country ranging from a minimum of $2.50 to a maximum of $10.00 per car per month, exclusive of parts. Installation of equipment brings charges from $15.00 to $25.00 per car, the charge varying with the number of vehicles, types of vehicles and their availability.

Anyone making an adjustment to the transmitter in a taxicab radio setup which may result in improper or off-frequency operation on the air must be licensed by the FCC. The easiest license examination possible to obtain for such work is a *radiotelephone second class,* which requires no knowledge of telegraphy.

Production Changes

IN STUDYING the variety of television receiver circuit diagrams which come across our desk, we found that revisions in these circuits were being made very often. In fact, many of the new models were found to have undergone up to nearly one hundred revisions in circuitry.

To keep Service Men posted on these revisions, SERVICE, beginning with this issue, presents a special TV receiver production change section (*page 22*).

Every effort will be made to present complete coverage on the changes being made each month.

Hope you like this new feature.

Long-Playing Records

THE RECENT INTRODUCTION of the 45-rpm record system has prompted a new, intriguing installation and servicing problem for the Service Man.

This system, developed by RCA, differs from the Columbia method not only in the increase in speed from 33⅓, but in the size of the record, the RCA being a 6⅞-inch disc and providing up to slightly more than five minutes of playing time. The record is also a bit thicker through the center portion from a 1½" center spindle hole to midway down the record. In addition, the pickup has a pressure of 5 grams and the needle is slightly thinner than the Columbia *lp* type.

A special eight-record automatic record-changer has been developed for the 45-rpm discs. An analysis of this record changer and other components and accessories for the new 45-rpm system will appear soon in SERVICE.
—L. W.

FM TUNER Design

by JOHN B. LEDBETTER

Engineer, WKRC-TV, WCTS-FM

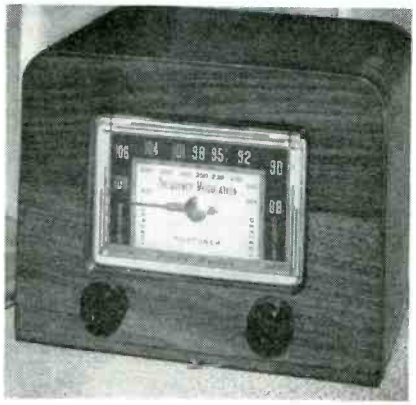


Fig. 1 (left). Capacity tuned FM unit. (*Pilotuner*)

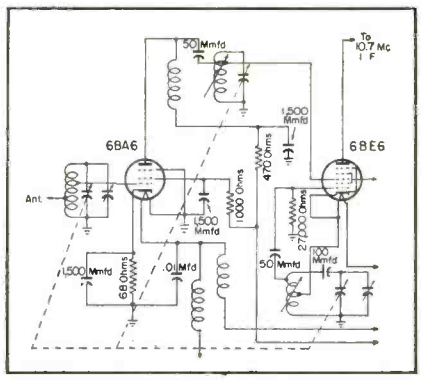


Fig. 2. Circuit of the capacity-tuned unit shown in Fig. 1.

OPTIMUM PERFORMANCE of *any* receiver is largely dependent on efficient design of its tuning system or *front end,* particularly in FM receivers and converters, which must tune the 88-108 mc range with a practically constant gain factor and a bandwidth of 200 kc.

Basic Design Considerations

From the viewpoint of the receiver design engineer, the major requirements which must be satisfied in good *front end* design are: (*1*) high signal-to-noise ratio, (*2*) sufficient bandwidth, (*3*) adequate gain, (*4*) high order of image and *if* rejection, (*5*) suppression of oscillator radiation, (*6*) high degree of second-harmonic oscillator image rejection, (*7*) good oscillator stability, and (*8*) absence or suppression of microphonics in the tuning system. To satisfy these requirements it is necessary to determine the number of tuned circuits, number and type of tubes, and the specific tuning circuits to be employed. Factors governing the quality, performance, and overall design are determined, of course, by the consumer price of the receiver in which the tuning system is to be incorporated, the ease with which the mechanism can be adjusted to machine tooling, mechanical assembly and mass production, and the judgment of the design engineer as to just how far the quality of design should be carried in order to insure satisfactory performance.[1]

Since the signal-to-noise ratio is primarily a function of the input circuit and *rf* tube (or converter if no *rf* stage is used), it presents no special problem provided reasonable care is exercised in designing the input and selecting a suitable tube. Very good results may be obtained, as a practical example, by employing a high-frequency pentode such as the 6AU6 and connecting it as a grounded-grid triode. Operation as a triode allows a much lower noise factor; the grounded grid acts as an internal shield between input and output circuits and prevents oscillation in the *rf* stage. Oscillator radiation and second harmonic image rejection as well as *if* and image rejection are all a function of the number of tuned circuits employed. The number of tuned circuits to be used in turn are dependent on the economical limitations of the particular design project.

For a *single* tuned circuit, the suppression of undesirable frequencies is a function of Q; for a *double-tuned* band pass circuit, it becomes a function of coupling. Where economical factors permit, the use of bandpass circuits is to be recommended, since they allow much better selectivity characteristics over single-tuned circuits, with the added advantage that overall efficiency does not vary with Q. Gain, bandwidth and microphonics in the variable tuning medium are factors which can be controlled through careful design of the *front end* portion of the receiver.

Variable Tuning Systems

Basically, the tuning range of all receivers is covered by varying either the capacitance or inductance, or both, in resonant tuning circuits. Each system has its advantages and disadvantages, the selection depending on individual design problems. Many variations of the foregoing methods of tuning are in use at the present time. Such improvements as coax lines, permeability tuning, simulated transmission lines, and continuously-variable inductance tuning are being used

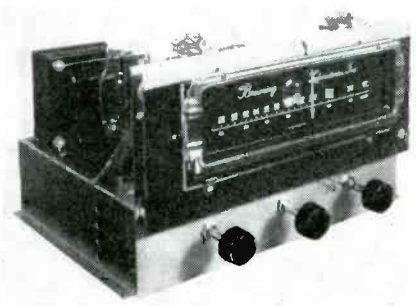


Fig. 3. The Browning RV-10 FM tuner.

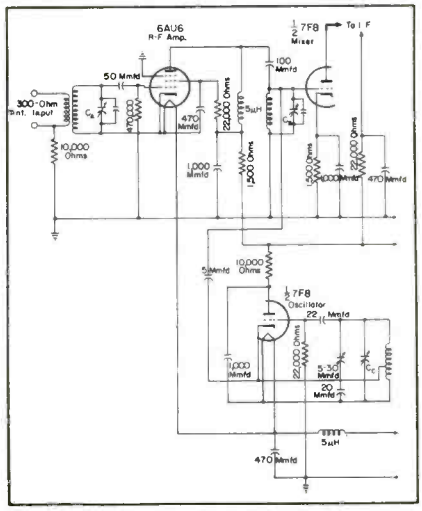


Fig. 4 (right). Circuit of the Browning tuner.

[1] C. R. Miner (G. E.). *Front-End Design of FM Receivers.*

Features of Seven Types of Front-End Systems: Permeability, Inductance, and Variable Capacitor Tuning; Continuously Variable Inductance Control; Modified Straight and Circular Long-Line Inductance Tuning, and the HF Variometer Method.

in many receivers. Generally speaking, variable-inductance systems have several advantages over capacity-tuned systems. There are other factors, however which must be taken into consideration in each tuner design.

In *uhf* receivers and converters employing the usual variable-capacitor method of tuning, several disadvantages are encountered which prevent optimum performance over any considerable range of frequencies. Since the signal-to-noise ratio, gain, image rejection and stability are affected by lumped capacities in the tuning capacitor, a practical limit must be placed on the total frequency range to be covered in any one band. This necessistates, for practical purposes, either a different system of tuning which is capable of tuning a wide range of frequencies in one continuous band, or a system of capacity-tuning wherein the tuned circuits are designed to operate efficiently over a narrow band of frequencies with bandswitching employed to change from one band to another. The only trouble with this system is the introduction of distributed capacity in the band switch and in the leads running to it, along with mutual coupling between turret coils and the possibility of trouble in the switch contacts.

Other disadvantages are excessive stray capacity in the gang unit, common coupling between gang sections, rotor contact resistance, bulky size, and a tendency to being microphonic in operation. In addition, the gain in a capacity-tuned circuit tends to *decrease* as the frequency *increases*. These problems have been solved by a number of FM receiver manufacturers through careful design and improved circuitry. However, capacity-tuned systems have five substantial advantages: (*1*) simplicity in design and operation, (*2*) low cost, (*3*) long operating life, (*4*) relatively trouble-free service, and (*5*) adaptability to mass-production.

The unit shown in Fig. 1 is an example of a reliable, low-cost *capacity-tuned* unit. Stability is accomplished in the front-end portion through the use of heavy brass capacitor plates. Rigidity in plate construction reduces drift caused by thermal contraction and expansion. Figs. 3, 4 and 5 illustrate other type tuners employing capacity tuning. Many FM/AM receivers also use capacity-tuned front ends.

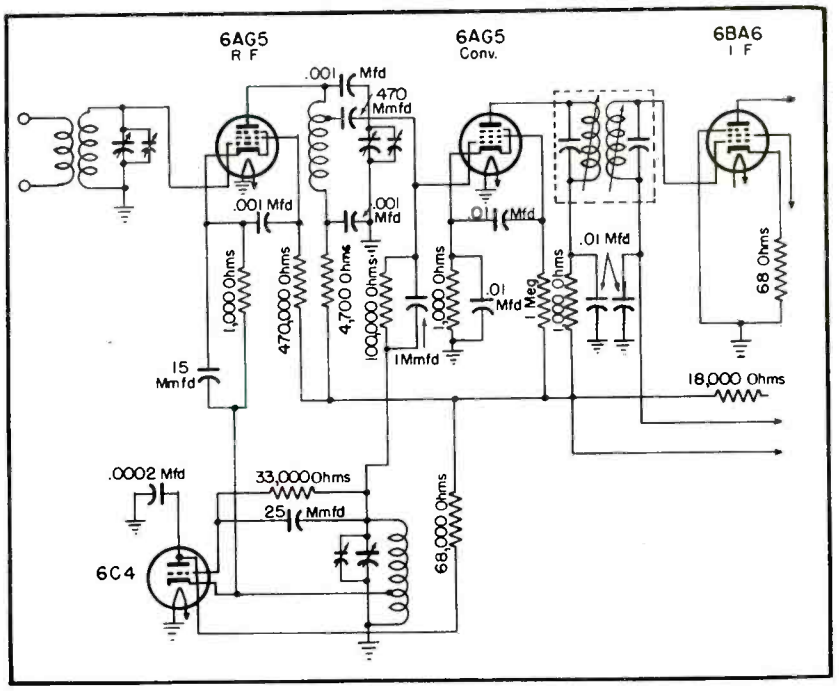
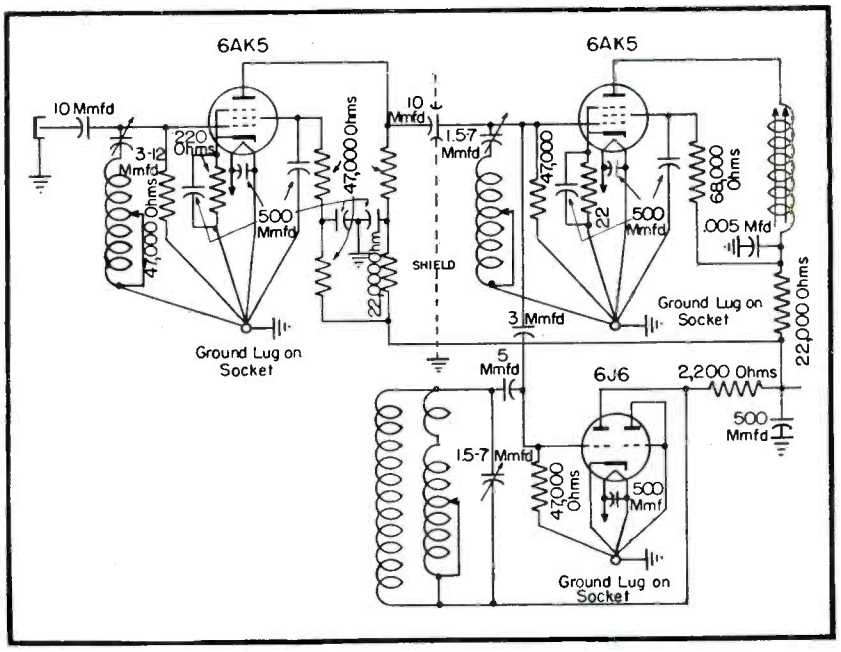


Fig. 5. Meissner 8C FM tuner circuit, which features capacity tuning.

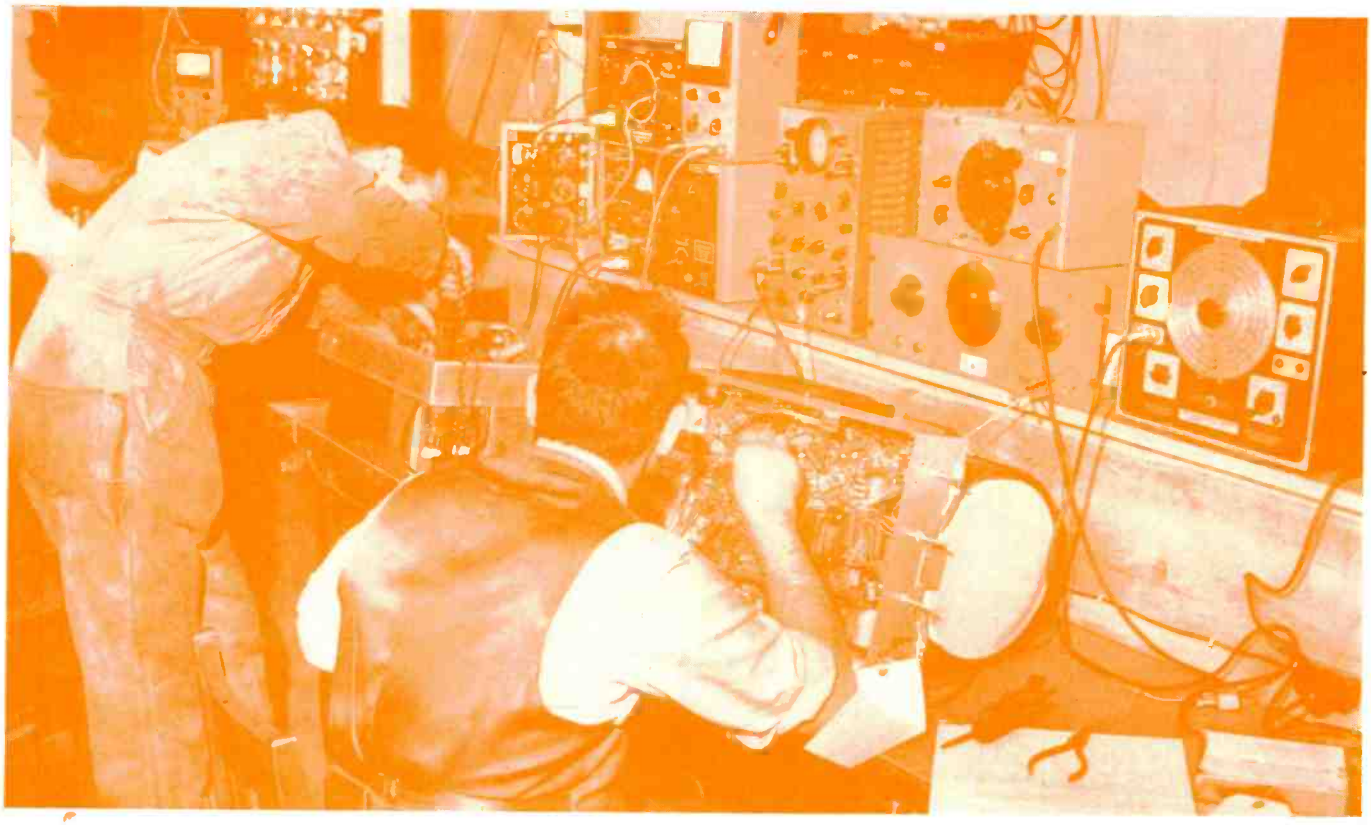
In *inductance-tuned* systems, some of the main advantages are improved circuit *Q*, minimum of distributed capacity effects, increased tuning range, less likelihood of common coupling, less tendency toward microphonics,

(*Continued on page* 35)

Fig. 6. Converter circuits using the inductance tuning method developed by Mallory.



The Business Aspects of



Careful Application of Management Programs Extremely Essential to the Successful Conduct of TV Installation and Service Work Today, Particularly in the Use of Correct Types of Installation and Servicing Agreements and Warranties.

THE BUSINESS aspects of TV antenna installations are as important as the technical factors, for unless TV installation men can realize a satisfactory income from their efforts, it is quite impossible to render any form of the efficient service essential to the promotion of a wide public acceptance for TV receivers.

TV receivers are being sold today on a *guaranteed basis* with the majority of customers receiving a one-year warranty on installations.

There are three groups who are participating in TV installation work today:

(*1*) Servicing dealers.

(*2*) Independent TV installation and service companies selected by TV distributors, dealers, or TV manufacturers.

(*3*) Service companies or divisions of TV manufacturing organizations.

By far, the greatest number of TV antenna installations are being performed by those in groups *2* and *3*.

Most dealers prefer not to do their own installations since the removal of the installation and service responsibility from overhead enables the dealer to determine his overhead liability more accurately and therefore eliminate those *hidden costs* which are the cause of so many business failures.

The non-servicing dealers usually sell the TV installation warranty to the customer with the statement that he supports the warranty and in some cases he states further "that this warranty is supported by the manufacturer of the TV receiver."

Above: A well-planned TV service bench which provides rapid checks in trouble shooting to accelerate receiver return, always a good business practice. (*Photo taken at Associated Television Service Corp. by Louis Rosenberg*)

Basis of Warranty Plan Success

The basis for the full success of all of the customer warranty plans is mutual good faith between the television manufacturers and their dealers. The manufacturers are dependent upon their own or approved independent service organizations to perform TV installations on a level which will develop the best possible reputation for their equipment. The TV receiver dealer is dependent upon the manufacturer for maintenance of product integrity. Under those agreements where the manufacturer establishes the installation and service warranty, the manufacturer is dependent upon his

TV Installations

by IRA KAMEN

Manager, Television Antenna Dept.
Commercial Radio Sound Corp.
New York City

dealers for full cooperation under his warranty plans.

There are three types of mutual agreements currently used:

(*1*) Between the manufacturer and independent installation and service companies.

(*2*) Between the distributor or dealer and independent TV installation and service companies.

(*3*) Between TV manufacturers, distributing companies and TV receiver purchasers, which are often in the form of warranties.

While there are no standard forms for agreements between TV receiver manufacturers and independent TV receiver installation and service companies, it is important that an *epidemic failure clause* be included in all types of agreements as a protection for the TV installation and service company. Most of the reliable, experienced manfacturers provide this protection clause in their agreements.

There are two types of epidemic failures:

(*1*) Ten per cent or more of the installations made by the installation and service company over some fixed period develop identical failures.

(*2*) Repetitious failures of components of any kind credited as manufacturers' design defects. (*Note*: All field modifications correcting design defects are always considered as the manufacturer's responsibility.

Manufacturers pay the Service Men group a fixed fee for all service calls resulting from epidemic failures.

Incidentally manufacturers always include a statement noting that . . . "Epidemic failures shall not include failure of the antenna installation."

There are six major points which may be used as a guide in preparing an agreement between a manufacturer and independent Service Men:

(*1*) Fee for warranty period.

(*2*) Definition of standard installation.

(*3*) Procedure for handling non-standard installations.

(*4*) Parts guarantee.

(*5*) Protective clause against damages caused by *Acts of God*, and customer negligence.

(*6*) Cancellation clause.

An *assist clause* is also a very desirable point to have included in a contract between the installation and service company. Such a clause is evidence of the manufacturer's good faith.

An *assist clause* usually provides that the manufacturer shall . . . "supply the installation and service company with sufficient TV chassis to enable them were necessary to replace the models requiring shop repairs. The customers chassis shall be repaired and subsequently returned to the customer's TV receiver cabinet. Title to these replacement chassis shall be retained by the manufacturer. The installation and service company agrees to insure these replacement chassis while on their premises or in transit."

The second type of agreement, which is between the distributor or dealer and independent installation and service companies passes on the manufacturers' guarantees to the installation and service company and thus is actually similar to the direct agreement between manufacturers and independent installation and service companies. The main differences usually occur when the dealers make direct arrangements with those installation and service companies who have limited financial responsibilities. These agreements usually include the following types of clauses:

(*1*) The installation and service company shall be paid by the dealer only for work done, with the balance of the money paid by the customer for his one-year warranty to be paid on a pro rata basis periodically as the guarantee time is consumed.

(*2*) All installation and Service Men are to be bonded and covered by insurance so that the dealer is protected against law suits arising from the negligence of personnel employed

(*Continued on page 37*)

Customer's TV Maintenance Policy

In consideration of the amount of $———, which you paid to your Stewart-Warner Dealer, the Authorized Service Station whose name appears in the registration section of this policy, has contracted to provide the following service **FOR A PERIOD OF THREE MONTHS** on the Stewart-Warner receiver herein identified by model and serial number:

Furnish all labor, materials, replacement parts, and tubes (including the picture tube) that may be required to repair or maintain the specified receiver and antenna in proper working order for best possible reception of television signals within the limitations of the customer location for a period of three months from date of installation as shown in this policy, provided that such service and replacement components are necessitated by normal usage of the receiver.

The service provided by this policy shall normally be available and rendered during the regular working hours of the customary work-week. Every effort will be made to give prompt attention to service requests of an urgent nature.

EXCEPTIONS

1. **MISUSE: SERVICING BY UNAUTHORIZED PERSONS:** This policy shall be voided immediately if the said television receiver has been subjected to misuse thru negligence or otherwise, if the serial number has been altered, effaced or removed, or if the receiver and antenna have been adjusted or serviced by any person other than a representative of the Authorized Service Station or the Stewart-Warner Distributor.
2. **DAMAGE:** This Policy does not cover replacement or repair due to loss or damage incurred in transportation of the television receiver, or due to fire, lightning, theft or other causes beyond the control of the Service Station.
3. **ELECTRICAL INTERFERENCE:** The television receiver specified herein and its antenna have been designed and installed to minimize the effects of external interference that may be created by passing automobiles, appliances, diathermy machines, aircraft, short wave and FM receivers and other electrical equipment such as motors and converters; however, liability on the part of the Service Station for the elimination of such interference in either the picture or sound is limited to minimizing the effects of such interference by utilization and correct placement of the proper antenna and transmission line.
4. **SUBSEQUENT INSTALLATION:** This Policy does not cover subsequent installations resulting from structural alteration of the premises, redecorating or movement of the instrument to a new location. If the receiver is moved from the point of original installation during the term of the Policy the Service Station shall be entitled to charge their regular fee for making an installation at the new address.
5. **AUXILIARY POWER SUPPLY:** The Service Station assumes no liability with respect to the installation, service or maintenance of motor-generators, converters or other devices that may be used under certain circumstances to supply power to the specified receiver, nor to the effects produced by such equipment on the performance of the receiver.
6. **FCC STANDARDS:** This Policy does not cover any changes in the specified receiver that might be required as a result of revisions in present television standards by the Federal Communications Commission.
7. **LIABILITY OF RECEIVER MANUFACTURER:** Stewart-Warner Corporation shall not be liable for any loss or damage to the customer or any other person resulting from or in connection with the installation, use, or servicing of the said television receiver.

VALIDATION OF POLICY

This policy shall be valid only upon payment of the prescribed fee and after the Registration Record Form has been properly filled out and signed by an accredited representative of the Authorized Service Station who installs the receiver. Factory and distributor copies of Registration Record Slips must be mailed as directed on bottom line of each.

A typical manufacturer's maintenance policy. (*Courtesy Stewart-Warner*)

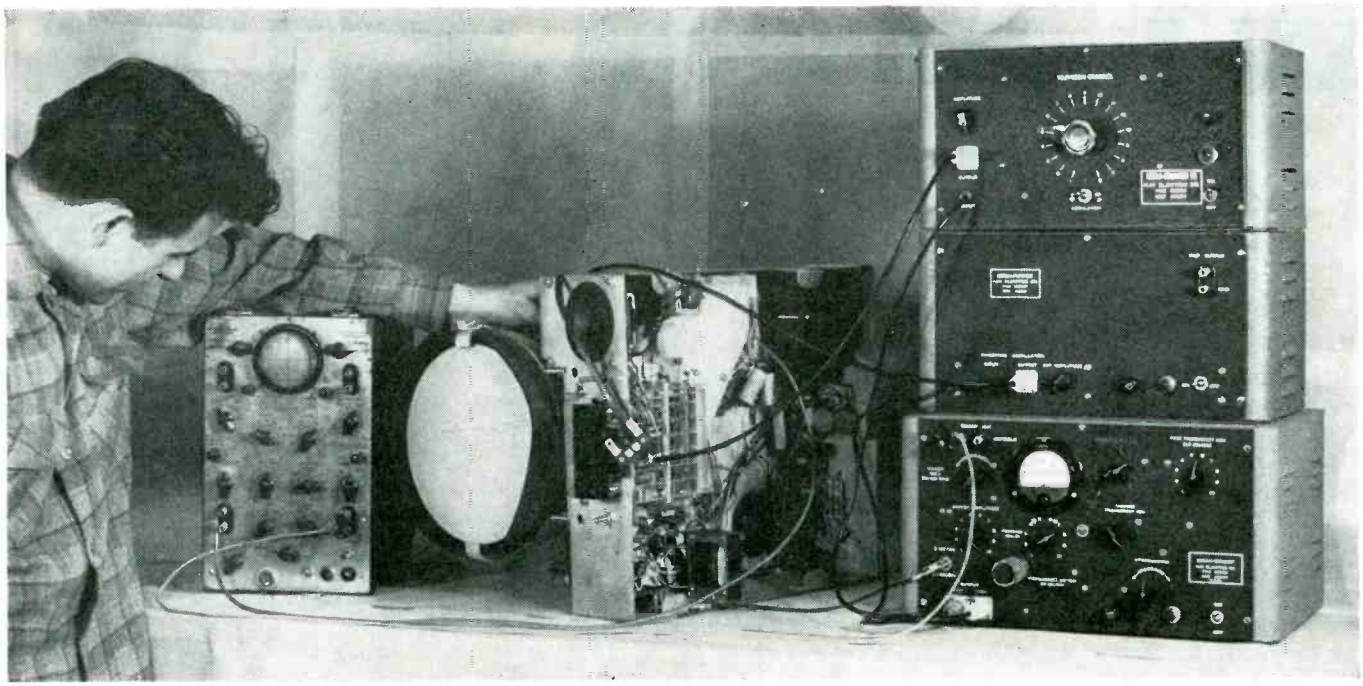


Fig. 1. Aligning the Bendix 235 TV receiver. Equipment used includes a 'scope, wide-range sweeping oscillator,[1] crystal-controlled *if* quadruple marker pip generator[2] and a twelve-channel crystal-controlled *if* sound carrier marker generator.[3] Not shown in this view, but required during certain phases of *if* alignment procedure, is a 29 to 39-mc tuneable *if* marker generator[4] employed in the alignment procedure applied to the Tele-Tone TV-149 receiver[5]. Although the setup above shows the picture tube mounted in place on the TV receiver chassis, it is generally necessary to remove this tube before proceeding with any *if* alignment work in order to attain access to some of the *if* transformer adjustments. For a preliminary overall alignment check where the sweeping oscillator is fed into the antenna output terminals, the picture tube need not be removed.

TV Receiver Visual Alignment Techniques

Part III . . . . Circuit and Test Analysis of the Bendix 235 TV Chassis.

by LESTER L. LIBBY

Chief Engineer

Ohmega Laboratories and Kay Electric Co.

CONTINUING WITH OUR discussion* of alignment techniques for particular models of TV receivers, we shall now consider the recently introduced Bendix 235M1 and 235B1 models. Both use the same chassis.

Circuit Analysis

Last month appeared a discussion of the *rf* tuner or *front end* portion of this unit, a December issue front cover feature. This month, the entire circuit is presented, Fig. 2. The heavy lines on the schematic show the paths for all signals of varying amplitude. It will be noted that a superhet circuit is used, with the first three *if* stages serving as a common amplifier chain for both the sound and picture signals.

The sound *if* carrier is selected from the plate circuit of the third 6AG5 *if* (V_{10}) and fed through a 6AG5 stage of sound *if* amplification (V_4) and a 6AU6 limiter stage (V_5) before it is demodulated in a conventional 6T8 FM discriminator circuit (V_6). The 6T8 is a multi-purpose type, combining within one envelope three diodes and a triode. The triode section is employed as a first audio amplifier and is fed by capacitive coupling directly from the output of the discriminator. The volume control is located between this first audio amplifier stage and a 6Y6 power output tube (V_7). One of the diode sections of the 6T8 (pin *6*) is used to delay the *agc* bias voltage applied back to the *rf* amplifier. The 6Y6 audio output stage is a conventional beam power amplifier.

Returning to the *if* channel, it will be noted that the 6AG5 fourth *if* (V_{11}) serves only as a picture or video *if* amplifier, feeding directly into the picture detector which is a 1N34 crystal diode. The output from the picture detector is fed into a 6AC7 stage of video amplification (V_{12}) whose output is connected directly into the 10" 10BP4 picture tube, V_{13}. The signal output of the 6AC7 video amplifier consists of all the sync pulses as well as the actual picture signal and is, of course, a fluctuating *dc* voltage. Although the cathode of the picture tube is at all times at a negative potential with respect to chassis ground, the picture signal is positive in phase, i.e., the dark portions of the picture and the sync

*SERVICE; October and November, 1948.
[1]Mega-Sweep.
[2]Mega-Pipper.
[3]Mega-Marker, Sr.
[4]Mega-Marker.
[5]SERVICE, October 1948.

pulses are of such polarity as to drive the cathode of the picture tube towards chassis ground potential, which is in effect causing it to go less negative or more positive.

The average *dc* component of the above-mentioned fluctuating voltage is applied to the control grid of one-half of the 6SN7GT *agc* amplifier tube (V_{15B}). The output of this *agc* amplifier provides separate automatic gain control potentials to the first three *if* stages and to the *rf* amplifier stage, respectively. As previously mentioned, the *rf* bias voltage from this *agc* amplifier is delayed by using one diode of the 6T8 (V_6) to hold or *clamp* this voltage near zero until the control signal reaches a pre-determined level.

The sync signals for both the horizontal and vertical sweep circuit are also taken off the plate of the 6AC7 video amplifier tube (V_{12}). These sync pulses are first applied to a 6SN7GT (V_{14}) which is a dual-triode, the first half serving as an amplifier and the second half as a sync separator. The output from this tube is fed into one-half of a 6SN7GT (V_{15A}) a sync clipper and amplifier, following which the individual horizontal and vertical sync pulses are separated and channeled to their respective oscillator circuits.

The vertical sync pulses are applied through a low-pass *rc* filter network to one-half of a 6SN7GT (V_{16A}), a vertical oscillator discharge tube. This tube is a triode operating as a blocking-oscillator, with the sync pulse applied to its grid in such a manner as to synchronize the oscillator frequency with the incoming vertical sync pulses. The output of this vertical oscillator is applied to an *rc* circuit which produces an almost perfect sawtooth wave with high, sharp negative pulses. This sawtooth wave is then applied to the other half of the 6SN7GT (V_{16B}) a triode amplifier which amplifies this sawtooth wave and applies it through a vertical output transformer to the vertical magnetic deflection coils in the yoke on the picture tube.

Returning to the sync clipper (V_{15A}) we find that the horizontal sync train is fed from a tap point on its output load resistor network through 68-mfd and .001-mfd coupling capacitors (C_{100} and C_{101}) to the 6SN7GT horizontal sync phase tube (V_{17A}). This tube controls the phase relationship of the horizontal sync signal which is derived from the complex *rc* network in its cathode circuit, as compared with the horizontal sync signal as it is applied through a 3.3-megohm resistor (R_{98})

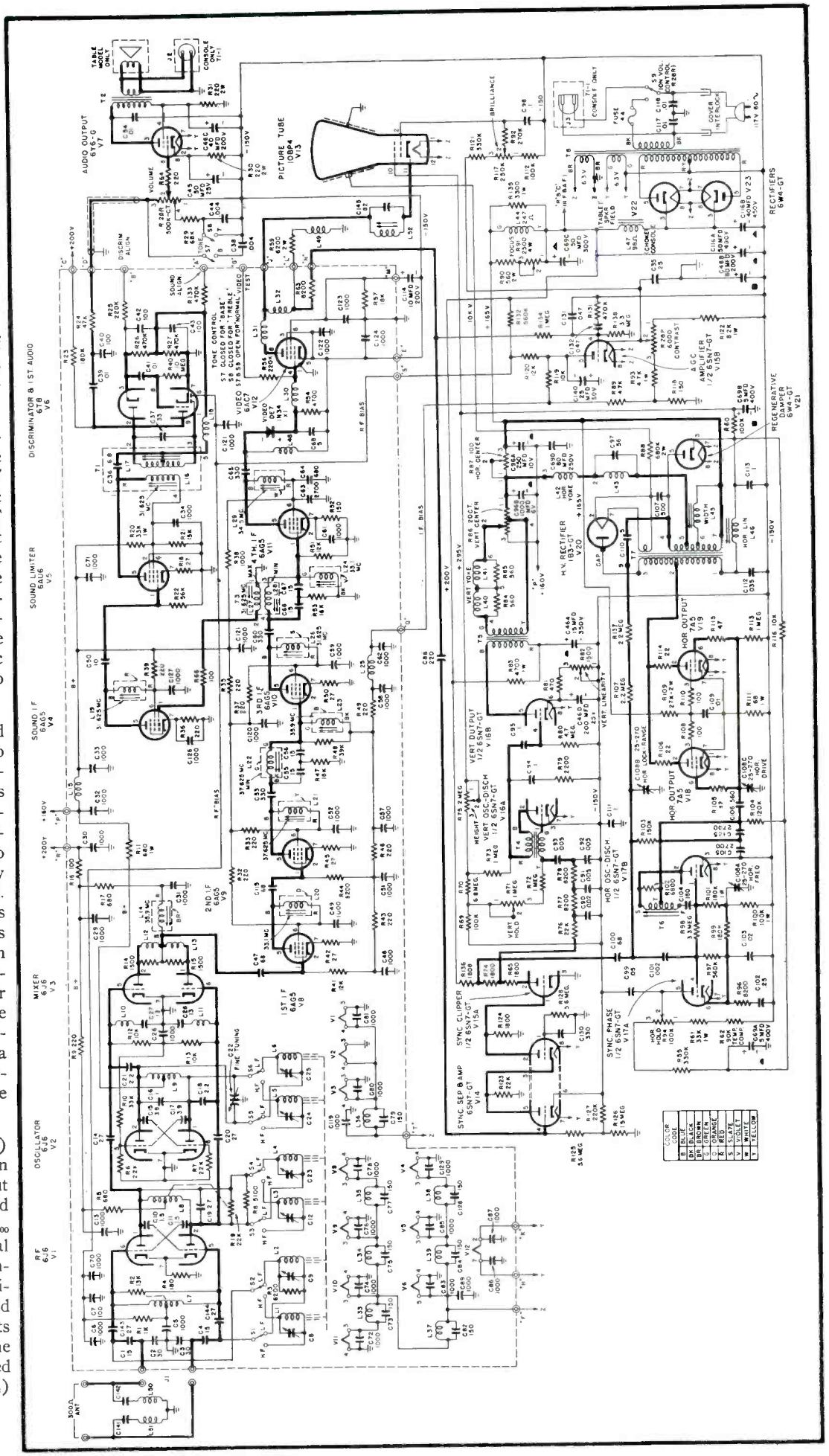


Fig. 2. Schematic of the Bendix 235 circuit.

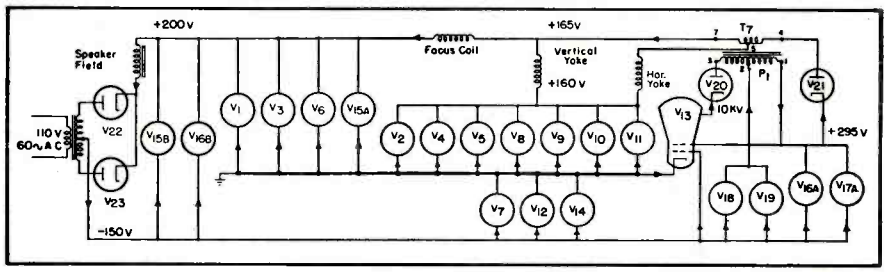


Fig. 3. Power supply distribution and division of potentials in the Bendix receiver; arrows indicate direction of electron flow rather than the conventional positive current flow.

to the following horizontal oscillator (V_{17B}). In other words, the frequency of the horizontal oscillator is synchronized by the horizontal sync pulse train after the phase of this pulse train has been properly adjusted by the 6SN7GT (V_{17A}). It should be kept in mind that the horizontal oscillator, which is of the blocking-oscillator type of circuit, operates in such a manner that its free-running frequency is always slightly lower than the standard television

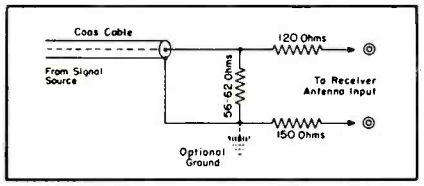


Fig. 4. Resistance matching pad, coax-to-balanced.

horizontal sync pulse frequency of 15,750 *cps*. This means that the incoming sync pulses or signals always exert a controlling force on the horizontal oscillator so as to increase its resultant frequency up from its normal free-running point.

The discharge network upon which the output of the horizontal oscillator acts is connected in the plate circuit of the 6SN7GT (V_{17B}). From this network the resultant saw-tooth wave is fed to a pair of 7A5 horizontal output tubes, V_{18}-V_{19}, and then through a special horizontal sweep transformer and control circuit to the horizontal magnetic deflection coils in the yoke on the picture tube.

During the very short period of time in which the horizontal sweep is returning the electron beam to the left side, or starting position, of the picture tube, the rate-of-change of current in the horizontal sweep transformer is very high. This rapid change in current is utilized in the primary autotransformer circuit to generate the high voltage required for the second anode of the picture tube. This high voltage is rectified by a 1B3GT (V_{20}) and applied to the picture tube anode at approximately 10,000 volts.

To prevent regeneration or oscillation occurring in the horizontal sweep output circuit, a 6W4GT diode damping tube (V_{21}) is connected in the circuit so as to prevent any appreciable oscillation from occurring.

The low-voltage power supply using a pair of 6W4GTs (V_{22} and V_{23}), provides plate voltage to all of the tubes in the television receiver except the picture tube. The various tubes in the receiver are connected between the +200 volt and —150 volt busses and ground so as to constitute a voltage divider system. This eliminates the need for a high-wattage bleeder system, reduces the total power consumption of the receiver and allows the use of a lighter-weight power transformer. The manner in which the power supply distribution and division of potentials takes place is illustrated in the voltage block diagram, Fig. 3. The arrows in this block diagram indicate the direction of electron flow rather than the conventional positive current flow. It will be remembered that electron flow is from negative to positive, e.g., from cathode to plate within a vacuum tube, and is hence the reverse of the conventional positive current flow.

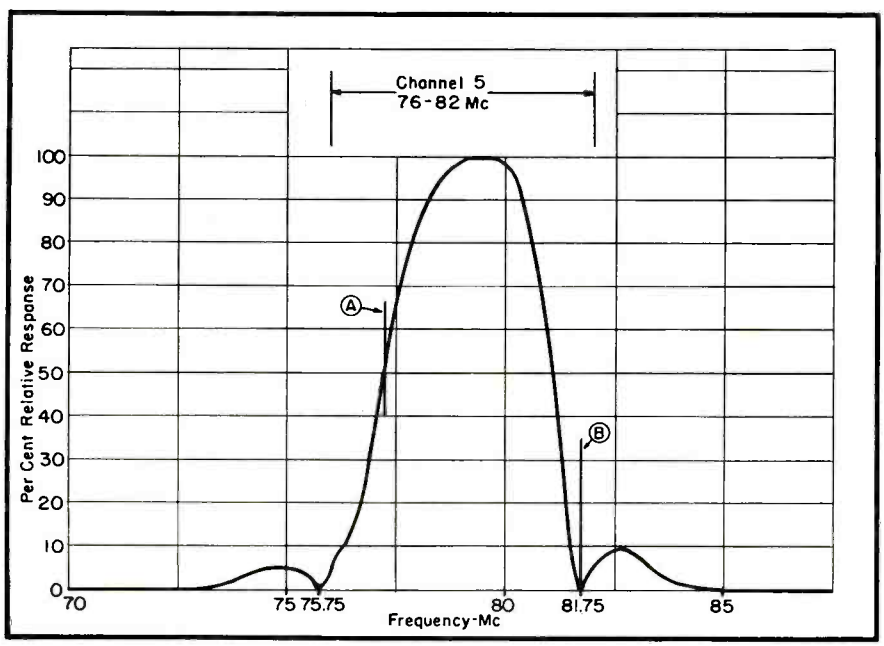


Fig. 5. Overall response at video detector. At (*A*) appears the picture *rf* carrier point, 77.25 mc, and at (*B*) appears the sound *rf* carrier point, 81.75 mc.

Production Changes

Returning for a moment to the circuit diagram, Fig. 2, the diagram shown applies to the *A* type chassis. There are six other types, *B, C, D, E, F* and *G*, indicated by a large block letter within a square, rubber stamped on the chassis.

The code *D* chassis carries the following revisions:

(*1*) Resistors R_{42}, R_{45} and R_{50} were changed from 27 to 68 ohms, ½ watt 10%.
(*2*) Resistor R_{41} was deleted and replaced with an *rf* choke L_{63}.
(*3*) Capacitor C_{35} was changed from .25 to 10-mfd, 200-volt electrolytic.
(*4*) Resistor R_{138}, 3.3 megohms, was deleted.
(*5*) Resistor R_{124} was changed from 1800 to 8200 ohms.
(*6*) Junction of C_{131} and R_{131} has been returned to chassis ground instead of to the —150 volt lead.
(*7*) Resistor R_{76} was connected directly to pin *2* of V_{15A} (plate) instead of to the junction of R_{65} and R_{74}.
(*8*) Alignment frequency of L_{14} was changed from 35.9 to 32.9 mc.
(*9*) Alignment frequency of L_{20} was changed from 33.1 to 35.7 mc.
(*10*) Alignment frequency of L_{23} was changed from 35.9 to 35.7 mc.
(*11*) Alignment frequency of L_{24} was changed from 33.1 to 32.9 mc.

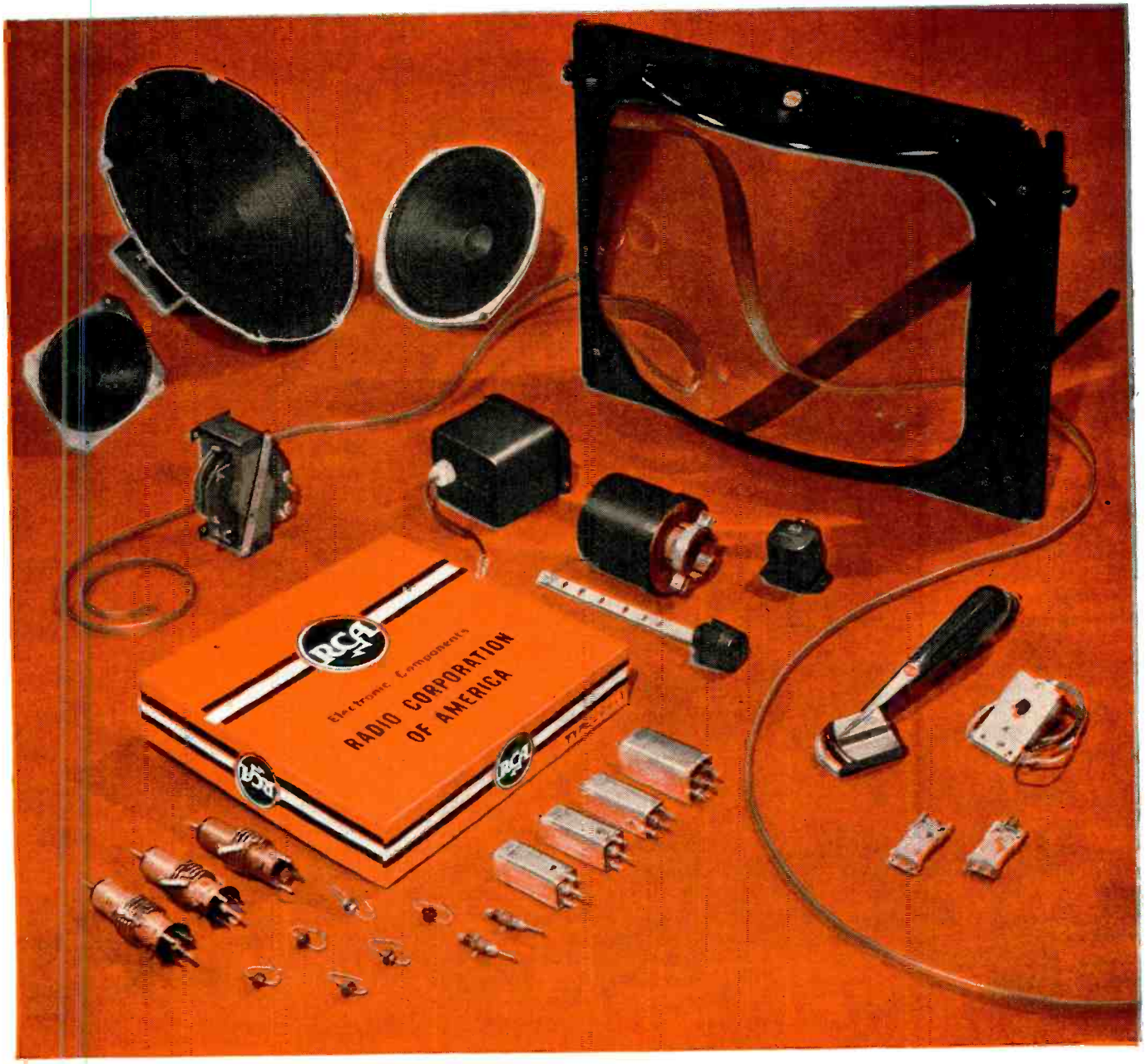
In the *E* chassis, a ½-watt 27-ohm resistor has been connected to terminals *1* and *2* of the horizontal centering potentiometer and to the junction of terminal *1* of the vertical centering potentiometer, C_{80B} and L_{42}.

In the *F* chassis, thirteen revisions have been included:

A 6BG6G has been inserted in place of two 7A5s (V_{18} and V_{19}) and is now V_{19}.

A 4-ampere fuse has been added

(*Continued on page* 40)



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Rotary Switch 7" TV Model

THE FRONT END of a 22-tube 7" TV receiver featuring intercarrier sound, switching via separate inductors controlled by movable iron cores and a dual 6" speaker system appears on the cover this month; National NC-TV7. To facilitate study of the front end, the complete circuit of the receiver is shown in Fig. 1.

[*See Front Cover*]

The *rf* unit selects the desired signal, amplifies and converts the signal to provide an output at the plate of the mixer, consisting of heterodyned picture and sound carrier frequencies for the twelve channels: For channels 2 to 6, the picture carrier is 37.3 mc and the sound carrier is 32.8 mc; for channels 7 to 13 the picture carrier is 34 mc, and the sound carrier 38.5 mc.

The input circuit of the 6AU6 *rf* amplifier tube is designed for a 300-ohm balanced line. The input signal is fed to the grid and cathode of the tube. A center-tapped coil with an iron core is connected to the antenna terminals for coupling purposes on channels two through six. On the higher frequency channels, two small air-wound coils are switched across the center-tapped iron-core coil to maintain the desired coupling. The plate circuit of the *rf* tube is resonated by an adjustable, brass core coil, in series with a multi-tapped coil.

It is possible to apply *agc* to the grid of the *rf tube* through a terminal panel which is fitted with a link switch to remove *agc* from the tube in fringe areas etc., where an increase in sensitivity is desired. Coupling to the mixer grid is accomplished through a capacitor, on channels 7 through *13;* the coupling is inductive on the lower channels.

The mixer circuit employs a 6AG5 pentode with grid leak bias. The grid of the mixer is resonated in the same manner as the plate circuit of the *rf* amplifier tube.

The local oscillator employs a 6C4 triode in a modified ultra-audion circuit. B+ is fed to the plate of the tube through a 2200-ohm resistor, R_7. Each channel has a separate inductor made adjustable by a movable iron core. A variable capacitor connected in the grid of the oscillator serves as the fine tuning adjustment. The oscillator operates on the high side of the picture carrier on channels 2 through 6 and on the low side of the picture carrier on the higher frequency channels.

IF Amplifier and Video Detector

The intercarrier sound system used in this model differs mainly from the conventional system in that the heterodyning frequency which determines the sound *if* frequency is the picture carrier and the *FM* sound carrier is not separated from the picture carrier until just before the video signal is applied to the picture tube. The intercarrier sound is relatively independent of local oscillator tuning, because the sound *if* is determined at the transmitter and not in the receiver. The system consists of three stages of symmetrical *if* amplifiers and four stagger-tuned circuits with two alignment frequencies. Traps are not required in this system, thereby greatly simplifying the alignment procedure.

The three *if* stages are similar for the most part. Tuning is accomplished by means of adjustable iron-core coils; the alignment frequency of L_{19} and L_{22} is 34.8 mc, of L_{20} and L_{24}, 36.9 mc. By use of a symmetical curve in the *if* band pass, the local oscillator is operated on the low side on the high-frequency channels to maintain oscillator stability. The plate supply to *if* tubes, V_5 and V_6, is shunt fed through *rf* chokes. This is done in the case of V_6 to keep the resistance in series with the *if* plate and diode detector small, and in the case of V_5 to keep the impedance in the grid of V_6 small to prevent bias from developing on this grid by noise pulses which are of sufficient amplitude to draw grid current. If bias were produced, the gain would be reduced for a time following each noise pulse. Each noise pulse, which modulates the carrier towards the black level, is followed by a white tail which would prove objectionable on the picture. The *agc* voltage is applied to the grids of the first and second *if* tubes.

The video detector is a conventional diode. The input to the detector is tapped down on L_{24} to obtain the proper operating Q. The output of the detector is fed through a series peaking choke, L_{25}, and a shunt peaking choke, L_{26}, to the input of the video amplifier. In this manner a video response is obtained relatively flat to 3.5 mc.

Automatic Gain Control

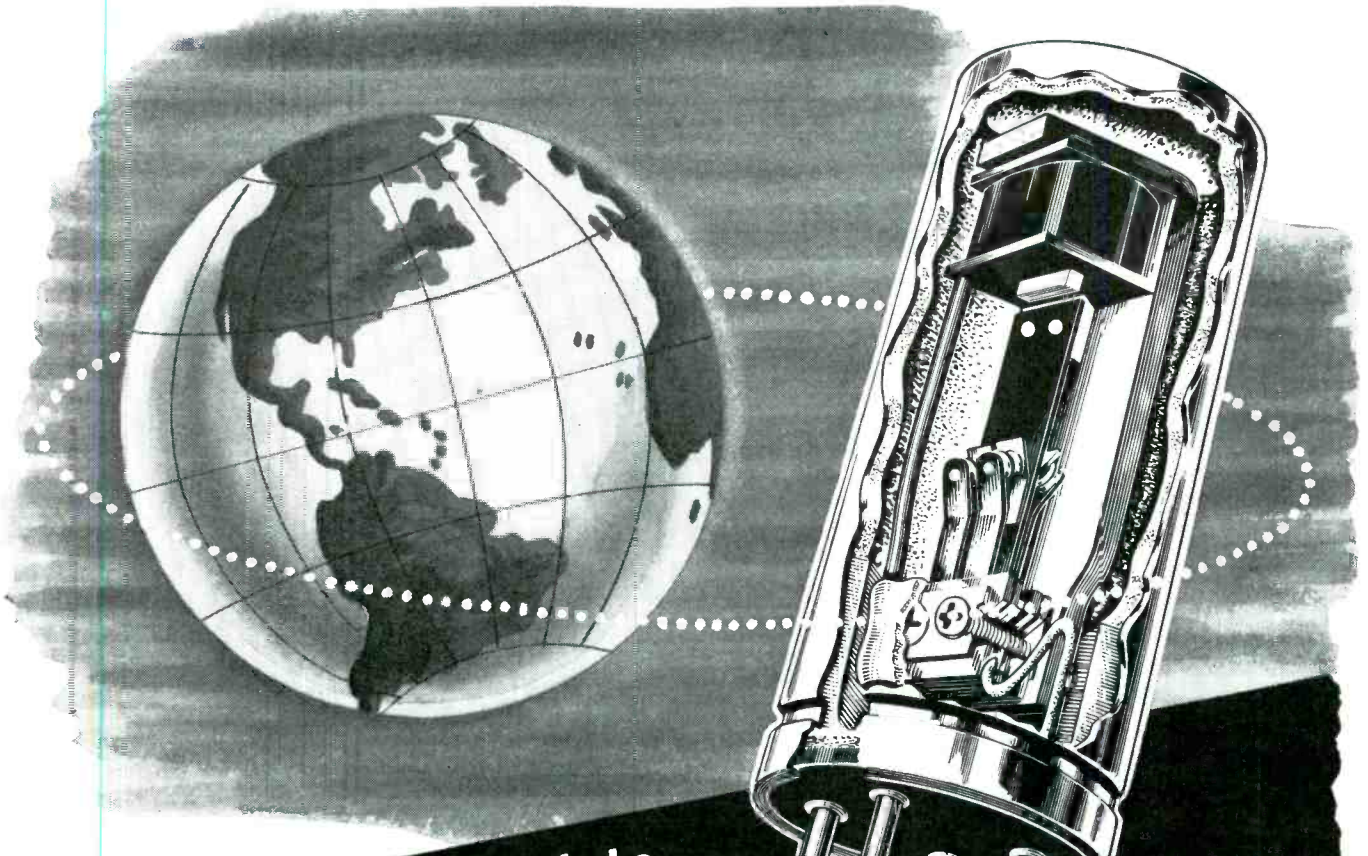
The automatic gain control circuit utilizes one-half of a 6AL5. The *agc* action in TV receivers is comparable to that of avc in conventional receivers. In this model *agc* is applied to the first two *if* tubes and the first *rf* to keep the contrast of the picture fairly constant with different signal input levels. This permits the op-

(*Continued on page* 41)

	CAPACITORS		CAPACITORS
C-1	Ceramic, 100 mmf., 500 vdc	C-52	Ceramic, 0.005 mfd., 500 vdc
C-2	Ceramic, 0.005 mfd., 450 vdc	C-53	Ceramic, 0.005 mfd., 500 vdc
C-3	Mica, 470 mmf., 500 vdc	C-54	Ceramic, 0.005 mfd., 500 vdc
C-4	Mica, 470 mmf., 500 vdc	C-55	Ceramic, 400 mmf., 500 vdc
C-5	Ceramic, 1 mmf., 500 vdc	C-56	Ceramic, 400 mmf., 500 vdc
C-6	Ceramic, 360 mmf., 500 vdc	C-57	Ceramic, 400 mmf., 500 vdc
C-7	Ceramic, 360 mmf., 500 vdc	C-58	Ceramic, 400 mmf., 500 vdc
C-8	Ceramic, 22 mmf., 500 vdc	C-59	Elect., 40-40 mfd., 450 vdc
C-9	Ceramic, 1 mmf., 500 vdc	C-59A	Part of C-59
C-10	Ceramic, 360 mmf., 500 vdc	C-59B	Part of C-59
C-11	Ceramic, 360 mmf., 500 vdc	C-60	Not Used
C-12	Not Used	C-61	Elect., 50-50 mfd., 150 vdc
C-13	Ceramic, 25 mmf., 500 vdc	C-61A	Part of C-61
C-14	Variable (Special)	C-61B	Part of C-61
C-15	Ceramic, 0.005 mfd., 450 vdc	C-62	Not Used
C-16	Ceramic, 100 mmf., 500 vdc	C-63	Elect., 50-50 mfd., 150 vdc
C-17	Ceramic, 1500 mmf., 500 vdc	C-63A	Part of C-63
C-18	Ceramic, 0.005 mfd., 450 vdc	C-63B	Part of C-63
C-19	Ceramic, 100 mmf., 500 vdc	C-64	Elect., 30 mfd., 150 vdc
C-20	Ceramic, 15-60 mmf., 500 vdc	C-65	Elect., 30 mfd., 150 vdc
C-21	Ceramic, 0.005 mfd., 500 vdc	C-66	Mica, 510 mmf., 500 vdc
C-22	Ceramic, 100 mmf., 500 vdc	C-67	Variable Mica, 400-1100 mmf
C-23	Ceramic, 0.005 mfd., 500 vdc	C-68	Mica, 220 mmf., 500 vdc
C-24	Paper, 0.25 mfd., 400 vdc	C-69	Ceramic, 500 mmf., 10,000 vdc
C-25	Mica, 100 mmf., 500 vdc	C-70	Ceramic, 500 mmf., 10,000 vdc
C-26	Mica, 2200 mmf., 500 vdc	C-71	Paper, .1 mfd., 400 vdc
C-27	Mica, 330 mmf., 500 vdc	C-72	Mica, 4700 mmf., 500 vdc
C-28	Ceramic, 5 mmf., ±1 mmf., 500 vdc	C-73	Mica, 4700 mmf., 500 vdc
C-29	Ceramic, 10 mmf., 500 vdc	C-74	Paper, .01 mfd., 600 vdc
C-30	Paper, 0.1 mfd., 400 vdc	C-75	Elect., 40-40 mfd., 450 vdc
C-31	Ceramic, 5 mmf., ±1 mmf., 500 vdc	C-75A	Part of C-75
C-32	Ceramic, 1 mmf., 500 vdc	C-75B	Part of C-75
C-33	Paper, .1 mfd., 400 vdc	C-76	Mica, 1500 mmf., 500 vdc
C-34	Paper, 0.25 mfd., 400 vdc	C-77	Paper, .25 mfd., 400 vdc
C-35	Elect., 10 mfd., 25 vdc	C-78	Mica, 1500 mmf., 500 vdc
C-36	Paper, .05 mfd., 400 vdc	C-79	Paper, .01 mfd., 600 vdc
C-37	Paper, 0.005 mfd., 500 vdc	C-80	Paper, .02 mfd., 600 vdc
C-38	Paper, 0.1 mfd., 600 vdc	C-81	Paper, .005 mfd., 5000 vdc
C-39	Paper, .02 mfd., 400 vdc	C-82	Paper, .005 mfd., 5000 vdc
C-40	Ceramic, 10 mmf., 500 vdc	C-83	Mica, 220 mmf., 500 vdc
C-41	Paper, .02 mfd., 400 vdc	C-84	Mica, 100 mmf., 500 vdc
C-42	Ceramic, 75 mmf., 500 vdc	C-85	Mica, 100 mmf., 500 vdc
C-43	Not Used	C-86	Paper, .01 mfd., 600 vdc
C-44	Paper, .1 mfd., 200 vdc	C-87	Variable Mica, 3.5-35 mmf
C-45	Mica, 330 mmf., 500 vdc	C-88	Ceramic, 500 mmf., 10,000 vdc
C-46	Not Used	C-89	Ceramic, 500 mmf., 10,000 vdc
C-47	Mica, 2200 mmf., 500 vdc		
C-48	Mica, 1500 mmf., 500 vdc		
C-49	Paper, 0.05 mfd., 600 vdc		
C-50	Paper, .1 mfd., 600 vdc		
C-51	Ceramic, 0.005 mfd., 500 vdc		

	RESISTORS		RESISTORS
R-1	1,000 ohms, 1/2 watt	R-56	40 ohms, 5 watts
R-2	100,000 ohms, 1/2 watt	R-57	82 ohms, 1/2 watt
R-3	100 ohms, 1/2 watt	R-58	580 ohms, 2 watts
R-4	1000 ohms, 1/2 watt	R-59	70 ohms, 5 watts
R-5	1000 ohms, 1/2 watt	R-60	1200 ohms, 1 watt
R-6	1,000,000 ohms, 1/2 watt	R-61	8,200 ohms, 1/2 watt
R-7	2200 ohms, 1 watt	R-62	820,000 ohms, 1 watt
R-8	18,000 ohms, 1/2 watt	R-63	3,900,000 ohms, 1 watt
R-9	10,000 ohms, 1/2 watt	R-64	3,900,000 ohms, 1 watt
R-10	82 ohms, 1/2 watt	R-65	Variable, 5,000,000 ohms
R-11	120 ohms, 1/2 watt	R-66	1,700,000 ohms, 1 watt
R-12	100 ohms, 1/2 watt	R-67	1,700,000 ohms, 1 watt
R-13	10,000 ohms, 1/2 watt	R-68	3,300,000 ohms, 1 watt
R-14	82 ohms, 1/2 watt	R-69	3,300,000 ohms, 1 watt
R-15	120 ohms, 1/2 watt	R-70	3,800,000 ohms, 1 watt
R-16	100 ohms, 1/2 watt	R-71	3,800,000 ohms, 1 watt
R-17	10,000 ohms, 1/2 watt	R-72	2,700,000 ohms, 1 watt
R-18	82 ohms, 1/2 watt	R-73	2,700,000 ohms, 1 watt
R-19	100 ohms, 1/2 watt	R-74	Variable, 5,000,000 ohms
R-20	560,000 ohms, 1/2 watt	R-75	Variable, 5,000,000 ohms
R-21	22,000 ohms, 1/2 watt	R-76	1,700,000 ohms, 1/2 watt
R-22	2,700 ohms, 1/2 watt	R-77	100,000 ohms, 1/2 watt
R-23	100,000 ohms, 1/2 watt	R-78	1,700,000 ohms, 1/2 watt
R-24	33,000 ohms, 1 watt	R-79	1,000 ohms, 1/2 watt
R-25	8,200 ohms, 1 watt	R-80	Variable, 1,000,000 ohms
R-26	8,200 ohms, 1/2 watt	R-81	10,000,000 ohms, 1/2 watt
R-27	1,000,000 ohms, 1/2 watt	R-82	Variable, 10,000,000 ohms
R-28	1,000,000 ohms, 1/2 watt	R-83	10,000,000 ohms, 1/2 watt
R-29	10,000 ohms, 1/2 watt	R-84	1,700,000 ohms, 1/2 watt
R-30	Variable, 1,000 ohms, ±10%	R-85	15,000 ohms, 1/2 watt
R-31	6,800 ohms, 1/2 watt	R-86	1,600,000 ohms, 1/2 watt
R-32	1,000,000 ohms, 1/2 watt	R-87	150,000 ohms, 1/2 watt
R-33	22,000 ohms, 1/2 watt	R-88	2,200,000 ohms, 1/2 watt
R-34	270 ohms, 1/2 watt	R-89	820,000 ohms, 1/2 watt
R-35	220,000 ohms, 1/2 watt	R-90	220,000 ohms, 1/2 watt
R-36	560 ohms, 1/2 watt	R-91	2,700,000 ohms, 1 watt
R-37	560 ohms, 1/2 watt	R-92	2,700,000 ohms, 1 watt
R-38	180,000 ohms, 1/2 watt	R-93	1,700 ohms, 1/2 watt
R-39	15,000 ohms, 1/2 watt	R-94	100,000 ohms, 1/2 watt
R-40	Variable, 25,000 ohms	R-95	1,000 ohms, 1/2 watt
R-41	150,000 ohms, 1/2 watt	R-96	Variable, 250,000 ohms
R-42	33,000 ohms, 1 watt	R-97	220,000 ohms, 1/2 watt
R-43	82 ohms, 1/2 watt	R-98	1,200,000 ohms, 1/2 watt
R-44	470 ohms, 1/2 watt	R-99	Variable, 5,000,000 ohms
R-45	68,000 ohms, 2 watt	R-100	10,000 ohms, 1 watt
R-46	33,000 ohms, 1/2 watt	R-101	1,700,000 ohms, 1/2 watt
R-47	33,000 ohms, 1/2 watt	R-102	1,700,000 ohms, 1/2 watt
R-48	Variable and S-itch, 1,000,000 ohms	R-103	7,000 ohms, 2 watts
R-49	8,200,000 ohms, 1/2 watt	R-104	47,000 ohms, 1 watt
R-50	390,000 ohms, 1/2 watt	R-105	2,700,000 ohms, 1 watt
R-51	270,000 ohms, 1/2 watt	R-106	2,700,000 ohms, 1 watt
R-52	47,000 ohms, 1/2 watt	R-107	1,000 ohms, 1/2 watt
R-53	1,700 ohms, 1/2 watt	R-108	3,900 ohms, 1/2 watt
R-54	20 ohms, 10 watts	R-109	100 ohms, 1/2 watt
R-55	82 ohms, 1/2 watt	R-110	1,000,000 ohms, 1 watt

Fig. 1 (*a*) (left) and (*b*) (right), list of parts for the National TV receiver circuit which appears on page 20.



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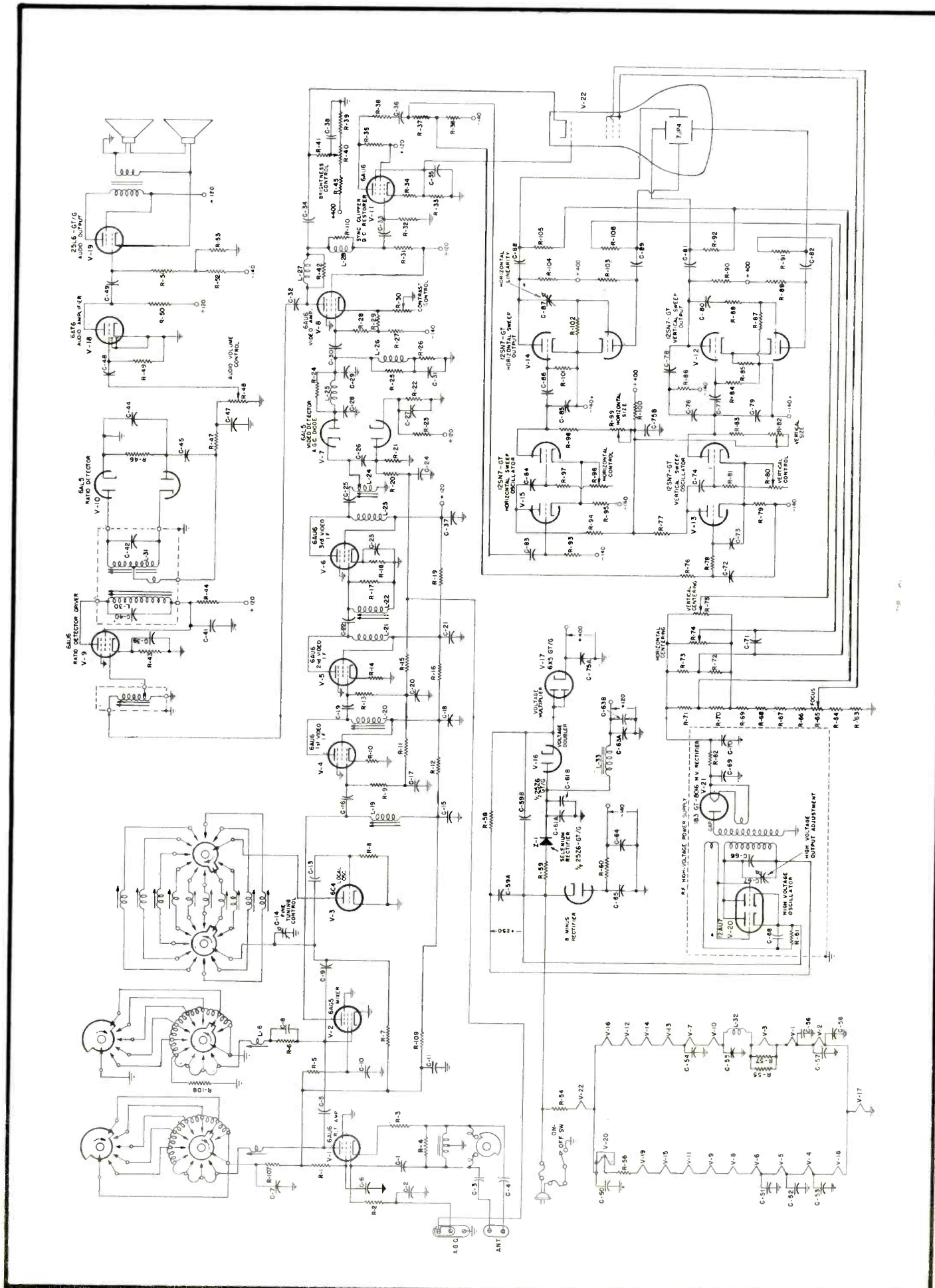

Fig. 1. Complete circuit diagram of the NC-TV-7/NC-TV-7M. (*See parts lists on page* 18.)

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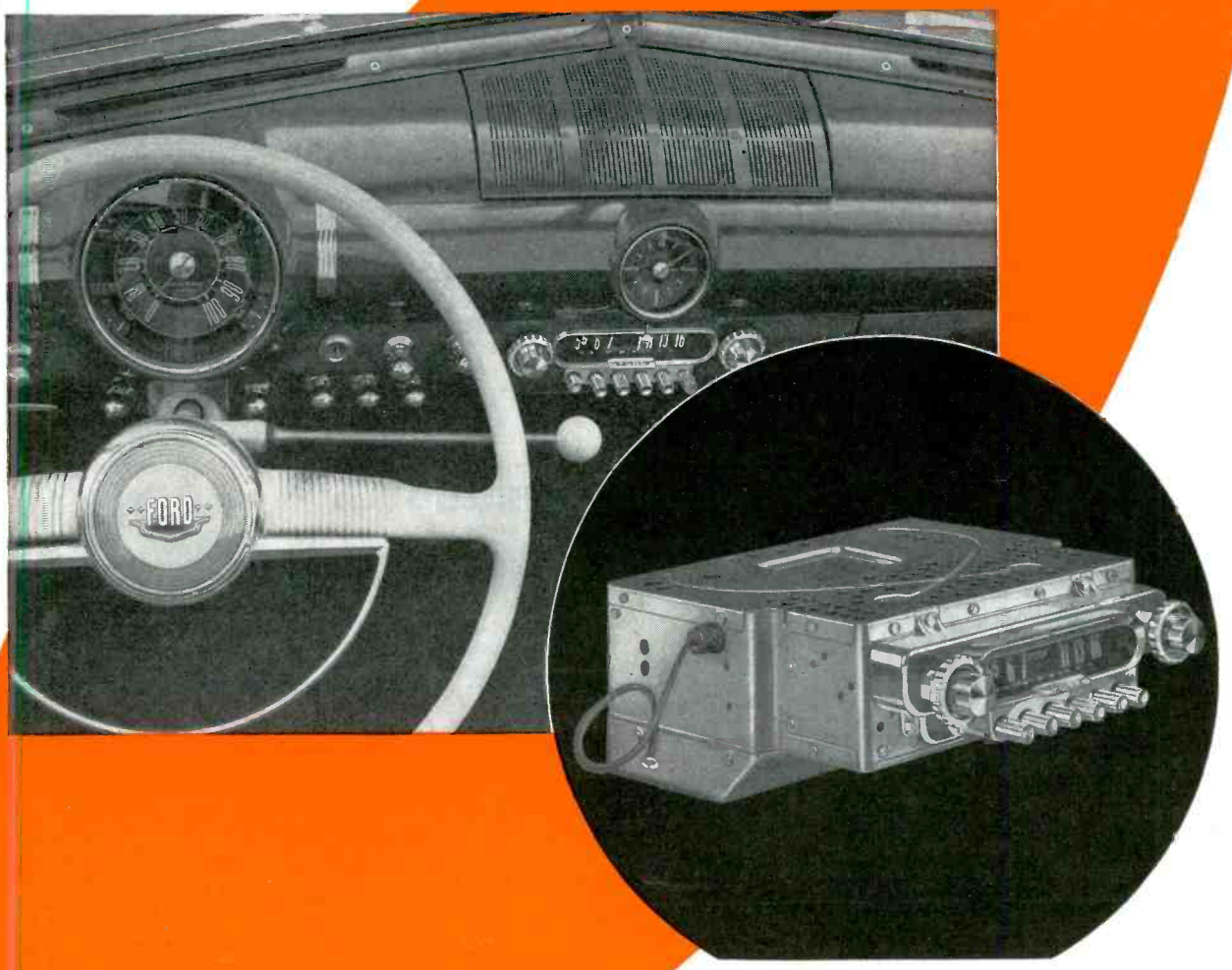

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TV Receiver Production Changes

First of a Series of Monthly Analyses of Production Changes in TV Receiver Circuit and Mechanical Designs Based on Data Supplied By TV Set Manufacturers. In this Installment Appear Notes on a New String Tuning Drive for the G. E. 810, Improving Audio 1F Selectivity and Brightness Control and Removing Howl in 810; Adding AFC to the Motorola VT71; And Substituting 6AU6s for 6AG5s in the Admiral 30A1.

by DONALD PHILLIPS

G. E. 810 Revisions

THE TUNING CONTROL on the G.E. 810[1] TV model has been changed from a rubber pulley friction drive to string drive, to eliminate a small amount of backlash which resulted in critical tuning adjustment on the high frequencies.

When making this change, it is necessary to remove and discard the rubber tuning control pulley, tuning drum and knurled tuning control concentric shaft; Fig. 1.

Vertical Size Change

On late production models, the vertical size potentiometer and R_{100} were interposed to protect the rectifier circuit against damage due to shorts in the vertical size control. The red wire from the vertical size control to the junction of C_{62} and L_{20} should be connected from the same side of the vertical size control to C_{33}. The end of R_{100} connected to C_{33} should be removed and connected to the junction C_{62} and L_{20}.

Audio IF Selectivity Improvement

To improve the selectivity of the audio *if* channel on the G.E. 810 and 814 and, increase the attenuation to the video *if* signal and to vertical pulses which might cause hum or noise, a transformer T_{21} has been substituted for L_5. The addition of this transformer reduces the audio *if* band width to approximately 300 kc. (The catalog number for this transformer is RTL-090.) To replace L_5 with T_{21}, it is necessary to remove coupling capacitor C_{98} and coil L_6. The primary of T_{21} should be connected between pin 5 of V_{22} and the load resistor R_{102}. Terminal *1* of T_{21} should be connected to R_{102}. A bypass capacitor C_{100} must be connected from the junction of R_{102} and terminal *1* of T_{21} to ground. Terminal *2* of T_{21} should be connected to pin *5* of V_{22}. Terminal *3* of T_{21} must be connected to ground. Terminal *4* is connected to pin *1* of V_{17}.

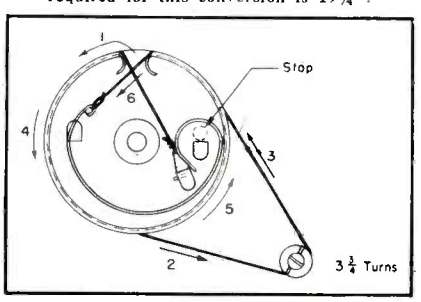
This transformer mounts in the same manner as L_5 and is double tuned. Therefore, when tuning this stage, it is necessary to adjust two iron cores of T_{21} for maximum amplitude and symmetry about the 21.8 marker.

Howl in G.E. 810/814

It has been found in the 810 and 814 receivers that howl may be caused by one or more of the three following reasons:

(*1*) A microphonic converter-oscillator 12AT7.
(*2*) The capacitor, C_3, located on the head-end unit under the tuning capacitor, may start vibrating.
(*3*) The metal guide ring on the rear side of the oscillator wafer rotor section or the textolite rotor in the oscillator wafer of the channel switch may be loose.

Fig. 1. How to make a tuning drive change in the G. E. 810 TV receiver. The length of string required for this conversion is 19¼".



A lead weight (RHX-014) is available to mount over the 12AT7 to dampen out mechanical vibration of the tube envelope and the internal components of the tube.

To prevent the capacitor C_3 from vibrating, a rubber block (RMM-081) may be wedged between the edge of C_3 and the front apron of the head-end unit. To facilitate the installation of this piece, it is suggested that it be cut ino a *V* or wedge shape so that the edge of C_3 will be held in the channel of the rubber cushion.

Item *3* can be corrected by cementing the textolite rotor to the shaft and the rotor guide ring on the rear side of the oscillator wafer rotor to the textolite rotor with *Dekadhese Cement*. Extreme caution should be observed when applying this cement. The cement should only be applied to the guide ring and the textolite rotor. The cement *should not* touch the fingers of electrical contact ring which extends through the textolite rotor.

In these models, R_{24} has been changed from a 3300-ohm *1*-watt unit to 3300-ohm *2*-watts. It was found that this resistor increased in value slightly, therefore limiting the brightness obtainable on the picture tube.

Adding AFC to Motorola VT71[2]

IN ADDING AFC to the VT71, it is necessary to change the functions of several tubes and to change one tube: V_{11}, a 12SN7, contains the horizontal sweep oscillator as before and a diode replaces the second clipper; V_{10}, a 12SN7, now contains both clippers; V_7, formerly a

[1] SERVICE; December, 1948.
[2] SERVICE; March, 1948.

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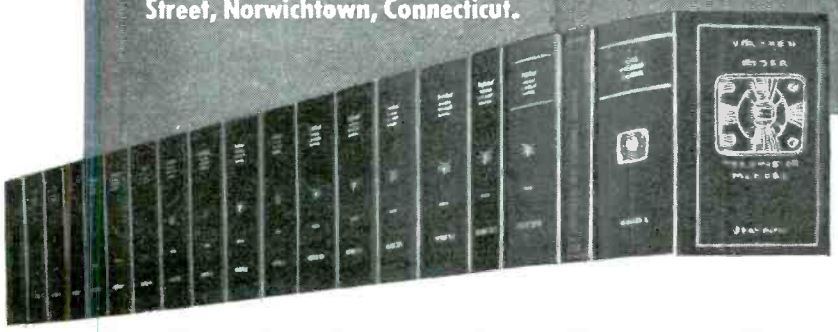
— says Bud Ward, Owner of Ward's Radio Service, 24 Town Street, Norwichtown, Connecticut.



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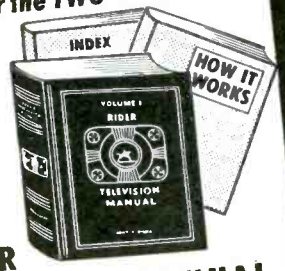

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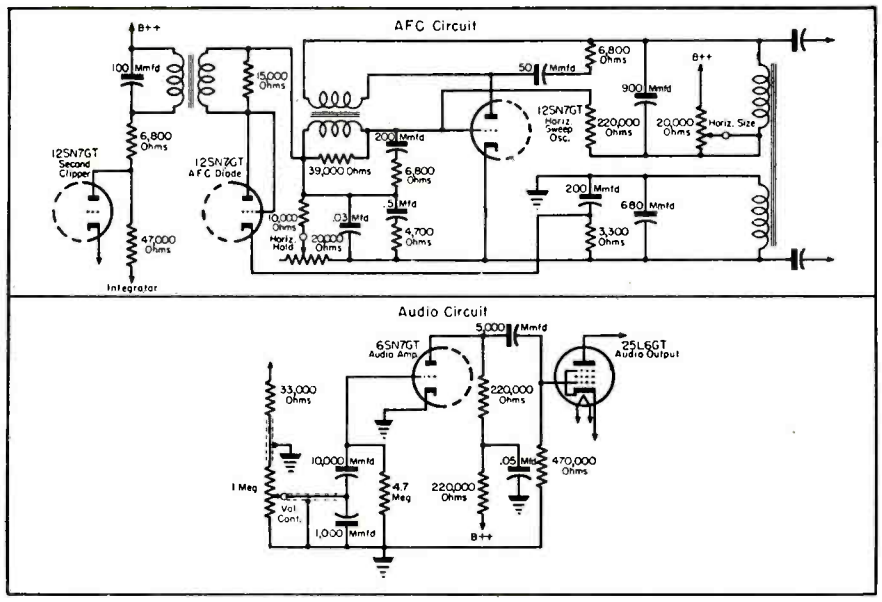

Fig. 2. Circuits developed to provide *afc* for the Motorola VT71 TV receiver. The audio circuit changes required are also shown in this figure.

6SQ7, has been changed in production to a 12SN7 and contains the first audio amplifier and the vertical sweep oscillator. In adding *afc* to existing receivers, however, a 6SN7 is used in place of the 6SQ7 in the V_7 socket. This simplifies the filament circuit change considerably.

Physical Layout Changes

Except for the filament circuit, the addition is identical electrically with current production. However, there is a considerable difference in the physical layout of the components made to simplify the change.

Procedure

(*1*) Clip out lead grounding pin *1*, V_7; remove couplate (printed circuit) entirely.
(*2*) Move C_{134}, .005 from pin 2 to pin 1, V_7; add another .005 in parallel or use a .01 in place of C_{131}.
(*3*) Move one end of R_{95}, 4.7 meg from pin *2* to pin *1*, V_7.
(*4*) Clip out jumper between pins *3*, *4* and *5*, V_7, and put jumper between pins *3* and *6*, V_7.
(*5*) Remove C_{133}, 1000, from terminal strip west[3] of V_7 and connect it between pin *3*, V_7, and the same terminal on the strip east of V_7 to which C_{134}, .01, and the shielded green lead are attached.
(*6*) Add 220,000-ohm unit between pin *2*, V_7, and junction of R_{36}, 220,000 ohms and C-41, .05.
(*7*) Add 220,000-ohms between pin *5*, V_{12}, and B— on strip east of V_7.
(*8*) Add .005 between pin *2*, V_7 and pin *5*, V_{12}.
(*9*) Clip out white lead from pin *6* of the ballast tube to the selenuim rectifier (B—); this is the only filament change required.
(*10*) Unsolder all leads going to pins *2*, *3*, *4*, *5* and *6*, V_{10}. Remove entirely blue lead going to pin *2*.
(*11*) Clip red lead (B+) from pin *6*, V_{11}, and solder it to pin *6*, V_{10}.
(*12*) Unsolder all leads going to pins *4*, *5* and *6*, V_{11}. Remove completely from circuit, .05 from pin *4*, 1 meg from pin *6*, 10,000 ohms from pins *4* and *6*, 50 mmfd from pins *5* and *1*, 6800 from pin *5* and 3900 ohms from pin *2*.
(*13*) Add 10,000 ohms from pin *4* to pin *6*, V_{10}.
(*14*) Add 1 meg from pin *2* to pin *6*, V_{10}.
(*15*) Add .05 mfd. from pin *2* to pin *4* (lay it next to chassis southwest of V_{10}, use spaghetti on leads.
(*16*) Move two white leads (B—) which were on pin *6* to pin *3*, V_{10}.
(*17*) Add terminal strip (one grounded, two insulated terminals), bolting or riveting through hole southeast of V_{10}.
(*18*) Run lead from pin *5*, V_7, across chassis to terminal *1* (southernmost) on strip just put in.
(*19*) Add blue lead from R_{54}, 3.3 meg, on strip south of V_8 to same point (terminal *1*).
(*20*) Run lead from pin *4*, V_7, across chassis to terminal *2* (northernmost) of strip just installed.
(*21*) Tie C_{54}, .1 mfd, from vertical hold control to terminal *1* of same strip.
(*22*) Tie C_{141}, C_{140} and R_{114} (.001, 250, and 3.3 megohms respectively) to terminal *2* of same strip.
(*23*) Replace C_{51}, .01, with .03 (runs from horizontal hold control).
(*24*) Construct and install sub-assembly: (100 mmfd, pins *1* to *3*, 15,000-ohm pins *2* to *4*, transformer red lead to pin *4*, other lead from same end to pin *3*, green lead to pin *1*, other lead to pin *2*. Mount with bolt or rivet on north side of strip through easternmost of the two holes north of V_{11}. Terminal *1* goes on the west terminal *4* on the east.
(*25*) Connect lead from pin *4*, sub-assembly, to pins *4* and *5*, V_{11}.
(*26*) Connect lead from pin *3*, sub-assembly, B++ on horizontal size pot.
(*27*) Connect lead from pin *2*, sub-assembly, to junction of R_{111}, R_{110} and C_{51}.
(*28*) Connect loose ends of C_{47}, .01, and C_{48}, .01, to pin *3*, V_{10}.
(*29*) Connect R_{44}, 47,000 ohms, to pin *5*, V_{10}.
(*30*) Put R_{43}, 6,800 ohms, between pin *5*, V_{10}, and pin *1* sub-assembly.
(*31*) Add 3,300 ohms from pin *3* to pin *6*, V_{11}.
(*32*) Add 200 mmfd from pin *6*, V_{11}, to any convenient B— point (e.g. pin *3*, V_8.)
(*33*) Add .5 (200 *v*) from pin *2*, sub-assembly, to open lug (terminal *2*) on terminal strip south of V_{11}. Put capacitor close to chassis in open area east of V_{11}.
(*34*) Add 4,700 ohms from pin *3*, V_{11}, to terminal *2* of strip mentioned in step 33.
(*35*) Add 6,800 ohms and 200 mmfd in series across R_{110}, 39,000 ohms (from pin *1*, V_{11}.)
(*36*) Add 6,800 ohms and 50 mmfd (use C_{46} which was removed) in series from pin *2*, V_{11}, to terminal 1 on terminal strip south of V_{11}. This terminal *1* already has one of the blocking oscillator leads attached to it.
(*37*) Add 220,000 ohms, 2 watts, from horizontal size arm to pin *1*, V_{11}.
(*38*) Replace C_{66}, .05, in the high voltage oscillator stage with a 10 mfd, 350 *v*.
(*39*) Replace C_{138}, 900 mmfd, with 680 mmfd.
(*40*) Replace V_7, 6SQ7, with a 6SN7.

[3]Locations are specified by points of the compass using this convention; with the chassis upside down, the front panel controls are north, the hold controls, etc., are south, the selenium rectifiers are west, etc.

[4]SERVICE; October, 1948.

Admiral 30A1[4] Revisions

Tube substitution: The 6AG5s have been used for V_{302} and V_{303} in the 30A1 models. Future production will use 6AU6s as a substitute. Due to differences in interelectrode capacities, video *if* transformers T_{301} and T_{302} must be changed when the 6AU6s are used. (When 6AU6s are used for V_{302} and V_{303}, T_{301} will be part number 72A81 and T_{302} will be part number 72A82. Connections to the substitute transformers are identical to those used with transformers 72B40 and 72B41, used with 6AG5s).

Chassis Code Changes

When 6AU6s are used for V_{302} and V_{303} in place of 6AG5s, the chassis will be identified by *E* after the chassis type number. For example, such a chassis would be marked *30A1S-E*.

Pulling at Top of Picture

In the Admiral 30A1 receivers, pulling at the top of the picture may show up in some models across the top of the picture extending approximately 1" down from the top of the picture. It can be noticed when there are vertical lines running to the top of the picture or pattern. These lines will pull to the right or left for a distance of 1" from the top of the picture.

Trouble in Vertical Sync

This trouble is caused by a portion of the vertical synchronization pulses riding through the horizontal sync discriminator circuit and upsetting the horizontal oscillator momentarily. As the vertical sync pulses occur 60 times per second this out of phase condition would exist immediately after the vertical blanking pulses and therefore show up in the top portion of the picture only. The low-frequency response of the horizontal sync discriminator can be reduced to overcome this problem. It is recommended that resistors R_{413} and R_{414} be changed from 470,000 ohms each to 180,000 ohms each. It will then be necessary to readjust the horizontal oscillator.

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by P. M. RANDOLPH

Preamp—Equalization*

To PERMIT the use of the variable reluctance type pickup[1] with the phono systems of normal receivers and audio amplifiers, it is necessary to employ a pream-equalizer.[2] Equalization provided in the dual-purpose unit affords the best compromise between record noise and high-frequency response and low-frequency response and rumble due to off-center recordings or turntables.

Magnetic reproducers operate on a velocity basis; that is, the output voltage is proportional to the velocity of the stylus movement when tracing a record groove. Present day recordings are made with a characteristic as shown in Fig. 1. This is an average curve and varies from manufacturer to manufacturer, no standards having been set for the industry. The frequency at which the low end of the curve starts to drop varies from 300 to 500 cycles depending upon the manufacturer, and the point at which the high-frequency end of the curve starts to rise ranges in the region of 1000 to 2000 cycles, although here too the exact frequency and the amount of rise vary with the manufacturer. Some of the available recordings do not have the high-frequency increase at all. Generally these are the older recordings which have been re-released.

Fig. 1 also represents the output voltage of an ideal magnetic device reproducing the average present day recordings. The output below the low-frequency cross-over point falls off 6 db/octave, the output above the high-frequency cross over point rises 0-6 db/octave. Thus it can be seen that equalization of the cartridge output is necessary to provide satisfactory reproduction.

It has been found that full equalization of the low-frequency portion of the curve is not desirable, since there are heavy low-frequency elements present in the reproduction due to imperfections in the turntable and motor bearings, and to eccentricities and rough spots in the recording. These low-frequency elements are composed of extremely high-signal levels and will overload the amplifier and loudspeaker unless care is taken to provide low-frequency attenuation. To provide a means of reducing these objectionable low-frequency elements, the low-frequency compensation in the variable-reluctance preamp-equalizer has been designed to have a 3 db/octave rise rather than the full 6 db. This provides satisfactory bass response for all but very few applications and effectively reduces the low-frequency rumbles. The 50-cycle response with the equalization provided is down about 8 db from the theoretically perfect response which would be achieved by the use of 6 db/octave equalization. This is not serious, since bass equalization must be provided in the main amplifier to compensate for the low-frequency characteristic of the human ear. The degree of compensation required depends upon the volume at which the sound is being reproduced, and is of the order of 25 to 30 db at normal room listening level. It can be seen that the 8 db is of minor importance as compared to the 25 to 30 db loss in the ear. The shape of the curve of the preamplifier response characteristic, however, is such that the extreme low frequencies, below the useful limit, are considerably attenuated and the rumble frequencies reduced. (*Lf* compensation is provided by R_{105}, R_{104} and C_{103}.)

If required, the low-frequency response can be maintained ±2db from

(*Continued on page 47*)

*From notes prepared by N. S. Cromwell, G. E.

[1] G. E. RPX-010.

[2] G. E. SPX-001.

Fig. 2. Schematic of preamp equalizer; G.E. SPX-001.

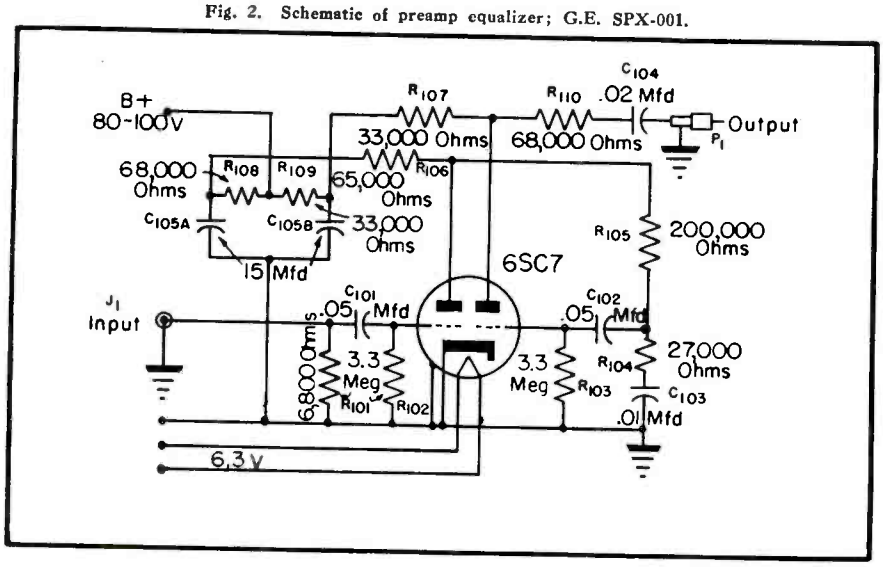
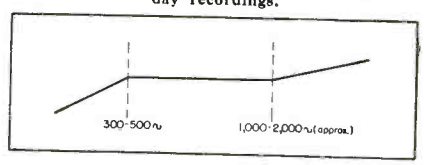


Fig. 1. Velocity characteristic of average present day recordings.



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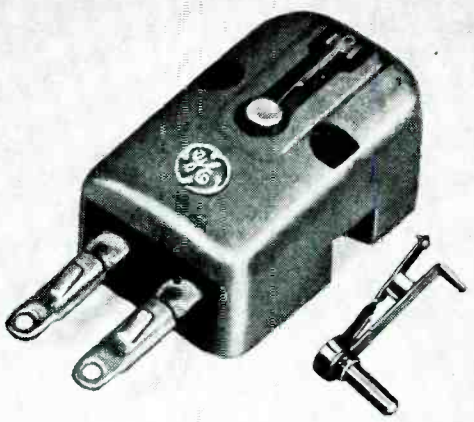

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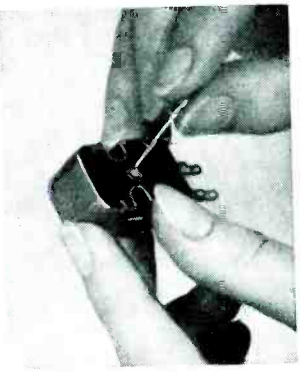

2 Use paper clip or wire to force stylus out of the cartridge.

3 Insert new stylus into cartridge with fingers.

4 Press firmly into position with thumb nail.

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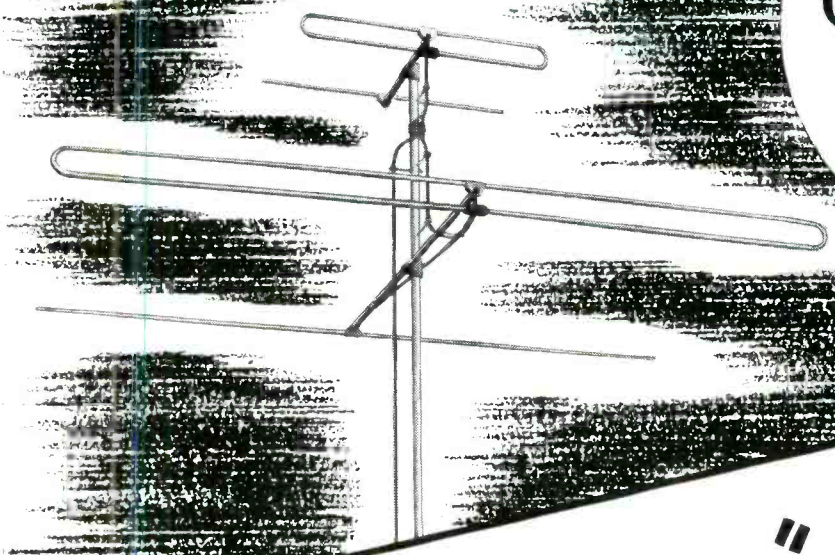

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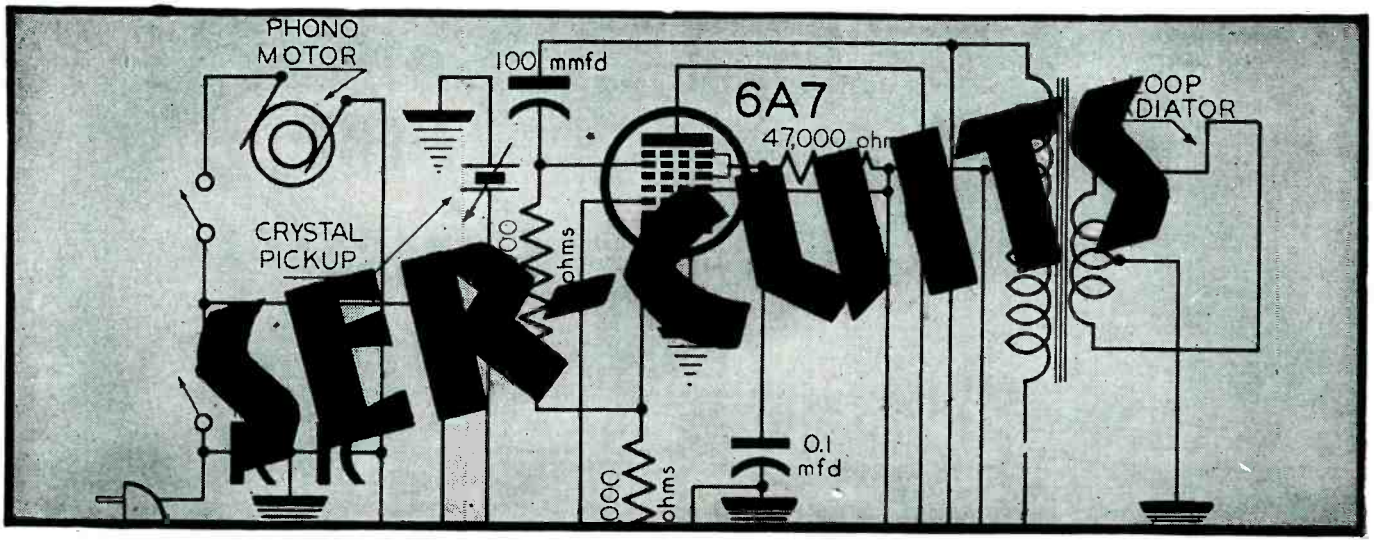
EXPORT... SCHEEL INTERNATIONAL... CHICAGO 18, ILLINOIS

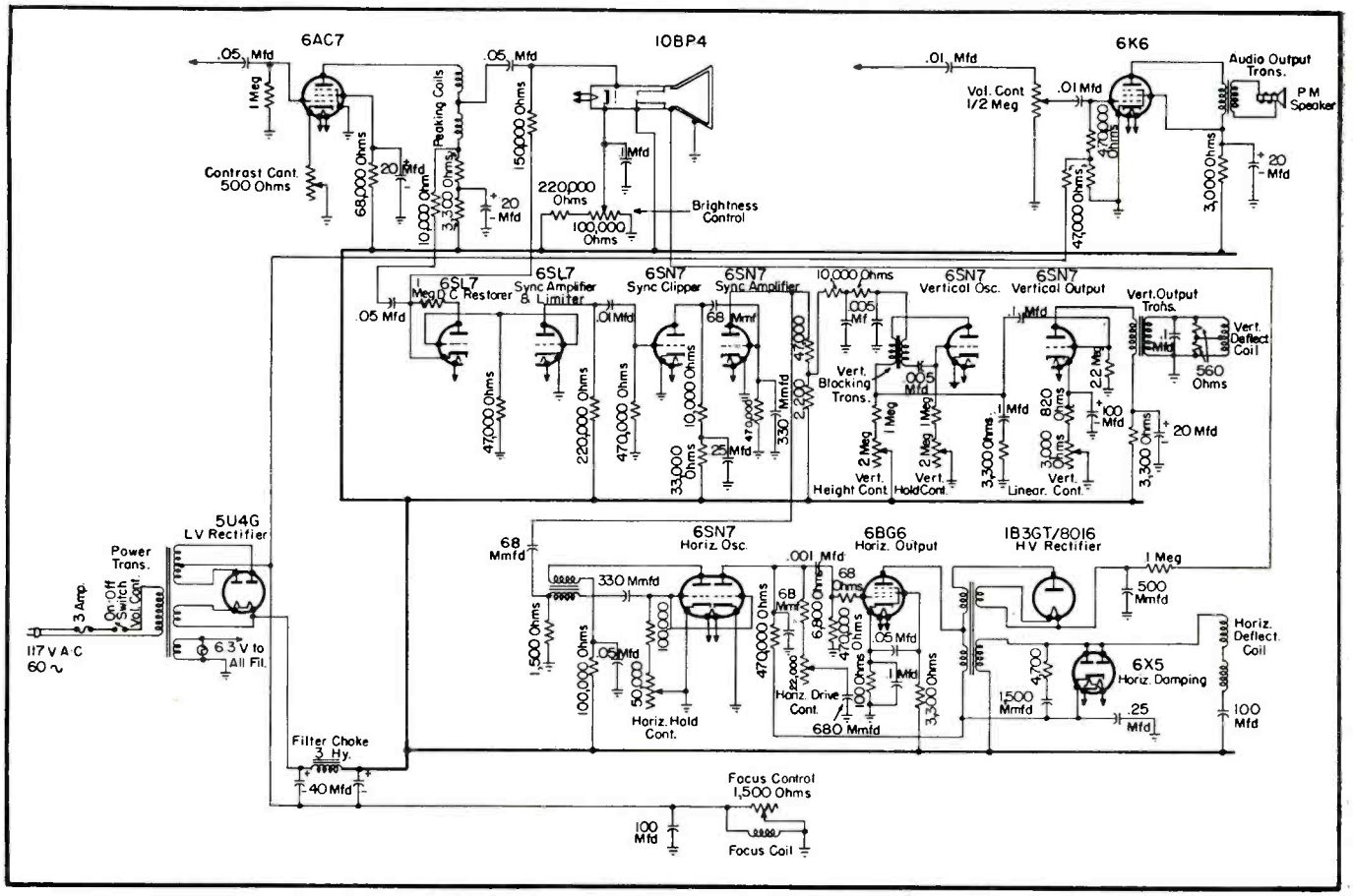


Olympic TV Duplicator Circuit . . . The Hallicrafters T-61/T-67 Push-Button TV Model . . . Farnsworth GV 260 Differentiation and Horizontal Control System.

TV DUPLICATORS, which are becoming increasingly popular in the home as well as hotel, contain many interesting circuit innovations. In one type, the Olympic RTU-3, shown in Fig. 1, there are 10 tubes including the rectifiers and picture tube: Video amplifier which is flat to 4 mc, *dc* restorer, vertical and horizontal blocking oscillators, vertical and horizontal output, synchronization amplifiers and clippers, power supplies for high and low voltage supply, and audio amplifier.

The signal to acutate the duplicator unit is obtained from the video and audio output stages of the television receiver. These signals are fed from

Fig. 1. The Olympic RTU-3 duplicator.



the receiver to the duplicator unit by a special coax cable consisting of RG62/U and a single insulated conductor. The video connection to the television receiver is made at the video output tube. This is the last tube in the video amplifier circuit, feeding the grid of the picture tube. Most manufacturers return the cathode of this tube either directly to ground, or to ground through a resistor, or a resistor-capacitor combination. This connection to the cathode of the tube must be opened and a coax cable inserted, the cathode return being completed through a 92-ohm resistor contained at the duplicator unit.

This return serves a dual purpose: It is the cathode bias return for the video tube and it is the terminating resistor for the coaxial cable. It is for this reason that the resistor used must be 92 ohms to match the surge impedance of the RG62/U coaxial cable used. *Any different value will be a serious mismatch* and will impair the quality of the picture. The 92-ohm resistor is supplied with the duplicator and is contained in a removable 4-prong plug.

When more than one *duplicator* is used, the plug containing the *terminating* resistor must be removed and an extension cable inserted in its place. Care must be taken, however, that the last unit in the chain must retain the plug with the 92-ohm resistor in its place.

In making the audio connection, a series combination of a 10-000-ohm resistor and a 1,500-ohm resistor is shunted across the primary of the output transformer. From the junction point of these two resistors a coupling capacitor of not less than .01 mfd/600 *wv* is connected, with a single insulated wire from the adapter cable connected to this capacitor.

Where the TV set does not have the cathode of the video output tube returned to ground or chassis but to a point *negative* with respect to chassis, the shield of the RG62/U coax must be connected to this point and *not to ground*. Care must be taken not to permit the shield to touch the chassis anywhere in the set. Otherwise the negative bias, which may be used throughout the set will be shorted out. The center conductor must be connected to the cathode and any resistor shunting the center conductor and shield must of course be eliminated.

The duplicator can be used with many types of TV sets, such as the Admiral 30A15, 30A16; Andrea C-VJ12, T-VJ12; Belmont 22AZ21,

(*Continued on page 32*)

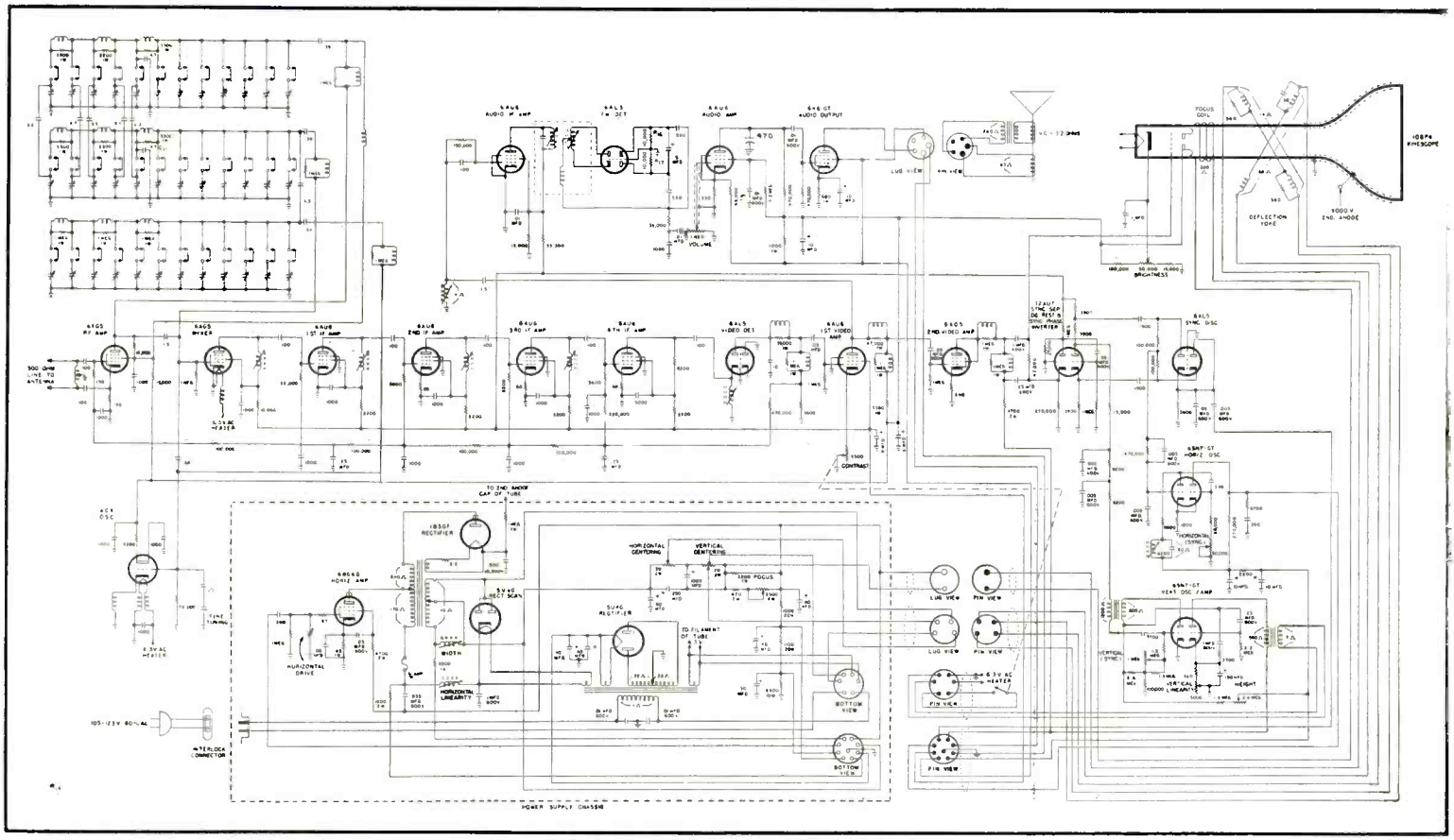


Fig. 2. Circuit of the Hallicrafters T-61 and T-67 TV chassis.

22AX22; Emerson 545; Fada 799; RCA 630TS, 648TPK, 641TV, 830TS; Garod, 3912TVFMP; DeWald BT100, etc.

Hallicrafters T-61/T-67

IN FIG. 2 appears the latest version of the Hallicrafter's push-button 10" model, T-61/T-67, using twenty-one tubes.

This model has an intercarrier sound *if* of 4.5 mc, picture carrier of 26.25 and sound carrier of 21.75 mc.

The second anode potential is approx. 9,000 v. Improper operation of the horizontal sweep circuit or circuit faults in the high voltage filter generally accounts for an abnormal anode potential. If the anode potential is low, the horizontal drive adjustment must be checked. This can be done in two steps:

(1) Connect a 50-megohm resistor string in series with a 200 microampere meter. Connect the free meter terminal to the chassis and the high side of the resistor string to the anode cap of the picture tube. The connection to the anode cap may be made with a fine wire slipped under the connector. Make up the resistor string with 10-megohm one or two watt resistors to provide a safety factor for voltage breakdown. If the 10-megohm resistors are used, a total of five will be required to obtain the 50 megohms. The setup should be self-supporting and adequate clearance being achieved between the resistor string and chassis parts to prevent high voltage breakdown.

(2) Turn on the receiver and set the *brightness* and *contrast* controls at minimum. The microammeter will read approx. 180 microamperes of 9,000 v at the anode. The anode potential is measured in this manner (*contrast* and *brightness* controls at minimum, meter current approx. 200 microamperes) to simulate the picture-tube load on the high voltage power supply.

Due to a broad frequency response of the *if* amplifier, it is necessary to use a 24.5-mc signal generator or oscillator (unmodulated) as a beat frequency oscillator to locate the center frequency of the *if* amplifier response for the correct local oscillator adjustment. This *bfo* generator should be loosely coupled by means of a wire from the generator output placed in close proximity to the 6AL5 video detector.

The high frequency signal generator output should be connected to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each conductor of the transmission line. Then an electronic voltmeter should be connected across a 5600-ohm resistor in the plate circuit of the 6AL5.

Farnsworth GV-260

TRACING THE differentiation and horizontal control circuit of the Farnsworth GV-260, last month, we found that the reactance of the cathode-coupling capacitor was considerably higher than the 10-ohm cathode resistor through which the oscillator currents flow. Therefore, the current leads the voltage by almost 90°. Potential and current associated with a resistor being always in phase, the potential injected into the cathode is essentially 90° ahead of the potential at the grid of the oscillator. This injected potential appears at the plate of the reactance tube in like phase—leading—and is injected into the oscillator. This is the same phase difference that would be expected from an inductatnce—the potential leading the current. Therefore, the reactance tube and associated circuit appears to the oscillator be an inductance, and frequency shift is had

even as though an inductance were attached across the oscillator coil.

Direct potential upon the grid of the reactance tube determines the amount of amplication within the tube. Highly negative amplification is reduced—and the amount of out-of-phase potential is reduced. Thus it appears to the oscillator that the size of our hypothetical inductance varies.

This direct-control potential must be a function of the oscillator frequency, so that as the frequency tends to deviate from its correct value a change in control potential will restore correct frequency through the action of the reactance tube.

In this model magnetically coupled to the oscillator winding of the transformer is a discriminator circuit quite similar to the detection circuit of an FM receiver. The sync pulses, along with the local oscillator pulses from the 6K6, are injected into the discriminator. Therein, comparison is made between the two frequencies and a direct control potential is derived. Frequency is maintained constant, despite sudden temporary bursts of interference, because of the long time constant in the control-voltage circuit.

Differentiation of the pulses from the local oscillator is obtained by a 390-mmfd capacitor and 6,800-ohm resistor, injection being to a clipper tube, one-half section of a 6SN7. Plate current flows only during the positive portions of the incoming pulses because the grid is quite highly negative. Some negative potential is from the cathode resistor; more due to grid current flowing through the 6,800-ohm resistor. This assures that, should the pulse amplitude change over a period of time, still only the positive of the sync pulse will pass.

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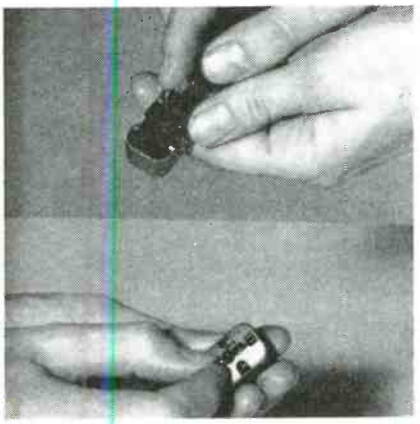
REPLACEMENT STYLUS



Two steps followed in exchanging the stylus of a variable reluctance phono cartridge. Top view shows how the stylus can be pushed out with a paper clip; bottom view shows how a new one can be inserted. (*Courtesy G.E.*)

ASSOCIATIONS

ARTA-ARSD

OFFICERS of the Akron Radio Technicians Association and the Associated Radio Service Dealers of Columbus, Ohio, met recently at a dinner in the Columbus Athletic Club to discuss the formation of a State Federation.

Members of the Akron group who attended the meeting were: D. C. Bruner, secretary; George Phillips, president; C. Kehree, treasurer; Jake Mintz and Cecil King. ARSD of Columbus was represented by Al Ray, president; William Hetrick, treasurer; Charles Hildreth, secretary; John Graham, editor of ARSD News and Fred Colton, chairman of the technical committee. Paul H. Wendel of Howard W. Sams & Co., and A. C. W. Saunders, Sams' television lecturer, were also at the meeting.

After the dinner the entire group attended a television lecture by Saunders in the main auditorium of the Central High School, Columbus. This was the twenty-seventh Saunders lecture in the Fall series arranged by Howard W. Sams and was sponsored by Hughes-Peters, Inc.; Thompson Radio Supplies; Whitehead Radio Co., and ARSD.

THE ARSD News reports that Bert Charles of WVKO was a recent guest. He outlined the activity of their new FM station, and offered ARSD free time, which was accepted. As a result, 15-minute ARSD programs were scheduled over WVKO.

Gregg, Young and Jones from the State Welfare Dept. appeared at a subsequent meeting and discussed *The Blind in Radio Service Work.*

According to ARSD, the Columbus telephone directory *yellow-page* section lists thirteen out of total of eighteen Service Shops with the ARSD symbol.

The ARSD technical committee plans to use a wire recorder with slides at their TV lectures to simplify presentation.

RTG, Rochester, N. Y.

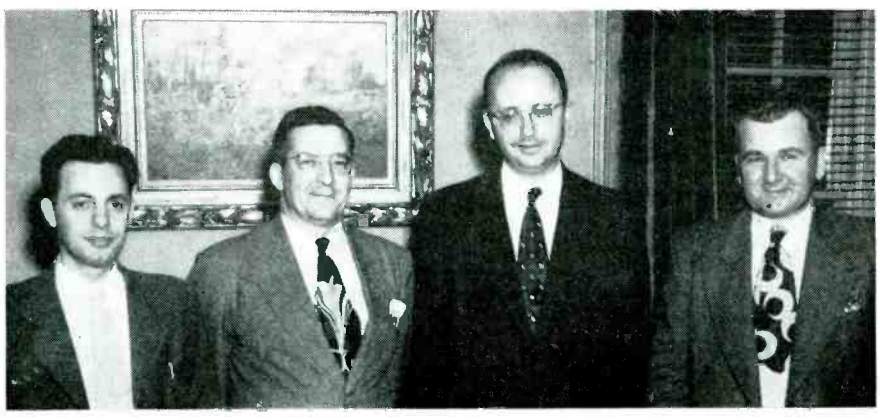
THE RADIO TECHNICIANS GUILD OF ROCHESTER presented their annual annual Christmas party at the Potter House, Fairport, N. Y.

At a December meeting Sam Sheer of Philco Corp., spoke on *Merchandising Service,* under the joint sponsorship of the R. T. G. and Beaucaire, Inc. Philco made the attendance to the meeting more attractive, by offering Philco test equipment, etc., as door prizes.

ART, British Columbia, Canada

THE ASSOCIATED RADIO TECHNICIANS OF B. C. held their annual convention at Stanley Park, and listened to talks by Wilfred Wheatcroft, on operating and servicing movie projectors, Garth Pither, RCA Victor, who explained the *magic monitor,* a device for reducing surface noise on records; Jack Gray of C.G.E. who spoke on the FM system of the Ontario Provincial Police, and how they control their 250 mobile units and 30 stations; and Nick Foster, Superintendent of Seattle Technical school, who explained TV servicing.

At a recent association TV lecture by Al Saunders in the Sterling Hotel, Wilkes-Barre, Pa.: Joseph Czapracki, treasurer, Radio Service Association of Luzerne County, Pa.; Saunders; Milan Krupa, president, and Marino Ruggere, secretary of the Luzerne County association. (*Courtesy Paul Wendell, Howard W. Sams*)



TEN YEARS AGO

From the Association News Page of SERVICE, January, 1939

RUSS LUND, of Clough Brengle, delivered a talk on *Dynamic Testing of Receivers* before the Alton, Ill. Chapter of RSA. . . . Glenn Browning was guest speaker at the Boston, Mass. Chapter and discussed servicing with the 'scope and the vacuum-tube voltmeter. He explained alignment, *avc, afc,* checking of circuits and finding distortion, and alignment of remote circuits. . . . Walter Kensworth of RCA Institutes, Chicago, spoke on TV before the Chicago Chapter. At the annual election Ray Manson was reelected president, and Robert L. Storey was renamed secretary. Harold Cunningham was elected vice president and O. S. Dawson, treasurer. . . . TV was described as a forthcoming major industry at several chapter meetings. The Danville group declared that they . . . "should be constantly on the alert for TV developments in spite of the fact that it was believed that television would not reach their community for some time." And the Houston Chapter indicated its TV interest by setting up several sources. . . . A. G. Mohaupt of the Radio Training Association covered *Alignment Procedure Under Dynamic Testing* before the Detroit Chapter. . . . The 1939 Lansing Chapter elected four to the board of directors for a two-year term: Ed Bloom, L. W. Aubil, J. H. Howe and Max Huntoon. E. J. Budd, C. Kachelski, H. Carlisle and R. Bell were elected to one-year terms. . . . Over 900 Service Men attended a meeting of the Metropolitan New York Chapter to listen to John F. Rider explain and demonstrate the Rider Chanalyst. . . . Charles W. Fox was elected president of the St. Paul chapter. . . . Dick Harris was named president of the Steubenville, Ohio, Chapter. Paul Wright became vice president; Walter Stephanovich, treasurer, and Leonard Roberts, Jr., secretary. . . . George Connors of Sylvania addressed the New Hampshire Chapter on the servicing of ten-dollar midgets at a profit.

FM Tuners

(*Continued from page* 11)

and increased efficiency and circuit stability. A high Q is made possible by the high L/C ratio and the absence of distributed capacitance. Absence of lumped capacities is also responsible for a high order of efficiency and overall circuit stability. Since a variable inductance exhibits much less minimum capacity than a variable capacitor, a much wider range of frequencies may be covered without the use of switching.

Systems employing *continuously-variable inductance* have several advantages. All losses due to resistance and distributed capacity in switch contacts and leads are eliminated, and microphonics and mechanical operation are reduced to a minimum. Since mechanical operation is minimized, longer, more trouble-free operating life can be expected.

In one tuner[2] using the continuous variable method the entire range of FM and TV frequencies is covered in one complete operation. The tuner consists of three separate variable inductance units ganged on a rotatable ceramic and brass shaft. As the unit is tuned, a sliding shorting bar (or trolley) varies the effective inductance and progressively shorts out the unused turns. This permits the inductance and distributed capacity effects to be minimized and allows a much higher operating frequency than would otherwise be possible. A converter developed by Mallory and employing the Inductuner is shown in Fig. 6.

Inductance tuning can be accomplished in several other ways. One is through use of *modified long-lines*,[3] with straight transmission lines 5½" long, spaced ½" apart. Two sets of lines are employed, one for *rf* tuning and the other to tune the oscillator. Tuning is accomplished by moving shorting strips along the lines.

Circular long-line tuning is used in another type[4] where six long-lines (a set of two for each stage) are bent into a semi-circle and tuned by shorting bars. Since the shorting bars travel in a rotary motion, they are attached directly to the tuning shaft.

In another type of inductance tuner,[5] tuning is accomplished by varying the

(*Continued on page* 36)

[2]Du Mont Inductuner, made under Paul Ware Mallory patents; see December, 1948, SERVICE.

FM Tuners

(*Continued from page* 35)

inductance of a two-turn coil by means of a movable plate inserted between turns. A fixed value of capacitor is also used in the tuned circuits.

Permeability-tuned systems are still another form of inductance-tuning. The main disadvantage of permeability tuning arises from the problem of adapting it to mass-production. Since the coils have few turns, and because a large wire size must be used to maintain high Q, difficulty is often experienced in winding coils with sufficient uniform pitch to insure satisfactory tracking and calibration. One manufacturer has developed a permeability-tuned coil which uses a special braided tinsel for the winding. Although this results in greater ease in winding, improved Q and increased tuning range, very close control of the winding pitch must still be maintained. Other difficulties are mounting and wiring arrangements, the necessity for very thin-walled coil forms, winding terminations, etc. These disadvantages, however, have been overcome by several FM receiver manufacturers. Belmont, for example, employs a continuous-tuning, mechanically-ganged permeability tuner in their 21A21 *television* receiver. In one tuner[6] there is a patented head featuring brass plungers to attain a Q of approximately 200.

A permeability-tuned head is used in the Zenith 7E01. In this model the top capacitor gang tunes the AM band, the permeability-tuned FM section appearing at the bottom. Coils employed in the *rf* and detector stages have four paralleled windings to increase the amount of frequency coverage per degree of slug insertion. Since the oscillator covers a smaller frequency range, a single wire-wound coil is satisfactory. A similar system of tuning is also used in a tuner made by Transvision; FMF-2.

Permeability-tuned transmission lines are also used by Motorola. By employing highly-efficient coax-line tuning in a double-superhet circuit, extremely high gain, sensitivity, and selectivity, along with very low stage noise, is accomplished. In fact, the high Q of the converter circuit eliminates the need for an *rf* stage and allows use of a 4.3-mc *if* frequency. This frequency permits greater stability and gain, as well as easier tuning adjustments, than the standard 10.7-mc frequency.

In still another type of variable-inductance tuning system the tuning unit encompasses a *high-frequency variometer* method.[7] Basically, the rotor and stator inductances are wires shaped in variometer style. Angular rotation of the rotor wire varies the inductance in the circuit. Three of these units are ganged on a non-metallic shaft to reduce interstage coupling effects. Advantages of such a system are freedom from microphonics and vibration, lightweight, sturdy construction, and easy to produce.

Many variations of the foregoing tuning systems are to be found in commercial FM tuners and FM/AM receivers. The tuners described are those more commonly known.

Many methods are used to provide gain, stability, etc., in the oscillator and other sections of the receiver. Generally, a ceramic trimmer having a negative coefficient is connected in the oscillator tank circuit to compensate for warm-up drift. Input circuits generally are designed for 300-ohm antenna leads, often with provisions for con-

[3]Edwards Fidelotuner.
[4]Approved Electronics.
[5]G. E. Guillotine tuner.
[6]Brooks, FMT-10.
[7]Bendix *egg beater*; SERVICE, July, 1948.

necting to a 72-ohm coaxial leadin. Double-conversion is used in several models such as the Meissner 9-1091 and the Motorola coaxial tuner, etc. Double-conversion allows greater selectivity, increased antenna gain, increased oscillator stability, greater freedom from regeneration, and very high image ratio.

Credits

The author is indebted to C. R. Miner, Myron F. Melvin, Gus Wallin, V. R. Beck, William J. Harrison, G. H. Browning, G. M. Brooks, and Norman Skier for material assistance in the preparation of this article.

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TV Business

(*Continued from page* 13)

by the installation and service company.

In the case of the small installation and service company devoting its full efforts to one or two dealers, the service company should try to be protected with a cancellation clause which states that . . . "In the event of cancellation, for reasons other than expiration of agreement, the dealer will be charged for all material and labor purchased or supplied prior to work stoppage, plus all reasonable costs arising from cancelling all material orders not yet received."

This clause is extremely important when the installation company must procure specialized material for TV receiver lines which are of the *custom installation* type.

Probably the most important agreement is the customer warranty. Failure by the independent installation and service company to clearly define the work they intend to do, and the parts they will guarantee, in their customer warranty agreement, may result in losses in labor and material that wipe out anticipated profits.

Typical Warranties

A general customer warranty outlines the responsibilities of an installation and service company and the contingencies against which the company must be protected, and usually states that the agreement is between the television installation and service company and the purchaser of the TV receiver. There are usually two sections covering installation and service.

In the installation portion of the contract five points are normally covered:

(*1*) The service group will fur-

(*Continued on page* 38)

TV Business

(*Continued from page 37*)

nish all labor and material necessary to effect a *normal* installation.

(*a*) A normal installation is one which can be made with: (*1*), A single antenna assembly of a type approved by the manufacturer; (*2*), 100 feet of transmission line, and (*3*), utilization of existing power outlet facilities and line cord furnished with the receiver.

(*2*) All installations are guaranteed by the service company for a period of ———— subject to proper handling by the purchaser or other persons in the purchaser's premises.

(*3*) The service company will not guarantee the installation under the following conditions:

(*a*) Acts of God, public enemy, fire, air raid, hostilities or any other cause beyond its reasonable control.

(*b*) Relocation or modification of the installation by personnel other than those assigned by the service company.

(c) Interferences caused by neighboring TV receivers, amateur transmitters, and electromedical apparatus.

(*4*) The service company installations made during the absence of the purchaser will be installed in accordance with the instructions received from the purchaser's family, employees or others on the purchaser's premises.

(*5*) The service company will adjust the TV antenna only for those TV stations transmitting at time of installation. Further adjustments for new stations placed in operation during the life of this agreement will be made for a fixed fee, to be established by the service company for each installation area.

In the *Service* section two points are usually covered:

(*1*) The service policy is void if the TV receiver is serviced or tampered with by persons not assigned by the ———— service company.

(*2*) All normal repairs will be made without additional charge to the purchaser for a period of ———— except for those repairs due to misuse by the purchaser, members of the purchaser's family, Acts of God, etc.

All repairs which are not covered by the contract are usually billed to the customer on a time and material basis.

There is no limit to the number of service calls in a purchaser's warranty, except where the calls are unjustified. Many purchasers expect motion picture quality from their TV Receiver and request service everytime their picture *wiggles* from line voltage surges, airplanes, ignition, etc. These types of complaints are usually referred to the manufacturer, whose local representative serves as an arbiter on such matters.

The successful installation and service company models their personnel after the public utility Service Man, all being taught four important fundamentals: (*1*) To be businesslike during a call, without being rude; (*2*) spend as little time as possible in the customer's home; (*3*) neatness of dress, and cleanliness habits for protecting the customers property, and (*4*) proper technique to instruct the customer in the operation of the receiver.

The television installation and service company must realize that while the salesman sells the TV receiver, it is up to the service company to keep the receiver sold.

WARRANTY

Receiver

"Bendix Aviation Corporation warrants to the purchaser of each new Bendix Radio television receiver that any part thereof (except tubes and lamps) which proves to the company's satisfaction to be defective in material or workmanship within 90 days from the date of original purchase for use will, at the company's option, be repaired or replaced.

"Any defect in said receiver should be brought to the attention of the dealer from whom it was purchased, who will be authorized to furnish or arrange for repairs or replacement within the terms of this warranty."

Picture Tube

"Picture tubes used in new Bendix Radio television receivers are, under this warranty, proportionately adjusted on the basis of one year's initial service. Full adjustment will be allowed for the first 90 days after original purchase at retail and decreasing allowances will be made for the ensuing 9 months at the rate of 10% a month, e.g., the fourth month after such purchase the allowance is 90%, during the fifth month 80%, and so on until the twelfth month realizes only a 10% adjustment. Claims for adjustment under this policy are acceptable only for a period of one year's service by the user, and must be substantiated by sales records."

"The foregoing is in lieu of all other warranties express or implied and Bendix Aviation Corporation neither assumes nor authorizes any person to assume for it, any other obligation or liability in connection with said receiver."

Owner's Policy

The purchaser of a new Bendix Radio television receiver may avail himself of more comprehensive service and broaden the scope of the foregoing warranty through arrangement with the Bendix Radio Dealer at the time of the original purchase of the receiver at retail.

Cautions

Each Bendix television receiver has been carefully shielded to prevent personal injury from inadvertent contact with high voltages employed to all television receivers. It is advisable, however, to refer to trained television technicians for any adjustments required within the cabinet.

Each television receiver operates *only* on 105-125 volt, 60 cycle alternating current. If power supply is questioned, consult local power company for information.

Ample ventilation is provided in cabinet design, and in order to prevent excess parts failures, this ventilation should not be impaired in the placement of the receiver.

If any evidence of improper operation occurs for which no correction is known, turn receiver off and consult qualified television service personnel before again placing instrument into operation.

A typical manufacturer's warranty form and a caution note supplied with every receiver. *(Courtesy Bendix)*

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RCA HF TV ANTENNA

A *hf* TV (type 203A1) antenna has been announced by the RCA Tube Department.

Antenna (folded dipole and folded dipole reflector) is designed for mounting on the same mast as the RCA 225A1 or similar television antennas.

Both the *hf* and *lf* antennas may be oriented independently for best reception. A *harness* is used to couple the two antennas into the signal transmission line running to the receiver. Besides permitting the single transmission line to serve for both antennas, the harness is said to act like an automatic switch so that when the receiver is tuned to stations in the high channels, only the *hf* antenna appears to be connected to the transmission line. When low channel stations are tuned, only the low frequency antenna is in effect, connected to the transmission line.

TV Alignment

(*Continued from page* 16)

between L_{48} and the junction of pin *3* of V_{21}, R_{80}, and C_{113}.

Resistor R_{109} was changed to 5600 ohms.

Resistor R_{111} is now 100 ohms.

Resistor R_{140}, a 5-watt 7500-ohm wirewound unit is now between ground connection at C_{46B} and electrolytic can B– terminal.

Resistor R_{141}, a wirewound 10-watt 7500-ohm unit, has been added between ground connection at C_{40B} and B+ (160 V) connection at C_{90A}.

Resistor R_{135} has been changed to 1500 ohms, 2-watts.

Resistor R_{109} has been changed to 3300 ohms, 1-watt.

Resistor R_{111} has been changed to 68 ohms, 2-watts.

Resistors R_{142} and R_{143} were added and connected in series between terminals *5* and *7* of the horizontal output transformer.

Capacitor C_{112} is now a .05 mfd 600 v.

Resistor R_{104} now has a value of 150,000 ohms, 2-watts.

Resistor R_{144} (1000 ohms ½ w) has replaced the decoupling choke L_{35}.

Two changes were made in the G chassis:

Horizontal centering potentiometer, R_{87}, is now a 200 ohm unit.

Vertical centering potentiometer, R_{86}, now has a value of 100 ohms.

Alignment Procedure

Preliminary Overall Check: Before attempting any alignment adjustments on the receiver it is prudent to verify whether or not such action is necessary by making a preliminary overall check of the receiver response curves, both picture and sound. If this check reveals that the response curve shapes or frequencies have departed appreciably from their normal values then you can proceed with the complete alignment adjustment procedure. To make such a preliminary check, the output of the sweeping oscillator is combined with the output of the twelve channel crystal-controlled *rf* sound carrier marker generator and fed to the receiver antenna input terminals through a coaxial-to-balanced matching pad. This matching pad arrangement is shown diagrammatically in Fig. 4. (It is important that the setup be constructed of good grade one-half watt carbon resistors, using the shortest possible pigtail lead lengths to keep them as non-inductive as practicable). The vertical input terminals of the alignment 'scope are connected by means of a length of shielded cable to *video test* terminal G and chassis ground, after first making sure that the 'scope has a blocking capacitor in series with its *high side* vertical terminal, as is usually the case. The horizontal input terminals of the 'scope are connected to the sawtooth sweep output terminals of the sweeping oscillator, as was described previously.*

The following procedure should then be followed:

(*1*) Disable the *agc* circuit of the receiver by placing a jumper from the *agc* amplifier grid (pin *4* of V_{15b}) to the junction of R_{28P} (contrast control) and R_{122}.

(*2*) Set the contrast control to produce —3.5 volts of *if* bias as measured from terminal *Q* to chassis with a *vtvm*.

(*3*) Push channel *5* button on the receiver, and set up the sweeping oscillator for a sweep excursion of approximately 15 mc and a center frequency of approximately 79 mc, the center of the 76 to 82-mc channel *5* band. Use the *high* output connector of the sweeping oscillator and turn its attenuator knob completely clockwise to obtain a full 26 db of attenuation which it provides.

(*4*) Switch the crystal-controlled *rf* sound carrier marker generator to channel *5* (81.75 mc output frequency) and adjust its

output level to new maximum, turning its *modulation* switch *on*.

With the 'scope vertical gain adjusted to a sensitivity of approximately one inch of deflection per volt of input a pattern resembling that shown in Fig. 5 should appear on the 'scope screen.

[To Be Continued]

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7" TV Model

(*Continued from page* 18)

erator to switch from station to station without having to reset the contrast control each time.

Cathode bias is used to delay the application of *agc* voltage until the video output is sufficient for full contrast.

Two time constants are used: C_{26} and R_{21} is the first with a time constant approximately one picture line long; C_{25} and R_{20} is the other and is considerably longer. Because of the short time constant C_{26} stores only a small amount of energy and at the end of each line the voltage across it has dropped to about the black level at which time C_{26} is again charged. Due to the small amount of energy stored in C_{26} it discharges quickly, even though it may charge to the peak of an interfering noise pulse, thereby minimizing the effect of relatively long noise pulses on receiver performance. The longer time constant, C_{24} and R_{20}, filters out the *ac* component and the 60-cycle component caused by the vertical sync pulses.

Video Amplifier, DC Restorer and Sync Clipper

This system employs two 6AU6s. A sync-negative signal from the video detector is applied to grid of the video amplifier, V_8, so that noise pulses, with an amplitude greater than that of the signal, will have negative polarity. The video amplifier stage is so designed that with a full contrast picture on the picture tube, the top of the sync signal will be at about cutoff and noise signals above this level will drive the stage beyond cutoff and be clipped. The contrast control is placed in the cathode of the video amplifier tube and controls the contrast by controlling the gain of the video stage. The range of the gain adjustment is about 8:1. The gain is not allowed to go to zero since this would attenuate the intercarrier sound signal below a usable level. The bias for the video amplifier remains constant at approximately 1.5 volts and is independent of the setting of the contrast control. A pair of peaking coils, L_{27} and L_{28}, are placed in the plate of the tube to maintain an output relatively flat to 3.5 mc. The output is coupled through a capacitor, C_{34}, and resistor R_{41} to the cathode of the picture tube.

The other 6AU6 tube restores the *dc* component, clips the sync from the composite signal and then clips the sync on the other side. A *dc* voltage is developed across cathode resistor, R_{33}, which is proportional to the average value of the input signal. This voltage is applied to the grid of the picture tube to reinsert the *dc* component. The value of the cathode bias is such that all picture information is beyond the tube cutoff and only sync pulses appear in the plate. These pulses are clipped on both sides since their peak amplitude rises beyond the tube's cutoff. The pulses are then fed through a voltage divider network to obtain the desired voltage for application to the horizontal and vertical sweep oscillators.

Horizontal Sweep Circuits

The horizontal sweep oscillator employs a 12SN7GT in a *Potter-type*

(*Continued on page* 42)

(*Continued from page 41*)

cathode-coupled multivibrator circuit. The input sync signal is of negative polarity with a potential of about ¼ to ½ volt. The method used in the initial adjustment of the controls in this circuit is quite interesting. The horizontal size control, R_{90}, is set for the largest possible size picture consistent with good linearity. The anode voltage on the picture tube is then adjusted by means of capacitor, C_{87}, to obtain the proper size picture. In this manner correct size is obtained along with the brightest possible picture. Thereafter, the horizontal size control is used for slight adjustment of the size of the picture. The sawtooth output of the sweep oscillator is applied to one grid of the 12SN7GT push-pull horizontal sweep output dual tube. Phase reversal is obtained by capacity coupling between the plate of the first triode to the grid of the other. A horizontal linearity adjustment is provided by a capacitor, C_{87}.

Vertical Sweep Circuits

The vertical sweep oscillator circuit is the same as that employed for the horizontal circuit. The output of the sweep oscillator is applied to one grid of the 12SN7GT push-pull vertical sweep output dual tube. Phase reversal is obtained by driving the same grid from a resistive voltage divider circuit from the plate of the first triode to ground.

Intercarrier Sound System

Coupling from the video amplifier to the sound system is accomplished through a 1-mmfd capacitor, C_{32}, whose small value minimizes any possible effect on the gain of the video amplifier below 4.5 mc. A trap inductance, L_{29}, with an adjustable iron-core, is made resonant at 4.5 mc for maximum transfer of the audio signal. The impedance in the grid circuit of the 6AU6 ratio detector driver is kept low by tapping down on inductor, L_{29}, to prevent self-oscillation of the tube. An audio output of 2 volts *rms* for 25-*kc* deviation at the detector necessitates the use of an audio amplifier ahead of the audio output. Degeneration is used in the audio output stage to improve the audio fidelity.

Low Voltage Power Supply

A low-voltage power supply furnishes voltages to the receiver circuits with potentials of +120, 250, 400 and —140 volts. The +120-volt supply is obtained across 50 + 50-mfd capacitors (C_{93A} and C_{93B}) from a selenium rectifier after filtering by choke L_{33}. The rectified output of one-half of the 25Z6GTG adds to the output of selenium rectifier to produce the 250 volts for the *rf* high-voltage oscillator tube. The output o fthe 6X5GTG adds to the 250 volts to produce 400 volts across the 40 + 40 mfd capacitor, C_{75A}. The other half of V_{16} is used as the B-rectifier to furnish 140 volts negative. This negative supply is used as bias for the video amplifier and audio output stage and in addition is added to the 400-volt supply for a total of 540 volts for the deflection circuits. The drain is approximately 160 *ma* at 120 volts, 25 *ma* at 250 volts, 15 *ma* at 400 volts and 15 *ma* at 140 volts negative.

High Voltage Power Supply

The high-voltage power supply is completely enclosed in a shield compartment to prevent emission of *rf* energy into the receiver circuits and as a safety measure. A 12AU7 is used as the *rf* oscillator and it is operated well within its maximum rating. The oscillator voltage is applied to the primary of a transformer, T_3. The high-voltage is developed across the secondary of the transformer rectified by the 1B3GT/8016 and is then filtered before being applied to the bleeder resistor network.

Heater Supply

The picture tube and the 6X5GTG rectifier are rated at 6.3 volts and .6 ampere. The balance of the tubes are arranged in two .3 ampere strings connected in parallel. The total voltage of one of the strings is 6.3 less than the other and a resistor, R_{50}, is added to make up the difference. Since the 6C4 heaters require .15 ampere, they are shunted by a pair of resistors, R_{55}, R_{57}, and thus draw .3 ampere at 6.3 volts. All the tubes in this series-parallel combination draw approximately 103 volts. A resistor, R_{54}, is placed in series with the entire combination.

●

RIDER PUBLIC ADDRESS EQUIPMENT MANUAL

A 2024-page *Rider Public Address Equipment Manual* has been published by John F. Rider Publisher, Inc., 480 Canal Street, New York 13, N. Y. Manual contains servicing data of 147 *pa* equipment manufacturers. It embraces a ten year span—1938 to date. An added extra is the *How It Works* book, which describes the special circuitry found in various p-a systems. Priced at $18.00.

G. E. APPOINTMENTS

Edward A. Malling has been appointed sales manager of quartz and germanium crystals for the specialty division of G. E.

George F. Devine has been appointed assistant to the manager of sales of the specialty division of G. E. Prior to his new appointment he was commercial engineer for the specialty division, previously having worked on radio receiver design for the electronics department's receiver division.

* * *

NATIONAL UNION RADIO LICENSES RCA

National Union Radio Corporation, Orange, N. J., has entered into a six-year license agreement with RCA granting the latter company and its subsidiaries the use of National Union's patents and research development work.

NEWS

AKEROYD AND BACKER NOW CHICAGO TRANSFORMER REPS

Arthur E. Akeroyd, with offices in Boston, Mass., and James J. Backer of Seattle, Wash., have been named reps for the replacement line of transformers of the Chicago Transformer Division, Essex Wire Corporation.

Art Akeroyd

Jim Backer

* * *

BURROWS JOINS MEISSNER AS SALES-AD MANAGER

Robert E. Burrows has been appointed sales and advertising manager of the Meissner Division of Maguire Industries, Inc., Mt. Carmel, Ill.

Burrows was formerly with Westinghouse Electric International Company, New York City, where he was manager of the home radio department.

* * *

TRANSVISION TELEVISION COMPONENTS FOLDER

A 4-page folder, No. P-1, describing and illustrating 19 television parts has been published by Transvision, Inc., 460 North Ave., New Rochelle, N. Y.

Components described include filter chokes, low-voltage transformers, high-voltage transformers, video *if* transformers, audio *if* transformers, power transformers, vertical output transformers, vertical blocking oscillator transformers, horizontal blocking oscillator transformers, horizontal output transformers (fly-back), focus coil, deflection yoke, ratio detector transformers and horizontal linearity coils.

* * *

SUPREME TEST EQUIPMENT CATALOG

A 24-page catalog, No. 848, illustrating and describing tube and set testers, tube and battery testers, dynamic tube testers, multi-meters, portable set testers, electronic set testers, push-button set testers, fixed-frequency signal generators, *af* and *rf* oscillators, audio generators, audolyzers, 3" and 5" scopes and panel meters, has been announced by Supreme, Inc., Greenwood, Miss.

HYTRON OCTOBER CONTEST WINNER

First prize in the October Hytron Service Men's contest was won by Charles A. Hurray, Jr., 529 Taylor Avenue, Avalon, Pittsburgh 2, Pennsylvania. Hurray received a Weston model 769 high frequency electronic analyzer.

Left to right: Jack Ludgate, Hytron rep.; center, Al Bauer, manager of the John Marshall Company where presentation was made; and Charles A. Hurray, Jr.

* * *

ELECTRO-VOICE TORQUE DRIVE REPLACEMENT SELECTOR GUIDE

A *torque* drive crystal pickup cartridge replacement selector guide, No. 146, has been published by Electro-Voice, Inc., Buchanan, Michigan.

Chart lists 3 basic types of *torque drive* cartridges that are said to replace over 150 standard model crystal pickup cartridges in common use.

* * *

WELLER SOLDERING TIPS HANDBOOK

A 20-page handbook, *Soldering Tips,* offering a step-by-step discussion of soldering, do's and don't's etc., has been published by Weller Manufacturing Co., Packer Street, Easton, Pa.

Can be obtained at 10c per copy from any Weller distributor, or by sending 10c in coin direct to Weller.

* * *

RIDER MANUAL VOLUME XVIII

Volume XVIII of the Rider manuals will be available at all Rider jobbers in late January, 1949. The latest addition will contain more than 2,000 pages. AM, FM and auto receivers, as well as a special record changers section will be included. *How It Works* books explaining modern theory will be included with a cumulative index covering volumes XVI, XVII and XVIII. Price, $19.80.

* * *

MEISSNER CATALOG

A 12-page catalog, 48B, covering TV kits, TV *rf* tuners, *if* strips, audio *if* strips, AM/FM tuners, analysts, portable radio-phono-recorders, superhet kits, chokes, replacement *if* windings, *rf* coils, oscillator coils, *plastic if* transformers, iron-core *ifs* and AM/FM radio-phono combinations, has been prepared by the Meissner Manufacturing Div. of Maguire Industries, Inc., Mt. Carmel, Ill.

* * *

TAC PROJECTION MANUAL

A 93-page manual, covering assembly details on a projection assembly TV receiver, has been published by Television Assembly Co. Manual prepared by John F. Rider Labs in collaboration with Gerard R. Francoeur, TAC's chief engineer, covers TAC Model P-520. Available at $2.50 per copy.

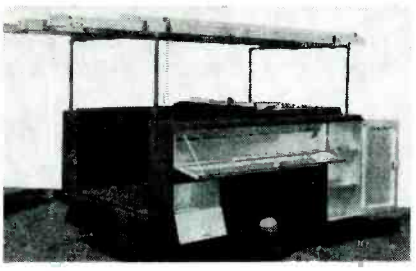
New TV Parts . . . Accessories

ARTISAN TV WORKSHOP TRAILER

A workshop trailer designed for transporting ladders, tools, materials and equipment for use by television installers has been announced by Artisan Products, Inc., 3540 W. 140 St., Cleveland 11, Ohio.

Has side compartments on each side equipped with shelves and a material tray, together with key locking handles. Trailer body is available for installing on a ½-ton and ¾-ton truck chassis.

Bulletin B contains further data.



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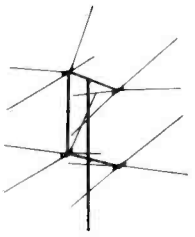
TELREX CONICAL ANTENNAS

A stacked conical *V* beam, 4X-TV for channels *2* to *13*, has been announced by Telrex, Inc., 26 Neptune Highway, Asbury Park, N. J.

Has low inception angle, 4:1 front-to-back ratio on all frequencies, 150-ohm non-varying center impedance. Can be used with 72, 150 or 300-ohm transmission lines.



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TACO STACKED HF TV ANTENNA ADAPTER

A *hf* TV antenna adapter, type 444, has been announced by Technical Appliance Corporation, Sherburne, N. Y.

By means of a coupling clamp included in the kit, the antenna can be mounted directly above the *lf* antenna. A connecting stub, cut to the correct electrical length and allowing enough mechanical length to orient the *hf* antenna independently from the low-frequency antenna, is also furnished.

* * *

JFD TV ANTENNA KITS

Four low-band and high-band TV antenna kits, the Sky-King series, have been announced by the JFD Manufacturing Co., Inc., 4117 Ft. Hamilton Parkway, Brooklyn 19, N. Y.

The *Sky-King* series is made up of 4 separate antenna kits: No. LD1 (low-band), consisting of one *lf* straight dipole, crossarm, *lf* reflector and ½ wavelength of 300-ohm twin-lead; No. HD1 (high-band), consisting of one *hf* straight dipole, crossarm, *hf* straight reflector and ½ wavelength of 300-ohm twin-lead. Two other kits are folded dipole *lf* and *hf* versions.

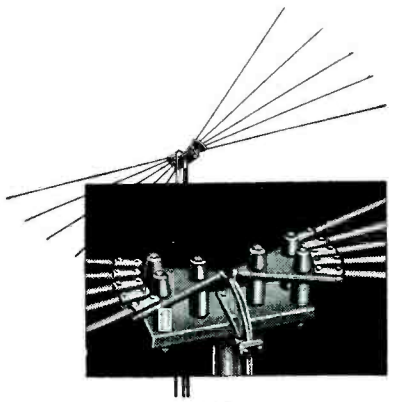
ANDREW TV/FM DI-FAN ANTENNA

A broadband antenna, type 710 Di-Fan, that is broadly tuned to all television and FM channels, has been announced by the Andrew Corp., 421 Seventh Ave., New York 1, N. Y.

The horizontal directivity pattern of the Di-Fan in TV channels *2* through *6* and in the FM band is a figure eight, broadside to the major axis of the antenna. In the high-frequency TV channels *7* through *13*, the forward gain is decreased somewhat while the angle of acceptance is enlarged.

Maintains 300 ohm standard impedance over the TV bands. Elements constructed of aluminum alloy. Supporting parts of plated steel.

For further information write to J. F. White.



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PHOENIX ELECTRONICS STANDOFF INSULATOR

An antenna standoff insulator which clamps on masts up to 1½" in diameter, has been announced by Phoenix Electronics, Lawrence, Mass.

Leadin cable is held in place by a plastic insert.

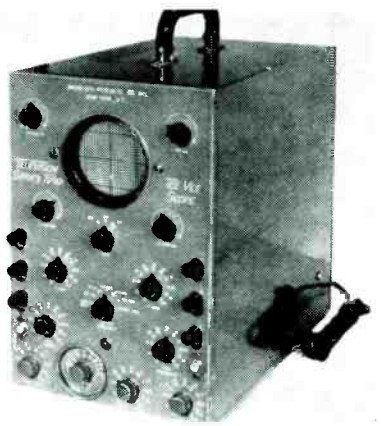
* * *

RCP TV 'SCOPE AND SWEEP GENERATOR

A combination 'scope and sweep generator, Tee Vee 90, has been announced by Radio City Products Co., Inc., 152 West 25 Street, New York City.

'Scope can be used independently with its own sinusoidal sweep generator. Sync is provided for internal positive or line frequency.

Independent sweep generator has continuously variable bandwidth from 50 kc to 6 mc with range of 4.5 to 30 mc.



* * *

Servicing Helps

(*Continued from page 26*)

1000 cycles to 50 cycles by changing the value of the 2700-ohm resistor, R_{104}, to 12,000 ohms and the value of the .01-mfd capacitor, C_{103}, to .03 mfd. This type of equalization provides a rise of 2 to 2.5 db at 300 cycles and a drop of 1 to 2 db at 50 cycles. Alternately, two compensation stages can be incorporated.

This effectively provides the full 6 db/octave and will produce an output curve which is flat within ±1 db from 1,000 to 50 cycles.

[To Be Continued]

Instruments . . . Accessories

SYLVANIA DC VOLTAGE MULTIPLIER FOR POLYMETER

A *dc* voltage multiplier for the Sylvania polymeter, which extends *dc* voltage measurements to 10,000 volts, has been announced by the Radio Tube Division of Sylvania Electric Products, Inc., 500 Fifth Avenue, New York 18, N. Y.

When used in place of the standard Polymeter low-voltage probe, it multiplies each of the present *dc* voltage ranges by a factor of 10.

* * *

JENSEN CONSOLES

A radio-phono cabinet, the customode Imperial Console, has been announced by the Jensen Manufacturing Company, 6601 S. Laramie, Chicago, Illinois. Incorporates a correctly proportioned bass reflex enclosure for 15" speakers.

Console is 36" high, 37¼" wide and 18" deep. Record changer compartment is of the integral drawer type and accommodates drop, micro-groove, or intermix-type changers. Two drop-front door compartments are provided for tuners, amplifiers or similar equipment.

Satin-finish brass door pulls. Available in muted blonde or Cordovan mahogany.

* * *

AMCON TV CAPACITORS

TV capacitors, *Amoil* type, rated at 6,000 volts *dc*, in capacities from .0005 to .05 mfd. have been announced by The American Condenser Company, 4410 N. Ravenswood Avenue, Chicago 40, Illinois. Uses Amcon's newly developed petroleum product, which is said to approach electrical properties of capacitors impregnated with mineral oil.

* * *

TUNG-SOL TUBE LABEL

A decalcomania type tube label designed to withstand the extreme operating temperatures of some of the hot miniature tubes, has been announced by Tung-Sol.

It is said that the label will not scorch, smoke, have offensive odor, or discolor.

•

Noll TV Article

THE EDWARD NOLL article on TV sync will appear in February SERVICE.

JOTS AND FLASHES

"TV IN 1949 will pass many other industries on its way up to one of the top ten industries of this country," predicted Ross D. Siragusa, president of Admiral Corp., in his annual message to the industry. He said that production for the industry will be more than doubled in '49 with an estimated 2,000,000 receivers being produced against 800,000 in '48. . . . TV tube production may soon be stepped up substantially as a result of new manufacturing techniques developed by the Pittsburgh Plate Glass Company. Older methods of molding glass blanks to obtain spherical perfection have been replaced by a method whereby the meticulous grinding and polishing operations are reduced to a standardized process which is completed while the glass is still flat. A newly developed bending process permits perfect sphericity. The new type face plates may be applied to glass and the alloy cones of the metal-type picture tubes soon to appear in TV models. . . . Operadio won first choice for a booth at the '49 Radio Parts Show, to be held in May in Chicago, at the recent booth drawing in New York City, and selected booth 87. James Millen was second and selected booth 140; V-M Corp., was third, selecting booth 42; Kwikheat Co. was fourth and selected booth 80, and Wincharger, was fifth, selecting booth 176. . . . Airdesign, Inc., Upper Darby, Pa., and Electronic Controls, Inc., East Orange, N. J., have been acquired by Tele-Video Corp., 241 Fairfield Avenue, Upper Darby, Pa. Paul Weathers is president of Tele-Video. . . . Zenith Radio has purchased the Rauland Corp. . . . Shuler Supply Co., 415 Dryades Street, New Orleans, La., has been appointed Sylvania distributor. . . . Bernie Brown, treasurer of D. R. Bittan Co., 53 Park Place, N. Y. 7, N. Y., was married recently. . . . The National Radio Parts Co., 611 New York Ave., Brooklyn, N. Y., are now Sylvania distributors. . . . Leroy W. Beier, 600 South Michigan Avenue, Chicago 5, Ill., is now a rep for Cannon Electric. . . . Les A. Morrow has been named a rep for Newcomb Audio Products, Hollywood, and will represent them in Ohio, Kentucky, West Virginia and western Pa. . . . Rocke, Inc., 13 E. 40th St., New York 16, N. Y., will represent the Clippard Instrument Lab. in metropolitan New York, northern New Jersey and Conn. . . . Louis G. Pacent Jr., has been appointed vice president in charge of manufacturing at Radio Speakers, Inc., 221 E. Cullerton St., Chicago, Ill. . . . Burrows Sales Co. is now located at 1152 South Olive St., Los Angeles 15, Calif. . . . Edward P. Atcherley has been named northwest division manager of renewal tube sales for Sylvania. . . . Paul Hetenyi, formerly president of Solar, has become a consulting engineer for Aerovox. . . . Robert Brotherson, 325 N. Hibbard St., Jackson, Mich., has become a sales rep for Aerovox in the Michigan area. . . . C. Philip Galloway is now sales manager of the L. S. Brach Manufacturing Co., Newark, N. J. . . . Charles Golenpaul of Aerovox and R. C. Sprague of Sprague Electric are on the program and speakers committee for the RMA silver anniversary celebration which will be held during the week of May 16 in Chicago, coincident with the annual parts show.

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The Little Fellow Gets BIG Results!

The Mallory Midgetrol

The first 15/16" diameter Replacement Control Line

"Phenomenal!"—that's the only word to describe the lightning-like acceptance of Mallory's revolutionary new standard in volume controls. But its success was a foregone conclusion when you realize what the Mallory Midgetrol offers:

WIDER APPLICATION—The small size lets you service portables, auto radios and small AC-DC receivers requiring 15/16" controls.

SIMPLER INSTALLATION—The new and unique flat shaft design of the Mallory Midgetrol saves installation time with *all* types of knobs.

LESS INVENTORY—Electrical characteristics allow you to use the Mallory Midgetrol to replace 1 1/8" as well as 15/16" controls. Since no special shafts are required, you carry fewer controls in stock.

Quietest and Smoothest by Actual Tests

And Mallory Midgetrol stays quiet, too. Creative research that has made Mallory the standard in carbon controls has seen to that. In addition, the Mallory Midgetrol offers nine big features all NEW:

NEW SIZE — NEW SHAFT — NEW SWITCH — NEW CONTACT
NEW DESIGN — NEW EXTENSION — NEW ELEMENT — NEW TERMINAL
NEW TWO-POINT SUSPENSION

See your Mallory Distributor for this new standard in carbon controls

P. R. MALLORY & CO. Inc.

MALLORY

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

*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

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

Engineering leadership is behind every Cunningham tube

RCA Laboratories, Princeton, N. J.
RADIO CORPORATION of AMERICA

CUNNINGHAM TUBES are far more than the end product of a factory. Behind every Cunningham tube are the vast engineering resources of the famed RCA Laboratories. It is here that continuing research in the fields of chemistry, metallurgy, and electron behavior helps to make *good* tubes *better.*

Engineering leadership is one of the reasons why you can be confident that every Cunningham tube you install in a receiver meets the highest standards of quality and dependability.

Cunningham tubes have enjoyed customer acceptance for over 32 years. Whether it's metal, miniature, or glass, there's a Cunningham type to meet practically every service requirement. Your Cunningham Distributor keeps complete stocks on hand to meet your immediate needs.

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