5 NY TV STATIONS & 3 FMs, STACKED ON NEW EMPIRE-STATE MAST

* Improved Video Recordings
* G Curves for Pentode Design
* Wide-Range Decade Generator

November • 1950
Here are a few of the unlimited design possibilities.

Inductances used in television and F.M. tuners have a whale of an effect on the ultimate performance of the set. If they are unstable when subjected to vibration or temperature changes, you’re in for trouble. You can forget about these problems by using Corning Metallized Glass Inductances.

With Corning Inductances, the integral contact of fired-on metallizing with specially selected glass forms, provides unusually high temperature stability. Drift is negligible, even under extreme temperature changes. And the unique, rugged construction of Corning Inductances makes them unaffected by rough handling or vibration. This all adds up to inductances that are completely trouble-free.

There is no limit to the design possibilities of Corning Inductances. Your most exacting specifications can be met in fixed tuned, permeability tuned or permeability inductance-trimmer combinations. Variable, double pitch or uniform windings are easily supplied. Assembly is quickly and simply accomplished by ordinary soldering or grommeting methods.

Put your inductance headaches in the hands of Corning engineers. Find how easy it is to get improved tuner performance at low cost. Further information on request. Write today.
TELE-Tech
Formerly Electronic Industries

NOVEMBER, 1950

COVER: AN ENGINEER'S DRAWING of the television antennas which will be operating on New York City's Empire State Building late this year or early 1951. Sketch on the left shows artist's conception of the completed tower. Photo on the right was taken during initial stages of construction. NBC and ABC temporary TV antennas can be seen projecting above the scaffolding. See page 45 for detailed account.

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Publishers also of Radio & Television Retailing
"AUTO-DIAL" TV ANTENNA ROTATOR
With Automatic TRAVEL ACTION

AMPHENOL takes pride in announcing the new "Auto-Dial" TV Antenna Rotator. It features an entirely new and different principle of rotator control called "automatic travel action," and represents the greatest single advance in antenna rotators.

There are no tiresome buttons or switches to hold while the antenna is turning. An effortless turn of the knob to the correct setting and "Auto-Dial" takes over. Automatically—just like magic—the antenna follows to point directly at the TV station—then stops! So accurately does it perform that even a child can "log" antenna positions, accurately returning to them time after time. Rotation is in steps of 6 degrees, accurately calibrated on the indicator. Because of this important feature, servicemen can now determine whether an antenna is functioning properly, whether it has the required front-to-back ratio and whether it is properly located for the best possible picture.

FEATURES

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- Antenna Rotates Rapidly—one revolution every 22 seconds!
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- Housing of cold-rolled steel, copper flashed and with attractive baked-on enamel finish!
- Neoprene Sealed at Factory Against Dust and Moisture!
- Accommodates Mast Sizes from ¾" to 2" Diameter!

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The newest and most outstanding member of Automatic Electric's relay family is the Class "B"—even better than the widely used, widely copied Class "A" Relay. Designed for ordinary relay service—opening, closing or switching circuits—and for extremely high-speed operation, independently operating twin contacts assure perfect contact operation. Contact points are dome-shaped to maintain uniformly low contact resistance. May be arranged in one or two pileups with maximum of 16 contacts on 13 springs in each pile.

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Automatic Electric Stepping Switches are designed and built to assure exceptionally long life. A complete range of Automatic Electric Switches is available for all remote control applications.

**The New Type 45 Switch**

Here, for example, is a rotary switch that's new and better! Faster... 70 steps a second. Greater capacity ... up to 10 (or more) 25-point bank levels, with single-ended wipers available for 50-point operation. Simpler ... only one field adjustment.

Compact rotary and re-set type switches are also available with 10-point bank levels and speeds of 35 steps a second for automatic or remote-control operations. And there's the famous "Two-Motion Switch" that selects one circuit from among two hundred in just 2 seconds or less. It's a re-set type switch adaptable to either automatic or remote control.

For help in the field of remote control, call in an Automatic Electric field engineer. Meanwhile, send for helpful literature. Address AUTOMATIC ELECTRIC SALES CORPORATION, Chicago 7, Ill. In Canada: Automatic Electric (Canada) Ltd., Toronto.
You have to try it before you can appreciate the taste—until then—you can't prove it's good.

"The proof of the pudding is in the eating," is a time-worn adage—and, if it's been around so long, there's a chance that there is a lot of common sense packed in those few words.

We don't mean to suggest that Soundcraft discs taste good. What we would like to get over is that, until you try Soundcraft products, we can talk our heads off about how good they are.

Use Soundcraft products in your operations—you'll prove for yourself that all Soundcraft recording media will guarantee you the one thing they are designed for—the best possible performance in recording sound.

**TELE-TIPS**

**PROJECTION SAMPLER**—A new motion-picture projector for outdoor theatres provides for showing on two screens at right angles, simultaneously, by means of a "stripe mirror" interposed in the projection beam. This mirror has vertical half-inch clear-glass stripes between half-inch mirror stripes. Thus half the total picture light-flux goes on through to the screen in front, while the other half is reflected onto a second reversing mirror which re-directs the reflected beam onto screen No. 2 in another section of the theatre lot. While each screen thus gets only one-half the usual illumination, the pictures appear "solid" since the slitted reflector is not at the beam focus and the otherwise dark strips are filled in.

**PULLMAN RESERVATIONS**—Like all other fields wherein electronic methods are involved, the communication art is taking on added (Continued on page 14)
Better TV picture resolution
...better picture gamma

...with this
SYLVANIA Type 1N60
Germanium Diode

This diode is a point contact rectifier, designed for efficient and dependable service as a video detector diode for TV receivers.

In terms of set performance, the efficiency of this Sylvania Germanium Diode means better picture resolution, especially at low signal levels. The improved linearity means better picture gamma, or range of picture contrast, in the near white regions where human vision is most critical.

Rugged Construction

The Sylvania 1N60 has construction features which assure long, trouble-free life and electrical stability. Flexible tinned leads are swaged to nickel end caps which are welded to threaded brass plugs. These plugs are screwed and firmly cemented into a strong ceramic body, thus providing a thermal reservoir, insulating the pig-tails from the active element and permitting close soldering. For further information mail the coupon today.

Important ADVANTAGES for set designers

1. Low series capacitance (plate-cathode)
2. Low shunt capacitance (stray to ground)
3. Complete freedom from hum
4. Absence of contact potential
5. Compact size and ease of mounting
6. Ruggedness and permanence of ceramic
7. Built-in thermal insulation ... (no soldering danger)
EIMAC 4.400A POWER TETRODE

TYPICAL OPERATION

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB: (Sinusoidal wave, two tubes, unless otherwise specified)

DC PLATE VOLTAGE 3000 4000 Volts
DC SCREEN VOLTAGE ... 750 600 Volts
DC GRID VOLTAGE ... -136 -116 Volts
ZERO SIGNAL DC PLATE CURRENT ... 0 0 Ma
MAX. SIGNAL DC PLATE CURRENT ... 620 510 Amp
ZERO SIGNAL DC SCREEN CURRENT ... 0 0 Ma
MAX. SIGNAL DC SCREEN CURRENT ... 28 10 Ma
EFFECTIVE LOAD PLATE TO PLATE ... 9200 16,000 Ohms
PEAK AF GRID INPUT VOLTAGE (per tube) ... 136 116 Volts
DRIVING POWER ... 0 0 Watts
MAX. SIGNAL PLATE POWER OUTPUT ... 1100 1200 Watts

*Adjust to give stated zero-signal plate current.

A pair of Eimac 4.400A tetrodes provides the ideal answer for a one-kilowatt AM or FM broadcast power amplifier stage. The 400-watt plate dissipation rating of these tubes allows extremely conservative operation at the 1-kw level, thus assuring long, trouble-free tube operation.

In AM service, the 4.400A is FCC rated for 500 watts output per tube in high level modulated amplifiers. In FM applications, the superlative performance of the 4.400A at VHF allows an easy 1-kw of useful power output from a pair of tubes.

The low driving-power requirement of these tetrodes allows the driving equipment to be reduced to simple low power stages employing low cost tubes. The rugged construction of the 4.400A, plus a Pyrovac plate and the use of other time-proven materials and manufacturing processes, contributes to the tube's long life and ability to withstand both physical and electrical abuse.

To simplify transmitter design, an Eimac air system socket and chimney assembly is available for the 4.400A. This assembly provides a balanced flow of cooling air to the tube with minimum air waste, as well as completing the shielding between input and output circuits.

The low driving-power required by the 4.400A makes it an ideal choice for audio as well as r-f application. High audio power at low distortion can easily be obtained with zero driving power. (See accompanying data.)

For tube economy in one-kilowatt equipment, consider the service-proven 4.400A developed by America's foremost tetrode manufacturer . . . Eimac. Complete technical data are available . . . write today.
When television won its wings

How multiple uses for airborne cameras and equipment were revealed by experiment

No. 10 in a series outlining high points in television history

Photos from the historical collection of RCA

- Put a television camera in the nose of an observation plane, and generals—many miles away—can watch and direct the course of a battle. Such, in World War II, was one of the suggested uses of airborne television as an “optic nerve.”

Feasible? Absolutely—yet this is only one of the many ways in which television can serve in fields outside those of news and entertainment. The entire subject of the use of television cameras and receivers in the air has been carefully investigated by RCA.

Not too long ago, at the time when plans for our inter-city television networks were in discussion, the idea of making telecasts from planes high in the air was proposed.

From New York, a plane equipped with a television receiver, set off on a flight to Washington—200 miles away. When above Washington, at an altitude of 18,000 feet, passengers in the plane clearly saw Brig. General David Sarnoff, of RCA, talking to them from Radio City! Later, RCA placed a camera and transmitting equipment in an airliner, and a bird’s-eye view of New York was successfully telecast to observers below!

It has also been proposed by authorities, that a television camera might be used as the “eye” of a guided missile. Placed in a rocket’s nose it would let a distant operator see where the missile was headed. If need be he could steer it in any direction to hit a moving target.

But less on the destructive side, and more important to us now, are the possible uses of television in “blind flying” conditions, when airports would normally be closed in from bad weather. With a television receiver in the cockpit, and a transmitter sending information from the landing field ahead, the pilot could clearly see conditions on runways and approaches—come in with far greater security than when guided by radio alone!
Now color tv for industry!

THE DU MONT TA-164A CLOSED CIRCUIT INDUSTRIAL COLOR TV SYSTEM

Now available! The Du Mont tried-and-proved industrial color television system in a complete, packaged, ready-to-operate form. Designed specifically for industrial applications, the new Du Mont TA-164A Industrial Color TV system provides bandwidth of 18 mc. and picture resolution of 525 lines. Full high-fidelity color from light pastels to deep colors.

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► DETAILS ON REQUEST

ALLEN B. DU MONT LABORATORIES, INC.
Television Transmitter Division, Clifton, N.J.
NEW RMC SPECIAL PURPOSE CONDENSERS FOR YOUR SPECIAL PURPOSE PROBLEMS!

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Rated at 2000 Volts

Negative 750TC – available in capacities between 25-75 MMF, in tolerances of ±5%, ±10%, ±20%. Tested at 4000 V.D.C. Developed especially for deflection yoke applications.

RMC Type 3K DISCAP
Rated at 3000 Volts

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RMC Type 6K DISCAP
Rated at 6000 Volts

Negative 750TC – available in capacities between 10-40 MMF, in tolerances of ±5%, ±10%, ±20%. Tested at 12000 V.D.C. Designed for use as a damper tube by-pass.

RMC Type B-GMV and Type C Temperature Compensating DISCAPS

RMC DISCAPS are approved by leading makers of TV sets, tuners and high frequency electronic equipment. Type B-GMV DISCAPS are available in the following capacities: .001, .0015, .002, .005, 2x.001, 2x.0015, 2x.002, 2x.004, 2x.005 MFD. Type C temperature compensating DISCAPS are available in a range between NPO and N2200TC and in capacities from 5 to 150 MMF.

Every DISCAP is 100% Tested for Capacity, Leakage Resistance and Breakdown

SEND FOR SAMPLES AND TECHNICAL DATA

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 1708 Belmont Ave., Chicago 13, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Condensers

November, 1950
A complete line for resistors too!

Unusual combinations of characteristics required in today's critical electronic circuits demand a complete range of resistor types. Specializing in resistors, IRC makes the widest line in the industry. This means ease of procurement—a single dependable source of supply for all your resistance needs. It also means unbiased recommendations—no substitution of units "just as good". IRC's complete line of products; complete research and testing facilities; complete network of licensees for emergency production—all add up to complete satisfaction for you.

PRECISION RESISTORS

IRC Precision Wire Wounds offer a fine balance of accuracy and dependability for close-tolerance applications. Extensively used by leading instrument makers, they excel in every significant characteristic. Catalog Bulletin D-1.

IRC Deposited Carbon PRECISTORS combine accuracy and economy for close-tolerance applications, where carbon compositions are unsuitable and wire-wound precisions too expensive. Catalog Bulletin B-4.

IRC Matched Pairs provide a dependable low-cost solution to close-tolerance requirements. Both Type BT and BW Resistors are available in matched pairs. Catalog Bulletin B-3.

IRC Sealed Precision Voltmeter Multipliers are suitable and dependable for use under the most severe humidity conditions. Each consists of several IRC Precisions mounted and interconnected, encased in a glazed ceramic tube. Catalog Bulletin D-2.

CONTROLS

IRC Type W Wire Wound Controls are designed for long, dependable service and balanced performance in every characteristic. These 2-watt variable wire wound units provide maximum adaptability to most rheostat and potentiometer applications within their power rating. Catalog Bulletin A-2.

**Insulated Composition and Wire Wound Resistors**

IRC Advanced Type BT Resistor meet and beat JAN-R-11 Specifications at 1/4, 1/2, and 1 watt combinations extremely low operational temperature with excellent power dissipation. Catalog Bulletin B-1.

IRC Type BW Wire Wound Resistors are exceptionally stable, insensitive units for low range applications. Have excellent performance records in TV circuits, analyzers, etc. Catalog Bulletin B-2.

IRC Type BTAV High Voltage Resistors, developed for use with discharge resistors in fluorescent "Quick Start" ballasts, withstand momentary peak surges of 6000 volts. Also suited to TV blanks circuits. Catalog Bulletin B-1.

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**High Frequency and High Power Resistors**

IRC Type MP High Frequency Resistors afford stability with low inherent inductance and capacity in circuits involving steep wave fronts, high frequency measuring circuits and radar pulse equipment. Available in sizes from 1/16 to 90 watts. Catalog Bulletin F-1.

Type MV High Voltage Resistors utilize IRC's famous filament resistance coating in helical turns on a ceramic tube to provide a conducting path of long, effective length. Result: Exceptional stability even in very high resistance values. Catalog Bulletin G-1.

IRC Type MVX High Ohmic, High Voltage Resistors meet requirements for a small high range unit with axial leads. Engineered for high voltage applications, MVX has exceptional stability. Catalog Bulletin G-2.

IRC Type MPM High Frequency Resistors are miniature units suitable for high frequency receiver and similar applications. Stable resistors with low inherent inductance and capacity. Body only 3/4" long. Catalog Bulletin F-1.

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**Power Resistors**

IRC Fixed and Adjustable Power Wire Wound Resistors give balanced performance in every characteristic — available in a full range of sizes, types and terminals for exacting, heavy-duty applications. Catalog Bulletin C-2.

IRC Type FRW Flat Wire Wound Resistors fulfill requirements of high wattage dissipation in limited space — may be mounted vertically or horizontally, singly or in stacks. Catalog Bulletin C-1.

IRC Type MW Wire Wound Resistors offer low initial cost, lower mounting cost, flexibility in providing taps, and saving in space. Completely insulated against moisture. Catalog Bulletin B-2.

IRC Type LP Water-Cooled Resistors for TV, FM and Dielectric Heating Applications. Cooled internally by high velocity stream of water; adjustable to local water pressure and power dissipation up to 5 K.W.A.C. Catalog Bulletin F-2.

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**International Resistance Company**

407 N. Broad St., Philadelphia 8, Pa.

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- [ ] Bulletin G-1 (MV)
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Technical Data Bulletins checked above.
THE TOWER OF STRENGTH

Superior construction features give LOW COST Vee-D-X sectional towers the highest safety factor of any tower in its price class.

If you have an elevated installation problem, absolute permanency of your installation is assured when you use a VEE-D-X sectional tower. Strength is a major factor. Don't take chances with structural failure. Be sure with VEE-D-X!

- Rugged, all-welded construction diagonally laced with angle iron for maximum rigidity.
- Can be erected on ground or on flat or peaked roof.
- Patented plate spaced at two foot intervals prevents twisting and affords rigidity found in no other tower.
- Safe and easy to climb.
- Completely galvanized, light weight tubular steel . . . 20 ft. section 72 lbs.

PRE-ASSEMBLED for fast, inexpensive installation

VEE-D-X towers are designed for use at any height from 10 to 140 feet. They are self-supporting up to 20 feet and, where space is limited, semi-guyed* type installations may be used at 30, 40, and 50 foot heights. Sketch at right shows the basic parts and necessary accessories for a complete installation. Three types of top mount are available. VEE-D-X towers may be ordered in separate units or as a complete package for a specific height. (Either guyed or semi-guyed.) Write the LaPointe-Plascomold Corporation of Unionville, Conn. for complete information.

*Semi-guyed towers employ one set of guy cables attached at a height of 10 ft. up the tower and anchored at a 6 ft. radius from the base.
AN IMPORTANT MESSAGE FROM Federal FOR USERS OF RG TYPE CABLES

Federal Telephone and Radio Corporation has received approval to manufacture—and can supply—RG type cables with the NEW LOW-TEMPERATURE NON-CONTAMINATING THERMOPLASTIC JACKET (An original development by Federal)

This modification is in accordance with "Exceptions to Specification JAN-C-17A," dated March 21, 1949, and amendments thereto.

THESE ARE THE TYPES APPROVED TO DATE—


Review your requirements now—to insure prompt delivery!

For further details on present and subsequent approvals, write or wire Dept. D-466 or telephone NUtley (N.J.) 2-3600

ANOTHER "Federal FIRST"

Federal Telephone and Radio Corporation
Careful attention to specifications is an outstanding characteristic of JOHNSON Antenna Phasing Equipment. It is made possible principally because each installation is individually designed. There are no “standard units” which must be adapted, no need of compromises with good engineering. You get what your consultant specifies!

Does this cost a lot? Emphatically no! Because JOHNSON manufactures nearly every component in an adequate variety of ratings and types, our engineers have available just the right material for any application. The cost is no more — frequently it is lower than less flexible, less generously rated equipment.

The same appreciation of technical and economic requirements is evident in other related JOHNSON equipment such as, coaxial line, phase sampling loops, isolating filters, tower lighting filters, RF contactors, pressureized capacitors, variable inductors and open wire line supports. For detailed information on any of these products write:

---

**Tele Tips**

(Continued from page 4)

Duties. This is evident in many applications aimed at speeding up service and relieving the operators of some of the monotonous parts of the work. An excellent example is shown in the recent installation of new ticket reservation systems in large railroad stations. Instead of having to wait while record clerks look up and report by telephone on the availability of reservations, such information is stored in a form so that it can be reported back immediately by automatic electronic searching units. The Pennsylvania Railroad system is now starting to use these methods in its Pullman operations.

**INVENTORY CONTROL!** There are many everyday business problems where forms of electronic reporting are finding support — notably in inventory control, production scheduling, and the handling of customer orders in large retail organizations. In the future it may be no longer necessary to talk over communication systems except by the fast-growing language of bits.

**HAPPY SICK-LEAVE!** Government workers are entitled to eight paid holidays, plus 26 days annual leave or vacation, plus up to 15 days sick leave. Based on the five-day week, employees may take off 49 working days, or 9.8 weeks a year.

In many government bureaus, it is customary to treat sick leave as “extra” annual leave. On one bulletin board there recently appeared a list of names under this heading: “The following employees will take their sick leaves according to these dates.”

Sick leave may be accumulated up to 90 days; annual leave up to 60 days.

**ICE-BREAKER**—Great success has attended the idea of having an informal “hobby” discussion precede the technical paper of the evening, as initiated by the New York Section IRE a couple of seasons ago, indicating that the plan could be used beneficially elsewhere. Kick-off topic was presented by F. X. Lamb, of Weston Instrument Corp., who has made a hobby of increasing the efficiency of his home oil-burner. He reduced the oil consumption of his burner from 2,700 gallons per heating season to 1,200 gallons. At this and following seasons, the attending membership was both highly entertained and thoroughly educated by “hobby talk.” Having engineers discuss their “hobbies” has proved an excellent social ice-breaker.
The response to Rauland’s new Indicator Ion Trap, after its introduction in the 12LP4-A, has been so enthusiastic that this feature has now been incorporated in all Rauland tubes—as a standard feature of the new Rauland Tilted Offset Gun.

In the field or on the assembly line, this new Indicator Ion Trap reduces Ion Trap Magnet adjustment time to a matter of seconds, eliminates mirrors and guesswork, and assures accuracy of magnet adjustment. It can increase profits for every service man and service dealer—and at the same time assure better customer satisfaction.

A bright green glow on the anode of the picture tube signals when adjustment is incorrect. Correct adjustment is made instantly, by moving the magnet until the glow is extinguished or reduced to minimum.

Only Rauland offers this advanced feature—one of a half-dozen important post-war developments from Rauland.

**RAULAND**

The first to introduce commercially these popular features:

- Tilted Offset Gun
- Indicator Ion Trap
- Luxide (Black) Screen
- Reflection-Proof Screen
- Aluminized Tube

---

**THE RAULAND CORPORATION**

Perfection Through Research

4245 N. KNOX AVENUE - CHICAGO 41, ILLINOIS
How a whiff of stibine led toward lower telephone costs

In the Bell System there are a million lead storage battery cells connected to telephone circuits in the central offices. Current seldom flows in or out of these cells beyond the trickle which keeps them charged. In the rare event of power failure, however, they stand ready to supply the current for your telephone service.

Even in this stand-by service, cells require water to make up for electrolysis. And they consume power and eventually wear out. But Bell Laboratories chemists discovered how to make a battery which lasts many more years and requires less attention — by changing a single ingredient, the clue to which came unexpectedly from another line of their research.

The clue was a minute trace of stibine gas in battery rooms which electrochemists detected while on the lookout for atmospheric causes of relay contact corrosion. In small traces the gas wasn't harmful but to battery chemists it offered a powerful hint.

For stibine is a compound of antimony—and antimony is used to harden the lead grids which serve as mechanical supports for a battery's active materials. Tracing the stibine, the chemists discovered that antimony is leached out of the positive grid and enters into chemical reactions which hasten self-discharge and shorten battery life.

Meanwhile, in the field of cable sheath research Bell metallurgists had discovered that calcium could be used instead of antimony to harden lead. And theory showed that calcium would not react destructively in a battery. The result is the new long-life calcium-lead battery which cuts battery replacement costs, goes for months without additional water, and needs but 1/5 the trickle current to keep its charge.

It demonstrates again how diverse lines of research come together at Bell Telephone Laboratories to keep down the cost of telephone service.
Mobile Unit Handles Film Commercials on the Spot for Better Control and Economy

Using the new GPL 16-mm Utility Projector, the American Broadcasting Company scored another television "first" by handling filmed commercials direct from its mobile units at football games. This new technique eliminates the need for expensive studio stand-by facilities and film-chain tie up. It results in smoother programming. And it gives the director on location full control of timing.

The GPL Utility Projector (PA-101) is used with a standard image orthicon camera without special phasing facilities. It projects either direct into the camera, or on an intermediate screen in a shadow box. With the latter, one of the cameras used for game pick-up can be swung around to the shadow box to take commercials.

The PA-101 is not only a professional auxiliary projector for the larger station, it is ideal for studio as well as field work in smaller stations. Easily portable, it may be used for film preview or rear screen projection. And for film telecasts, it may be used with regular studio cameras to provide quality equal to specialized iconoscope film-chain equipment.

ABC ENGINEERS designed a special projector-camera mount for their mobile units. Set-up is easily removable; camera rotates on base for adjustment. Split coupling keeps out light.

NO EXTRA CAMERA required with this alternate arrangement which uses shadow-box screen in stadium camera booth. Camera used for game pick-up may be swung to shadow-box to make commercials.

Write, wire or phone for details...
NEW DESIGN THRILLS AT YOUR FINGER TIPS...

**Type SRE Bantams** — The smallest electrolytics yet. Especially suitable for personal radios, filter circuits and similar functions. Hermetically sealed aluminum cans with diameter-reducing stud terminals. Improved processing and materials combined with more efficient space utilization, means smaller sizes — but no reduction in life.

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**Type 89ZXY Aerolites** — Aerovox improved metallized paper capacitors were developed to meet present-day requirements for capacitors of improved reliability and reduced size. Type 89ZXY Aerolites® are metallized-paper capacitors in hermetically sealed metal cases. Other Aerolites® capacitors are available in tubular, bathtub and other case designs.

**Type P123Z0 Miniatures** — Metal-cased, metallized-paper capacitors featuring vitrified ceramic terminal seals for maximum immunity to climatic conditions — heat, cold, humidity. For severe-service applications and for usage in critical as well as ultra-compact radio-electronic assemblies.

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There is something new in sizes!

- Never was so much capacitance packed into so little bulk. And with improved performance and life, too. Aerovox Research and Engineering have developed capacitor materials that now challenge the thinking of the progressive radio-electronic designer on several counts:

  For elevated temperatures: Immunity of Aerolene impregnant and Duranite® end fills. For humidity extremes: perfected hermetically-sealed metal-can casings even in tiniest sizes. For miniaturizations: perfected metallized-paper sections. For compact filters: smallest electrolytics yet. For maximum reliability: the most conservative ratings. For lower prices: advanced engineering backed by highly mechanized fabrication.

New design thrills at your finger tips! That’s what these latest Aerovox capacitors mean to you by way of still better radio-electronic assemblies.

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*Trade-mark


AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A. • Sales Offices in All Principal Cities

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Those in the Radio and Television Industries know from actual use the fine performance of these Tubes. They also know that our large production capacity assures them of a dependable source of supply with prompt delivery.

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TELE-TECH • November, 1950
Uniform sharpness of trace to the very edges of the screen distinguishes the new Du Mont Bent-Gun.

A higher degree of pre-focusing passes a smaller-diameter beam through the deflection field. Spot distortion is reduced and a uniform overall focus results. Other design changes are: Improved bulb spacer insures proper anode contact and electron gun centering; rounded corners on pertinent gun parts eliminates stray emission at higher anode voltages; new grid-cathode assembly allows a longer G-2 (second grid) without increasing overall length.

This new Du Mont Bent-Gun is now being incorporated in ALL Du Mont Teletrons. Therefore, whether planning a new TV receiver or modifying an old one, be sure to include the Du Mont Teletron for the best in TV pictures. Simply specify DU MONT.
"The Public Interest" and Color-TV

Each FCC Commissioner upon beginning his term takes a solemn oath "to serve the public interest." It is this central idea of the "best public interest" which underlies the whole radio law and the administration of that law by the Commission.

Fantastic authorizations of standards incomplete and not yet even given first laboratory tests, were never contemplated by the framers of the radio legislation.

Nor is it in the public interest —

To obsolete 10,000,000 present TV sets in which the public has invested three billion dollars.

To require future TV purchasers to spend $40 to $130 extra for gadgets they may never use.

To degrade TV picture quality, and limit pictures to small sizes which the public has already discarded.

To risk plant shut-downs, unemployment and financial disaster for manufacturers, distributors and dealers.

To force upon the public an incompatible color system which cannot even be launched without driving away existing audiences.

To promote color-TV at a time when color gadgets and circuitry must siphon off radio parts and components needed by the military.

To disrupt the entire television industry.

★★★★★★

Good sportsmanship provokes admiration for the achievements of Inventor Peter Goldmark and Strategist Adrian Murphy in advancing the CBS non-compatible low-detail small-picture system to its present political status.

But from the standpoint of "the public interest" demanded by the radio law, the majority of the Commissioners have obviously failed in their sworn duty. In contrast, the dissenting opinions of Engineer-Commissioner George Sterling and Lawyer Commissioner Frieda Hennock revealed at least their convictions that the FCC final action of Oct. 10, was contrary to the public interest. With these exceptions, the actions of the technically-informed Commissioners and staff in going along with this absurd and destructive color-TV ruling have created amazement throughout the radio engineering fraternity.

FCC TV STANDARDS INCORPORATING COLOR, EFFECTIVE NOVEMBER 20
COMPONENTS SURVEY—Intensive study of the radio-electronic components' situation for military production, both as to likely and current critical shortages and need for expansion of manufacturing facilities for certain component types, was undertaken during October by the Munitions Board's Electronics Division, headed by Marvin Hobbs. More than a dozen subcommittees, which were established through the cooperation of the MB's Electronics Equipment Industry Advisory Committee and its chairman, Western Electric vice-president Frederick Lack, met in lengthy sessions at the Pentagon on a variety of military "production-outlook" plans for the different components, including transmitter tubes, receiving tubes, quartz crystal, resistors, capacitors, transistors, sonar traducers, indicating instruments etc. As a result of their surveys both the armed services' Interservice Advisory Committee to the Electronics Division and the radio industry's advisory committee will be able to make a more exact blueprint in sessions to be held in November on the handling of the military procurement load.

NEW PLATE-POWER SOURCE for portable TV sets. The Army's Engineers Research and Development Labs. at Ft. Belvoir have built two electrostatic generators furnishing 20,000 v. and 6,000 v. respectively. These devices, each weighing only about 10 lbs., are spring-driven and will furnish power at low current up to 19 mins. at one winding. These results are due to the use of new insulating materials, new plastics and new techniques of hermetic sealing. Between the spring motor and the generator is a 14-to-1 gear reduction. A governor is also used.

The rotor of the generator consists of plastic laminated with metallic foil. It turns between charged metal plates so that a voltage is built up by induction on the foil. First the plates are weakly charged by a friction-type generator. Next in the process is the building up of the desired voltage and its continuous transportation to the plates where the charges are accumulated. Corona-discharge tubes act as voltage regulators of the output.

TELEVISION HELPS take the risk out of aviation. Although not the first time it has been done, the latest and most practical application of TV to testing aero-planes leaves the pilots on the ground while remote-control flies the aircraft, and television cameras in the cockpit transmit instrument readings to the testpanel in the laboratory. Thus if the plane cracks up it is only a camera chain which has to be replaced instead of a test pilot!

900-1200 MC

AVIATION NAVIGATION equipment in the 900 to 1200-MC region is not panning out exactly as expected, and there is a move afoot to attempt a transfer of some of these functions to the 500 to 900-MC band. In fact, and this may be news to many broadcasteers, there are already some experimental operations in this band—which is supposed to be for television use. If this frequency range is good for aviation radio purposes the next thing may be aviation moving in with UHF-TV. Why not just make an exchange of all or part of the UHF-TV band for more VHF-TV spectrum space?

MORE REALISTIC approach to calculating population served by television stations is shown by new NBC plans to use the 0.1 M/V contour in arriving at audience counts. This takes into account only the unduplicated viewers in areas of coverage overlap from two or more stations. An equal intensity 0.1 M/V contour is drawn and viewers on the respective sides of this contour are credited to the station in their zone.
Situations of Significance in the Fields of TV and Telecommunications

**UHF CONDUCTION**

ENAMELED WIRE in place of coaxial cables or rigid wave guides, for the transmission of ultra-high-frequency signals, is forecast in a report (PB-100-712) now available from the Office of Technical Services of the Department of Commerce. The novel UHF transmission means, developed by Dr. Georg Goubau for the Army Signal Corps, utilizes the hitherto-unexploited principle that non-radiating cylindrical surface waves can be guided by a conductor that is coated with a dielectric layer, or the surface of which has been otherwise modified, for example, by being threaded.

According to the report, surface wave transmission lines, using special horn-shaped signal-launching devices, can be built to operate with lower loss than coaxial cables, or even than rigid wave guides.

**PICTURE TUBES**

BUTTERFLY BURNS are the latest problem encountered by manufacturers of glass rectangular picture tubes. Due, apparently, to the different shape of the bulb, the effect of the earth's field on the ions differs from the more familiar center burns on round tubes, and produces discoloration of the screen at the top and bottom. The outer edges of these burns curve inwards thus producing an appearance similar to the wings of a butterfly. The cure for this seems to be to improve the conductivity of the coating; sometimes by using graphite, which is employed by one manufacturer.

**MATERIALS**

BORON-CARBON RESISTORS—A markedly improved type of deposited carbon resistor, expected to find widespread use in the communications field, has been developed at Bell Telephone Laboratories. In this new resistor, the element boron, as well as carbon, is pyrolytically deposited in a thin film on a suitable ceramic core. The addition of boron, it has been found, gives considerably lower temperature coefficients of resistance than those possessed by plain carbon resistors, as well as good stability. In addition, the new borocarbon resistors provide access to resistance ranges heretofore impossible to attain in stable, accurate film-type resistors. These advantages are expected to permit widespread substitution of borocarbon resistors for the larger and more costly wire-wound types.

**MINIATURES**

"THE FIELDISTOR", a sub-miniature vacuum tube, 1/90th the size of a present-day tube, is being developed by the Air Materiel Command’s Components and Systems Laboratory, Dayton, O. This tube which is about the size of a match-head, may be the answer to how to reduce size and weight of air-borne equipment. Only 250 handmade samples, (which appear to have too high a noise output) are now in existence. If and when they become available for civilian use, they may be found advantageous for portable radio sets and TV receivers, hearing aids, and other devices requiring compactness and light weight.

**MANAGEMENT**

EXECUTIVE SALARIES in the radio-TV field seem pretty well stacked against the radio engineer who creates the merchandise the other well-paid officials sell. From a study recently made in the radio-TV industry, the averages came out as shown below. It will be noted that total-compensation figures do not equal the sum of base salary and bonus figures, since some sources were not able to differentiate or furnished base salaries only. Bonus figures available for design engineers did not permit compilation of averages, although in some instances it was recognized that bonuses were being paid ranging up to 40% of base salary.

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<th>Position</th>
<th>Base Salary</th>
<th>Bonus</th>
<th>Total</th>
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<td>$11,300</td>
<td>$27,700</td>
</tr>
<tr>
<td>Merchandising managers</td>
<td>16,800</td>
<td>6,600</td>
<td>19,900</td>
</tr>
<tr>
<td>Salesmen</td>
<td>5,500</td>
<td>3,300</td>
<td>7,700</td>
</tr>
<tr>
<td>Purchasing agents</td>
<td>11,800</td>
<td>—</td>
<td>11,800</td>
</tr>
<tr>
<td>Chief design engineers</td>
<td>13,000</td>
<td>40%</td>
<td>15,000</td>
</tr>
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**40 TV CHANNELS BY EXTENDING PRESENT VHF BAND**

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TELE-TECH’s proposal for a continuous TV-spectrum extension (instead of a jump to the uhf) has met encouragement from unexpected quarters. Now word comes from Washington that some of the military authorities would like to trade their present VHF channels in this region for UHF frequencies which are better adapted for field purposes. Such a switch would largely clear the way for the continuous band of 40 channels sought by TV broadcasters and manufacturers—and everybody would be happy!

TELE-TECH • November, 1950
Testing and Aligning Video

The relatively new technic of equipment vision amplifiers is discussed and a logi-

By F. E. Cone and N. P. Kellaway,

TV Terminal Equipment Engineering, Radio Corporation of America,

Camden, N. J.

It is the purpose of this article to provide a general guide or approach for the testing and alignment of video amplifiers as well as specific information for setting up the test equipment. Television station engineers and technicians concerned with the operation and maintenance of video amplifiers and other TV equipment should find this information particularly useful. Since many of the video testing procedures and techniques are relatively new and must be performed at relatively high frequencies, suitable test methods, adequate test equipment (which is available commercially) and sufficient care in making measurements are recommended.

The video signal is made up of many frequencies of varying amplitudes and characteristics. Faithful reproduction of this signal is obtained only when the amplifiers are relatively free from frequency, amplitude, and phase distortion over the required frequency band. Therefore, the testing procedures described in this article are confined to those characteristics which are most likely to affect the performance and quality of the video signal.

The frequency response characteristic of an amplifier indicates frequency distortion directly and is a means of judging phase distortion. This characteristic may be obtained by the well known point-by-point method. However, this is a time consuming task and is too cumbersome. A more convenient method uses a sweep frequency generator, a crystal detector, an oscilloscope with good low frequency response, and a square wave generator for 30 cps and 7.5 KC.

The sweep generator recommended is the RCA WA-21A. It consists of a fixed frequency oscillator and a sweep oscillator, frequency modulated at 60 cps. The swing of the frequency modulated oscillator ranges from a few kilocycles on one side of the frequency of the fixed oscillator to 10 MC on the other side. The beat frequency output over the usable range (100 KC to 10 MC) is of constant amplitude within 1 db. This gives a well-defined zero frequency reference. The frequency marker pip which is available covers the usable range of the sweep.

Blanking is provided internally (60 cps) to blank out the signal during retrace.

In conjunction with the sweep, a crystal detector is used, which is shown schematically in Fig. 2. It is a voltage doubler and rectifier which converts the frequency modulated signal to its envelope.

The efficiency of rectification is about 90%; hence in setting up a specific output level of 1.5 v, the signal output of the detector should be approximately 1.35 v. In constructing such a detector it is important that leads to components be kept as short as possible. Distributed capacity should be reduced to a minimum.

High Frequency Response

For this measurement, the sweep generator, the crystal detector, and the oscilloscope are used. The method consists of coupling the low impedance output of the sweep generator to the grid of an amplifier stage, the plate circuit of which contains the circuit to be checked or adjusted. The detector should be connected to some low impedance point of the following stage such as the unbypassed cathode.

The circuit of Fig. 4 indicates a typical video amplifier stage. Removing the cathode bypass capacitor makes this second stage a cathode follower. The cathode resistance is on the order of 100 ohms so that the effect of feed-through capacity will be negligible.

An alternative to this scheme is to leave the cathode bypass capacitor in place and connect a 100-ohm resistor across the peaking coils of the second stage to shunt both the series and shunt peaker. Attach the detector across this resistor. This stage would then be a plate output stage.
Amplifiers

adjustment for tele-
cal system indicated

Most of the amplifiers of television terminal equipment are terminated with low impedance plate output stages or cathode followers. This affords a convenient point to attach the detector since the effect of the added capacity falls outside the frequency band being considered. Hence, the detector is usually left there for the duration of the test.

The video sweep signal is then injected at the grids of the preceding stages, starting at the output end and progressing towards the amplifier input. Care should be exercised not to overload the amplifier, creating the illusion of a good response. The test signal should be the same as that handled by the amplifier during normal operation.

The specification given for various responses is representative of typical production equipment. Reasonable variations in response can be expected between units of the same type due to normal manufacturing tolerances.

In amplifiers where clamping, blanking, and sync signals are added, precautions are taken to maintain normal operating conditions. Clamping tubes add considerable capacity and affect circuit tuning. Such a tube is replaced with a tube of the same type that has its filament pins removed. A temporary grid leak resistor is added (470,000 ohms K for 6AC7) to the opened grid.

Blanking is usually inserted by an amplifier, the plate of which shares a common plate load resistance with one of the video amplifiers. In addition to the circuit capacity it contributes, quiescent voltages of the video amplifier are dependent on the current drawn by the blanking amplifier. Thus, blanking cannot be removed by simply removing the blanking amplifier. Instead, the tube which drives the blanking amplifier (usually 1/2 6SN7) is replaced by a tube with its grid, plate, and cathode pins removed. These tubes should be plainly marked, possibly with red paint, to identify them.

This will help prevent them from being left in the equipment.

It may occur that a high gain amplifier tends to regenerate and oscillate due to leads being attached to it. In such cases the alternative of disrupting the amplifier in the middle and checking the amplifier in parts will be sufficiently accurate to insure proper performance.

Beware of rapid variations in amplitude as shown in Fig. 4. Such variations of frequency response are accompanied by severe variations of the phase characteristic of the amplifier and may cause ringing or reflections in the video signal.

In carrying the frequency response of the typical series-shunt peaked stage out to 6 or 7 MC, the phase response should be good out to 5 or 6 MC. Assuming this phase response to be adequate, the difficulty in making phase measurements is eliminated.

The response of an amplifier at the low frequency end is usually determined by the time constant of the inter-stage coupling networks. The low frequency response requirements vary from unit to unit depending on their relationship with clamping. With clamping occurring at a horizontal rate, 60 cycle response is not necessary. However, the amplifier should pass a 7.5 KC square wave with less than the specified maximum amount of tilt. This requires good phase response down to 7.5 KC which implies good amplitude response down to 1/10 or less of this frequency when no special low frequency compensating circuits are employed. The 7.5 KC square wave corresponds to a signal such as a bar extending the full width of the scene.

After clamping, the amplifier response should be such that the tilt should be less than the specified maximum for a 30 cps square wave.

After alignment of any amplifier the final check should be the passage of a signal through it and close inspection of the signal on a monitor. The RMA Resolution Chart is a very useful signal source. The wide range of picture resolution gives rise to a wide range of frequency components and will be a good overall check.
A 30-Element Electrostatically-

Trend in tubes based on control by electron beam tube found useful in time division communication.

By A. MELVIN SKELETT and PAUL W. CHARTON
National Union Radio Corp., Research Div., Orange, N. J.

As the communication field expands, many attempts to get greater efficiency in the utilization of facilities have brought about many systems which utilize some form of time division of those facilities among a number of services. Again, in the field of testing and measurement, there arises problems of spot checking system currents or voltages, at a rapid rate. By electronic methods, speeds greatly in excess of anything possible with mechanical methods are obtainable. Numerous attempts at using deflected beams as a switching means have been suggested and tried. One form of switching tube that is exceptionally versatile for such application, is shown in Fig. 1. In this tube a radial beam is rotated continuously across a number of electrodes arranged on the circumference of a circle.

This radial beam type of switching tube or electron commutator finds its way into many new applications because of the inherent advantages it possesses in comparison with other types of tubes designed for similar purposes. These latter types usually employ an electron gun similar to that in a cathode ray tube, and consequently the operating voltage is high, usually one or two KV. Experience shows that the secondary electrons in such tubes sometimes prove troublesome although their effects have been solved in a number of cases by finding a use for these secondaries. This expedient, however, results in considerable non-uniformity from element to element because of the difficulty of maintaining uniform secondary characteristics from one target element to another. The radial beam tube suffers from neither of these handicaps; the maximum ac and dc voltages applied to the tube need not be greater than 400 or 500 volts. Secondary emission is not employed and it is easily suppressed by considerations in the structural design.

The combination of electrostatic fields by which it is possible to focus a radial beam of electrons in a coaxial cylindrical structure has been described referring to a 12-element radial beam tube employing this principle. Increasing the number of elements to 30 required a larger radius for the structure. Although this modification brought in new problems, such as mica charging at the top and bottom of the focusing space, a practical design has resulted.

During this development it was found that if the length along the axis of the working structure of the tube was not less than the diameter, no serious distortion of the focusing field occurred because of end mica charging. Presumably this condition holds because the electrons in the beam do not stray far enough in the axial direction to reach the micas. To handle 30 separate grids and anodes the necessary increase in the radius permits the electrons to reach the micas and thereby distort the beam at the ends (top and bottom) so that the focus at the screen structure (see Figs. 1 and 2) assumes a sort of hour-glass form. No means has been found to restore the field exactly to the correct configuration, but practically, a good enough approximation can be obtained by placing shielding elements on the micas near the screen elements and around the cathode. This expedient, along with that of limiting the beam length slightly, gives a good rectangular focus for the 30-element tube.

Fig. 1 shows a section through the tube perpendicular to axis.
Focused Radial Beam Tube

deflection is typified by this high-speed sequential switching measurements, telemetering, sampling and spot checking.

The tube at right angles to the axis. Fig. 2 is a cut-away view looking into the tube structure. A standard cylindrical cathode is positioned on the axis at the center. There are no grids or other elements between it and the screen elements to which the six phases of voltage are applied. The electron beam is focused and rotated in this region by the action of these polyphase potentials in conjunction with a focusing bias applied to the cathode.

Screen Segment Structure

Each screen segment has 4 windows and there are 6 additional windows located between the adjacent screen elements, giving 30 windows in all for the beam to pass through. Back of each window there is a control grid and an anode. Fins attached to the screen elements segregate the sections and prevent crosstalk.

The mica shielding flanges and charge ring that are attached to the bottom mica can be seen in both figures. Each flange is welded directly to its adjacent screen element and a separate lead is brought out of the tube for the two rings (top and bottom). These rings are operated at a negative potential with respect to the cathode and provide some axial focusing for the beam.

The grids are of standard receiving tube design and since the electrons must pass through the laterals on both sides, they are very effective in controlling the current and in providing a low voltage cutoff, approximately 5 volts in the present design. This is obtained by grid design and placement. If a greater cut-off voltage can be tolerated the grids may be located just in back of the windows and made with fewer laterals and the resultant anode current will be increased considerably. Furthermore, the cut-off is made sharp since it is not so easy for stray electrons to get around the side of the grid laterals.

To meet industrial requirements two types of tubes were made available, identical in construction. In one, all of the grid leads are brought out separately with all the anodes but one tied together, and in the other, the anode leads are brought out separately and all the grids but one tied together. This saves 28 leads and for most applications, one of these two types, or one of each, is required. The separate channel element is often used for synchronization or other marking signals.

Fig. 4: Typical tube circuit. Voltage drop across cathode resistor provides the focus.

Fig. 3: Photo of unbased thirty element tube.
An Air-Cooled 5-10 KW

Trend away from water cooling of operation and elimination of

By L. B. PETERY, Design Engineer
Gates Radio Co., Quincy, Ill.

MANY years ago, the development of the water cooled tube made possible transmitter powers above 1 kw. Later, these same tubes were equipped with fins so that the problems inherent with water cooling were solved eliminating the water. For broadcast problems were equipped with above transmitters break loran, and vision, new types were developed for was output tubes have remained unchanged almost since the development of the original tube type.

With the initial problems of air cooling solved, the development of air cooled tubes for industrial use was accelerated. Also, a number of new types were developed for television, frequency modulation, radar, loran, and other specialized services.

The BC-5B and BC-10B transmitters break away from the tradition of an 892-R tube in the final amplifier and either 891-R or 892-R tubes in the modulator, by introducing the 3X2500F3 as both power amplifier and modulator. In searching for a suitable tube, this was found to be the most acceptable, having successfully served for several years in other radio applications.

The transmitter is constructed in three cubicles, the power amplifier and modulator being located in the center cubicle. These tubes mount in an air chamber, which is supplied by a single blower. Each tube requires 125 cubic feet of air per minute at 1.6 in. pressure. The blower delivers 800 cubic ft. at 1.75 in. pressure. Since the motor and blower unit are rubber cushioned to the housing, and the entire unit is on shockmounts, no transmission of vibration occurs. Surplus air is taken from the ends of the air chamber for unit ventilation. A diaphragm type pressure switch mounts on the air chamber insuring positive air protection.

The power amplifier tank occupies a frame half the width of the cubicle above the blower, and behind the power amplifier tube location. Tuning is by a variable inductance tapped across the bottom few turns of the main tank coil. This parallel operation of the tuning coil permits operation of the coil at low currents. Coupling to the transmission line is in two sections, the first coil being fixed, and the output coil adjustable from the front panel for power adjustment. This network provides high harmonic attenuation, permits the use of standard capacity condensers, and gives a flexible frequency and line load coupling. A pickup loop with a change relay automatically sets the modulation monitor for proper pickup on either of two operating powers. Neutralizing is obtained by a fixed vacuum condenser coupling from the power amplifier tank to the r-f driver tank.

Operation of R-F Driver

The r-f driver consists of two type 810 tubes, operating with 1500 v. on the plate. This stage is also tuned with a variable inductance across a portion of the tank coil. The 813 buffer operates with 1000 v. on the plate and 200 v. on the screen. This is driven by the frequency control unit consisting of a 6V6 oscillator and 807 output tube.

The 3X2500F3 modulator tubes are driven by four 845's in push-
AM Broadcast Transmitter

is emphasized by simplicity ancillary cooling devices

pull parallel with conventional transformer coupling. Preceding the 845's is a push-pull stage using 807's, with triode connections. The main feedback is introduced to the cathodes of the 807's, and amounts to 8 db. The transmitter was designed for optimum audio response before feedback was introduced. The result is that the presence or absence of feedback is not detectable aurally, although it can be detected with distortion measuring equipment. The input audio stage consists of two triode-connected 6J7's in pushpull. This stage has a feedback loop so arranged that the frequency response may be slightly varied by modifying the feedback characteristic. Thus, overall response may be changed to suit the station engineer without encountering the difficulties attendant to an overall feedback loop.

Power reduction in the BC-58 from five kilowatts to one kilowatt is obtained by changing the power amplifier plate supply to half voltage obtained from the center tap on the power transformer. Power change from ten kilowatts to one kilowatt requires both voltage reduction and radio frequency load tap change. A pad in the audio input automatically adjusts the audio level to the proper value for the power. Power change is by a switch on the front panel taking only a fraction of a second. The circuit is readily adaptable to phasor switching control circuits.

The main rectifier uses six 808 rectifier tubes for five kilowatts, and six 673 rectifiers for ten kilowatts. Mountings and filament transformers are designed so that the two types are interchangeable. The operating plate voltage is 5000. This reduces the insulation requirements, and makes high voltage cable more readily obtainable. The filter system consists of two branches with separate filtering for the modulator and power amplifier. The filter condensers are equipped with surge limiting resistors. The high voltage, low voltage and bias rectifiers have grounding relays.

Low Voltage Rectifier

The low voltage rectifier supplies 1500 v., and uses two 8008 rectifier tubes. Low voltages, such as for the frequency control unit and first and second audio stages, are taken from separate voltage dividers to minimize interaction and to stabilize the voltages on these units. The bias rectifier supplies 300 v. and is loaded to 1 amp., and also uses two 8008 tubes.

All stages with the exception of the frequency control and first two audio stages, are protected by overload relays. Both power amplifier and modulators are protected against under-bias. The primary power circuits are protected by magnetic circuit breakers. The high voltage primary also has a primary disconnect for safety and for testing control circuits. The modulation transformer primary and secondary, and the modulation reactor, have safety gaps so that transient surges will be dissipated through the gap.

The control circuit is designed so that the transmitter will recycle until the fourth overload. This automatic reset is so arranged that opening a door will de-energize the circuit and require manual application of plate voltages. Thus, there is no danger that an operator might be trapped inside the transmitter by the accidental closure of a door, with the automatic reset applying the high voltage.

Low voltage wiring is by short connecting jumpers between matched terminal boards on each cubicle. This makes the control circuit very adaptable to modifications as required by the phasor, or other special

(Continued on page 64)
CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Edited by John H. Battison

Program Monitor for AM-FM
R. D. HOUGH, Chief Engineer, WPDX, Carksburg, W. Va.

The device is automatic in operation and can be switched out instantly. It is mechanical in construction requiring only one 12v. dc telephone type relay, a telechron clock motor and a micro switch. The one RPM clock motor has a cam already installed. The size and shape of the cam is shown on the diagram. A roller-leaf actuating type of micro-switch is mounted above the cam so it makes contact when the longest portion of the cam strikes the roller. This cycle occurs twice during a revolution thus energizing the relay every other 15 seconds and holding it in an energized position for 15 seconds. This gives 15 seconds of the AM monitor and then 15 seconds of the FM monitor and then repeats or for each minute thus sampling the AM twice and the FM twice.

A three pole two position wafer type switch is used to turn the motor on and set the monitor circuits up for the relay contacts. The switch in the off position connects the monitor amplifiers to separate speakers for tracing trouble or monitoring when the two transmitters are carrying different programs. Before this switch is turned to the off position the motor should be allowed to turn until the contacts of the micro-switch are in the open position.

Transmitters can also be equipped with carrier failure alarm circuits so that if one goes off during the fifteen-record cycle that it is not being monitored it will be known at once.

Semi-Automatic Antenna Change Circuit
H. N. BLACK, Chief Engineer, KSMO, San Mateo, Calif.

Having damaged several antenna relays due to accidental operation while supplying power to the antennas, the following system was devised which has proven very effective. The system prevents operation of the antenna relays while under load thus preventing contact arcing and subsequent burn-out.

The preset switch is operated to the desired position then at changeover time the transmitter final plate voltage control circuit is momentarily de-energized and re-applied. During this off air instant the antenna relays are operated automatically. They will then remain in this position during any later transmitter or until the preset switch is reversed. Then at the next outage the antenna relays will reverse their positions.

The point CCT is any portion of the transmitter final plate control circuit de-energized when the plate voltage is off. Can be one side of the plate primary contactor, etc. (Must be at a point 115 v. to ground.) Point 115 v. HOT is one side of the transmitter filament primary, 115 v. to ground.

Turntable Motor Switch and Attenuator
TONY VACCARO, Chief Engineer, Portsmouth, N. H.

Occasionally it is necessary to install turntables in a small, or remote studio, or even in the announce booth. This means the announcer starts the turntable motor, attenuates output of the reproducer and also switches each turntable to either "Broadcast" or "Cue Record" positions. The main problem here is to start the turntable, throw "Broadcast-Cue" switch to broadcast position, and open the attenuator. In a set-up of this type it is

(Left) Circuit for monitoring AM-FM transmitters automatically
(Below) Prevention of antenna relay operation while under load.

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**$$ FOR YOUR IDEAS**

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.
On mounting switch to the attenuator, it had to be done so that the latter would actuate the switch in the same way as a standard AC-DC receiver is turned on by using a switch on the volume control.

The problem was to attach the micro-switch to the attenuator, and then provide some means of actuating the micro-switch plunger. This was accomplished by securing a cam to attenuator shaft. The completed switch is shown in the cross sectional drawing. Material needed includes a piece of brass or bakelite rod ¼ x 1” long, two right angle brackets, two small bolts, two small self-tapping bolts and one headless bolt ½” long.

Procedure—Tap a hole completely through the one inch rod for the headless bolt available.

Remove dust cover from attenuator and drill a half inch hole through its center.

Tap a hole ¼” into center shaft of attenuator, with same thread as headless bolt.

Drill a hole through one end of a piece of flat copper or brass stock ¾” long and ¼” inch thick.

On opposite end of flat stock, drop a large ball of solder, this is the cam.

Attach switch to brackets and secure brackets to dust cover by using the self tapping screws.

Upon completion it was found that 110 volts could be connected directly to the switch terminals without interference. To start turntable motor turn attenuator knob approx. ¼” Reverse movement turns motor off.

Soundmirror Modifications
GERALD J. BOOS, WDLD, WDLB-FM, Marshfield, Wis.

In the forward operation when the forward button is depressed and the start button is pressed, the resistor is in the drive motor circuit, until the take-up motor has a chance to pull the tape taut and close the forward limit switch S2. The resistor is not in either motor circuit, until the operator allows the start button to return to normal, and at that time the resistor is switched in the take up motor circuit. During the fast forward operation when the tape bypasses the heads, capstan, and limit switch, the start button must be held down. Hence full voltage is applied to the take-up motor. During the rewind cycle, when the stop button is pressed, full brake voltage is applied to the motor.

Transmitter Tuning House Monitor
Q. V. PROCHASKA, Chief Engineer, KDIX, Dickinson, N. Dak.

Here is a handy transmitter room monitoring setup especially adaptable to small station operation. The block diagram shows sound originating in the transmitter room and picked up by the microphone, amplified and fed to the remote monitoring speakers. Ordinarily no additional equipment is required as most stations have emergency announce microphone and associated amplifiers at the transmitter.

Monitor speakers can be located at the tuning house, in the basement and outside. The operator can hear the output of the regular program monitor, the telephone or any other sound originating from the transmitter room while he is at the tuning house, in the basement or even watering the lawn.
Video Recordings Improved by the Use of Continuously Moving Film

The elimination of line structure in film recordings is obtained by optically "stopping" the film and applying 10-15 MC modulation to beam.

By WALTER D. KEMP, Development Engineer, British Broadcasting Corp., London, England

The advent of television recording has made it possible to store and reproduce the television program at will. Much effort has been expended in perfecting the various technics employed, and the purpose of this article is to describe some of the work which has been carried out by the B.B.C. on this process.

In sound broadcasting, considerable use is made of recordings, and although the reasons for recording television programs are similar in some respects, it may be of interest to review some of the principal purposes for which recordings are used in Britain, before considering the technical problems in detail.

Many of the important topical events occur at times when the majority of viewers are unable to see the direct transmission. It is therefore desirable to make a record of the event as televised, which can either be transmitted as a complete item in that evening's program, or can form an item of the current newsreel.

Most drama productions, and some of the more ambitious light entertainment programs are repeated a few days after the original performance. At present, this is done by the staff and artists repeating the whole show, but this involves the tying up of studio space, which could be better used for rehearsal of another production.

Transcriptions

With the growth of television abroad, there is an increasing demand for cheap but good program material. The high cost of elaborate studio productions must inevitably render them relatively infrequent in countries where television is only becoming established, and there is no doubt that a recording of a good play, or an important outside broadcast of world-wide interest (such as the Olympic Games, etc.) would be welcomed outside Britain. As B.B.C. television recordings are recorded at a speed of 25 frames/sec. and have no line structure, they are suitable for reproduction on television film projectors, or standard cinematograph projectors anywhere in the world.

In motion picture photography, a complete image is formed on each film frame and after the exposure period a shutter closes and a new unexposed frame is pulled into position, registered, then exposed. At any instant during the exposure period every picture element of the emulsion is receiving light from the subject, and the exposure time is the same for all picture elements, being, as a rule, about 50% of the total time of the cycle, or 1/48th sec. at 24 frames/sec.

Recording a cathode ray tube image is fundamentally different, since the image is scanned line by line, and each picture element on the film receives the major part of its exposure in an extremely short period. This period corresponds to the time when the electron beam exciting the fluorescent screen is actually directed upon the element of the screen concerned, and on British standards is about 0.3 μsec. There is, of course, some exposure due to the afterglow produced, but this dies away in a short period, so that the total effective exposure time is very small when compared with motion picture practice. This means that figures of emulsion speed, etc., obtained by normal photographic technic cannot be relied on for photographing television images, even if correction is made for the different spectrum of the light emitted by the cathode ray tube, because the exposure produced on the film is not proportional to the
The process is therefore more analogous to that of recording sound photographically on film. The image obtained by photographing a television picture is a variable density photographic recording of the electrical signals composing that picture, each line of the picture being an individual "sound track". There is no necessity to make the individual variable density tracks form an image at all, but it is obviously desirable not to arrange them in one straight line, since the linear velocity or writing speed is so high. There is thus no fundamental reason why television programs should be recorded in the form of recognizable images on the film, but this method has overwhelming advantages for editing and re-transmitting, since standard apparatus can then be used. In view of this, it has been the constant aim of those responsible for the development of television recording in the B.B.C. to produce an absolutely standard motion picture film in every respect. The only variation from cine standards that has so far been tolerated is operation of recording and reproducing equipment at 25 frames/sec., the television picture repetition rate on British standards. This enormously simplifies both functions, and the 4% reduction in speed should such films be projected at 24 frames, is relatively unimportant, as greater variations are tolerated in the commercial theater due to variations in supply frequency.

All methods of recording television, so far, have used a cathode ray tube as the modulating device, and hence have produced variable density recordings. It is interesting to speculate on the possibility of making a variable area recording. If this could be done, processing would not affect the gamma of the image produced, and this might be an advantage. At present, however, we lack a suitable modulator.

**Principal Recording Problem**

One of the principal difficulties of recording television signals is due to the standards which have been adopted. To obtain efficient use of bandwidth, most standards allow a minimum period between pictures: thus in Britain the frame suppression period is 14 lines or 3.46% of the picture period. In the United States, the figure is about 3.75%, but as the picture period is slightly less, due to operation at 30 pictures/sec. instead of the British 25 pictures/sec., the time interval is actually somewhat smaller. The time available on British standards is about 1.4 milliseconds, and for any intermittent method of recording, the film would have to be pulled down and registered in this period. So far as is known at present, no camera has been made which can achieve this rapid pull down, as the high film accelerations needed require forces to be exerted which damage the sprocket holes.

Attention was therefore focussed on the use of continuous motion for the film, with optical or electrical compensation. A method at present used by the B.B.C. for 35 mm. recording employs continuous motion with optical compensation.

Intermittent methods of recording have been devised (as in the Eastman Television Recording Camera) which take advantage of the difference between Television and Film repetition rates. These do not require as fast a pull down as mentioned above, but they cannot record all the information present in the original television signal. The information lost may not be vital to the picture quality since the original television signal may have been more than adequate in this respect.

Systems of Telefilm Recording may therefore be divided into two fundamental categories — those which employ an intermittent movement, and those employing continuous motion of the film.

**Intermittent Motion**

Experiments in Telefilm Recording were made shortly after the war, using a standard cine camera driven by a synchronous motor at 25 frames/sec. and phased so as to be in step with the television signals. Due to the fact that pull down consumed about 50% of the total picture period, only half the active number of lines were recorded. The results obtained, however, showed that telefilm recording was a practicable proposition, although severe interference patterns were produced when the film was re-scanned. These interferences, or moiré patterns, are caused by the opaque areas between lines, since it is impossible to arrange that the re-scanning of the film exactly follows...
VIDEO RECORDING (Continued)

the original scanning which produced the image. Even when the full number of lines are recorded, patterns can be produced, particularly when the re-scanning is done by the "flying spot" system, which involves no storage. Fortunately, however, a technic has been perfected which enables the line structure of the image to be completely eliminated, and present B.B.C. recordings can be scanned on any standards with no sign of this effect.

A recent invention by the author enables a process akin to step-printing to be carried out in the cameras, and an experimental camera is now being built on this system using 16mm film. The advantage gained is that the film speed is 25 frames/sec. and so sound can be recorded in the usual manner; moreover, since no high rates of pull-down are involved, there is time to register the film accurately. The latter point is extremely important when using 16mm.

Continuous Motion Systems

In 1948 experiments were carried out using a 35mm continuous motion projector, the "Mechau" (made by A.E.G. in Germany) as a camera for television recording. These experiments were so successful that it was decided to construct two cameras using parts of this projector, which could be used for recording on an operational basis. This was done and the channel is now in service.

This continuous motion system of recording is described in detail, as, although it is normally used to record at 25 frames/sec. from a television picture repetition rate of 25 p.p.s., a relatively simple modification will enable it to record at 24 frames/sec. from a television picture repetition rate of 30 p.p.s.

The Camera

Fig. 2 shows a schematic arrangement of the camera and cathode ray tube. The optical system of the camera, comprising the lens L.1, the fixed mirror M, an iris, pivoted mirror M.1 mounted on a rotatable drum D, and focusing lens L.2, serves to form a succession of images of the cathode-ray-tube screen upon the continuously moving film P.

The mirror drum D and film F are driven at fixed relative speeds by the motor which is mechanically coupled (by means indicated diagrammatically by broken lines) to the drum D and to the film driving sprockets S.1 and S.2. The path of the film is from the feed magazine through the curved gate, round the sound recording drum and back to the take-up magazine, as shown by the arrows in Fig. 2. The field curvature of the lens L.2 is designed to be equal to the curvature of the gate. A correcting lens, not shown, is fitted immediately in front of the curved gate to compensate for the field curvature of L.2 at the sides of the film frame.

In Fig. 2 an image of the point P on the cathode ray tube screen is shown formed at a point P' on the film in the gate. As the film moves downwards through the gate the mirror M.1 in use is tilted by a cam mechanism in the drum in such a manner as to cause the image P' to move downwards with the film at the same velocity, so that the image P' is held stationary relative to the film. A recording of the image is made during the exposure period. The tilting of the mirror can in fact be analyzed into two angular displacements, one radial, referred to above, and the other tangential. The tangential displacement compensates for the fact that the mirrors are rotating in a curved path at an angle to the incident beam of light.

Fig. 4a shows a plan of the mirror drum. There are eight glass, back-silvered, pivoted mirrors disposed equally round the periphery of the drum. The circle C.1 indicates the area over which the light falls from the point P when the image P' is in the center of the gate (Fig. 2) —at this particular distance of time the light reaching the film at P' is reflected from mirror M.1 only. Rotation of the drum causes the area C.1 (Fig. 4a) to move relative to the mirrors in the direction indi

Fig. 2: (left) Diagrammatic view of the interior of the recording camera.

The large black drum visible in the photographs contains the rotating mirrors. Fig. 3: (right) Graphic representation of waveforms and time sequences involved in recording 24 frames and 30 frames per second.
located by the arrow, and the shaded area bounded by the circle C.2 indicates the zone over which the light falls from the point P (Fig. 2) when the image P' is nearing the lower end of the gate.

It will be seen from Fig. 6a that light falling over the shaded area is partly reflected from the mirror M.1 and partly from the mirror M.2. The light reflected from the mirror M.2 forms a second image P" (Fig. 2) on the film in the gate, and the mirror M.2 is tilted with the rotation of the drum to hold P" stationary in relation to the film as in the case of P'. The disposition of the mirror tilting cam is such that the displacement between the image P' and P" is equal to the distance between adjacent frames on 35mm film. For a fraction of the exposure period, therefore, there are two frames of the film being exposed simultaneously, but each frame receives its exposure from one mirror only.

In this way a succession of television images is formed on the film as it passes through the gate. The brilliance of each image rises from zero, being low at first when the image is at the top of the gate, then increases to a constant intensity, and finally fades out to zero when the image reaches the bottom of the gate. This is shown graphically in Fig. 3b.

### Exposure is Continuous

With this arrangement exposure is taking place continuously, and no shutter is required. Moreover there is no period when intelligence is not being recorded on the film. For example, assuming the camera is running at a speed corresponding to 25 frames/sec., a film frame F.1 enters the gate at the commencement of a television frame scan T.1. It takes the film frame F.1 approximately 1/25th of a second to pass through the gate, and in that time T.1 is recorded on F.1, and in addition the interlaced frame scan T.2 is also recorded on F.1, so completing the recording of one television picture. When F.1 is in the lower half of the gate, however, and the exposure of F.1 to T.2 is diminishing towards the zero, the next film frame F.2 occupies the upper half of the gate and is beginning to receive an increasing amount of exposure from the next frame scan T.3. When the film frame F.2 is in the lower half of the gate the next television frame scan T.4 is recorded on the film frame F.2. The recording cycle is then repeated.

When it is desired to record a 30 frame/sec. television signal so that a 24 frame/sec. film is produced, it is necessary to black out a portion of the mirrors to avoid more than two fields being recorded on one film frame. The portions of each mirror which it is required to black out are shown in Fig. 4b, and the modified exposure cycle in Fig. 3f. Fig. 3d shows what would happen if the mirrors were left unmodified, and the camera was run at 24 frames/sec. when recording a 30 frames/sec. television signal. In this case, it will be seen that each frame on the film receives an extra portion of a field scan and that this portion occurs alternately at the top and bottom of a frame. This is shown in Fig. 3e. Hence, when the film is projected, a severe 12 cycle flicker is noticed. If 1/5th of each mirror is blacked out in the manner shown, one field in five is not recorded, and this produces the required 1/5th reduction in repetition rate. The blacked out areas have not been spaced regularly around the mirror drum; as if this were the case, the position of the "overlap zone" would change every alternate frame, and this might give rise to 12 cycle flicker on projection. The overlap zone is shown in Fig. 3f. It is the area of the film frame in which the exposure of one set of lines of the interlace has been due to two superimposed scans of less than full intensity. The total exposure produced is the same as that which would be produced by one scan at full intensity, because the exposure curves are symmetrical about the time axis. This symmetry is a con-
Wide Range Decade

Laboratory measurements are aided by precise and easily identifiable marker source are available, and when used with auxiliary harmonic gen-

By J. M. SHAULL, National Bureau of Standards, Washington 25, D. C.

LABORATORY frequency measurements and calibrations are greatly facilitated by having precise and easily identifiable marker frequencies available throughout the radio spectrum. A decade frequency generator supplying separate filtered outputs of any or all of the harmonics of a 100-KC frequency standard in the range of 100 to 1000 KC is shown in Fig. 1. If used with auxiliary harmonic generators a great number of precise markers may be obtained throughout the high-frequency and microwave ranges. Additional multiplier-converter units and an adjustable oscillator of high stability may be used to obtain a high-precision frequency generator having complete coverage of any desired frequency band.1

The decade frequency generator consists of limiting and pulse-shaping circuit arrangements, grid filters for separating the desired harmonics of 100 KC and ten output amplifier stages. The output power is 0.1 watt at each frequency at a nominal impedance of 100 ohms. The tube plates are coupled to the output jacks through tuned transformers and a separate switch is provided in the plate supply lead of each stage for controlling the output. All undesired components, such as harmonics and multiplier side frequency in each output are attenuated by more than 60 db. When the outputs are used to drive frequency converters or make critical measurements, such as exploring resonances of quartz-crystal units, these spurious frequencies can cause considerable difficulty if not greatly attenuated.

A power output of 0.1 watt at 100 ohms was adopted as having the greatest utility with the minimum of unfavorable design considerations. The 100-ohm impedance is in the range of most crystal mixers and connecting cables, and at the same time develops sufficient voltage to drive the grids of multiplier or converter stages directly. This nominal output is obtained easily from a class A tuned amplifier with low power drain, while still maintaining a high plate tank Q with its additional attenuation of harmonics. Shielding and decoupling requirements also are much less severe at this low operating level.

The complete circuit schematic for the unit is shown in Fig. 3. For operation, a 100-KC signal from a frequency standard or other stable source, with an output voltage of 2 to 10 v. at about 100 ohms, is supplied to the input jack. The 100-KC amplifier makes a 100-KC frequency of very low harmonic content available on the front panel which serves as a limiter and impedance changer. The second harmonic frequencies between 100 and 1000 KC to the harmonic bus line. From the harmonic bus the individual multiples of 100 KC are filtered and supplied to the grids of the amplifier tubes V-4 through V-12. To remove the small amount of harmonic distortion generated in the amplifier tubes and to couple from the tube plates to the output jacks, tuned transformers with low-impedance link windings are used.

Pulse Circuit

The pulse generator consists of the dual triodes V-1 and V-2 and associated circuits. The input triode of V-1 is driven at relatively high amplitude by means of the series-tuned input transformer and generates an essentially rectangular pulse across its cathode resistor. The leading edge of this pulse is differentiated by the RC coupling
Frequency Generator

able marker frequencies. Filtered or harmonic outputs of 100 KC erator many markers may be obtained throughout microwave ranges

Fig. 3: Schematic diagram of generator. Litz wire is used on the powdered iron cores of the t-f coils. Magnetic shielding is important

network and passed through the next two triode amplifier-clipping stages. A short positive-going pulse with a small negative overshoot is impressed on the grid of the second triode of V-2. This tube serves as a pulsed power amplifier driving the harmonic bus and its resistive load. The bypassed cathode resistor in series with the load supplies sufficient bias to eliminate the negative overshoot and results in a rectangular positive output pulse. The peak pulse power output is approximately one watt.

The differentiator circuit was adjusted to give a pulse width of approximately one-half microsecond, which gave a maximum output for the 1000-KC stage. With this ad-
justment the power in the bus for the lower desired harmonics follows a sin x/x distribution. The use of an untuned single class C harmonic generator stage at 100 KC was not found satisfactory as it gave very low output at certain frequencies and a drop in amplitude for several of the frequencies, which shifted with changes in excitation level or operating angle.

The grid filter elements were designed to operate at the highest working Q value obtainable with the type of coils used. This was particularly desirable at the 1000-KC end of the range as these frequencies were the most difficult to filter because of the smaller percentage separation and lower amplitude. For the wire size and core material used, the parallel-tuned grid winding at 1000-KC was found to have maximum Q at a value of about 180 μh, while the 400-KC grid coil gave optimum filtering with about 1130 μh. Intermediate values were geometrically spaced between these limits.

The input series tuned links from the harmonic bus above 300-KC were chosen to operate at inductance values which tuned 20 to 30 μf in order to obtain the highest practicable working Q and minimum loading of the bus for the other frequencies. The intermediate tuned coupling windings have total inductance values about half-way (Continued on page 60)
THE solution of circuit design problems where the properties of electron tubes must be considered is often a difficult chore. Of late considerable interest has developed among design engineers in the usefulness of the G Curve technic for simplifying these solutions.

The papers presented to date have devoted themselves primarily to the study of triode tube applications. This article will be concerned primarily with the use of the G Curve technic with pentode tubes. It is based on a recently released report on this subject.

The curves presently available on most pentode tubes offer design data useful for a limited number of possible operating conditions. When one is confronted with a design problem involving somewhat unusual arrangements it is often difficult to make a "paper" guess concerning the operating properties of the proposed stage.

A re-evaluation of the pentode problem has been attempted. Its purpose was to try to organize the data available to give information applicable to as wide a range of operating conditions as possible. At the same time the method of obtaining results has been simplified in order to make its use direct and convenient.

Since the value of the screen voltage is the key factor determining operating conditions in a tetrode or pentode tube, it is desirable that curves on these tubes place emphasis on the effect of screen voltage variation. Study of the usual type of plate characteristic with constant screen voltage confirmed the feeling that the variations shown in these curves represented a less significant variation than that due to screen voltage change.

The screen to plate current division, being determined primarily by the ratio of the corresponding voltages, suggested making experimental plots with fixed ratio but varying voltage magnitudes. Such a set of curves with \( E_s/E_p = 2 \) is shown in Fig. 1. These curves are for a 7E7 tube. A complete set of plate and transconductance characteristics was taken to establish the variation range from the value given in the curves in Fig. 1. These data were reduced to correction multipliers and plotted. The curves appear as in Fig. 2 if the following definitions apply:

\[
E_s = E_p/E_s; \quad E_m = 2; \quad F_p = I_p/I_m; \quad F_s = g_m/g_m 
\]

(1)

The range of variation of these curves is shown by the dotted lines plotted on the \( F_p-E_s \) portion of Fig. 3. As can be seen, the range of variation is less than \( \pm 5\% \). This is adequate since overall tube data vary more than this. The curve for \( F_p \) vs. \( E_s \) is nearly the same as that for \( F_p \) vs. \( E_m \). This is a consequence of the relative dependence of \( g_m \) on \( E_p \) and independence of \( g_m \) and \( E_s \). The current division effect does cause some small variations.

Now to consider a possible design problem with this set of curves we suppose a 7E7 is to be used as a video amplifier for a signal having a peak amplitude of \( \pm 3 \) volts, and an average transconductance of 1100 \( \mu \)mo is desired.

The first step is to find the minimum screen voltage which will give a reasonably linear output. Examination of Fig. 1 gives the following table.

<table>
<thead>
<tr>
<th>( E_s ) (Volts)</th>
<th>( G_m(0) )</th>
<th>( G_m(2) )</th>
<th>( G_m(4) )</th>
<th>( G_m(6) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>800</td>
<td>725</td>
<td>600</td>
<td>400</td>
</tr>
<tr>
<td>50</td>
<td>1200</td>
<td>1175</td>
<td>1000</td>
<td>500</td>
</tr>
<tr>
<td>75</td>
<td>1500</td>
<td>1475</td>
<td>1300</td>
<td>800</td>
</tr>
<tr>
<td>100</td>
<td>1650</td>
<td>1620</td>
<td>1400</td>
<td>950</td>
</tr>
</tbody>
</table>

Both the 25-and 50-v. conditions can be discarded immediately. Linearity is fair for the other two. The distortion at 75 v. is about 14\%, and that at 85 v. about 12\%. Only 85 v. will offer a transconductance reasonably close to the desired average of 1100. Hence 85 v. is the minimum screen voltage for this application.

If the plate supply for this tube were 250 v., and the load resistor 10,000 ohms, the minimum plate voltage would be approximately
Curves for Pentode Circuit Design

characteristics, which is always difficult and tedious, presentation as developed by military laboratories

150 v. For this application it will be shown that $g_a$ may be neglected. Assuming this, the stage voltage amplification ranges from 5.9 to 16.3 at the extremities of the load line. The average is about 11.2.

If this amplifier were an audio amplifier, the attenuation might be quite different. Because of the limit on minimum screen voltage, the load resistance is limited in size. For good operation, it would be unwise to operate to an $E_2$ less than 0.5. For this problem the minimum is chosen to be $E_2 = 50$ v. Then $R_L$ has a maximum value of 20,000 ohms. This doubles the available amplification.

Possible effects of $g_a$ must now be considered. The value of $g_a$ is dependent on three factors. These are $E_2$ and $I_1$ for $E_1 = 2$ and the slope of $F_p$. From these facts the equation $g_a = G_s(I_s/E_p)$ (2) may be derived. The factor $G_s$ is proportional to the slope of $F_p$, $I_s$, and $E_m$ (which is twice $E_2$) are the nominal plate current and plate voltage corresponding to a given bias. The graph of $G_s$ for the 7E7 is also plotted in Fig. 3. Extrapolation of the value of $G_s$ at $E_2 = 0.5$ gives approximately 0.5. This gives $g_a = 26 \mu$mho. Hence, $g_a R_L = 0.52$. The amplification under this condition is reduced to 2/3 of its nominal value, or 22. At $E_2 = -3$, $I_1 = 5.5$ ma, giving $E_m = 140$ v. Here, $E_2 = 1.6$. The value of $g_a$ is 2 $\mu$mho. Then $g_a R_L = 0.04$. Here the amplification is practically unchanged.

The main difference between the procedure just described and that for triode design is first that here a screen voltage to give desired transconductance and bias ranges is chosen, and second the denominator term $g_a R_L$ often may be neglected.

Where a wide range of plate voltages are developed, one additional step is required. First a table of plate current and transconductance values at different bias voltages is determined. The approximate tube plate voltage is estimated from this. The values of $g_a$ and $I_1$ are corrected from the curves, and the tube plate voltage redetermined. In most cases even the uncorrected values will be within tolerances to be expected from tolerance limits on tubes. If operation into the knee of the curves is desired, then correction will be required. This correction may be repeated if desired.

Variable Screen Voltage

Variable screen voltage operation may be desired for any of several reasons. In a tetrode, grounding the screen to the signal voltage may be necessary to prevent oscillation. Only in this way can grid and plate be adequately isolated. If cathode degeneration is present, a variable screen voltage is introduced.

Allowing the screen voltage to vary may either decrease the variation of the tube transconductance or increase this variation, as desired. The former is used to decrease distortion; the latter to increase distortion, and as a result the mixing action of the tube.

The characteristic curves of the sort shown in Fig. 1 can be used for design of circuits in this condition also. In screen degeneration a set of curves similar to Fig. 1, but carrying screen current and screen transconductance as determined by screen voltage and bias, and a set of correction curves similar to Fig. 3 would prove convenient. Some means of determining the change in screen voltage as a function of grid bias is necessary.

As an example of variable screen operation, let us examine a cathode degenerated 7E7 with the screen bypassed to ground. Take the case with $E_2 = 75$ v., and $R_L = 750$ ohms. The bias voltage then is $-3$ v., and $g_a R_L$ is approximately 0.8, neglecting the screen transconductance. If the screen transconductance is approximately a quarter that of the plate, then $(g_m + g_a)R_L$ will be about unity.

When $(g_m + g_a)R_L$ is unity, the cathode amplification of the 7E7 is 0.5. The screen voltage variation is now half the incoming signal. Consequently, a screen load line can be plotted on Fig. 1. The load line for this case is labeled "A" in Fig. 4. Once the screen load line is deter-
G CURVES (Continued)

mined, proceed as in the ordinary pentode. Read plate current and transconductance at each bias point, and make corrections as indicated below.

An auxiliary triode or cathode coupled amplifier can be used to vary the screen voltage. The load line for \(E_i = 5v\), is identified as "B" in Fig. 4. Load line "C" is for \(E_s = 10\text{v}\., "D" for \(-5\text{v}\., and "E" for \(-10\text{v}\. Cases where the change is not linear also can be solved by use of the proper voltage and bias data.

The value of the transconductance of the tube is varied when the screen voltage is altered is evident from the fact that the plate current rate of variation is changed. Our next problem is to make the corrections necessary to correct for this.

In order to understand how the correction may be carried out, one may recall the arrangement used in the solution of triode circuits. A load line is drawn, and values of \(g_m\) and \(g_s\) read along the line. Examination of these triode curves further shows that although the plate conductance, \(g_m\), could be approximated from the slope of the constant bias contour, the transconductance cannot be obtained in a similar manner to a reasonable accuracy.

The problem, with a set of pentode curves of this sort, and a load line, looks very much like a typical triode problem. It then can be handled as one for the initial approximation. Then the necessary corrections may be made. The effective transconductance of the tube, after correction for screen variation, takes the form

\[ g_m = g_{m/} (1 + G_{sr} R_{m}) \]  

(3)

Here \(G_{sr}\) is the slope of the \(I_p-E_s\) line at the point being determined, and \(R_{m}\) is the reciprocal of the slope of the screen load line. As long as the same units are used for each of these factors, no error will result, as the product of \(G_{sr}\) by \(R_{m}\) is dimensionless.

Solution is Simple

At first glance, the solution appears complicated. But actually, considering the number of variables available, it is surprisingly simple. After the approximate solution is obtained as indicated, corrections of the sort used on the standard pentode circuit will permit the adjustment for plate voltage variations. The \(E_i\) at each individual point must be used in the correction.

In Eq. 3, the term \(G_{sr} R_{m}\) may have either a positive or a negative sign. In order to keep the equations of this type strictly rigorous in use of definitions of calculus, this term should carry a minus sign. Then the \(R_{m}\) would have a negative slope. However, in keeping with tradition in the field, we write

\[ VA = -\mu R_e/(R_e + R_m) = -g_{m} R_e/(1 + g_{m} R_e) \]  

(4)

rather than

\[ VA = \mu R_e/(R_e - R_m) = g_{m} R_e/(1 - g_{m} R_e) \]  

(4a)

Circuits for use of the pentode for modulation or mixing are designed in a manner which is similar to that of the variable screen circuit. Design is simpler in some respects, however. Since this technique applies to converter tubes as well as pentodes, its application to converters is explained here. Application to pentodes is made in an equivalent manner.

Figs. 5, 6, and 7 present measured data collected on a sample 6SA7 type tube. The first grid, or main control grid, is labeled as C1 and the third, or auxiliary control grid as C2. Managability of the transconductance contours made use of the main control voltage as the abscissa more convenient than use of the auxiliary grid voltage.

A problem in signal mixing is reviewed to indicate the method. This problem takes a signal on C2 large enough so that the transconductance varies when either grid voltage is applied separately. For small signals on one grid, the problem is simpler.

Assume an incident signal on C2 of \(\pm 2\text{v}\. amplitude. The grid is biased at \(-2\text{v}\. The local oscillator signal is \(\pm 3\text{v}\. with rectification bias. Using \(E_i = 67.5\text{v}\., find the conversion transconductance.

The first step in solution is to average the effective transconductances met by the signal which causes the smallest changes in \(g_m\) (This approximation simplifies the general problem somewhat. Strictly, it need not be made.) For this problem, the incident signal trans-

(Continued on page 45)
MODIFIED RESONANT CIRCUITS

MATCH IMPEDANCES — Number 10

By PETER G. SUIZER,
Radio Engineer, Nat'l Bur. Standards Washington, D. C.

Frequency - selective impedance-matching devices of the inductive type, widely applied to communications equipment, have the disadvantage that variable coupling (or impedance transformation) requires a mechanically complicated coil design. In addition, reactances may appear at the circuit terminals, requiring an additional tuning adjustment for efficient coupling. In one familiar solution, the pi network of Fig. 1, the capacitor Cₐ is used to determine the coupling. Unfortunately, when the impedance ratio R₂/R₁ is high, Cₐ becomes excessively high rendering impractical the use of a variable capacitor.

In a less common circuit, Fig. 2, a small capacitor Cᵢ serves as the coupling adjustment. The parallel circuit L₂Cₐ is adjusted to present an inductive reactance at the operating frequency which combined with R₁ provides an impedance equivalent to R₂ plus an inductive reactance which is tuned out by adjusting Cᵢ, L₂, R₂, and the bandwidth are known factors. In Fig. 2, X₁, X₂, Xₐ, and X₀ are the effective reactances of L₂Cₐ, L₁Cₐ, L₂Cₐ, and L₂Cₐ respectively. When X₀ is obtained from a parallel L-C circuit the impedance-transformation ratio and the circuit Q can be adjusted separately, which is often desirable.

Assuming matched conditions the equivalent resistance across the tuned circuit is then R₂/2. If it is assumed that Q has the value Q = R₂/2L₂, (see Appendix), then X₀ = R₂/2Q (1) giving the reactance of L at the operating frequency fₜ.

To solve for X and X₀ write the impedance of R₂ and X in parallel, and equate R₂ to the resistive component of Z.

\[ Z = \frac{1}{\frac{1}{R_2} + \frac{1}{X_0}} \]

For the parallel combination of R₂ and X₂, the reactance X₂ at Z is obtained from (5).

It is of interest to determine the range of impedance transformation available with the circuit. Examination of (2) shows that the real part of Z will be minimized when X has its minimum positive value, which is X₁. Substituting X₁ from (1) in (2), equaling the real part of Z to R₂ as before, and solving for R₂ = R₂/(1 + 4Q²), shows the maximum impedance ratio is 1 + 4Q², which becomes 4Q² for Q >> 1. Under this same condition the maximum turns ratio of the equivalent transformer is 2Q. The minimum turns ratio is unity, (not a limitation because the network can be reversed end-for-end).

To facilitate the use of a universal chart it is convenient to normalize all reactances with respect to R₀, indicating normalized values by lower-case letters,

\[ x_0 = \frac{1}{2Q} \]

(6)

\[ x = \frac{R_2}{R_2 - R_1} \]

(7)

\[ x_1 = \frac{1}{2} \]

(8)

\[ x_2 = \frac{x_0}{1 - x_0} \]

(9)

Fig. 3 contains plots of (7), (8), and (9) for a wide range of values of Q, R₂, and R₁. Values of x might be read from the vertical scale, although x is not used in the final result.

Use of the Chart

At high frequencies where it may be difficult to measure the inductance L accurately, the values of X₀ and X₁ may be determined as above, and then the inductance L is adjusted to resonate with Cᵢ at some frequency fₜ, such that L has a reactance X₀ at fₜ. Considering the parallel circuit L₂Cₐ, fₜ/f₀ = X₀/Xₐ, where X₀ and Xₐ are the reactances at fₜ. Substituting the value of X₀ obtained from (5), and substituting...
(3) and (4) to eliminate \( X \) and \( X_1 \).

\[
\frac{f_1}{f_2} = \left( \frac{X_1}{X_2} \right) \left( \frac{X_2}{X_1} \right) = \frac{1}{1} \quad \text{.......... (10)}
\]

In using the chart, by selecting \( R_2 \) on the lower horizontal scale, an intersection is obtained between an ordinate erected at this point and the appropriate curve marked \( R_1 \). A horizontal line drawn through the intersection is then used to obtain \( x_1, x_2, \) and \( f_1/f_2 \). The values at the intersection of the horizontal line with the curve marked \( x \) determines \( x \), which is read on the upper horizontal scale. This also applies to \( x_2 \) and \( Q \): providing that the curves corresponding to the proper value of \( Q \) are employed.

(1) Consider the design of the output circuit of an experimental 2.5-KW pulse transmitter operating at a frequency of 3.492 MC. A loaded \( Q \) of 10 is desired with a 50-ohm antenna. With a plate supply of 5000 volts, 3500 volts rms can be assumed across the single-ended tank circuit. Thus \( R_1 = 5000 \) ohms for 2.5 KW, while \( R_1 = 50 \) ohms and \( Q = 10 \). Applying (7), \( x = 0.05 \). Referring to Fig. 2, a horizontal line drawn through the intersection of the ordinate \( R_2 = 5000 \) and the curve \( x = 50 \) will intersect the curves marked \( x_1, x_2, \) and \( f_1/f_2 \). The values at the intersections are then read on the upper scale. For this example, \( x_1 = x_2 = 0.1 \), while \( f_1/f_2 \) is not used. Multiplying by \( R_2, x_2 = 250 \) ohms, and \( x_1 = x_2 = 500 \) ohms. With the aid of a reactance chart it is found that \( L = 11.4 \) microhenrys, and \( C_1 = C_2 = 92 \) microfarads.

(2) A good high-frequency example is the design of the input circuit of a broad-band FM booster using a parallel-connected 12AT7 as a grounded-grid amplifier. A match is required between 50-ohm coaxial cable and the amplifier cathodes, which present an impedance of 250 ohms, while a \( Q \) of 5 is necessary for a bandwidth of 20 MC. Referring to Fig. 2, \( x = 0.4, x_2 = 0.12, \) and \( f_1/f_2 = 1.1 \). Since \( x_1 = 100 \) ohms and \( x_2 = 30 \) ohms, \( C_1 = 16 \) micromicrofarads, and \( C_2 = 53 \) micromicrofarads. The inductance \( L \) is adjusted to resonate with \( C_1 \) at 108 MC (1.1 \( f_2 \), where \( f_2 \) is 98 MC) with a grip-dip oscillator.

**APPENDIX**

The properties of \( Q \) defined in terms of the effective shunt resistance \( R \) may be derived by considering the relations for a parallel RLC resonant circuit. Writing its impedance \( Z \),

(Continued on page 65)

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Fig. 3: Universal chart with normalized reactances from which values of \( R_1, R_2, \) and \( Q \) can be read. \( X \) can also be read on the vertical scale.
Modified TV Field Switcher

Minor changes in TS-30A switcher increase usefulness of equipment by providing additional camera control facilities

By C. J. AUDITORE
TY Facilities Engineer
WOR-TV, New York City

The much used RCA TS-30A field switcher provides for direct switching between any of six video signals, four of which are local cameras and the other two auxiliary (normally composite) video signals. Fading to or from black, between signals and the use of superpositions has long been sought by television broadcasters using field pick-up equipment. Recently, RCA has made available an auxiliary field switching control, which when used with the modified TS-30A field switcher, provides these added facilities with certain limitations.

All of the TS-30A and auxiliary field switchers at WOR-TV have been modified to improve performance and add to operational facilities. These modifications are: (1) addition of Camera Control 5 and 6 tally lights; intercom and program-cue facilities on the TS-30A; (2) modification of Aux. 5 and Aux. 6 positions to become Cam. 5 and Cam. 6 inputs on the auxiliary switcher; (3) modification of the fader input grounding bus in the auxiliary switcher to reduce switching flashes; and (4) addition of a 6J6 cathode follower in the auxiliary switcher.

Adding Cameras 5 and 6

The addition of camera control 5 and 6 tally, intercom and program-cue facilities on the TS-30A requires the installation of two connectors similar to* J-13, 14, 16, and 17. These connectors may be located on the rear of the TS-30A in the space between the master monitor power connector and the coaxial cable connectors as shown in Fig. 1. Terminals 1, 2, 3, 4, 5, and 6 are connected in parallel with the existing camera control circuits. Terminal 5 for camera controls 5 and 6 are both connected to the switch S7 at the coil side of L1, for intercom. An added tally circuit is paralleled with each of the four existing camera controls, terminal 9, for tally indication out of the auxiliary switcher. Terminal 9 for camera controls 5 and 6 are each tied through to the auxiliary switcher for tally indication on position 5 and 6 respectively. See Table I for a tabulation of the added wiring in the TS-30A.

Two voltages are provided out of the TS-30A for use in the auxiliary switcher. These are, (1) 6.3 v for local tally lights in the switcher and the cathode follower filaments, and (2) +280 v d.c. through R102 for camera tallies and B+ at the cathode follower. "Aux 5" input in the TS-30A is also modified for bridging (high-impedance) input. Nine pin connectors must be mounted on the TS-30A and the auxiliary switcher to provide for the required circuits. In the auxiliary switcher, the camera tally-voltage bus must be extended to the back of the TS-30A, and tally outputs paralleled, and a camera 5 and 6 camera tally circuit connected directly to the nine pin connector. When push-button switching with

---

*The specific technical information included supplements and refers to the instruction sheets furnished by RCA with the auxiliary field switching control.
the auxiliary control is used between takes, flashing may be observed in the output signal. This is due to the make-before-break operation of the switches. As a new picture is being pushed-up, the signal which is being released (or vice versa, dependent on sequence) momentarily puts a ground on the fader input via the fader input grounding bus. It is this momentary grounding which produces flashing. This is effectively remedied by using a 120 ohm \( \frac{1}{2} \) watt resistor in a common return to ground for both fader input grounding buses. This allows for a ground return on the fader input with no signal pushed-up, and at the same time overcomes the switching flashing due to a direct zero resistance ground.

**Cathode Follower**

The auxiliary switching control as provided by RCA is restricted in its placement with respect to the TS-30A by the 4-foot maximum length of RG-62U low capacity output cable. Furthermore, there are undesirable frequency response variations when fading to, and from, signals set up on the black and the white push-buttons, even when the fader levers are ganged together as recommended by the manufacturer. The overall bandwidth as measured was useable to about 4 MC. These are rather serious limitations.

These restrictions were lifted, however, with the addition of a 6J6 cathode follower at the auxiliary switching control as shown in Fig. 2. This amplifier was easily added since the filament and plate supply voltages are already available at the auxiliary switcher. The tube was mounted externally in a standard shielded socket in the location occupied by the RCA name plate. A flat metal strip was bent to form a "U" ground around the tube. This location for the tube was chosen to simplify its cooling and replacement as required. The balance of the cathode follower is readily mounted inside the switcher unit.

The advantages derived from this modification are three-fold: (1) the frequency response variations with fading are eliminated; (2) the effective bandwidth is increased to beyond six MC with a smooth roll-off beyond flat output; (3) it is possible to extend the output of the auxiliary switcher a full 20-feet with RG-62U low capacity cable without serious degradation of the frequency response. This is most important with respect to convenience of operation and picture quality, especially when the equipment is employed in studio installations.

There is some loss of signal in the cathode follower which is easily made up in the TS-30A switcher. The transfer in this circuit is:

\[
\frac{G_{RL}}{1+G_{RL}} = \frac{1}{1+10,600 \times 10^2} = 0.96
\]

This works out to be close to unity, due to the high effective value of transconductance \((G_m)\) which is obtained by paralleling the two triode sections of the 6J6.

**Grade of Fellow is Conferred on 41 by the Institute of Radio Engineers**

The grade of Fellow has been conferred upon 41 engineers and scientists in the radio and allied fields by the Institute of Radio Engineers. The awards will be presented at the IRE Annual Banquet in March, 1951. Recipients of the Fellow Award are:


(Continued on page 61)
**CONDUCTANCE CURVES**

(Continued from page 40)

Conductance is averaged. Using
\[ g_m = \frac{1}{4} \left( g_{m1} + 2g_{m2} + g_{m3} \right) \quad (5) \]
for this, we have, from Eq. 8,

<table>
<thead>
<tr>
<th>TABLE II</th>
</tr>
</thead>
<tbody>
<tr>
<td>( g_m )</td>
</tr>
<tr>
<td>( E_i )</td>
</tr>
<tr>
<td>( 902 )</td>
</tr>
<tr>
<td>( 394 )</td>
</tr>
</tbody>
</table>

The second step is to approximate the power series representation of the transconductance. This series takes the form

\[ g_m = g_m e^* \quad (6) \]

Determining the coefficients from Table II, we find the series is

\[ g_m = 902 + 94 e^{-5 e^*} \quad (7) \]

Carried out on the basis of \( E_i = 0 \),

\[ g_m = 902 + 89 e^{-5 e^*} \quad (8) \]

Since these expressions agree to closer than tube tolerances, it is seen that the simpler solution is adequate. Now, essentially, the two input voltages are added by isolated circuits and intermixed by the transconductance non-linearity. Substitution of \( e_i = e_i \sin \omega_1 t + e_i \sin \omega_2 t \) in

\[ i_1 = g_m e_i = 902 e_i + 89 e_i e^{-5 e^*} \quad (9) \]

gives the first order mixing term as

\[ i_1 = 2g_m e_i e_i \sin \omega_1 t - \sin \omega_2 t \quad (10) \]

Neglecting the sum term, Eq. 10 takes the form

\[ i_1 = \left( g_m e_i \right) e_i \cos \left( \omega_1 - \omega_2 \right) t \quad (11) \]

From this it is seen that the conversion transconductance is \( g_m e_i \) in this case. For the data computed this is 267. If \( e_i \) were rectangular rather than sinusoidal, the conversion efficiency should be somewhat higher.

Experience may show it possible to consolidate curves of the type shown in Figs. 5, 6, and 7 into a combined set. However, availability even of curves of the sort shown in these figures should prove convenient for aiding design of mixer circuits.

It appears that the techniques here discussed when used with the methods reported in the earlier Tele- Tech articles offer a very flexible technique for design and analysis in electron tube circuits. In spite of the fact the curves presented apply to tubes having only nominal similarity to the theoretical “Bogie” tube, experience has shown that they make available a simple design technique which appears to permit determinations to be made with surprising accuracy. It is therefore believed that further tests will prove the suitability of the method for general practical use.

**REFERENCES**


**Empire State Building’s 1466-ft. Mast Carrying Five TV and Three FM Antennas**

The 1250-ft Empire State Building, long the showplace of New York and the world’s highest building, is about to become the world’s most antennad tower. Our cover shows constructional details of the 216-foot antenna-mast structure which will mount five television antennas and three FM antennas for five New York television stations, or 13 carriers in all.

For stations WCBS-TV, WABD, WJZ-TV, and WPIX, the new RCA Super Gain Dipole Antenna is being used, and for WNBTV a Channel Four superturnstile will mount the structure. Frequency modulation will be transmitted by WNBC-FM from an antenna probably mounted above the television turnstile. For stations WCBS-FM and WJZ-FM the antennas are expected to be mounted somewhere about the center of the respective TV radiators.

The tower on which all these antennas will be mounted is a work of art in itself and mounting and protecting the antennas along a vertical length of tower section will not be simple. Heating elements are provided to keep ice loading down: to a safe limit and a six-foot lightning conductor on the top of the tower takes care of static discharges. An additional CAA requirement which has been added, since the original plans were drawn, is a 300-mm rotating beacon of the type used to mark aerial navigation hazards.

**Transmitter Locations**

Down below, on floors ranging from the 81st to the 85th will be the transmitters. On floor 81 will be the WPIX installation connected by 6½ inch diameter coaxial cables to the antenna. All the other transmitters will use 3½ inch diameter coaxials to connect to their respective radiators. Floor 82 houses the WABD stations, and number 83 has WCBS-TV and WCBS-FM. The two existing stations, WJZ-TV and WNBTV are installed on floors 85 and WJZ-FM will also be added there at a later date.

As previously reported in Tele-Tech, the presence of thirteen carriers in the area of the tower may reasonably be expected to cause some degree of interaction between the stations. Early theories tended to the view that considerable spacing would be required to prevent this. However, tests at the RCA laboratories are reported to have shown that there is little, if any, interference as far as can be ascertained on the scale models used for the experimental work. It is understood that the spacing between the antennas is of the order of inches rather than feet and that mechanical and physical considerations, rather than electrical, set the spacing.

In addition to the television and FM antennas on the tower there are 8 microwave receiving installations on the base for the AT&T television remote pickup relay service (see cover photo). Although the sharp vertical directional patterns of the television antennas reduce downward radiation in the vicinity of the tower to a very low figure it will be interesting to discover what effect all the RF in the vicinity will have on the microwave installations.

Although predicted figures can never be taken exactly there is no doubt that the increased height for the stations not previously on the Empire State Building will enable their service areas.

The man responsible for television’s largest and most complex antenna installation to date is Dr. Frank G. Kear of the firm of Kear and Kennedy, Consulting Radio Engineers, Washington, D. C.
**FCC DECISION DEFENDED BY COY**—The radio-television industry received in all probability the most extraordinary defense of an FCC decision ever undertaken, in the addresses of FCC Chairman Wayne Coy in Chicago before three groups, the National Electronics Conference, the Chicago Television Council, and the Association of National Advertisers. Mr. Coy undertook to justify in detail the FCC’s viewpoint that the move for the establishment of bracket standards for video receivers was not only beneficial in making present sets compatible with the CBS color system, but also held promise of future changes in black-and-white receiver standards to bring about improvements in picture resolution through horizontal interlace and the use of long-persistence phosphors.

**COURT TEST WOULD PROVIDE DELAY**—Any Federal court test of the FCC-CBS color-television decision, as now being discussed by radio-TV manufacturers opposing the “rush” edict on the designing of bracket standards for receivers, Washington thinks might well be a victory for the FCC in the final judicial determination. But such a legal move, if undertaken by the manufacturers, would be a delaying action of probably two years’ duration on the decision’s effectiveness. The reason why Washington circles view a defeat in the courts as pretty well a foregone forecast, is that Federal courts follow the policy of accepting unequivocally the findings of fact of a Federal agency because the latter is regarded as an “expert(?)” governmental body and are disposed to upset a Federal agency’s ruling only if constitutional rights are violated.

**FCC COERCION CHARGED**—Probably the only springboard for alleged violation of constitutional rights of the manufacturers would be the purported “coercion” of them in forcing a deadline for the bracket standards’ design by the November date. As is now generally recognized there is an almost unanimous united front of engineering opinion among the radio-TV manufacturers against the FCC-CBS ruling. RCA, Philco, General Electric, DuMont Laboratories, Zenith, Motorola, Admiral, Hallicrafters, Andrew, Emerson, Magnavox, Stewart-Warner, Sentinel, Packard-Bell, Tele-Tone and Transvision, in their letters to the FCC all lined up to assail various phases of the FCC decision and the short timetable for the bracket standards’ production plan.

**RADIO RELAY VALUABLE IN KOREA**—Radio relay, despite the numerous mountains in Korea, has proved a most valuable tool of military communications, Maj. Gen. S. B. Akin, Chief Signal Officer of the Army, reported in a statement to TELE-TECH’s Washington bureau after his return from an inspection of combat communications in the Korean Theater. To overcome the obstacles of the mountainous terrain, Signal Corps communications specialists erected an unusual number of microwave radio relay stations on mountain tops as well as valley floors. Then the Army communications specialists “crossed” the mountains by projecting the radio beams from one valley up to a mountain crest and down from the latter to the valley relay point. In this manner, Gen. Akin cited, messages were bounced for many miles with most reliable communication results along a chain of stations.

**MARINE RADIO LAGGING BEHIND**—There is a definite lag in the use by the marine radio services of the available radio-electronic navigational aids in contrast with the prompt acceptance of proved new radio systems by the aviation field. This was a keynoted sounded at the recent first joint meeting of the Institute of Navigation, Radio Technical Commission for Marine Services and the Radio Technical Commission for Aeronautics. FCC Commissioner E. M. Webster discussed the frequency problems in the radio navigational field and the need to coordinate domestic use of frequencies with the international allocations. The growing use and value of shore-based radar in harbor installations was the subject of an interesting report by Director of Telecommunications E. C. Phillips of the National Federation of American Shipping. And CAA Federal Airways Director C. F. Horne, in describing the progress in the aviation RTCA SC-31 program, stressed that the electronic aids plan is advancing aviation safety just as has the national highway system for the automobile.

**MOBILE RADIO VITAL IN CIVILIAN DEFENSE**—Mobile radio systems, especially those of police and fire departments and of land transportation services like busses and taxicabs, are considered invaluable links of communications in the civil defense planning of the Federal Government by the National Security Resources Board. In all municipal and state civil-defense plans the NSRB civil defense office has emphasized that the paramount requirement is for adequate basic and standby communications facilities. Broadcasting, television and the telephone networks are the basic and primary methods of alerting populations in event of bombing attacks, and after the destruction of atomic bombing. Since telephone and broadcasting-TV facilities would undoubtedly suffer heavily, the mobile radio systems are vital auxiliary and ancillary communications networks.
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KESTER SOLDER COMPANY
4210 Wrightwood Avenue, Chicago 39, Illinois
Newark, N. J. • Brantford, Canada
Random Noise Generators

A series of random noise generators have been designed to produce a known output noise in the frequency range of 2600 to 18,499 MC. Available in five separate models, each noise source utilizes a standard commercial 12-volt lamp in a JAN-type wave guide. A separate cabinet houses the power supply for the lamp, which is provided with direct connection of the lamp to the output terminals. A unique feature of the equipment is that all units are of the same design. The generator models listed below are available:

- Model T-92: A single frequency generator is capable of producing frequencies from 2600 to 18,499 MC. It is designed for use in laboratory equipment and can be easily modified for other applications.

Front-Surface Mirrors

Development of the Zenon Kote process has resulted in the production of front-surface mirrors which are unusually durable and tarnish-resistant. The reflecting surface is secured by thermal evaporation of a special aluminum alloy under high vacuum. The reflecting surface is then protected by the deposition of an extremely hard but transparent film, which in no way affects the reflectivity of the mirrors. Mirrors produced by this new process have a reflectivity of about 95% in the visible spectrum, and they can be made to meet any optical or dimensional tolerances. — Zenith Optical Laboratory, 129-0 Waltham 20, Mass. — TELE-TECH.

Double Pulse Generator

Producing two pulses individually controllable in width, amplitude and time relation to each other, the Model 992 double pulse generator is a basic laboratory instrument, useful for testing TV equipment and checking characteristics of wide band amplifiers. Pulse amplitude is individually adjustable, without cross effect, from 0 to 500 and 0 to 2000 volts. Amplitude of both pulses after mixing can be varied by means of a continuous fine control in a 1 to 1 step generator. Pulse rise time is 0.8 usec, decay time 10 usec, and duration is individually adjustable from 1.0 to 1.5 usec. Repetition rate is adjustable in 3 ranges: 1 to 10, 10 to 100, and 100 to 1000 cycles, and can be externally triggered. Output impedance is approximately 500,000 ohms. Overall accuracy of control equipment is within 1%. — Berkeley Scientific Co., 146 and New St., Richmond, Calif. — TELE-TECH.

Wave Traps

The RLW-906 wave trap (right) has been designed to counteract interference on TV receivers caused by signals at frequencies between 41 and 47 MC, such as police and fire communications, or maritime and mobile services. It can be used on balanced transmission lines and contains two resistors, capacitors and inductors in each leg. The two series-resonant circuits are tunable by means of screwdriver adjustments. Installation is made at the antenna input terminals on the TV set. Inference on TV receivers which is caused by FM broadcasting stations operating in the 88 to 108 MC channel is reduced or eliminated by the RLW-906 wave trap (left). Tuned by two screwdriver adjustments, the RLW-095 may be used on balanced or unbalanced lines. The trap contains two resonant circuits, one circuit consisting of each side of the transmission line to a common grounded connection. Installation is made by means of screwdriver connections at the antenna input terminals on the TV receiver. — JAN Microwave Electric Co., Syracuse, N.Y. — TELE-TECH.

Hermetically-Sealed Coil Holders

A new line of hermetically-sealed coil and transformer holders is structurally designed using Aalghty Metal-Hydrogen-annaled after fabrication. They serve the two-fold purpose of magnetic shield and wound container. Where additional stray shielding is required, close fitting nested shields, consisting of a copper shield and another Aashty Metal shield, are available. All transformers and the balanced core type, coil and core structures are then sealed with being horn-shunting. — Thermador Electrical Manufacturing Co., 5110 District Blvd., Los Angeles 23, Calif.

Video Relays

The class S video relay (foreground of photo) is said to be free of contact chatter and is unusually compact, measuring only 1½ in. overall length, 1½ in. in height, and 1 in. in width. The class C video relay is in the background. One of its advantages is the small opening space it occupies. A mere 0.847 in. is width. — Automatic Electric Co., 1033 West Van Buren St., Chicago 7, Ill. — TELE-TECH.

Power Supply

Model 515 power supply features one regulated B supply, one regulated C supply and one unregulated filament supply. Excellent regulation, low ripple content, and low output impedance are characteristics of the unit. The supply is continuously variable from 0 to 150 and delivers 5 ma. For all output voltages (of the C supply) the output voltage variation is less than 1 mv, for line fluctuations of 100 to 125 v. At 150 v, the regulation is less than 0.1% between 9 and 5 ma. At other settings below 150 v, the internal resistance of the supply will increase to a maximum of 50,000 ohms Ripple is less than 1 mv. — Kenep Laboratories, Inc., 139-143 1st Ave., Florence, N.Y. — TELE-TECH.

TV Monitor

All the controls on the new MTV-15 TV monitor, are located on the front panel making them easily available to operating personnel. In addition to a 12½ in. picture tube the unit contains an audio channel, and speaker which may be used forconvenient programming. The high gain on TV receiver construction (as well as the handle grips on the lamp socket) permit the unit to be used for receive TV pickup use. Overall dimensions are 16 in. x 20 in. x 11 in. — Thermador Manufacturing Co., Waltham 9, Mass. — TELE-TECH.

Wire Stripper

Actually permitting mechanical wire stripping in instances where hand methods were thought to be the only safe way, the Rush Wire Stripper (two-

wire stripper is said to be able to increase production as much as 400% over former methods. Model shown will strip wires gauge 18 through 25, including Litz wire up to 10/4. Stripping wheels may be resharpened or dressed as they wear, thus keeping wheel costs to a minimum. All present models use principle of frictionally generated heat to melt enamel and Formex type insulation. Through proper selection from large number of different grades of stripping wheels, practically all kinds of insulations can be cleanly removed without damage to the wire — Rush Wire Stripped Div., The Fraser Co., 104 South State St., Syracuse 2, N.Y. — TELE-TECH.
Capacitors

sealed for Life with silicone rubber

SILICONE—the amazing new synthetic that made headlines when General Electric brought it out—is back in the news again. For today, G-E small capacitors, up through 5000 volts, are hermetically sealed with silicone rubber bushings or gaskets.

This means that your new G-E capacitor is sealed positively, permanently—for maximum life. For silicone seals by compression alone, without the use of adhesives. It will never shrink, loosen or pull away—it remains elastic at any operating temperature a capacitor will ever meet. It is impervious to oils, alkalies and acids. Its dielectric strength is permanently high and it is not easily damaged during installation for it has a flexibility that withstands mechanical and thermal shock.

This exclusive G-E feature—designed to surpass established installation requirements—makes General Electric capacitors finer and more dependable than ever before. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

Silicone-rubber bushings, permanently elastic and formed to close tolerances, seal themselves by compression to the capacitor cover. They are used with capacitors 1500-v d-c, or 660-v a-c, and lower. Silicone rubber gaskets with plastic or porcelain stand-offs are used for higher voltages.
SUPERIOR REPRODUCTION WITH

Gray RESEARCH

TRANSCRIPTION ARMS

NEW VISCOS-DAMPED
108-B ARM

For all records — 33 1/3, 45 and 78 r.p.m. Radically new suspension development on the viscous damping principle for perfect tracking of records and elimination of tone arm resonances. Instant cartridge change with automatic correct stylus pressure. Solves all transcription problems. Ideal for LP records. For Pickering, new GE (short), old GE (long) cartridges. Write for bulletin. Price, less cartridges, $56.00 (effective Sept. 1st). Cartridge slides for both GE and Pickering are furnished.

MODEL 106-SP ARM

Designed to meet strictest requirements of modern highly compliant pick-up cartridges. 3 cartridge slides furnished enable GE 1-mil, 2 1/2-mil or 3-mil cartridges or Pickering cartridge to be slipped into position in a jiffy. No tools or solder! Superb reproduction of 33 1/3, 45 or 78 r.p.m. records. Low vertical inertia, precisely adjustable stylus pressure. Write for bulletin. Price, less cartridges, $45.15

EQUALIZERS

MODEL 603 EQUALIZER

Latest of the universally adopted Gray Equalizers used, with Gray Tone Arms, as standard professional equipment by broadcast stations. High-frequency characteristics comprise 5 steps — flat, high roll-off, NAB, good records, poor records. For both GE and Pickering cartridges. Price, $50.70

MODEL 602 EQUALIZER

Has 4 control positions, highly accurate response curves. Price, $49.50

Write for bulletins on Gray Equalizers.

Gray RESEARCH

Division of The Gray MANUFACTURING COMPANY

Originators of the Gray Telephone Pay Station and the Gray Audograph

Traveling Wave Power Amplifier

A traveling wave power amplifier has been developed to deliver a power output in excess of 18 watts with a power gain of 20 db.

Known as the 525B, it is of the helix type, the r-f terminals are arranged for waveguide circuit and the tube operates with an external electromagnetically field. Federal Telecommunication Laboratories, Inc., Nutley, N. J. - TELE-Tech

TV Sync Lock

The use of TV-28A television sync lock unit makes it possible to insert local commercials, special effects or other local program material into remote picture signals without interference. This is accomplished by means of automatic synchronization of the local sync generator with the remote sync signals. During network shows, local program material can be inserted by means of superimpositions, lap, fade or wipe dissolve. On a local remote pick-up, the use of the TV-28-A eliminates the necessity of transporting expensive additional equipment to the pick-up point, or of flapping-in to the local sync generator for each commercial.—General Electric Co., Syracuse, N. Y. — TELE-Tech

SPEED UP AND MAINTAIN UNIFORM PRODUCTION

FREED NO. 1010

COMPARISON BRIDGE

This self contained, AC operated bridge is ideal for laboratory and production testing of resistors, condensers and inductors. Resisters of 10 ohms up to 1 meggohm are measured by the comparison method at 60 cycles. Condensers of greater value than 1 meggohm can be measured by using the instrument as a limit bridge. Condensers from 500 microfarads up to 10 microfarads are measured by the comparison method at 1000 cycles. Condensers above 10 microfarads are measured by the comparison method at 60 cycles. Small condensers 500 microfarads to 25 microfarads are measured at 1000 cycles, with the instrument used as a limit bridge. Inductors can be measured at 60 cycles, 1000 cycles or 10,000 cycles, depending upon their values.

Ranges: L-100 Hz to 1 Hz, F- 60 cycles L-1 Hz to 1 mHz, F-10,000 cycles L-0.1 Hz to 1 mHz, F-10,000 cycles

SEND FOR NEW FREED CATALOG

FREED TRANSFORMER CO., INC.

Dept. N.K., 1718 Waverly St., Bklyn (Ridgewood) 27, N. Y.
TV Pointer

A new device enables a narrator or commentator to insert a black and white pointer about 20 lines high and seven lines wide at point in the television picture to more effectively describe the action taking place. Known as the "Electronic Pointer (TV-SEAL), it consists of a rack-mounted chassis and a simple control unit, which may be located anywhere a picture is available to the operator. The pointer is operated by a control similar to the "stick" of an airplane. A toggle switch selects either a black or a white pointer. General Electric Co., Syracuse, N.Y. TELE TECH

Preamplifier

Model 230H, a compact, small preamplifier, will equalize box frequencies and provide necessary gain for magnetic pickups. It is self-powered and operates with any high-quality, high-input impedance amplifier. It is said to be the most broadcast station equipment in the frequency range and accuracy of equalization. Furthermore its intermodulation and harmonic distortion is said to be lower than any other preamplifier available. Pickering & Co., Oceanside, N.Y. TELE TECH

Soldering Gun

Dual spotlights to eliminate shadows are features of a new high-duty soldering gun. The new model is considerably smaller and lighter than previous 135-watt guns; yet it has substantially greater soldering capacity. Dual heat (180/125 watt) is provided for all light and delicate soldering. Heating time is 2 sec. A trigger-switch control adjacent to the work and eliminates need for unplugging gun between jobs. Weller Electric Corp., Easton, Pa. TELE TECH

Specify BREEZE "Monobloc" Waterproof and Pressure Sealed CONNECTORS

The only APPROVED Monobloc System for Advanced Radar, Communications, and Electronic Equipment

Breeze "Monoblocs", with single piece plastic inserts, offer outstanding advantages in assembly, wiring, mounting and service in the field.

Single piece inserts make a tighter unit, eliminate the air spaces within conventional multiple-piece inserts, greatly reduce the opportunity for moisture shorts.

Removable contact pins make possible bench soldering of leads, quick, error free assembly of Breeze Waterproof Connectors and panel-type "Monobloc Miniatures."

Single-Hole Panel Mounting is all that is required for either Waterproof or Pressure Sealed types.

Pressure Sealed types are available for values up to and including 75 psi, or they can be specially engineered for greater pressures.

Breeze "Monobloc" Waterproof and Pressure Sealed Connectors are engineered to your requirements in aluminum, brass or steel—in all sizes and capacities. They are fully tested and approved...cost no more than ordinary types.

Write for Details

If you have a tough connector problem, ask BREEZE for the answer!

BREEZE CORPORATIONS, INC.

411 South Sixth Street, Newark 7, N. J.
Distortion & Noise Meter

The fundamental circuit of the type 25-A distortion and noise meter comprises a series of eight fixed band rejection filters covering the 50 cps to 15 kc range, followed by a stable, wide range (50 cps to 45 kc) high gain amplifier. There are no tube circuits at other sources of inherent distortion between the input of the 33-A and the filter network. The circuit is extremely low level, in that the output can be extremely high. There are a pair of output jacks provided for measuring the output of the external scope in place of the input meter.

ULF Frequency Meter

Accurate measurement of r-f signals throughout the ULF television band can be provided by the 536 ULF frequency meter. The dial is calibrated in Mc and a coaxial type cavity resonator is employed in which the center conductor is adjusted by rotation of the frequency dial so as to vary the resonant frequency continuously from 470 to 650 Mc. Polytechnic Research & Development Co., Inc., 209 Tillary St., Brooklyn 1.

Beacon Antenna

A high gain beacon antenna (model 511W) for the aircraft frequencies has a gain of approximately 3 db, thus effectively multiplying transmitter and receiver power by two. Communication in all directions is possible due to its omnidirectional radiation pattern. A specially designed side tube facilitates communication with aircraft while aloft.

Operating efficiency is further insured by matching each antenna to the operating frequency and by a low loss coaxial cable construction plus built-in lightning protection substantially eliminates maintenance and assures dependable performance. The Workshop Associates Inc., 134 Crescent Road, Needham, Mass.—TELE-TECH.

Tape Recorder

Two hours of dual track recording in a 3.75 in./sec., or one hour of dual-track recording at 7.5 in./sec., are provided by the model 3-71 portable tape recorder. Signal-to-noise ratio is 45 db at 7.5 in./sec. and 49 db at 3.75 in./sec. Twelve hundred feet of tape can be rewound in three minutes. The unit has three outputs, an internal speaker with a 6 in. F-1 Alnicco V heavy-duty 2 ohm voice coil, an external speaker with a 4 in. 10 ohm voice coil, and a 500-ohm output to line or external amplifier. Precision-made and Pressurized when required. Over 300 types available, most of them in stock.

Backed by the name KINGS—the leader in the manufacture of co-axial connectors. Write for illustrated catalogs. Department "T".

IT'S KINGS FOR CONNECTORS

Manufacturers of Radar, Whip, and Aircraft antennas Micophone Plugs and Jacks.

Radar Assemblies, Cable Assemblies, Microwave and Special Electronic Equipment

Manufacturers of Radar, Whip, and Aircraft antennas Micophone Plugs and Jacks.

Radar Assemblies, Cable Assemblies, Microwave and Special Electronic Equipment

Power Supply

A highly-regulated dc power supply has been developed for any application requiring a voltage between 10 and 60 kv with a maximum current of a 2 ma. Known as the EME-2, it consists of a driver unit and a rectifier unit, and is available with either positive or negative ground. The final output voltage is taken from the rectifier unit and can be continuously varied between 10 and 50 kv. Ripple voltage is held to a maximum of 6 v.—Radio Corporation of America, RCA Victor Div., Camden, N. J.
John M. Miller, Jr. has been named chief engineer of the television and radio research and engineering department, Bendix Television and Broadcast Receiver Division, Bendix Aviation Corp.

W. D. Loughlin has been elected chairman of the board of directors of Bounton Radio Corp., Boonton, N. J.

Dr. G. A. Dounsibrough is the new president of the organization and Dr. D. M. Hill has assumed the post of vice president in charge of research and development.

Edmond Sherman, formerly chief engineer of Starrett Television Corp., has been elevated to the post of vice president in charge of engineering.

Harry R. Smith has been named head of the television transmitter development department of Standard Electronics Corp., subsidiary of Claude Neon, Inc. He was formerly associated with the television transmitter division of the Allen B. Du Mont Laboratories, Inc., as senior development engineer in television broadcasting equipment.

Dr. R. G. E. Hutter, head of the electronics research section of the physics laboratory, Sylvania Electric Products Inc., Bayside, N. Y. has been appointed adjunct professor at the Brooklyn Polytechnic Institute.

John Rhoades, since 1946 on the engineering staff of the Hofman Radio Corp., Los Angeles, has been upped to the post of chief engineer of the special apparatus division.

E. Arthur Hungerford, Jr., a pioneer in television engineering, production expert on many of the nation’s first telecasts, and wartime radar specialist for the Navy, has joined the sales staff of General Precision Laboratory, of Pleasantville, New York. He will handle sales work on the video recorders, television film projectors and other electronic units.

Howard E. Anthony, president of Heath Manufacturing Co., Benton Harbor, Mich., has been awarded the honorary degree of Doctor of Science by the University of Hollywood, Hollywood, Calif. He graduated from Hillsdale College, Hillsdale, Mich., in 1931, and four years later founded the Heath Company.

Richard Sachleben has been appointed production manager of the U. S. Electronics Corp., Lyndhurst, N. J., manufacturers of coil components. Mr. Sachleben comes to U. S. Electronics after having spent more than 20 years in the communications and electronic industries. Prior to joining his present company, he spent five years with Sperry Gyroscope as manager of their transducer division. Earlier, he served with GE as assistant production manager and chief of their engineering-sample section for more than 15 years.

Dr. F. N. Hambleton, formerly of the Philco tube-development laboratory, has been appointed electronic engineer in charge of the electronic laboratory at Superior Tube Co., Norristown, Penna.
WOR-TV and Skiatron Test Subscribervision

A new system of fee television developed by the Skiatron Corp., makers of theatre and large screen television equipment, known as Subscribervision is being tested by WOR-TV, New York City, on channel 9.

The system is simple in principle, but complex in security, in other words "bootlegging" television programs is almost impossible. The system uses a plastic card, or slide, about the size of a 35 mm transparency which has a specific pattern on it. When the television signal is transmitted part of the synchronizing signal is omitted resulting in a scrambled picture on receivers not equipped with a decoder. The decoder itself is very simple and utilizes the flying spot scanner principle.

A small cathode ray tube illuminates the plastic decoder slide; the resulting signal, which is picked up by a photoelectric cell, contains the missing portion of the synchronizing pulse. This is then inserted in the sync circuit of the receiver and decoded, or unscrambled, the picture.

Since no other connections are required, and the signal is received entirely by radio methods the system is eminently suitable for other purposes such as military communications use. The Subscribervision plan envisions the weekly mailing of new keys to the users, who would thus be protected against "stolen" television by the regular change of code keys which require an accuracy of .0001 in.

Test transmissions from WOR-TV are being made between the hours of 10:00 A.M. and 10:00 P.M. daily and at other hours when the station is not normally on the air. The experiment is under the direction of Jack Poppele vice president in charge of engineering for WOR and the Subscribervision equipment is installed at the WOR-TV transmitter at North Bergen, N. J.

Screen Chemicals Developed for Color-TV Tubes

Two groups of fluorescent powders for the development of color television picture tubes which are suitable to several types of electronic color TV systems now being considered have been developed by the Tungsten and Chemical Division of Sylvania Electric Products Inc., according to Dr. Elmer C. Larsen, chief engineer.

Dr. Larsen said that the two groups of TV color phosphors, which are now available in engineering sample quantities, include sulphide and oxide types in the three basic TV colors: red, green and blue. The oxide powders are relatively fine texture while the sulphides are of about the same particle size as those now used in standard black and white picture tubes.

"The development of suitable red phosphor material," Dr. Larsen commented, "has hitherto presented a problem. Conventional red phosphor mixes have lacked color depth due to relatively low brightness obtained and excessive light output in the green and blue region. A new red phosphor which we are now making available for color tube development is a magnesium activated zinc phosphate."

Coming Events

October 30-November 1 — IRE and RTMA, Radio Fall Meeting, Hotel Syracuse, Syracuse, N. Y.

November 3-4 IRE, UHF-Microwave Conference, Kansas City Section, Kansas City, Mo.

November 12-16—National Manufacturers Association, Fall Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

January 10-12 High Frequency Measurements, Conference, Sponsored by the IRE, AIEE, and National Bureau of Standards, Hotel Statler, Washington, D. C.


January 22-26 AIEE, 1951 Winter General Meeting, Hotel Statler, New York City.


June 18-20 American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.
Propagation Problems on Empire State TV Site

A glimpse of some of the problems incident to erecting new steelwork during continued operation of television stations appeared recently during the construction work going on at the Empire State Building, New York, which is to carry five television antennas. By an error fine mesh wire netting was used to catch rivets at one stage in construction, this was fine until the platform was raised, then, since fine mesh wire netting is opaque to VHF radio waves a shadow was produced. Moving the netting solved the problem. Then another sudden poor standing wave ratio was noticed. This turned out to be due to resonant members at channel 4 which when riveted together acquired better conductivity and resulted in an antenna mismatch. Adding a new piece of steel improved the SWR! Finally, one evening some unsecured steel cables were allowed to hang and away in the wind when the steel crew left. Considerable distortion and fading was noticed in the transmissions as a result. Such are the perils of constructing while transmitting.

Field Wire Proves Worth in Combat

A new type military field communication wire is proving effective in combat. Recently developed by the Army Signal Corps, and now being produced in quantity by industry, the new wire has withstood all the rugged conditions of combat encountered in Korea. It can be laid at speeds up to 120 miles per hour from airplanes with good results.

The wire represents a successful effort by Army Signal Corps engineers to combine the substantial talking range and other characteristics of standard field wire with the reduced size and easy carrying of assault wire used by fast moving troops in World War II. It is particularly suited to airborne operations.

RCA Acquires Cincinnati Plant

A new plant for the manufacture of miniature-type electron receiving tubes will be established by the RCA Victor Division of the Radio Corporation of America in Cincinnati, Ohio. The plant, to be operated by the RCA tube department, is scheduled to be in full production by autumn of 1951. Orders for high-speed tube-making machinery have already been placed in anticipation of the acquisition of the new plant.

GE to Open Clyde, N. Y. Plant

The General Electric Company has announced that it will reopen its Clyde, N. Y., plant and transfer the production of germanium products now made at the G. E. Thompson road plant in Syracuse to the Clyde factory.

The Clyde plant, formerly used for assembly of small radios, must be completely renovated and specialized machinery installed before germanium product production will begin about December 1. Full production is expected about February 1.

Erratum

Page 42 of the September issue of Tele-Tech contains an error in the switch connections shown for the Cueing Amplifier Bridging-Coupling Circuit by E. W. Hill, chief engineer of WDHL, Bradenton, Fla. The DPDT switch should be shown with a neutral center position instead of the split connections shown.

Choice of new all-in-one front model, or trunk mount unit—both are drawer-type with quick lift cover.

Motorola
FM 2-WAY RADIO

New UNI-CHANNEL SENSICON DISPATCHER—
with the marvelous Sensicon circuit...

Now the best in 2-way radio—in the Utilities and General Industry—Uni-Channel is hitting a new high in performance and a new low in maintenance costs. It will do everything that’s being claimed to reduce your time and costs in material and crew handling. Motorola engineered, with eight exclusive features, it guarantees you permanent selectivity and reliability—minimum adjacent channel interference and maximum long-term protection against obsolescence and loss of investment. REMEMBER! When you add 2-way radio—you’re ahead. When you make it MOTOROLA, you stay ahead!

QUICK INSTALLATION

In any of several mounting positions, the complete, permanent installation requires only four screws.

COMPLETE "SHAKE-DOWN" TESTED

—by Motorola's engineering laboratory, the unit undergoes exhaustive tests to meet extreme conditions of service. (Tests made against temperature, humidity, and shock.)

ANTI-DUST HOUSING, with heavy duty construction throughout. Here is truly the all-purpose 2-way radio for every type of mobile application—offering the owner the benefits of advanced design, complete reliability, enduring economy, and freedom from obsolescence.

RAULAND DEVELOPING METAL RECTANGULAR

A laboratory model of a 17 in. rectangular TV metal tube produced by the Rauland Corp., Chicago 41, III. Overall length will be 11 11/16 in. maximum and the screen size will be 11 by 14½ in. Rauland has not disclosed when production of the 17 in. tube will begin.
Radio Communication at Ultra High Frequency


This is a welcome addition to the current literature on UHF. While much of the material is basic, it is of a type which will not become of less value as the years pass. Much of the information concerns equipment which is still in the development stage. Although the subject is handled from the British point of view (terminology etc.) it should be interesting to the American reader. A reasonable amount of theory in the form of mathematics is included, but there is also a wealth of practical matter. In short, this is a book which is recommended reading for engineers.—JHB

Handbook of Motion Picture Techniques

By Emil E. Bradford. Published by Whittlesey House, 330 West 42 Street, New York 18, N.Y., 1950; 311 pages. Price $5.95

This is a useful book for the television engineer who has to work with films either in a new job or as an extension of his regular work. It describes motion picture techniques and lighting with a clarity which should be of value to the TV cameraman.—JHB

TV Receiver Specifications

Standard Coil Products, Inc., 2329 North Pulaski Road, Chicago 39, Ill., has announced the availability of a complete list of specifications for all TV receivers now being manufactured, reprinted from Radio & Television Retailing for September, 1950, (Caldwell-Clements, Inc., publishers). Marketing and technical data on each of the 724 models is included. Copies will be sent on request.

NEW DYNAMIC MICROPHONE

The American D-33, full vision, dynamic microphone, manufactured by American Microphone Co., Pasadena, Calif., provides full vision for audience and artist. No pre-amplifier is required for the D-33. It weighs 7 oz. and is available in all popular impedances.
Military Contract Awards

Manufacturers who have received contract awards for producing of radio - radar - electronic equipment for the Armed Services are listed below by name city, equipment and amount of contract. Subcontractors interested in bidding on performance of any part of each contract should sell their services to these prime contractors. This list, which is current for each month up to our press time, covers the period from August 30 to October 4, 1959.

Connecticut Telephone & Electric Co., Meriden, Conn., Telephone System el 16C, $2,544,000.00; Cincinnati Electronics Co., Cincinnati, Ohio, Receivers, R-17A, ARC-3, $677,243.00;

Federal Tele. & Radio Corp., 100 Kingsland Rd, Clifton, N. J., Radio Set AN/GRC 3-8 Series, $3,000,000.00; Radio Set AN/TRC-25, $250,000.00;

General Electric Co., 840 So. Canal St., Chicago 90, Illinois, Capacitor, $14,312,500.00;

The Hallicrafters, 5th & Kostner Ave., Chicago 24, Ill., Radio Set AN/GRC-16 & AN/MRC-2, $2,500,000.00; Hubbard & Miller Co., 81 Wiloughby St., Brooklyn, N. Y., Sound Locating Set GR-6, $219,650.00;

Lavoie Laboratories Inc., Morganville, N. J., Oscilloscope & Maintenance Spare Parts, $185,525.00; Lear, Inc., 110 Ionia Ave., N. W., Grand Rapids 2, Mich., Actuators: for use on various aircraft, $25,520.00; Actuator, gear case for FT-3-5, 3N, 4N, 2D aircraft, $46,588.00; Actuator, Linear, elevator trim tab for use on F4U-5, 5N, 5P aircraft, $22,450.00; Lewyt Corp., 60 Broadway, Brooklyn, N. Y., Radio Set AN/GRC-9, $200,000.00;

Molded Insulation Co., 335 E. Price St., Philadelphia 44, Pa., Radiosonde Transmitter T-69, $138,000.00; T-69 (1) ANT-2, Radiosonde, Transmitter, $67,000.00;

Radio Corporation of America, Camden, N. J., AN/PRC-10 Radio Set, $270,000.00; RCA Victor Radio Corp. of America, Harrison, N. J., Tube, Electron JAN 829B;

Sperry Gyroscope Co., Great Neck, N. Y., Radar Set AN/MPQ-10, $2,000,000.00; Radar Set AN/MPQ-10, $2,000,000.00, Tube Electron JAN 2K 41, $242,356.00;

Sprague Electric Co., 201 Beaver St., North Adams, Mass., Capacitor, $27,105.00; Sylvania Electric Prod., Buffalo N. Y., Radio transmitters, power junction box, cl-02Q, $2,473,000.00;

Telephonic Corp., Park Avenue, Huntington, L. I., N. Y., Microphone & Microphone element, $35,140.00; Microphone, Carbon, low impedance, $42,085.00; Times Facsimile Corp., Times Bldg., 229 W. 43rd St., New York 19, N. Y., Modification Kit for AN Facsimile Set AN/TRC 1 & AN/TXC-1A, $28,198.00; Transmitter Equip. Mfg. Co., Inc., 345 Hudson St., New York 14, N. Y., Terminal Set AN/TRC-3, $129,928.00;

Western Electric Co., Inc., 120 Broadway, New York, N. Y., Radio Set AN/TRC 24, $400,000.00.00.
Radial Beam Tube

(Continued from page 27)

tube all of the anodes are tied together as they would be for the input tube of a time division multiplex or telemetering system and the common output appears across the load resistor $R_L$. The 30 inputs are applied to the 30 grids at the terminals marked 1 to 30. Common grid bias is obtained by tapping along the cathode bias resistor as shown. Fig. 5 shows the pattern of output pulses obtained with all the anodes tied together.

Operating Characteristics

Measurements have shown that with the beam stationary, the tube is no more noisy than a tetrode of usual design operated with the same current. The formation of the electron beam does not seem to introduce any appreciable noise. When the beam is rotated, of course, the noise level of the common anode current is high because it is sharply interrupted 30 times a revolution.

The crosstalk to adjacent channels is at least 30 db down with the beam centered on one of them. This measurement varies with focus as would be expected, becoming worse when the beam is spread out to overlap adjacent slots.

The speed of rotation is limited

Fig. 5: Oscillogram showing output pulses of tube when the grids are all at zero potential and with anodes tied together

only by the circuit connected to the tube and by its internal capacitances. Rotational speeds in the megacycle range are quite possible.

There are 3 slot positions in the tube where the beam experiences different conditions. The first is at the gap between screen segments. When the beam is in this position each screen element adjacent to the slot has a voltage equal to 0.866 times the maximum or peak ac voltage. The next is the first slot adjacent to the gap and the third is the second slot in. For each there is a slightly different set of voltages near the screen elements with the results that the beam varies slightly in width and speed of rotation between these three positions. These variations are so small as to be
negligible for most applications. However, they give the variations in the grid characteristics shown by curves A, B, and C in Fig. 6.

The tube is generally applicable wherever it is desired to switch at high speed and with no inertia between as many as 30 separate circuits. For example, one use is in the commercially available instrument known as the SONOLATOR, an instrument which continuously scans the spectrum of an audible signal such as that of the human voice and presents this spectrum instantaneously. Other applications are found in the fields of multiplex telephony and telegraphy, telemetering, various coding and decoding problems, frequency generators and tone generators with special waveforms and various other high speed scanning operations.

The writers wish to acknowledge the very able assistance of Mr. Fred F. Crawford in the development of this tube.

New Values of Electrical Units Established by Law

By an act approved July 21, 1950 (Public Law 617), the 81st Congress has given formal statutory sanction to a revision of the practical system of electrical units. In large part, the values adopted for these units resulted from research by the National Bureau of Standards, and the present legislation was proposed by the Bureau. The changes in magnitude of the units are small, in no case larger than 1/20 of one per cent, but the new law puts the values on a clear and unambiguous basis which assures the closest practical agreement between electrical and mechanical units. The law previously in effect, enacted 56 years ago, included double definitions of the units.

---

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WRITE FOR DESCRIPTIVE CATALOG

American Microphone Co.
370 S. Fair Oaks Ave, Pasadena 1, Cal.

DECADE FREQUENCY GENERATOR
(Continued from page 37)

between those of the grid and the bus-coupling windings. Proper grid drive for each stage was obtained by adjusting the spacings and relative turns of these series-tuned link circuits to give about 1.5 v. rms at the tube grids.

The 200 and 300-KC grid filters were of simpler design, consisting of only two tuned circuits as the percentage separation of interfering signals was much greater. They were coupled to a voltage divider on the harmonic generator to prevent overdriving the output stages. The inductance value for these coils, which were spaced for critical coupling, was 1130 ohms each, this being the maximum size coil that could be accommodated conveniently by the shield cans.

Type 6SK7 tubes are used for all output amplifiers with single-tuned transformer output coupling. These tubes have excellent internal as well as external shielding which greatly reduces instability and stray coupling problems where both grid and plate circuits are tuned.

Operating conditions for a tube power output of 0.2 watt (0.1 watt output to load and 0.1 watt loss in tank) were chosen as follows:

Eg = 250 v.; Er = 100 v.; Ee = —3 v.

For minimum harmonic distortion at this level a load impedance of 25,000 ohms was used, corresponding to 5LQ/r, with a 100-ohm secondary load.

For a peak grid excitation of 3 v. a maximum class A power output of 0.4 watt may be obtained. For a tube output of 0.2 watt a peak grid excitation of about 2.1 v. or 1.5 v. rms is required which reduces harmonic distortion considerably from the maximum class A value.

Plate Filters

The plate coupling transformers, as indicated above, were designed to operate with a working Q of about one-half their unloaded Q. The powdered-iron-cored coils of the type used had an average unloaded Q of about 120. For a loaded Q of 60 the inductance for each primary was determined by the equation, L in henries = 25000/60w. The output secondaries were wound on separate iron cores to reduce capacitive coupling of harmonics and the two cores were clamped tightly together by means of bakelite nuts on a bakelite rod through the core centers. The outputs were connected through coaxial lines grounded only at the shielded output jacks. Secondary to primary turns ratio required to drop the Q to one-half for a 100-ohm load was about one-to-six except the 100-KC stage which required a one-to-ten ratio.

Operating the outputs with no secondary load doubles the load impedance seen by the tube and increases the harmonics generated, but the rise in tank Q more than compensates for the increase, so that the harmonic content in the output is not greatly affected by loads of more than 100 ohms. Any load impedance higher than 50 ohms, resistive or reactive, may be used satisfactorily, although the lower values cause appreciable drop in output voltage.

The built-in power supply is of conventional design employing choke input with two stages of filtering. The ac input is bypassed at the entrance point and the filament and plate leads to the amplifier stages are also bypassed to reduce mutual coupling between stages or coupling to other units through the power line. Separate resistance-capacitance decoupling is also employed in the screen and plate leads of each amplifier stage. The unit should preferably be operated from a stable ac source to minimize phase shift which might cause a slight frequency modulation if used to drive very high frequency equipment. Power consumption with all output stages operating is about 75 watts.

Construction Details

The unit is suitable for standard relay rack mounting, having an 8 x 9 in. panel. All jacks and switches controlling the outputs are located on the front panel. A 1000-KC jack is also provided on the rear apron for possible use in driving a similar unit having outputs in the range of 1 to 10 MC.

All r-f coils were universal wound on cylindrical powdered-iron rods using seven-strand No. 41 litz wire, except the 100-KC plate transformer which was wound with 10/41 litz for increased harmonic attenuation in its output. The location of powdered-iron cores in strong power-frequency fields should be avoided, especially in class C stages, as cross modulation may take place.

The tuning condensers are dual ceramic mounted, air-dielectric type, shunted by silvered mica...
fixed condensers where necessary. The coils were mounted on the tuning condensers by means of threaded bakelite rods through the holes in the core material. Bakelite spacers were used between the cores for adjusting the coupling, where necessary, and a threaded bakelite washer was used as a retaining nut. Aluminum shield cans were used on all r-f transformers.

After the 27 tuned circuits are properly aligned further adjustment is seldom required. A wide-band oscilloscope is useful for observing the pulse waveform on the harmonic bus and the ratios of the output stages by obtaining Lissajous figures. In the unit described, after proper adjustment, the output voltages into 100 ohms with all outputs operating ranged from 3.2 to 3.7 v.

Undesired frequency components in the various outputs were measured as shown in Table I. These values were approximately the same with all or only one output stage operating.

---

TABLE I.
Output Undesired frequencies 100-ohm load no load

<table>
<thead>
<tr>
<th>(side frequencies)</th>
<th>1000 Kc</th>
<th>100 Kc</th>
<th>100 Kc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 Kc</td>
<td>± 100 Kc</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>900 Kc</td>
<td>± 100 Kc</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>800 to 200 Kc</td>
<td>± 100 Kc</td>
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<td>100</td>
</tr>
<tr>
<td>100 Kc</td>
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<td>90</td>
</tr>
<tr>
<td>200 Kc</td>
<td>± 100 Kc</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

(Continued from page 44)

IRE Fellows


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We manufacture Metal Housings for every purpose—from a small receiver to a deluxe broad-cast transmitter. And the cost is low!

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PROBLEM? Send for "Special Problem Sheet"
VIDEO RECORDING

(Continued from page 35)

Since telecine apparatus is normally arranged to give optimum conditions when transmitting normal cine films, it is found satisfactory to attempt to make a telefilm standard as far as contrast gradient and contrast range are concerned. A detailed treatment of this subject is outside the scope of this article, but the main techniques at present in use, are as follows:

Negative and Print.—A fast panchromatic stock is used, such as Eastman Kodak Plus X. A positive picture is produced on the cathode ray tube screen of contrast gradient approx. 2.0. The negative is developed to a 'control gamma' of approx. 0.5, and printed with a control gamma of about 2.3. Since the television pick-up tubes have a contrast gradient of about 0.5 over the working range, the picture produced on the Kinescope is substantially similar to the original subject, and this when photographed by the above technique, gives a print substantially similar to that which would have been obtained had the original scene been photographed directly, except that the contrast range has been reduced due to distortions in the television system.

Negative and print with electrically reduced contrast gradient.—In this case, the contrast gradient of the kinescope tube is reduced electrically to lower the contrast ratio to about 10 or 20 to 1. This is photographed using a high gamma stock such as Eastman Kodak 1398 and the negative is developed to a control gamma of about 2.0, contrast range on the negative. It is then printed normally. The advantage is that tonal distortions occurring in the Kinescope are minimized due to the low contrast range, and the effective brightness is enormously increased, since the brightness corresponding to picture black can now be raised without crushing on whites.

Direct Positive.—In this technique, a negative picture is produced on the kinescope tube by phase reversal. Some electrical contrast gradient correction is employed. The process is the cheapest, but only if one copy is required, since to obtain a second copy, a duplicate negative must be made and a print taken from this.

Negative.—For speed and cheapness, it is sometimes convenient to transmit negative film in the telecine machines, intended to save the time and cost of printing. As the sound quality attainable is low, unless a separate recording system is used, it is considered that the Direct Positive method is superior.

The kinescopes used for television recording at the present time have a picture of approximately 8" x 6", but it is proposed to replace those with high intensity kinescopes using a 4" x 3" picture. Using an accelerating potential of about 20 kv, these will give a brightness which...
Sylvania has been using Metex gaskets for over a year as conductive shields for their TR tubes used in radar and micro-wave ranging equipment.

To quote their experience: “We have found Metal Textile knitted wire gaskets excellent for conducting high frequency currents without boundary arcing. The gaskets are resilient, and yet do not deform too readily. Best of all, the material is inexpensive to assemble through soft soldering techniques.”

A Sylvania Electric TR tube showing Metex gasket loose and in position

The properties—electrical and physical—which make Metex Electronic Gaskets effective in this, and other demanding HF and UHF applications are due to their being made from knitted (not woven) wire mesh. The hinge-like action of the knitted mesh permits controlled resiliency of the finished gaskets. These can be die-formed to close dimensional tolerances, when required. There is practically no limit to the metal or alloy which can be used.

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will allow a smaller lens aperture to be used in the camera. This will minimize blurring on movement, will improve definition and will give a greater depth of focus in the film gate. A special feature of the monitors is a device which effectively eliminates the line structure of the image recorded on the film so that no interference patterns result when the film is subsequently scanned for transmission. The method adopted is to deflect the scanning spot with a small sine-wave displacement in the field scan direction, the deflecting frequency being several times higher than the maximum detail frequency of the television system. The deflection amplitude is variable, and is adjusted to the correct value on test, then fixed.

Two corrections can be applied to the incoming electrical signals; these are frequency/phase correction and the contrast gradient correction already mentioned. The frequency response is adjusted to provide a boost at the higher frequencies to compensate for recording losses, and the phase corrector takes the form of a number of filters, introducing their maximum correction at different frequencies, which are set up when observing a test card from the camera before a recording is made.

A satisfactory continuous motion system of 35mm recording has been evolved, and work is in hand to improve the quality of the recordings obtained, and the operational facilities offered.

It is now necessary to produce an equivalent 16mm system, but it is felt that the accuracy required, if a continuous motion system is used, may be difficult to achieve. Work is therefore proceeding, on the intermittent system, briefly described earlier, but in parallel with this, it is proposed to experiment with a continuous motion camera of the present type, using a reduction optical system placed after the film gate. This would reduce the image size, and at the same time, its linear speed of travel, so that this matches the lower linear velocity of 16mm film.

Haydu Bros. Acquire West Coast Plant

Recent expansion of the plant facilities and manufacturing operation of Haydu Brothers, Plainfield, N. J., with the addition of a west coast plant to spearhead the firm’s entry into the television tube field was announced recently by George K. Haydu, president of the company. The company has recently initiated production of its own line of “North Star” television picture tubes, and the Haydu antenna rotator.

Guesswork is eliminated when you use an ACE Pre-built Screen Room. The area background level of radio interference is suppressed and the room does not introduce any errors in your measurements. Attenuations of 100 db. — and higher — at frequencies as low as 0.15 and as high as 10,000 mc. are readily obtainable. Specially designed Screen Rooms can give attenuations as high as 140 db.

ACE attenuation characteristics have been determined by reputable electronic laboratories. These Screen Rooms are used for various applications such as evaluation and suppression of radio interference; radio and radar calibration, sensitivity, susceptibility, spurious response and radiation; measurements involving electronic instruments used in medical laboratories and many others. Write for descriptive bulletin.

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5-10 KW BROADCAST TRANSMITTER

(Continued from page 29)

cial considerations in the installation. As all but the power transformer, modulation transformer and reactor, are inside the transmitter, very little external wiring is required. The 5000 v. plate supply permits the use of readily obtainable high voltage cable.

The transmitter is 78 in. high, 48 1/2 in. deep, and 125 in. long. With the matching phasor cubicle added to one end of the transmitter, the length becomes 165 in. The phasor can be located separate from the transmitter. With the heavy components mounted on the floors of the cubicles, heavy reinforcing of shelves and brackets is avoided, weight is saved, and installation is made easy.

The output powers of 5 and 10 kw have ample margin to allow for phasor losses. With the 80% efficiency obtainable, the plate dissipation is slightly over half that specified by the tube manufacturer. The power demand on unmodulated carrier is 12.5 kw for 5 kw, and 21 kw for 10 kw output. Average program modulation draws 15.5 and 23 kw respectively.

The frequency response from 100-7500 cps is plus or minus 1 db, but as already shown, the response may be modified to suit individual preferences. The noise with a random selection of tubes and connections of components shows -60 db; with tube matching, phasing of filaments, modulation transformer primary, etc., it has been reduced to -70 db. This indicates that with normal op-

Fig. 4: Modulation and output stages mounted on air chamber supplied by blower

Fig. 5: Antenna coupling network (right). Left, adjustable pickup loop for monitors

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Plants 222, 79 Chapel St., Hartford, Conn.
Also mfrs. of dielectric paper tubes
Modified Resonant Circuits
(Continued from page 42)

\[ Z = \frac{1}{j\omega L + 1/R} \]  \hspace{1cm} (1)

where \( u = (\omega/\omega_n - \omega_n/\omega), \omega_n^2 = 1/LC, \) and \( R = \omega L. \) It is seen that the magnitude of \( Z \) is \( R/\sqrt{2} \) when \( Q = 1. \)

It is next necessary to investigate the properties of \( u. \) By definition

\[ u = \frac{\omega}{\omega_n}, \]  \hspace{1cm} (2)

and \( \omega = \omega_n \left( \frac{1}{1 + \frac{Q^2}{\omega_n^2}} \right). \]  \hspace{1cm} (3)

Insert Cut E selecting the positive sign for the radical. At the limits of a band \( \Delta \omega \) the angular frequencies of \( \omega_n \) and \( \omega \) are defined, with corresponding values \( u_n \) and \( u. \) If \( \omega > \omega_n \) substitution in (2) shows that \( u_n = -u, \) while from (3), \( \Delta \omega = \omega_n - \omega_n = u, \omega_n \) or simply \( u\omega. \) Therefore \( u = \frac{\Delta \omega}{\omega_n}, \) where \( \Delta \omega \) is the fractional bandwidth.

Thus from (1) the fractional bandwidth \( \omega_n \) (whose limits are defined when \( Q = 1 \)) of the parallel RLC circuit is equal to \( 1/Q, \) if \( Q = R. \) \hspace{1cm} (4)

This relation in which \( Q \) is expressed in terms of the effective shunt resistance \( R \) of a parallel RLC circuit, holds for all values of \( Q, \) which is not true for \( Q \) as usually defined in terms of the effective coil series resistance.

New Components
Manufacturer

A new entrant into the radio-TV components manufacturing field is the Tetrand Co., 4921 Exposition Blvd., Los Angeles 16, Calif. Founded by Leonard Juniper, president, the firm will specialize in the manufacture of miniature solenoid coils. Other items include horizontal flyback output transformers, deflection yokes, focus coils for television and miscellaneous coil components. Joseph McGarvey has been named plant manager. He has a record of 20 years as production chief in components manufacture.

Additional support for this article would be appreciated.

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**BULLETINS**

**Vacuum Pumps**

Welsh Dun-SeaL Pump, products of the W. V. Welsh & Brothers Co., 1161 Bidgwick St., Chicago 10, III., are described in a new bulletin just released by the company. These pumps are capable of producing a vacuum of .00 microns and better.

**TV Equipment**

Polaroid Electronics Corp., 190 Metropolitan Ave., Brooklyn 11, N. Y., is now issuing its new catalog on television equipment for broadcast, manufacturer and laboratory use.

**Antenna & Transmission Line**

Product Development Co., Arlington, N. J., has produced the availability of a new catalog describing its "Prodelin" line of antennas and transmission lines.

**Polystyrene**

A guide which summarizes recommended techniques for machining and working with polystyrene has been published by Plux Corporation Division. (P.O. Box 1949) Hartford-Empire Company, Hartford, Conn. Entitled "Fabrication of Polystyrene", the guide covers use of coolants, sawing, turning, milling, drilling, threading, tapping, grinding, finishing, polishing, forming, cementing, die-cutting and checking for stress.

**Resistance Percentage Bridge**

A brochure (S142) illustrates and describes operation of a resistance percentage bridge having an accuracy better than one one-hundredth of one per cent (0.01%) throughout its range of indication. The instrument is used for quick, accurate calibration of high-precision potentiometers. The brochure can be obtained from Specialties, Inc., 888 Misery Road, Bayside, N. Y.

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1. The names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, M. Clements, Rumson, N. J. Editor, Orestes H. Caldwell, Caldecott Road and Bible St., Cos Cob, Conn. Associate Editor, R. F. Cobb, 596 Eighth Ave., Brooklyn 1, N. Y. Business Manager, M. H. Newton, 383 W. 215th St., New York, N. Y.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereafter the names and addresses of the officers, directors, and stockholders owning one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership, or other unincorporated firm its name and address, as well as those of each individual partner, must be given.) Caldwell-Clements, Inc. 480 Livingston Avenue, New York 17, N. Y. M. Clements, O. H. Caldwell, Charles A. Peterson, Trustees, 480 Livingston Ave., N. Y. C. N. Clements, Trustee, Rumson, N. J. O. H. Caldwell, Trustee, Caldecott Rd. and Bible St., Cos Cob, Conn. Charles A. Peterson, Trustee, 474 Seventh St., Brooklyn, N. Y.

3. The known bondholders, mortgagee, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are: If there are none, so state.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the names of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which such stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

(Signed) Orestes H. Caldwell

Sworn to and subscribed before me this 25th day of September, 1950.

[Signature]

M. Phillips

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TELE-TECH
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<table>
<thead>
<tr>
<th>STOCK NO.</th>
<th>VOLTAGE</th>
<th>OHMAGE</th>
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<td>R-811</td>
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<td>R-524</td>
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<td>R-830</td>
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<td>R-845</td>
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<td>3A, 2C</td>
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<td>1B 1A</td>
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<td>1C 5 Amps.</td>
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<td>1A Dbl. Brk./10 Amps.</td>
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<tr>
<td>2A Dbl. Brk./10 Amps.</td>
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