ELECTRONIC INDUSTRIES

TELE-TECH

A Caldwell-Clements Publication

OCTOBER, 1953

FRONT COVER: MAGNETIC MATERIALS—KEY TO ELECTRONIC FUTURE! Magnets and magnetic core materials are playing increasingly vital roles in the development of communications equipment, computers, industrial controls, audio and measuring devices. One of the prime characteristics of these materials is the familiar hysteresis loop, which is actually a record of flux versus field strength during a magnetization cycle. Loop shape depends on several factors, including composition, impurities, fabrication, heat treatment and stress. Some years ago, the graceful lazy-S was the order of the day. More recently the rectangular shape has come to the fore, representing new nickel-iron alloys and oriented silicon steels, with their well-defined states of residual flux. A valuable tool for studying magnetic material behavior is the photomicrograph, such as the one shown (courtesy Arnold Engineering Co., Marengo, Ill.) of Alnico V permanent magnetic alloy. For a thorough evaluation of today's magnetic materials, see the article starting on page 86.

DEPARTMENTS

TELE-TECH*, Vol. 12, No. 10. Published monthly by Coldwell-Clements, Inc. M. Clements, President; Orestes H. Caldwell, Treasurer. Acceptance under Section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., February 8, 1952 with additional entry at New York, N. Y. 75c a copy. Annual Subscription Rates: United States and Possessions: $7.00; Canada: $8.00; All Other Countries: $10.00. Please give title, position and company connection when subscribing.

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Because of increases in circulation which obviously cannot be shown in current audited statements, advertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH'S guaranteed circulation of 21,000.

Facts and Figures Round-Up
October, 1953

ELECTRONIC INDUSTRIES TOTALS

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in August 1953.

Actuators	$351,866	Flight Simulators	1,095,824	Power Supplies	597,644
Amplifiers	298,791	Generators	1,120,315	Radar Sets	411,340
Automatic Pilot Systems	1,942,682	Gyros	142,345	Receivers	356,140
Batteries	28,050	Gyro Indicators	565,062	Receiver Transmitters	4,995,598
Cable	401,272	Homing Groups	30,000	Recorders, sound	78,000
Coils, oscillator & antenna	76,451	Indicators	7,781,293	Regulators	582,375
Communications Facilities	279,470	Jet Instrument Trainers	585,292	Relays	25,526
Control Panels	604,462	Light Assys	32,638	Switches	667,501
Converters	205,425	Motors	65,244	Test Equipment, instrument	39,258
Countermeasure Transmitting Sets	218,715	Motor Generators	3,343,052	Trainers, instrument flying	250,757
Crystals	59,263	Mounts, vibrator	255,081	Tubes, electronic	235,125
Dynamotors	1,000,584	Oscillators	88,956	Tuners	413,737
Filter Controls	45,625	Panel Assys	51,847	Waveguides	52,164

Broadcast Stations in U.S.

	AM	FM	TV
Stations on Air	2392	569	173 VHF 68 UHF
Under Construction (CPs)	130	65	102 VHF 187 UHF
Applications Pending	233	10	312 VHF 155 UHF

Radio and TV Receiver Production

	TV		Radio
August, 1953		Home	283,000
		Battery	159,000
		Auto	354,000
		Clock	178,000
Total	582,000		974,000
Eight months, 1953 Jan.-Aug. Incl.		Home	2,480,000
		Battery	1,216,000
		Auto	3,762,000
		Clock	1,382,000
Total	4,701,000		8,640,000

FCC Has 1138 Employees

Office or Bureau	Washington	Field	Total
Commissioners	35	0	35
Office of Opinions and Review	8	0	8
Office of Hearing Examiners	15	0	15
Office of Information	4	0	4
Office of Administration	129	0	129
Office of Secretary	37	0	37
Office of General Counsel	17	0	17
Office of Chief Accountant	24	0	24

Federal Taxes

Taxes, taxes, and still more taxes, reach into the lives of every citizen. According to *Tax Outlook*, published by the Tax Foundation, 30 Rockefeller Plaza, New York City, last year's lion's share came from corporations ($21,466,910,000) and salary withholding $21,313,072,000). More directly related to the electronic industries, the Federal taxes ran as follows:

Telephone & telegraph users	$395,434,000
Radio-TV-phono purchasers	118,244,000
Patent & copyright owners	6,253,000
Phonograph record purchasers	6,888,000
Electrical energy users	53,094,000

RETMA Estimate
7 Million TVs in '53

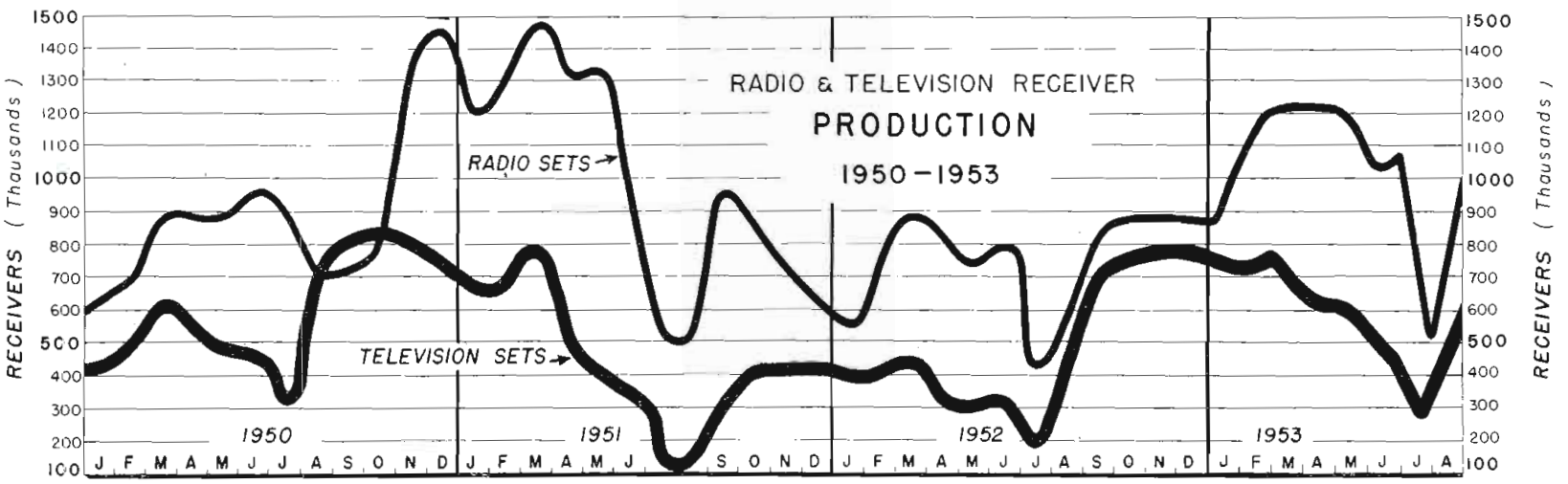
An informal poll of members of the RTMA board of directors developed an estimate that seven million TV receivers will be produced in 1953. The directors' "guesstimate" ranged from a low of five million sets and a high of eight million with an average of seven million. Earlier a poll of parts manufacturers showed average estimates of 7 million sets for the year, with a low of 6,250,000 and a high of nine million.

Electronic Ins and Outs

Sixteen manufacturers of electronic equipment and components and eight distributors of radio, TV and electronic apparatus failed during the year ended May 30, according to the annual report of the RTMA Credit Committee.

Of the 16 electronic manufacturers who experienced financial difficulties, four were assemblers of radio and TV receivers; one manufactured test equipment; one produced hearing aids; two produced sound equipment and phonographs; three manufactured items primarily of a military nature, and five produced components.

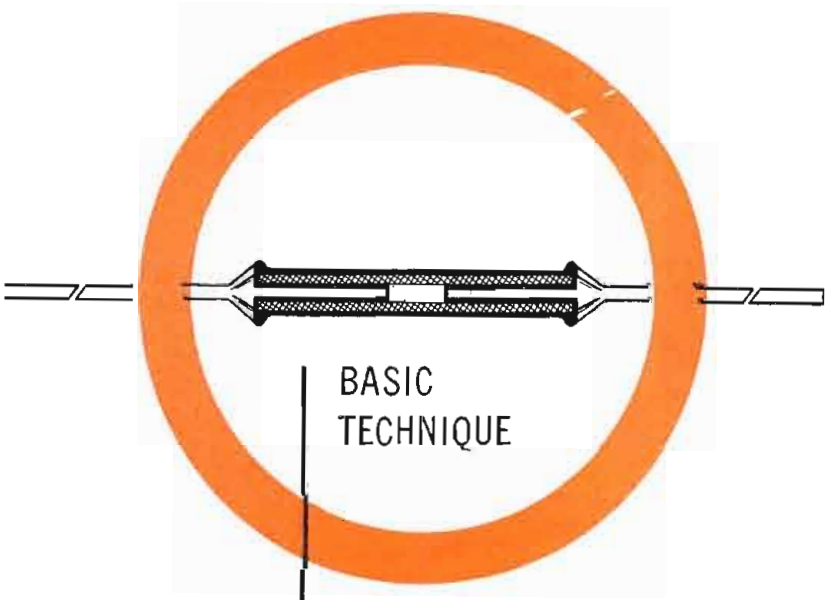
"The most common cause of these failures," Chairman H. A. Pope reported, "may be summed up as inadequate management. That circumstance was, however, manifested in a variety of ways. In several instances it was clear that management had not provided itself with satisfactory accounting tools and records. These businesses were losing money but were reporting profits. Others had accepted defense contracts at too low a price, or the contract called for work too difficult in terms of their production or engineering experience."



(SEE "AS WE GO TO PRESS" STARTING ON PAGE 11, FOR LATEST INDUSTRY NEWS)

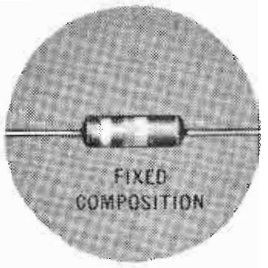
Highly specialized production process
for Boron-Carbon Precistors

ONLY FILM TYPE RESISTORS MEET HIGHER



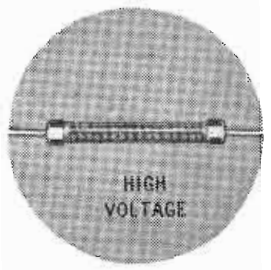
A thin coating of pre-cured and stabilized resistance material is bonded to special glass or an inorganic core to form IRC's exclusive filament type element. This is in contrast to the carbon pill or slug principle of construction. Its uniformity and stability have proved superior since the earliest days of radio.

Advancing requirements of instrumentation, military electronics and television focus emphasis on greater stability for non-wire wound resistors. IRC believes its filament type construction offers the best answer to more exacting standards. For over 28 years the film type resistance element has proved its superior stability—even in today's newest IRC Boron-Carbon Precistor.



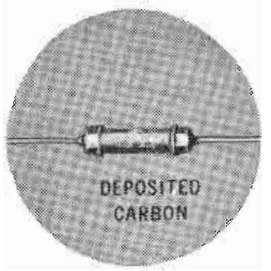
high popularity—high stability

More IRC Filament Type BT Resistors are used in radio and TV sets than any other brand. They meet and beat JAN-R-11 specifications, and have been tested and approved by most producers of government equipment. Exceptionally stable—in ⅓, ½, 1 and 2 watts. Send coupon for Data Bulletin.



high voltage—high stability

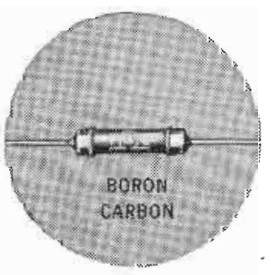
IRC Type MV High Voltage Resistors offer outstanding stability even in very high resistance values. Filament resistance coating in helical turns on ceramic tube provides a long, effective conducting path. 2 to 90 watts. Check the coupon for detailed information.



high economy—high stability

Type DC Deposited Carbon Resistors combine accuracy and economy with high stability. Excellent where carbon compositions are unsuitable and wire wound precisions too large or expensive. Available in ½, 1 and 2 watts. Use coupon for further facts.

STABILITY STANDARDS



high accuracy—high stability

The ultimate in *stable* non-wire wound resistors, Type BOC Boron-Carbon Precistors conform to all requirements of MIL-R-10509 Voltage coefficient less than 20 parts per million per volt. Extraordinary load life. ½, 1 and 2 watts. Send for Bulletin.

Boron & Deposited Carbon Precistors • Power Resistors • Voltmeter Multipliers • Low Wattage Wire Wounds • Insulated Composition Resistors • Volume Controls •

Wherever the Circuit Says

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Seal Terminals •

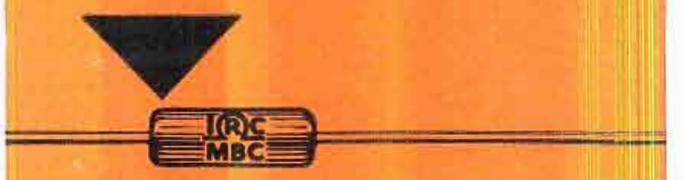
IRC

NEW

resistor

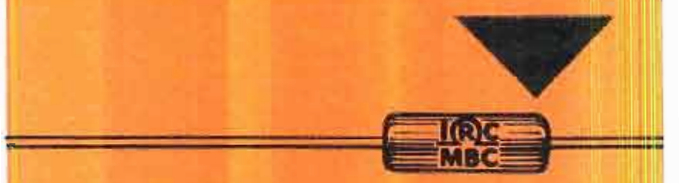
MOLDED

boron-carbon precistor



Eliminates Possibility of End-Cap Trouble

Eliminates Danger of Mechanical Damage



Improved Electrical Characteristics

The new Type MBC ½ watt, 1% resistor offers the inherent superiority of a Boron-Carbon resistor plus the advantage of a fully insulated unit. Send coupon for full details.

INTERNATIONAL RESISTANCE CO.

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

In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send me full data on: ☐ DC Deposited Carbon; ☐ BT Insulated Filament Type Resistors; ☐ MV High Voltage Resistors; ☐ BOC Boron - Carbon Precistors; ☐ MBC Molded Boron-Carbon Precistors

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TELE-TECH* & ELECTRONIC INDUSTRIES is edited for top-level engineers and executives throughout the electronic industries. It gives the busy engineering executive authoritative information and interpretation of the latest developments and new products, with emphasis on subjects of engineering import and timeliness. Speciol attention is given to:

MANUFACTURING

—Electronic equipment, communicotions, broodcasting, micrawave relay, instrumentation, telemetering, computing.
—Military equipment including rodar, sonar, guided missiles, fire controls.
—TV-FM-AM receivers, phonographs, recorders, reproducers.

OPERATION

—Fixed, mobile and airborne communicotions in commercial, municipal, aviation and government services.
—Broadcasting, video ond audio recording, records, audio and sound systems, motion picture production.
—Military, civilian ond scientific electronic computing ond control systems.

*Reg. U. S. Pat. Off.

THE ELECTRONIC INDUSTRIES DIRECTORY
Published annually as an integral section of TELE-TECH in June

As We Go To Press...

Radar Safety Beacon Recommended

The development of a Common System Secondary Radar Safety Beacon having characteristics proposed by the Joint Communications-Electronics Committee of the Joint Chiefs of Staff has been recommended by the Radio Technical Commission for Aeronautics as a supplementary aid to primary radar for improving air traffic control and increasing flight safety.

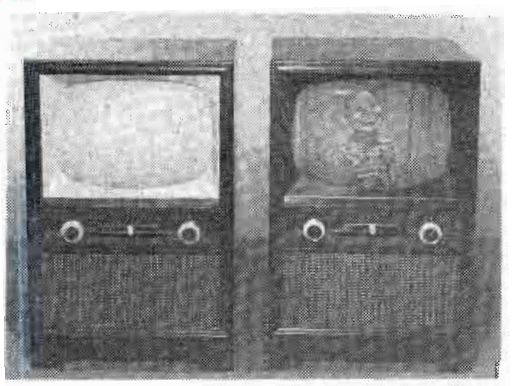
Use of the Radar Safety Beacon offers three principal advantages:

1. Improved reliability of the radar traffic control system.
2. Positive identification of aircraft by use of coded replies.
3. Faster movement of traffic due to closer separation intervals.

It will be particularly effective at distances and under weather conditions which render unsatisfactory the reflected signals of Airport Surveillance Radars (ASR) now in use.

In the secondary system, the ground signal "triggers" equipment in the aircraft which transmits a reply pulse signal many times stronger than an "echo." In addition, these replies may be coded to provide aircraft identification. This permits closer spacing of aircraft in the traffic pattern by eliminating the need for maneuvers necessary with primary radar to associate each aircraft with a particular "blip" on the radar scope.

Safety Glass Improves Television Picture



A clearer TV picture even under bright light is assured with new safety glass screen. Tinted glass is so toned that it absorbs unwanted light and gives sharper contrasts. Large spotlight above provided light equal to sunlight. These identical television sets were photographed at 1/10th second with f 6.3 lens opening. Receiver at the right has the new safety glass developed by the Libbey-Owens-Ford Glass Co.

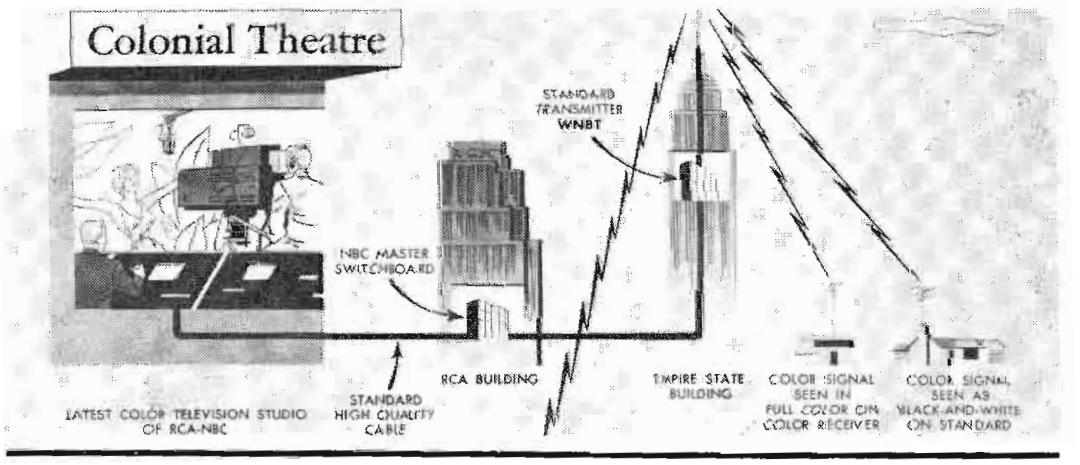
NBC Expands Color TV Schedule

Following the first publicly announced color TV broadcast of "Kukla, Fran and Ollie," Sylvester L. Weaver, vice-chairman of the NBC Board, disclosed that the network will institute a regular series of experimental "color premieres" starting Sept. 28, 1953. It was further noted that virtually the entire NBC operating personnel in New York has completed a color indoctrination course.

To date, some 55 affiliates have signed color agreements to supplement their affiliation contracts, and have agreed to order color equipment. By the end of this year, $25,000,000 will have been invested by RCA-NBC in color TV research and development, and another $15,000,000 would be added to the investment to establish the medium as a commercial reality.

Color broadcasting facilities include New York's Colonial Theatre, presently operating seven days per week, and studio 3-H in Radio City. The huge Warner Brothers sound stage in Brooklyn and the NBC audience studios in Burbank, Calif., are also being converted. A mobile unit is nearing completion to provide coverage of special events such as football games and the Mardi Gras.

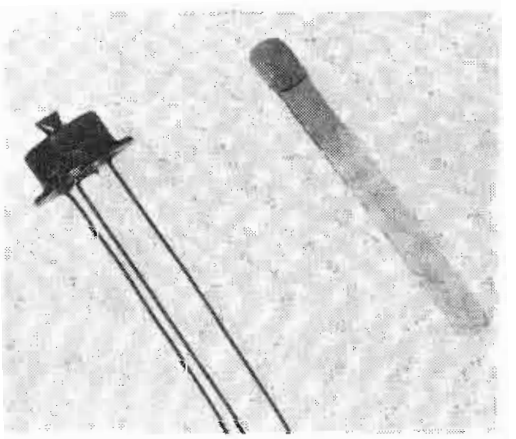
RCA-NBC compatible color TV set-up originates broadcast from New York studio, feeds signal through master switchboard to WNBT antenna atop Empire State Building, and then transmits signal



All-Welded Transistors Available

The General Electric Co. is beginning production of a new all-welded, hermetically-sealed junctin transistors with essentially infinite life expectancies. They are reported to be the first to have all-welded construction, which eliminates the aging effects of moisture and trapped solder flux fumes.

According to Sales Manager J. H. Sweeney, the new construction allows power ratings up to three times those of any previously announced transistors. It has been designed to permit automatic mass production, and an automatic factory is now being developed. Pilot production is now under way at Electronics Park. Similar production lines are being established at the company's germanium products plant at Clyde, N. Y., with sample quantities of the new transistors scheduled for this month. Production quantities will follow as the Clyde plant gears up to produce several million of the new devices yearly.



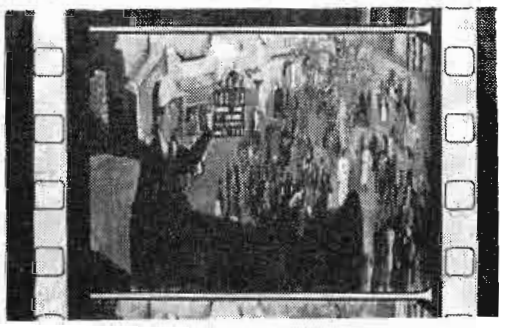
All-welded, hermetically-sealed junction transistor allows power ratings three times those of previously announced units

MORE NEWS on page 12

As We Go To Press . . . *(Continued)*

"Cinemascope" Gets New 3-D Magnetic Sound

Combining for the first time a picture and four magnetic sound tracks on one 35-mm film strip, 20th Century-Fox's single-film magnetic sound system promises to be an historic new development in motion picture sound projection. The system, which obviates the need for a separate sound reproducer required until now for the projection of stereophonic sound, will become an integral part of the Cinemascope process. (See Tele-tech & Electronic Industries, May 1953, page 66.) Exhibitors will continue to be able to use standard projection equipment.

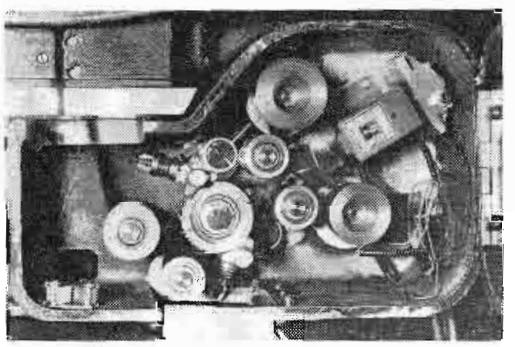


Cinemascope film, developed by 20th Century-Fox, carries two magnetic tracks on either side of both sprocket holes to produce 3-D sound. Anamorphic lens "spreads" view on wide screen

To accommodate the quartet of magnetic sound tracks, Earl I. Sponable, 20th Century-Fox's research director, and his staff narrowed the sprocket holes of standard 35mm film from 0.110 to 0.078 in. Two of the tracks are placed on either side of the picture. Changes required in the projector are a slight reduction in the width of the teeth of the intermittent and other sprockets, together with a correction of center-line spacing of the teeth, and the addition of a simple film-driven sound head installed between the upper magazine and the regular projection head. The new sprockets will carry all types of film.

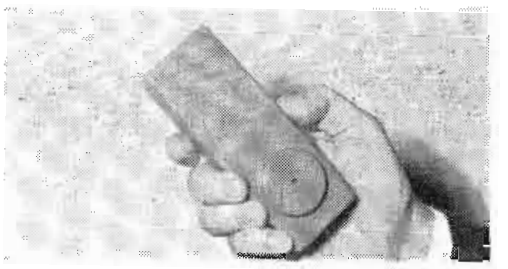
To run the new magnetic sound film, the projectionist has only to thread it through the new "Penthouse" sound head, the projection picturegate system. When threading only for optical or ordinary single-track-sound the projectionist utilizes only the guide rollers in the "Penthouse." It insures perfect synchronization at all times.

The new sound head is being produced by General Precision, (a National Theatre Supply affiliate), RCA and Westrex, with other manufacturers expected to join the list.



"Penthouse" sound head built by General Precision Labs. mounts above projection head. Cinemascope film is threaded past Brush multiple pick-up. Rollers bypass standard film

VEST-POCKET RADIO PAGING



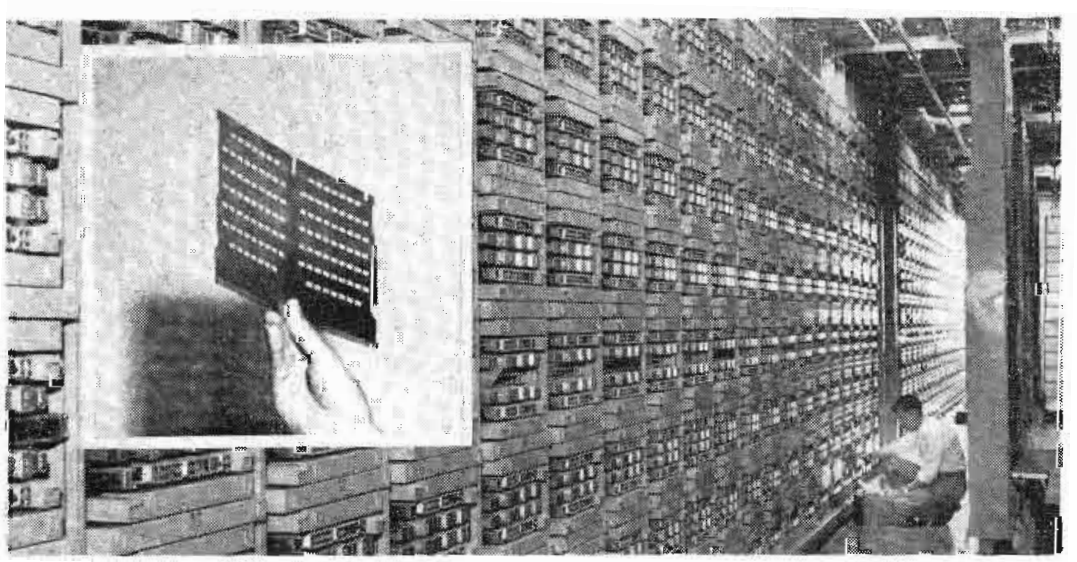
Six-ounce "Page-ette" receiver permits subscriber to be notified that a party is paging him. GE transmitter covers up to 35 mi. on 43.58 or 35.58 MC. Magnetic drum repeats messages. Service costs $5 to $20 per month

Low-Cost Color TV Receivers Predicted

In a letter to FCC Chairman Rosel Hyde, Emerson President Benjamin Abrams indicated his company's aim to produce color TV receivers at prices approximately 25% above the cost of present black-and-white sets, within 18 months after adoption of compatible color TV standards by the FCC. This would bring prices down to the $250-$300 range. At the same time, Sightmaster Corp. announced that it was prepared to offer a color slave unit for $250. Chromatic TV Labs. has indicated it plans to market a color tube for under $100

Transistor Switching Installed by Bell

New automatic switching equipment has been placed in service in Newark, N.J., enabling long distance operators in that city to dial direct to telephones in more than 2000 communities. The facilities are provided jointly by N. J. Bell and AT & T Long Lines, and will handle 113,000 long distance calls per day by 1954.



Installer tests one of the 130,000 relays in N.J. Bell's 4A system. Inset shows metal card which has 40 selecting tabs and 118 holes, representing information for routing calls

Heart of this "4A" system is the transistor card translator. When the operator dials the long distance number, a punched metal card with corresponding pattern of holes is dropped into the translator. Light rays passing through the holes strike certain photo-transistors which are energized and actuate groups of relays. The relays supervise a search through the vast 4A installation to pick out a circuit to the distant switching center, and also to test this route. The card translator's work is done in less than one second. Fifteen to 30 seconds from the start of pushing keys, to a ring at the far end, is a fair average.

MORE NEWS on page 15

As We Go To Press . . . (Continued)

WGLV on Air with Dumont 5-kw UHF Transmitter

An interesting demonstration of the coverage of UHF was recently witnessed at the Empire State Building. TV signals were relayed from WABD in New York to the new channel 57 station, WGLV, in Easton, Pa., 70 miles away. WGLV then broadcasted the program at 100 kw ERP, using its 5-kw Dumont UHF transmitter with Eimac klystron. This program was received directly in New York with an indoor antenna. Picture quality compared favorably with that transmitted by WABD.

The service area completely covered by WGLV contains about 1.5

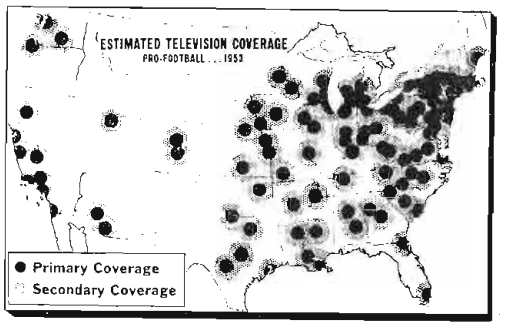
Richard Hubbell (1) of WGLV, and Moe Jaffe, Dumont engineer, inspect Eimac klystron used in WGLV's 5-kw Dumont UHF TV transmitter

million people. Some 15,000 of the region's 90,000 TV receivers are equipped to receive UHF, and this figure is expected to rise to 45,000 by the end of the year. Field tests conducted in the Easton area by the Paul Godley Co., consulting engineers, produced some important results. Multi-path UHF transmission was eliminated in all but two locations, and in no instance was man-made noise seen to produce interference.

Allen B. DuMont Labs. has also announced that it is developing a UHF TV transmitter which will deliver 1000 kw ERP, the maximum limit set by the FCC.

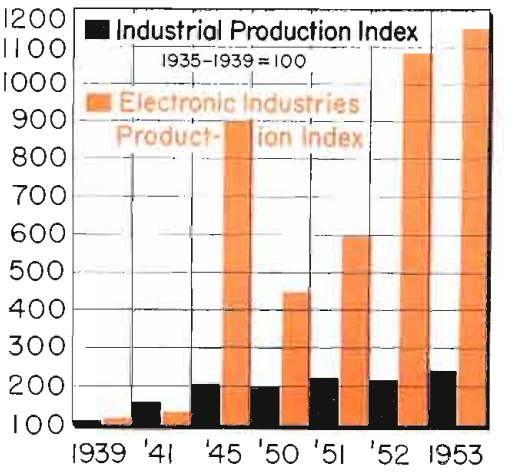
TELE-TIPS
Begin on Page 62

FOOTBALL TV COVERAGE



Regularly scheduled pro-football games will be seen on TV in 42 states this year. In 1952 it was only 29 states. Audience is expected to reach 35 million. Westinghouse will bring games to 87-station audience using DuMont net

PRODUCTION GROWTH ELECTRONIC and All Industries



COMING EVENTS

Oct. 2-11—First Annual National Electronic Show, Santa Monica Pier, Santa Monica, Calif.

Oct. 5—First International Tool Exposition, 132 54th St., Brooklyn, N.Y.

Oct. 5-8—URSI-IRE, Joint Technical Meeting, National Research Council and Defense Research Board, Ottawa, Can.

Oct. 5-9—74th Convention of the SMPTE, Hotel Statler, New York, N.Y.

Oct. 6-8—Fractional Horsepower Motors Conference, AIEE, Fort Wayne, Ind.

Oct. 12-14—Symposium on Simulation and Computing Techniques, NADC, Johnsville, Pa., and Univ. of Pennsylvania, Philadelphia, Pa.

Oct. 13-15—National Conference On Tube Techniques sponsored by Subpanel On Tube Techniques of the Department of Defense, Western Union Auditorium, New York, N. Y.

Oct. 14-16—Machine Tool Conference, AIEE, Hotel Cleveland, Cleveland, Ohio.

Oct. 14-16—Recorder-Controller Section, SAMA, Mid-year Meeting, Seaview Country Club, Abescon, N.J.

Oct. 14-17—Audio Fair, Hotel New Yorker, New York, N.Y.

Oct. 19-21—RTCM Fall Assembly Meeting, Edgewater Beach Hotel, Chicago, Ill.

Oct. 19-23—41st National Safety Congress and Exposition, Conrad Hilton, Congress, Morrison, and Hamilton Hotels, Chicago, Ill.

Oct. 19-23—National Metals Show, Cleveland Auditorium, Cleveland, O.

Oct. 20-22 1953 AAR Communication Section, 30th Annual Session, Plaza Hotel, San Antonio, Texas.

Oct. 20-22—8th Annual Industrial Packaging and Materials Handling Exposition, Mechanics Hall, Boston, Mass.

Oct. 22-23—Fall 1954 Assembly, RTCA, Sheraton Park Hotel, Washington, D.C.

Oct. 23-24—Fourth Annual National Noise Abatement Symposium, Armour Research Foundation, Ill. Inst. of Technology, Technology Center, Chicago 16, Ill.

Oct. 26-28—RTMA, Radio Fall Meeting, King Edward Hotel, Toronto, Canada.

Oct. 29-30—AIEE, Textile Industry Conference on Electrical Equipment, No. Carolina State College, Raleigh, N.C.

Oct. 30-31—Semi-Annual Meeting, ASTE, Dayton Biltmore, Dayton, Ohio.

Nov. 2-6—AIEE, Fall General Meeting, Muelebach Hotel, Kansas City, Mo.

Nov. 4-6—17th Annual Time and Motion Study and Management Clinic, sponsored by IMS, Sheraton Hotel, Chicago, Ill.

Nov. 9-12—Conference on Radio Meteorology, Univ. of Texas, Austin, Texas.

Nov. 12-13—IRE Professional Group on Vehicular Communications, Hotel Somerset, Boston, Mass.

Nov. 13-14—IRE Annual Electronics Conference Hotel President, Kansas City, Mo.

Nov. 17-19—RTMA, Palmer House, Chicago, Ill.

Nov. 18-20—AIEE-IRE, Conference on Electronic Instrumentation in Nucleonics and Medicine, Hotel New Yorker, New York, N.Y.

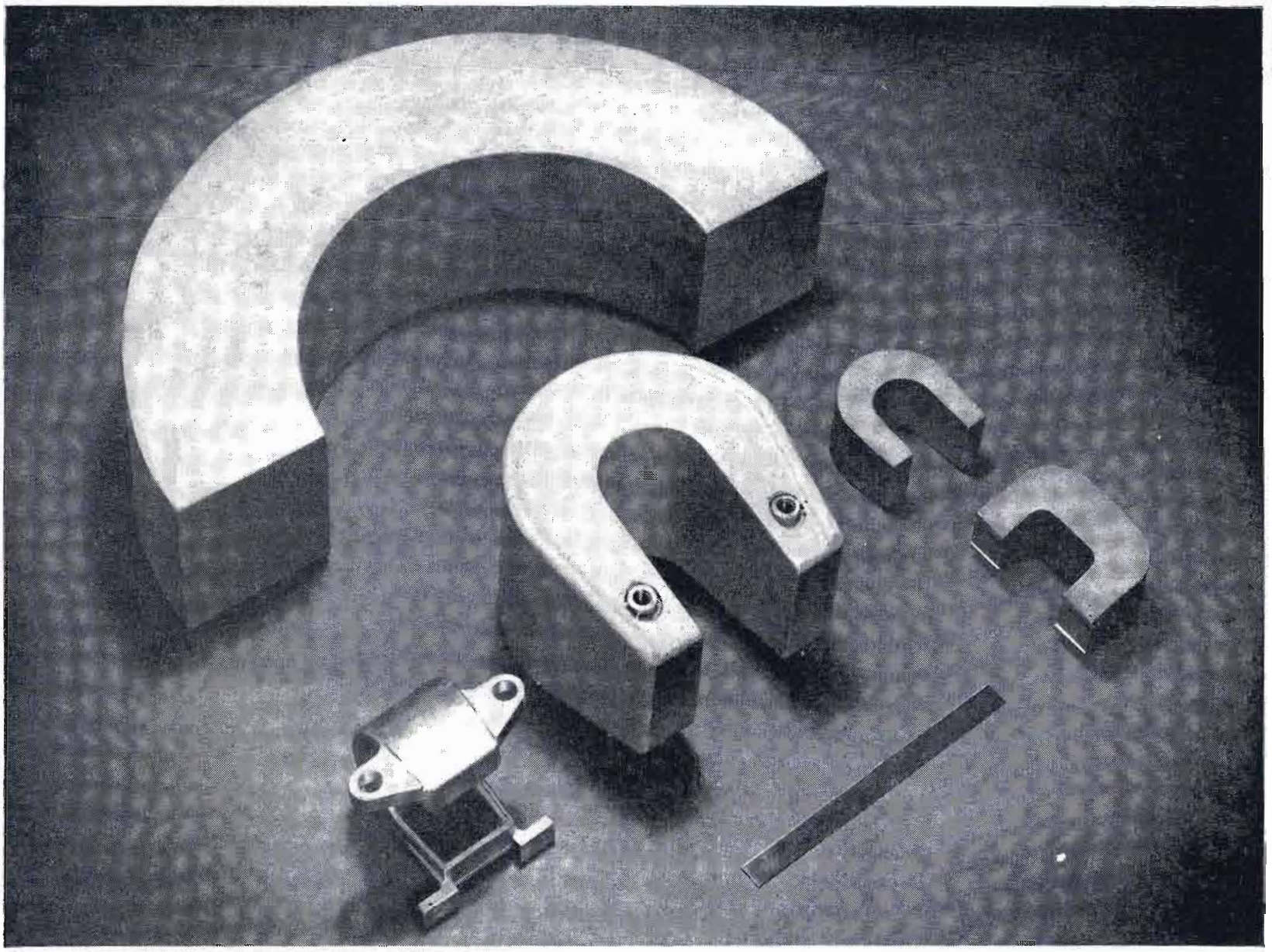
Dec. 8-10—AIEE-ACM-IRE, Eastern Computer Conference, Statler Hotel, Washington, D.C.

Jan. 18-22—AIEE-ACM-IRE, Winter General Meeting.

Jan. 25-28—Plant Maintenance & Engineering Show, International Amphitheatre, Chicago, Ill.

Jan. 27-29—Tenth Annual Technical Conference of the Society of Plastics Engineers, Royal York Hotel, Toronto, Can.

AAR: Association of American Railroads
ACM: Assc. For Computing Machinery
AIEE: American Inst. of Electrical Engineers
ASTE: American Society of Tool Engineers
IRE: Institute of Radio Engineers
IMS: Industrial Management Society
NADC: Naval Air Development Centre
RTCA: Radio Technical Commission for Aeronautics
RTCM: Radio Technical Commission for Marine Services
RTMA: Radio-TV Mfrs Assc.
SAMA: Scientific Apparatus Makers Assc.
SMPTE: Soc. of Motion Picture and TV Engineers
URSI: International Scientific Radio Union



PERMANENT MAGNETS and ASSEMBLIES for Magnetrons and Traveling Wave Tubes

The group of magnets illustrated above, weighing from a fraction of a pound up to 75 pounds, are indicative of the wide range of Arnold production in this field. We can supply these permanent magnets in any size or shape you may need, with die-cast or sand-cast aluminum jackets, Celastic covers, etc. Complete assemblies may be supplied with Permendur, steel or aluminum bases, inserts and keepers as specified . . . magnetized and stabilized as desired. ● *Let Arnold handle your magnetron and traveling wave tube permanent magnet requirements.*

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LETTERS...

Electronic Engineering Standards

Editors, TELE-TECH:

This will reply to your letter concerning the listing of standards on electronic engineering in our price list.

The American Standards on this subject are listed under "C—Electrical Engineering," in our price list since they have been developed by ASA Sectional Committees which have rather arbitrarily been assigned number designations in the "C" series. All of these sectional committees are at present under the cognizance of the Electrical Standards Board, which is subdivided into the Power Division, and the Communications and Electronics Division. The standards on electronic engineering and the committees which developed them are, of course, under the jurisdiction of the Communications and Electronics Division of the Electrical Standards Board.

Perhaps in the future a separate standards board on electronics will be established. At that time, the sectional committees under its jurisdiction will be given different letter designations other than "C."

In the meantime, however, we do intend to amplify our index of the price list and in doing so, we will list the subject of electronics separately.

S. DAVID HOFFMAN
Staff Engineer
American Standards Assoc.
70 E. 45 St., New York 17, N. Y.

Ed. Note: The above letter was received in reply to our letter suggesting that in future listings of American engineering standards radio, television, and electronic standards be grouped together under the general heading of "Electronic Engineering." At present electronic standards for this $6 billion industry are listed as radio and/or are mixed in with the standards relating primarily to electrical power engineering.

National Selenium Situation

Editors, TELE-TECH:

In your August issue, I note a letter to the Editor dealing with the subject of salvaging scrap selenium. In this correspondence, mention is made of the possibility of there existing 4,000,000 lbs., of scrap selenium available for possible salvage.

While undoubtedly, you do not take the occasion to check the accuracy of figures submitted in letters of this kind, in this case it might be advisable for you to determine whether or not there was an error in the figure of 4,000,000 lbs. The reason I suggest this is that from my knowledge of the use of selenium, I have reason to believe that the entire selenium poundage applied to the manufacture of rectifiers during the past 6 years, does not exceed half of the amount represented in the correspondence referred to as available for scrap.

Although undoubtedly there is a great need for an increased selenium supply, I feel you will want to help keep records straight as to a possible source of such selenium.

JULIAN LOEBENSTEIN,
Sales Manager
Selectron and Germanium Division
Radio Receptor Company, Inc.

Ed. Note: In response to our request for clarification, Mr. G. Eannarino's telegraphic reply states:

"RE YOUR LETTER OF AUGUST 25, TYPOGRAPHICAL ERROR. SHOULD HAVE READ 4000 LBS. ....."

We wish to thank Mr. Loebenstein for calling the error to our attention.

Pick Young Engineers Carefully

Editors, TELE-TECH:

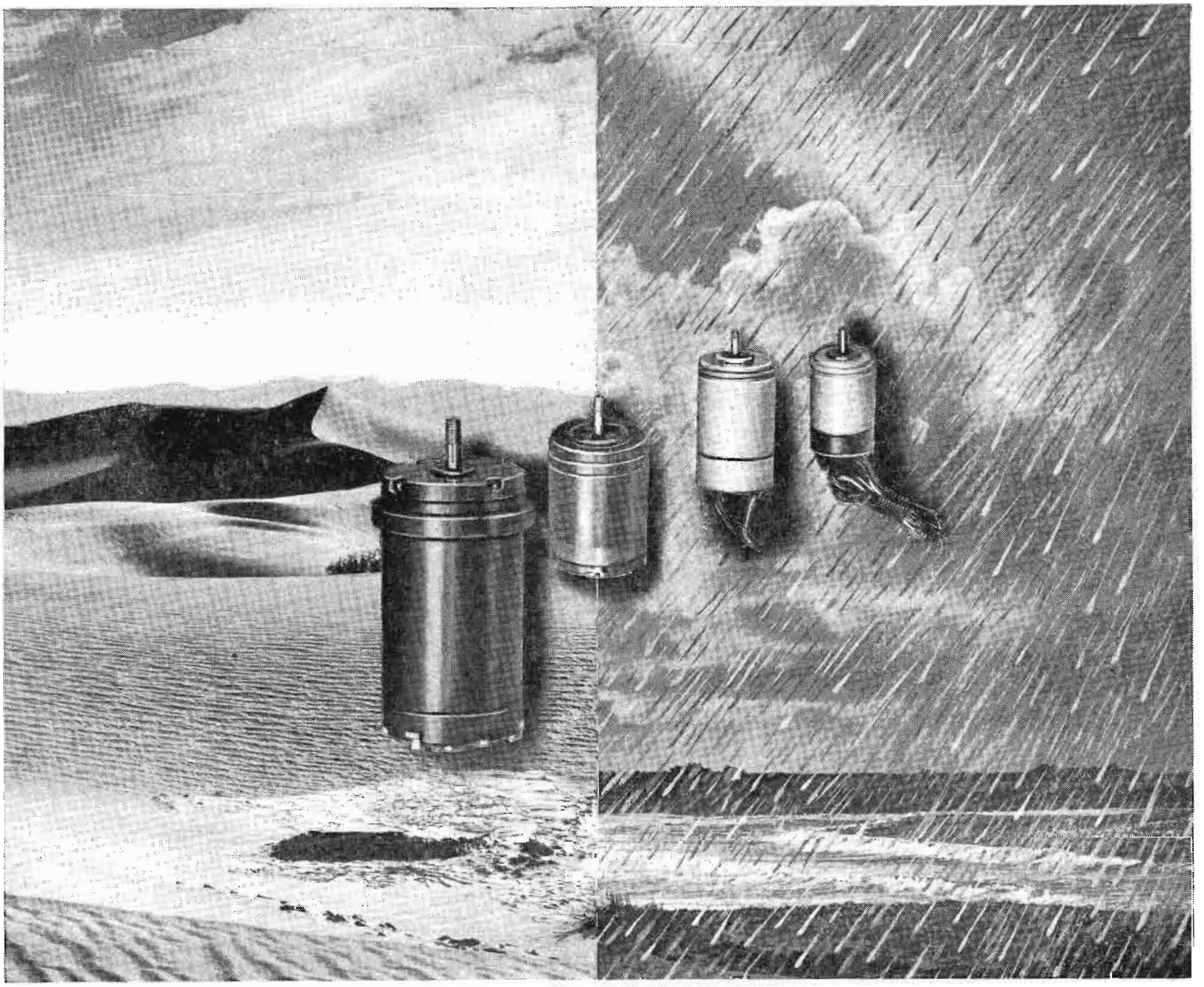
Your recent editorial on "Training Young Engineers" was excellent.

I had charge of a part of the student engineering course when it started at one of our large radio manufacturers, and I have been interested in young engineers ever since. The growth factor of large companies depends, more than one would think, on the college men being taken into the ranks from June to June. What features should the young graduate look for in making his decision of which job to accept? What type of "scout" should radio companies send to colleges to bring in the right men? In my student days the brusqe treatment I received at the hands of one of Bell Lab's ranking men (now dead) who came to MIT looking for men, still remains. It was a valuable lesson to me in later years when I interviewed hundreds of men for research and engineering jobs.

GEORGE WILSON
Chicago, Ill.

A LETTER

on the status of Japanese television begins on page 50 of this issue.



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Long experience in the development of precision instruments enables Ketay to manufacture Synchros, Servos and Resolvers to meet the cycling humidity requirements of MIL-E-5272

As a leader in the use of *corrosion resistant* materials in Synchros, Servos, Resolvers, Control Equipment and related instruments, Ketay has enormously broadened their usefulness for both the government and industry.

Ketay has built an outstanding record as originators of units to meet individual specifications. Ketay engineers will be glad to discuss your requirements.

CORROSION RESISTANT UNITS

Ketay offers a complete line of Corrosion Resistant Instruments, four of which are pictured above. From left to right they are:

- Synchro, Size 23, Frame O.D. 2.250", 26 V and 115 V 400 & 60 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor—115 V 60 Cycles.
- Synchro, Size 15, Frame O.D. 1.437", 26 V and 115 V 400 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor Mk 7—115 V 400 Cycles.
- Synchro, Size 11, Frame O.D. 1.062", 26 V and 115 V 400 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor Mk 14—115 V 400 Cycles.
- Synchro, Size 10, Frame O.D. .937", 26 V 400 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor—26 V 400 Cycles.

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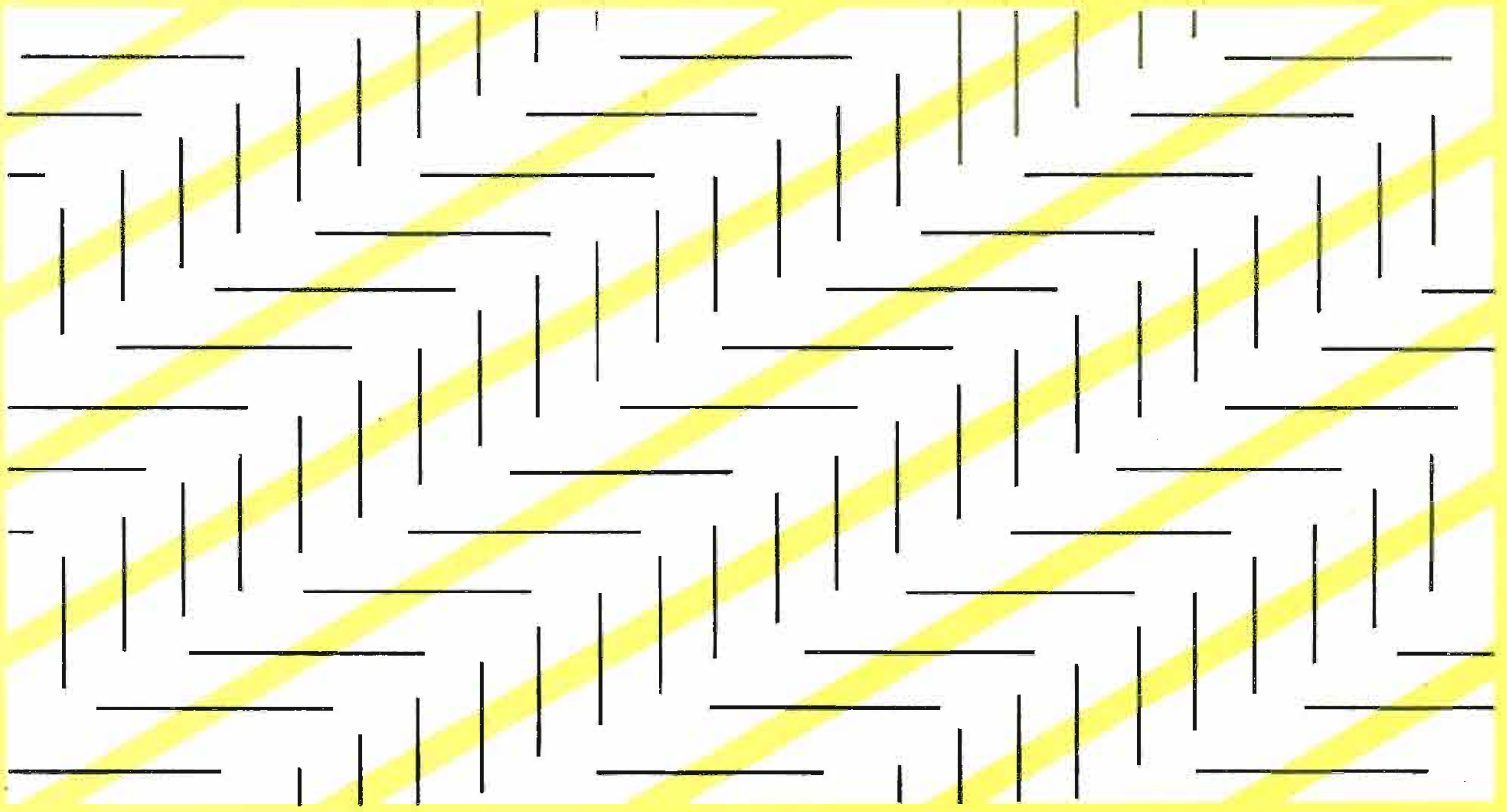
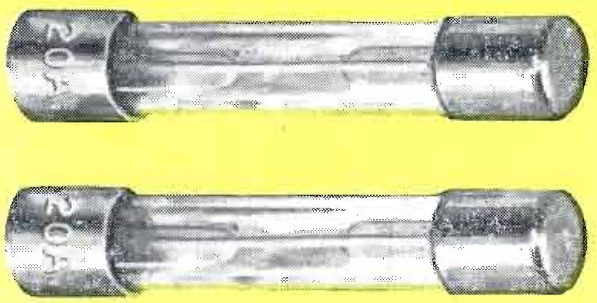
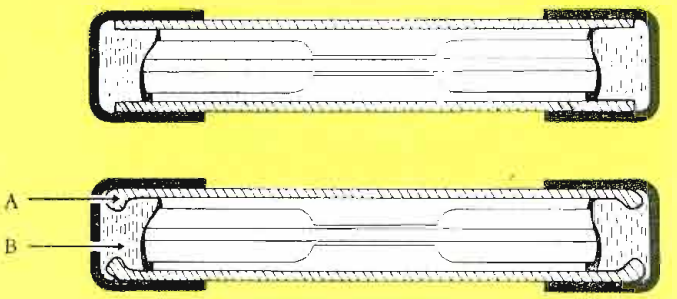


THINGS ARE NOT AS THEY SEEM...

The long lines are strictly parallel—
that they appear otherwise is an optical illusion.

This fuse merely has the metal caps cemented to the glass.





The difference between these two fuses is no illusion . . .

This Littelfuse has the caps locked to glass like this.

The ends of the glass are formed[A]. The solder which is bonded in a separate operation to the cap reflows through the small aperture and spreads out to form a permanent collar-button lock[B] between cap and glass—impervious to moisture and vibration. The exclusive Littelfuse feature eliminates fuse failure due to loose caps.

Littelfuse leads all other fuse manufacturers in design patents on fuses. Lock-cap assembly patent no. 1922642

LITTELFUSE

DES PLAINES, ILLINOIS

Puerto Rican Electronics Company

Rectifier Corp. of Puerto Rico, a new company incorporated under Island laws to produce selenium rectifiers and related electronic equipment, has begun operations in a new plant in Fajardo. Markets will be on the mainland. According to Lloyd J. Hughlett, president, delivery from Puerto Rico to the Eastern Seaboard and the Midwest can be as rapid as it can be in the States.

New Federated Research Foundry

R. D. Taylor, assistant to the vice-president in charge of development, and Donald L. LaVelle, research metallurgist in charge, pour the first casting made in the new research foundry of American Smelting and Refining Company's Federated Metals Division at South Plainfield, N.J. The new foundry enables the solution of customer problems, and the technical and practical investigation of melting techniques, gating practices, and pouring procedures.

New Motorola Plants Leased

Motorola Inc. has leased two one-story plants now under construction on N. Cicero Ave., near North Ave., Chicago, Ill., covering 150,000 sq. ft. on 300,000 sq. ft. of property, that will be occupied by the company's manufacturing, parts, and service departments.

Less than a quarter-mile from the two main consumer division and communications and electronic division plants on Augusta Blvd. near Cicero, the move to adjacent plants will enable the consolidation of many operations, according to Robt. W. Galvin, company executive vice-president.

A modern cafeteria will service both plants, and black top parking lots will be provided for employees. Locker and shower facilities will be available for the manufacturing division. Early in October, the new north plant will house the screw machine division, stamping, plating, antenna assembly, tool and die shop, and supporting departments.

Parts, orders, advertising, and some warehousing departments will move from the present Halstead St. plant the first week in November. Microwave, Handie-Talkie assembly, and some warehousing facilities will remain in the present Washington Blvd. plant. Other warehousing and departments will be consolidated in the huge Franklin Park, Ill. TV assembly under construction and scheduled for occupancy in October.

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- ***100% Microscopic Inspection***
- ***Lowest Vibrational Noise Output***
- ***Higher Plate Voltage Ratings***
- ***Higher Bulb Temperature Ratings . . . 265°C.***
- ***More Uniform Low Heater Voltage Performance***
- ***Higher Heater Cycle Life Test Voltage***

Each tube meets the latest military requirements for RELIABILITY – based on field and production tests for Shock, Vibration, 5000 Hour Life, Centrifugal Acceleration, Heater Cycle Life, High Temperature Life, Lead Fatigue.

All these Raytheon Reliable Subminiature Tubes must pass microscopic inspection

TYPE	DESCRIPTION	MAX. RATINGS			TYPICAL CHARACTERISTICS								
		Vibration Output mVac	Bulb Temp. °C	Plate Volts	Heater Volts	Heater Ma.	Plate Volts	Plate Ma.	Grid Volts or R_k	Screen Volts	Screen Ma.	Amp. Factor	Mut. Cond.
CK5702WA	RF Amplifier Pentode	**50**	**265**	**200**	6.3	200	120	7.5	200 ohms	120	2.6	—	5000
CK5703WA	High Frequency Triode	**10**	**265**	**275**	6.3	200	120	9.4	220 ohms	—	—	25.5	5000
CK5744WA	High Mu Triode	25	**265**	**275**	6.3	200	250	4.2	500 ohms	—	—	70	4000
CK5783WA	Voltage Reference	50	**175**	—	Operating voltage approximately 86 volts between 1.5 and 3.5 ma.								
CK5784WA	RF Mixer Pentode	100	**265**	**200**	6.3	200	120	5.2	−2	120	3.5	—	3200
CK5787WA	Voltage Regulator	—	220	—	Operating voltage approximately 100 volts between 1 and 25 ma.								
CK5829WA	Dual Diode	—	220	360*	6.3	150			Max. I_o = 5.5 ma. per plate				
CK6021	Medium Mu Dual Triode	50	250	165	6.3	300	100	6.5	150 ohms	—	—	35	5400
CK6111	Medium Mu Dual Triode	50	250	165	6.3	300	100	8.5	220 ohms	—	—	20	5000
CK6112	High Mu Dual Triode	25	250	165	6.3	300	100	0.8	1500 ohms	—	—	70	1800
CK6152	Low Mu Triode	**25**	**265**	**250**	6.3	200	100	10.0	270 ohms	—	—	17.5	5100
CK6247	Low Microphonic Triode	**1.0**	**250**	**275**	6.3	200	250	4.2	500 ohms	—	—	60	2650

*Peak inverse voltage

Note: All dual section tube ratings (except heater) are for each section.

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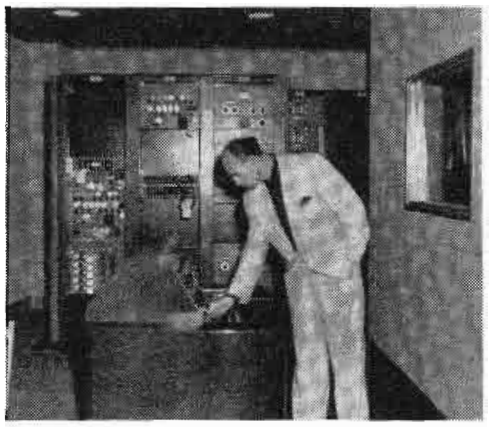
LETTERS

(*Continued from page* 35)

Report from Japan

Editors, TELE-TECH:

Here are some data which survey the present TV development of Japan. NHK, the government-run TV station, is using its Japan-made 3-kw visual power transmitter to broadcast a signal from the NHK building in the center of the town (which carries on its roof the antenna tower). NHK has two small studios, former broadcasting studios, and two badly fitted studio con-



Dr. Duschinsky checks master control equipment at Japan's JOAX-TV presently under construction

trol rooms. It uses GPL and RCA equipment. It does a tremendous job in remotes, like classical Japanese "Sumo" wrestling and baseball and special events like the departure of the Crown Prince for the coronation.. Presently its main producer is a young American who is doing a good job with the limited facilities at his disposal. NHK tower about half a mile away from our is presently constructing a 560-foot tower and is also building a transmitter building and a temporary structure to house a couple of studios in there. This may in about six months' time give NHK a better chance to operate more efficiently.

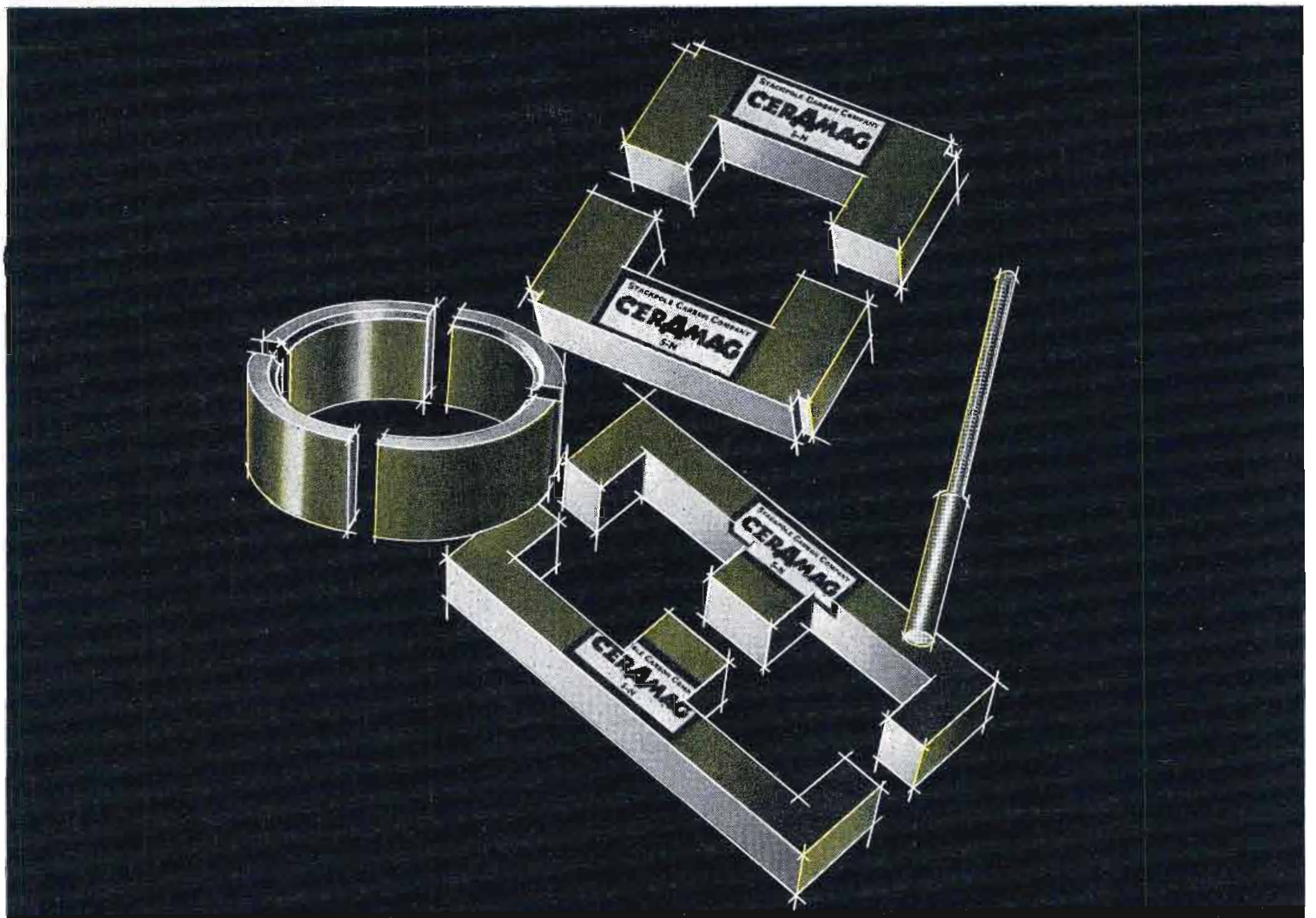
The definite number of existing TV sets is unknown, but about 5000 is a safe number. Most of these receivers are of U.S. make, with practically all manufacturers represented. The standard of the picture signal received is fair and the reception in Tokyo is generally good.

TV set production at present time is more or less limited. Nevertheless, the impact of TV is appearing in one picture which I took recently on a street corner shows a large number of persons watching the program in the window of the radio shop (I counted 47).

On the average, there are approximately 40 to 50 viewers per set looking at a 21-in. screen. This is only the average and to pass the sidewalk when a program is on and the TV set is displayed in a shop, is practically impossible. This gives you an idea that while the audience in the U.S. for 1000 sets may be about 6000 persons, in Tokyo it is about 50,000.

There are about 38 TV set manufac-

(*Continued on page* 58)



THE PRODUCTION UNIT IS LIKE THE SAMPLE . . . AND EACH PRODUCTION UNIT IS LIKE THE OTHER . . . *ELECTRICALLY AND MECHANICALLY!*

STACKPOLE Ceramag®

FERRITE CORES

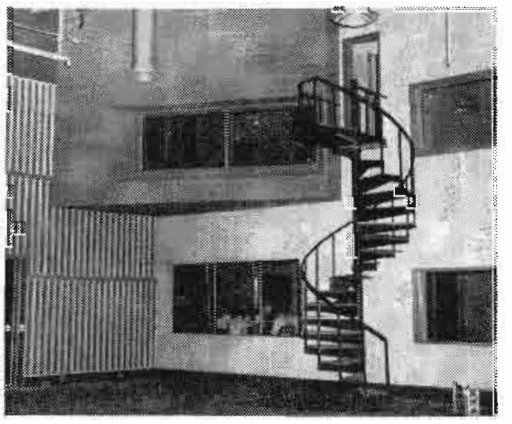
Electronic Components Division, STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

LETTERS

(*Continued from page* 50)

turers who want to start production. Only by limiting the number of models will they be able to achieve mass production.

Our building (Nippon TV Network) is about 85% finished. We have received, except for the transmitter, antenna, 35mm projector and some TV studio cameras, all other equipment and have checked it through. We are presently installing the master control equipment. The tower is completely finished. It is an imposing structure and is actually 40 feet higher because of the



JOAX-TV studio shows studio control room (u-l), master control (l-l), audience view (u-r)

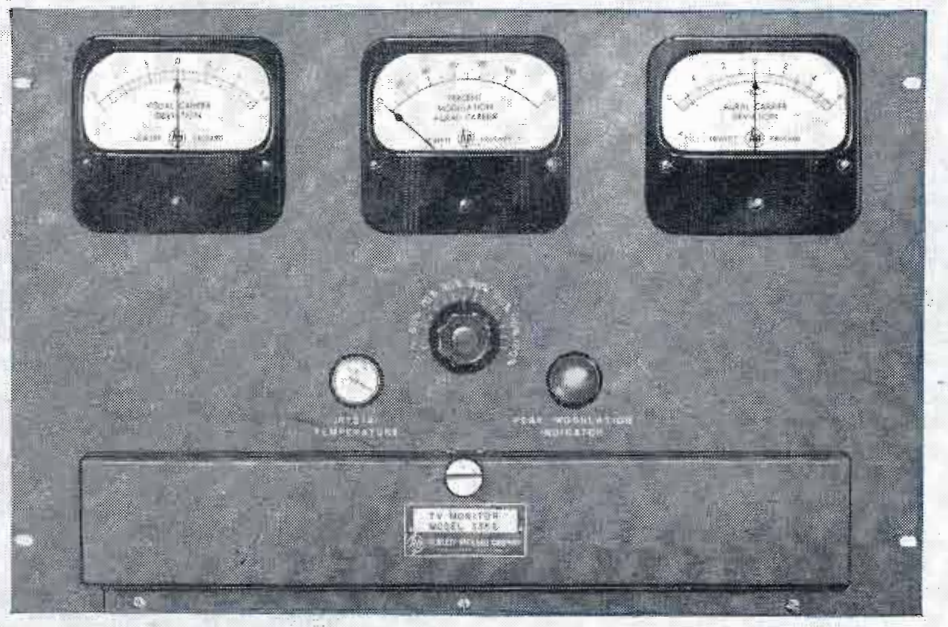
temporary structure which will be used as scaffolding, during the erection of 12-bay superturnstile antenna. An elevator going up $\frac{2}{3}$ of the structure will serve to handle microwave equipment speedily and efficiently. The building is large and includes two large studios and a small one and all areas needed for efficient production. There is a large building housing two Diesel motor generators supplying us with our own power, and a large air conditioning plant supplying most facilities.

My real work is the setting up of administrative, sales, production, programming, film, public relations, and clerical departments which were nonexistent. We have made headway in this respect and have already started by moving into the half finished office area of our new building. I had to set up class rooms for our production staff and engineers to learn from each other, and to give them basic ideas about operation of the TV station. As Tokyo is only one station in the group of many others to come, the organization has to be tailored now to take care of network operation, and this is not a small task. We have to go into such details as design program schedule forms, time schedules, engineer work sheets and many other things.

DR. WALTER DUSCHINSKY
Nippon Television, Network Corp.
1 Yuraku-cho, Chiyoda-ku
Tokyo, Japan

Editor's Note: Dr. Duschinsky, as representative of Unitel, Inc., which has been retained as consulting engineering firm by the privately-owned Nippon Television Network, is presently supervising the establishment of the Tokyo station, JOAX-TV, which will be the nucleus of a widespread network, eventually covering all of Japan's major islands. Report at press time notes that JOAX-TV has just gone on the air.

ELECTRONIC TEST INSTRUMENTS



TV MONITOR

MODEL 335E

All channels 2 to 83

Exceeds F. C. C. requirements

12¼" high; rack mounted

High stability, accuracy, long-term dependability

Monitors visual, aural frequencies; percentage aural modulation

New! Small, low-cost monitor for all TV channels gives continuous, precise indication without adjustment

The unusually compact, low-cost Model 335E occupies just 12¼" of a standard relay rack. Yet it accurately and continuously performs all VHF and UHF television monitoring functions including visual and aural carrier frequency and aural carrier percentage modulation measurement.

Carefully engineered crystal reference oscillators provide accuracy in excess of F. C. C. requirements for all channels. Because discriminator accuracy does not depend on a tuned circuit, no time-consuming adjustments are required during operation. It is never necessary to reset carrier level or realign circuits. Proper operation of the monitor can be checked conveniently by controls located behind the front panel cover.

Trouble-Free Dependability

The monitor is specifically designed to operate at full accuracy over long periods of time without maintenance. Highest quality components and construction are used throughout. A new chassis design increases accessibility of components and makes possible cool operation through forced ventilation. Extra features include provision for remote indicating meters, remote peak modulation indicator lamp, and a demodulated signal for aural monitoring.

The instrument also includes a front-panel crystal temperature indicator and illuminated meter faces. It fits a standard relay rack, and can be color finished to match your transmitter installation.

SPECIFICATIONS

AURAL FREQUENCY MONITOR

Deviation Meter Range: +6 kc to −6 kc.
Accuracy: Better than ±1,000 cps for at least 10 days.

AURAL MODULATION METER

Modulation Range: Meter reads full scale on 33.3 kc swing. Calibrated to 100% at 25 kc swing; 133% at 33.3 kc swing.
Accuracy: Within 5% of mod. full scale.
Meter Characteristics: Meter damped in accordance F.C.C. requirements. Reads peak value of modulation peak of duration between 40 and 90 milliseconds. Meter returns from full reading to 10% of full value within 500 to 800 msec.
Frequency Response: Flat within ± ½ db, 50 to 15,000 cps.

MODULATION PEAK INDICATOR

Peak Flash Range: Fram 50% to 120% modulation (25 kc = 100%).

VIDEO FREQUENCY MONITOR

Deviation Meter Range: +1.5 to −1.5 kc.
Accuracy: Better than ±500 cps for at least 10 days.

AUDIO OUTPUT

Frequency Range: 50 to 15,000 cps. Response flat within ± ½ db. Standard 75 μsec de-emphasis circuit.
Distortion: Less than 0.25% at 100% modulation.
Output Voltage: 10 volts into 20,000 ohms at 100% modulation (low frequencies).
Monitoring Output: 1 milliwatt into 600 ohms, balanced, at 100% modulation (low frequencies).
Residual Noise: At least 70 db below output level corresponding to 100% modulation (low frequencies).

GENERAL

Frequency Range: Channels 2 to 83 inclusive, including offset channels.
R. F. Power Required: Approx. 1 watt.
External Meter Indication: Available for aural carrier deviation, video carrier deviation, aural modulation percentage and peak indication.
Size: 12¼" x 19" x 13". Rack mounting.
Power: 115 volts, 50/60 cps, 180 watts.
Price: $1,950.00 f.o.b. factory.

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TELE-TIPS

HOW IS the college graduate of five years ago doing today? To find out, Illinois Institute of Technology surveyed its class of 1948 and came up with some interesting statistics. Financially, the '48 graduate is doing very well. In fact, he has bettered himself just about 100 per cent in five years' time. He started work after graduation at an annual salary of $3,180, and today he is earning $6,340. Over-all, 96% of the '48 class earn more than $4,500 annually; 76% earn more than $5,500; 46% make more than $6,500; and 17% are in the over-$7,500 bracket. There was no discernible correlation between salary and age. However, those graduates who had the greater number of family dependents also had the larger salaries.

SCIENCE BEATS TRAFFIC RAP!—When Art Leinwohl of Dalmo Victor was tagged for passing a red light, he demanded a trial and put his slide rule to work. He timed the duration of the caution light as 2.5 seconds, and then computed that at 35 mph it would take 2.55 seconds plus normal reaction time for a prudent driver to stop at his given distance from the changing signal. Case dismissed.

ONE MAN'S MEAT—Steeplejacks who change antenna tower lights atop the Empire State Building sometimes find the weather a bit threatening. However, they take it in their stride and resignedly climb up the 1470-ft. structure. But building engineer Don Gibson says the beacon lamps give him less trouble than the thousands of others in the skyscraper. His explanation is simple. "No bulb snatching problem."

BUILD YOUR OWN—It is interesting to note that our British cousins still go in for home construction of television receivers. Of course in the early days of TV here thousands of TV kits were sold—witness the success of Transvision. But in the United Kingdom the radio and television trade papers still print multi-part constructional articles from which many TV receivers are being built. One reason for the popularity of these build-it-yourself sets may be the saving of 33% purchase tax on completed receivers!

(*Continued on page* 64)

SMOOTH ACTION

NEW Houston-Fearless TV CAMERA PEDESTAL

Camera is raised quickly, easily by lifting on steering wheel.

New smooth action... new stability... new convenience and ease of operation are offered in the new Houston-Fearless Television Camera Pedestal, Model PD-3. Camera is accurately counter-balanced, making it possible to raise and lower quickly, smoothly by simply lifting or pressing on steering wheel, even with pedestal in motion. Three pairs of dual-wheels assure smoother rolling-dolly shots. Two types of steering: for straight tracking or sharp turning. All controls are within easy reach of cameraman for maximum convenience. Dependable Houston-Fearless quality throughout. Makes possible better, more showmanlike productions in any studio. Write for details today.

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"WORLD'S LARGEST MANUFACTURER OF MOTION PICTURE PROCESSING EQUIPMENT"

TELE-TIPS

(*Continued from page* 62)

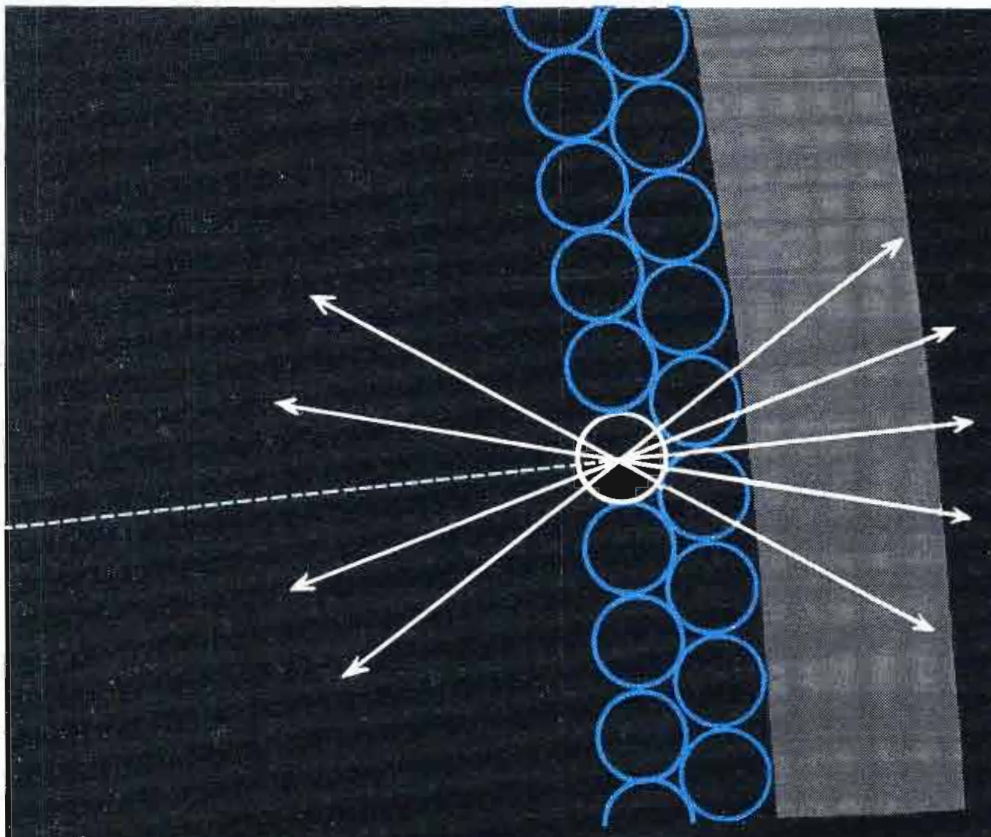
POLAROID SPEEDS TV—A picture-in-a-minute camera has helped Miami TV station WTVJ win the coveted McGill Foundation Cup presented each year by National Association of TV News Directors to the station who has topped all others in outstanding news coverage. Says Lee Ruwitch, WTVJ's general manager, "The use of a Polaroid camera for fast coverage of local events has played a leading role in gaining this nation-wide honor for our station. Our photographers take the camera along to snap pictures of local accidents, fires, and other happenings—rush the picture back to the studio and we flash them on the screen almost as the news is taking place."

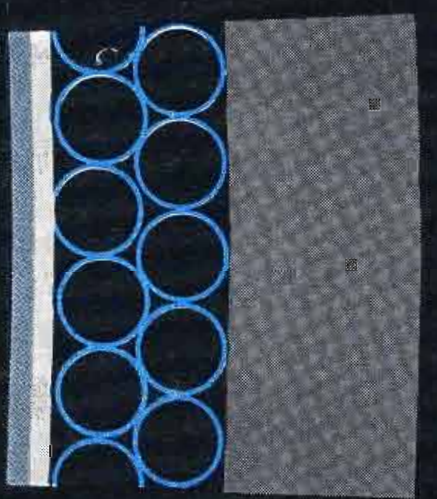
ELECTRO-OSMOSIS is holding back the soil which would otherwise pour into an excavation at a power plant near Bay City, Mich. Steel anode rods driven into the ground around the excavation are charged with low voltage dc. Current flows to a second series of cathode rods, forcing water from the soil to the cathode pipes. This action dries out the soil and reduces shifting, eliminating the need for small dams and considerable sheet piling. The process was developed by Dr. Leo Casagrande, now of Harvard Univ.

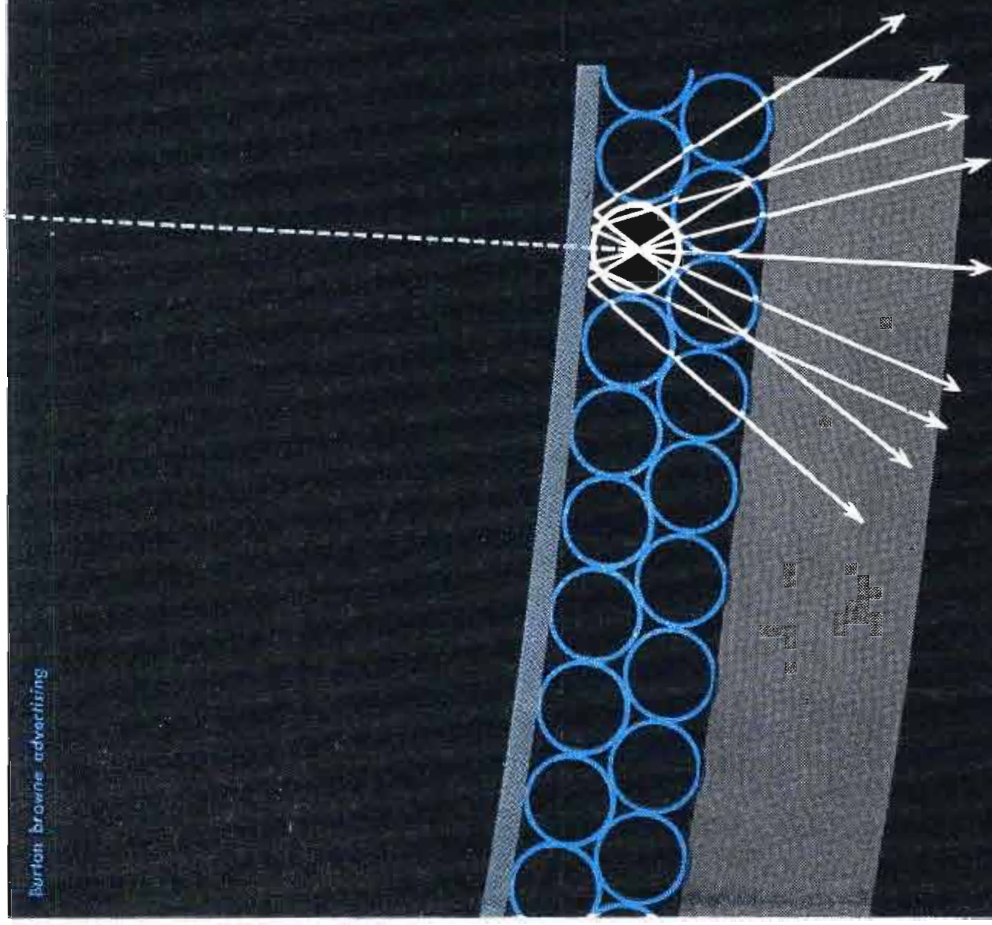
PFFST! "Are you fighting the battle of the bugs?" asked the announcer over General Electric radio station WGY. He didn't know it, but he was. In the middle of his "bug" commercial, his voice died out momentarily. WGY engineers were puzzled, but at South Schenectady the answer was obvious. A huge bug had crashed into the G-E transmitter there. Things were only "buggy" for an instant though; the insect went up in a flash of blue flame and power surged back to normal.

EUROPEAN TVI is already being experienced in France at Lille, and in Belgium at Mons, due to transmissions in the 200-223 mc band from Lagenberg in Germany. Observations by French engineers show that the interference is worst in calm, dry weather and least under wet, turbulent conditions. Lille uses 819 lines and Lagenberg 625 lines.

(*Continued on page* 70)







what Aluminizing means

Aluminizing means the efficient use of light—light is energy—energy is the pay-off.

Aluminizing means a brighter TV picture, greater contrast, lower beam current, smaller spot size, sharper focus, reduced screen scorch—*all* from the efficient use of light.

On the inside of any TV tube face is a coating of phosphor crystals—the picture screen. As the electron beam—tracing the picture—strikes these crystals, they glow, giving off light in all directions. And there's the problem! Half the light thus generated is *inside* the tube, either lost to usefulness or lighting areas that should be dark. Both brightness and contrast suffer.

But—put a mirror behind the phosphor and "wandering" light is reflected back through the tube face. *Aluminizing creates this desired mirror!*

To aluminize a picture tube, deposit a nitrocellulose film evenly over the phosphor. Over that, deposit a film of aluminum only millionths of an inch thick—just thick enough to reflect the light and just thin enough to let the electrons pass through. Under heat, evaporate the nitrocellulose film to leave a thin smooth coating of aluminum. Result—an efficient light reflecting mirror to specifications.

Simple as it sounds, Rauland research engineers worked for three years to solve the problem and were among the first to do so.

Rauland

Perfection through Research

ZENITH Subsidiary

Burton Browne advertising

TELE-TIPS

(*Continued from page* 64)

LINELESS PICTURE TUBES are on the way, predicts U. A. Sanabria, president of American Television, Inc., and inventor of a means for making raster lines less visible without obscuring the picture. This is accomplished by placing a screen such as nylon mesh in front of the tube face. At some critical angle of placement for the proper mesh, the system is reported to split the scanning lines in such a manner as to make them unnoticeable, while improving the apparent definition. The fine mesh itself is hardly visible. Mr. Sanabria also reports the development of electron guns and apertures that split the lines by producing three spots instead of one. Combination of these two methods is supposed to make the TV picture as smooth as a photograph.

INDIVIDUAL TV—Using your own TV set to see who is at the door and using it when you phone the butcher shop to actually see the meat you are ordering—these two advanced uses of TV in the home were demonstrated at the Belden-Stratford Hotel in Chicago, by Central Television Service, Inc., distributor for Dage TV cameras.

When a visitor uses the house phone at the hotel desk, a small Dage television camera transmits his picture.

TRANSISTORS for electronically operated wrist watches are being developed by CBS-Hytron. The project is still in a very early stage.

3 IFs PLUS—In Great Britain, manufacturers have a choice of three frequencies for television intermediate frequencies! Actually these are not necessarily the only ones used, but reflect those most commonly encountered. A case for some form of standardization seems to be indicated! The British frequencies are: 10, 11, 16, and 34 mcs.

TRUE VALUE—"I will pay more for the ability to handle people than for any other ability under the sun." —John D. Rockefeller.

TELE-TECH
& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

Congress and the Spectrum Grabbers

On the day that Congress adjourned, a bill was introduced by Rep. Charles A. Wolverton, Chairman of the House Interstate & Foreign Commerce Committee, to explore the government's entire telecommunications policy. The idea of presenting the bill at the last minute is to give those agencies which will be affected a chance to prepare their views for hearings to be held next year.

In brief, the bill would set up a Telecommunications Policy Committee, comprising representatives from the State, Defense and Commerce Departments, FCC and other agencies. Its chairman would be appointed by the President. This Committee would decide policies, indicate to appropriate agencies what action is required to carry out these policies, and recommend legislation to Congress.

It is not yet clear exactly how the Committee would function, but there are several considerations which must be fully investigated. First of all, under the present Communications Act, the President has the power to set aside those frequencies needed for exclusive government use. A sound method of accomplishing this is to have a personal advisor who is not an interested party. This service was admirably performed by the Office of the Telecommunications Advisor to the President, which, unfortunately, has been eliminated in the present structure.

Instead, a little-known group called the Inter-department Radio Advisory Committee (IRAC), representing the various government departments, does the deciding. Each member is an interested party, working to obtain spectrum allocations for his own department. To date IRAC has gobbled up about 50% of spectrum, including large blocks of frequencies which are seldom used. The FCC is then left with the problem of assigning the remaining second-choice frequencies to the general public.

Quite recently an Assistant Director for Telecommunications of the Office of Defense Mobilization was appointed. This top-level post assumes the duties formerly handled by the Telecommunications Advisor to the President, and includes the direction of IRAC. Whether or not it will curb the spectrum-hungry appetites of IRAC remains to be seen.

Whether it be through the ODM or the proposed Telecommunication Policy Committee, the important point is that each government agency should be forced to justify its occupancy of the radio channels, within the bounds of national security, in no less stringent manner than is required of commercial licensees.

More Problems for UHF

Many people's confidence in UHF has been rudely shaken by the recent surrender of CP's by several UHF grantees. Thankfully, most of the TV grantees, in spite of being hard-pressed, refuse to throw in the towel. Some grantees caught in the squeeze have called for an immediate tie-in with subscription TV. It is doubtful that such a venture would meet with more than limited success because most of the basic problems would remain unresolved. Other UHF operators, more panicky than most, have started yelling for the government to take a stronger hand. This could be a Frankenstein monster.

The real problems underlying the UHF dilemma are threefold—and they are amenable to solution.

TECHNICAL: Before we can consider anything else, UHF must be able to produce an acceptable picture in a sufficiently large area. Fortunately, engineers have proven more successful than other people involved. With higher power transmitters becoming increasingly available, and receivers being designed with greater sensitivity (we hear heartening reports of excellent pictures at 1000 μv/m), this phase of the problem does not appear menacing. Improved tuning designs with lower noise factors and requiring less critical adjustment at the receiver should be forthcoming.

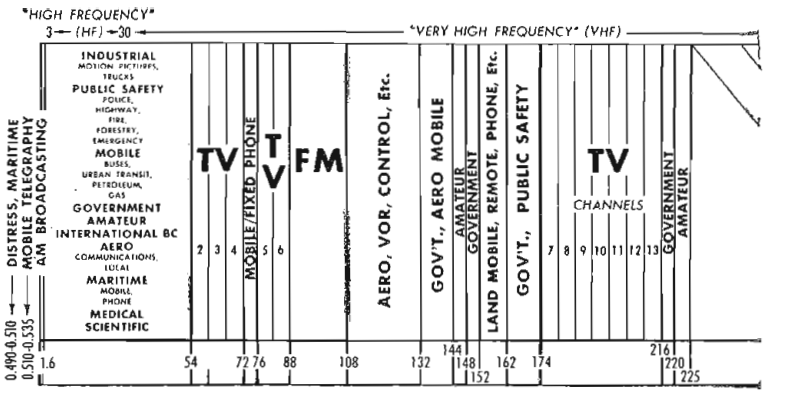
PROGRAMMING: Some of the networks have been considerably more business-minded than public spirited. In numerous cases they have refused programs to the new stations. Admittedly, the competitive situation makes a large immediate audience most important, but the long range view also indicates that high-budget network originations will help build that audience, eventually benefiting broadcasters, public and sponsors alike. As this is realized, "hard dollar" attitudes should soften. At the same time, the UHF's should pioneer new program approaches and cultivate imaginative ideas.

PUBLIC PROMOTION: Heavy promotion is in order to get the idea across to the public that UHF will provide first-rate service, and that conversion is not so difficult or expensive. Certainly, TV manufacturers have done a wonderful job in making UHF receivers and converters easily available. UHF stations, and particularly those invading established VHF markets, must recognize that two-fisted salesmanship is their responsibility. For example, they could buy a number of single-station converters, and in conjunction with advertisers, sell them for real bargain prices.

We believe that UHF is a vital element in broadening TV horizons. The joint efforts of the new stations, networks and manufacturers can, and will, make it the monumental success that VHF is.

RADARSCOPE

Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications



UTILITIES

POWER RADIO EXPANSION—Statistics just released by the National Committee for Utilities Radio show a spectacular growth of utilities mobile radio stations during the past two and a half years—from 38,000 transmitters in January, 1951, to more than 66,000 today, an increase of more than 70%. Indications are that the pattern of growth is in the expansion of existing power radio service radio systems rather than in any large increase of number of licensees, as the number of licensees during the period grew from 1175 to 1500 while the number of base and fixed stations during the time increased from 3000 to 5600 and the number of mobile units authorized by the FCC jumped from 35,000 to more than 60,500.

ELECTRONIC CONTROL

AUTOMATIC FACTORIES may shortly effect practical economies dollarwise, declared Prof. R. C. Canning of the University of California before the recent Los Angeles meeting of ASME.

Although a master scheduling computer has not yet been designed, he said, it is now feasible to design an electronic machine that will assemble data, translate the work schedule into specific shop instructions and measure and feed back the rate of progress for the next scheduling computation.

"Certain plants with over 1000 employees almost certainly should consider the purchase of such a system. A data system might well pay for itself in a short time by savings in clerical salaries, thus paving the way for introduction of a master scheduling computer at a later time.

"The scheduling machine, with all pertinent memory data stored in it, assigns shop orders to machine tools in just the same decision-making manner as is done in the shop. But the machine is much faster.

"The machine is then able logically to determine what is most likely to be happening in the shop for each hour during the next few weeks. In 15 minutes the machine can run off a schedule of the next 40 hours' shop time. At a plant used for this study the functions of 14 of the 29 people now in production control could be handled electronically.

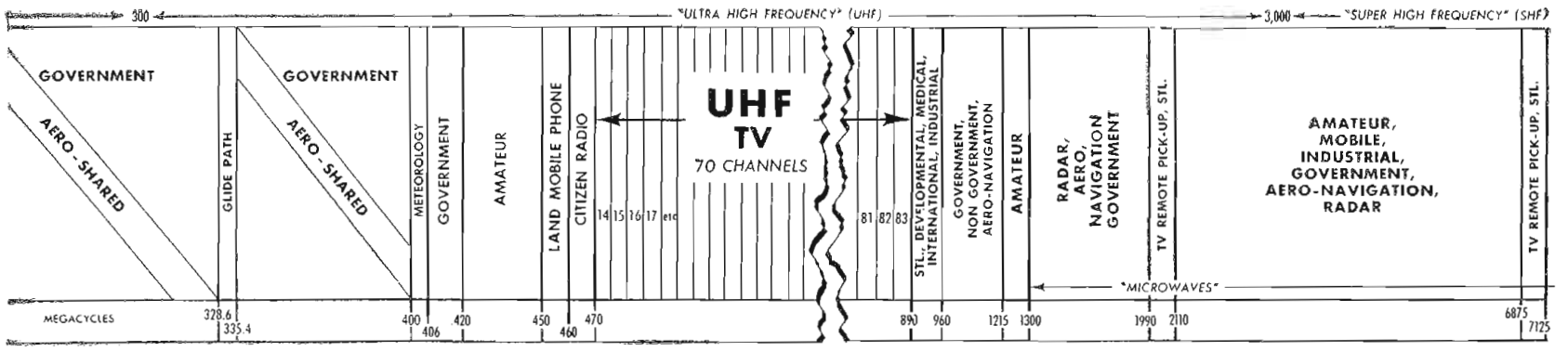
"The direct saving from salaries and overhead would amount to $175,000 in two and a half years. Since the company's output would be around $12,000,000, even a 3% saving from reductions of bottlenecks would mean a saving of $360,000, or almost twice as much as the clerical savings. The cost of the electronic equipment would be between $250,000 and $300,000 as compared with a total saving of $535,000 in 2½ years."

ENGINEERING MANPOWER

INDUSTRIAL DEFERMENT—The Engineering Manpower Commission continues to receive reports from various companies of the increasing difficulties in obtaining occupational deferments. The reports indicate that special difficulties have lately been attached to receiving additional deferments for those persons who have already had deferments covering a period of from one to two years. It is significant to note that as of Dec. 31, 1952 there were 31,017 Selective Service registrants deferred for reasons of industrial occupation. As of June 30, 1953, this number had fallen to 25,797. Prior to December, 1952, the number of industrial occupational deferments had remained roughly stable in the vicinity of 32,000. The conclusion is, therefore, that for some reason local and appeal boards in various parts of the country are not only refusing to grant additional de-

For Executives Only — or What the Boss Thinks About His Job!

An executive has practically nothing to do except decide what is to be done; to tell someone to do it; to listen to reasons why it should not be done, or should be done by someone else, or done in a different way; to follow up to see if the thing has been done; to discover that it has not; to ask why; to listen to excuses from the person who should have done it; to follow up to see if the work has been done properly at last, only to discover that it was done incorrectly; to point out how it should have been done; to conclude that as long as the work has been done to let it stay as it is; to wonder if there is not time to get rid of a person who cannot do a thing right, but also to reflect that he probably has a wife and 10 children, and that anyway, someone else would be just as bad if not worse; to consider how much simpler and better the work would have been done if one had done it himself in the first place; to reflect sadly that one could have done it right in 20 minutes, and that, as things turned out, one has had to spend two days to find out why it has taken three weeks for someone else to do the work the wrong way —FROM THE OLD EGYPTIAN.



ferments to those already deferred, but also are refusing to grant occupational deferments for the first time. One large company with much critical work, for example, has been unable to obtain occupational deferments for any of its 1953 engineering and science graduates. Indications are that certain companies are throwing in the sponge and ceasing to request needed industrial deferments because of their recent lack of success with such requests. We recommend most strongly to these companies that they should not give up. The continuation of selection in our Selective Service System, proved so well in World War II, and in the Korean conflict, may very well be vital to our survival. Let's get some long-range mobilization thinking in our mobilization planning.

TELEMETERING

MONITORING REACTIONS of jet pilots in the air is made possible by a telemetering system developed by the Naval Medical Research Institute. In effect, a doctor on the ground can give the pilot a physical examination by observing instrument dials in a laboratory or, as was demonstrated in one case, in a comfortable hotel room. To accomplish this, tiny silver electrodes are taped to various parts of the pilots' bodies. The electrical signals thus generated are amplified and fed to a UHF transmitter, which transmits them to a receiver on the ground. The instruments connected to the receiver can determine heart performance, respiration, body temperautre, pulse rate and brain wave activity.

INDUSTRIAL TV

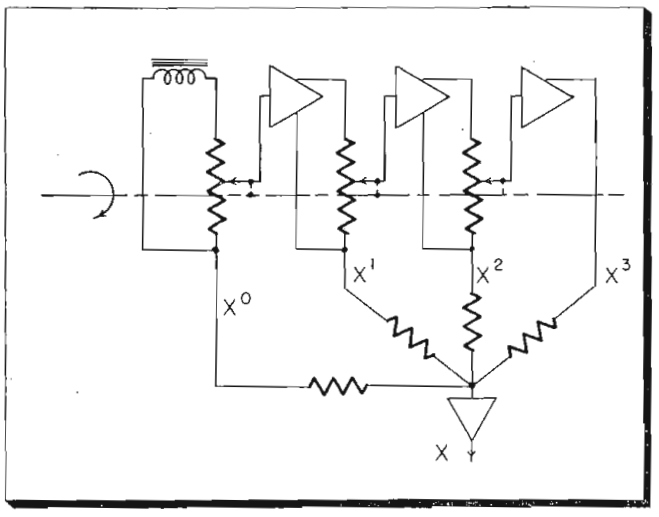
BIG BROTHER IS WATCHING YOU! Industrial TV, which has proven so useful in monitoring production processes and studying radioactivity, is finding new applications in plant security. It should be a boon to companies suffering many thousands of dollars in losses caused by mysterious depletion of inventory. Petty (and not-so-petty) pilfering—a tube here and a resistor there—has a way of adding up. An example of a recently successful use of industrial TV took place at the RCA Service Co. in Los Angeles. After $38,000 worth of TV tubes were reported stolen since the first of the year, engineers installed a standard RCA industrial TV camera with wide-angle lens capable of viewing the warehouse tube storage area. A 10-in. monitor was placed in a building 100 yards away. When the star performer (an employee) came on-camera, he was observed by police and company officials watching the monitor while he loaded the tubes into a waiting auto. In "dragnet" fashion, police waiting outside were radioed and the culprits were taken into custody.

COMPONENTS

TRANSFORMER BLUES! We do not know why, but quality seems to be distinctly variable in the component field. Particularly this seems to be so right now in the case of transformers. Perhaps steel has been difficult to obtain in good, high-permeability stampings, but there have been a number of complaints recently in one field due to low current and voltage output from presumably normal transformers. Strange how these production faults seem to run in cycles—not long ago tubes were the big offenders.

Screen of new surveillance-radar system in operation at the Norfolk, Va. Municipal Airport shows CAA traffic controller the location and flight path of every aircraft flying within the 30 to 60 mile radius of the safe and efficient traffic pattern. Only moving aircraft are displayed on airport, and assists him in directing each plane via radio through a the screen of the new radar. The system at Norfolk is the first of 23 delivered by General Electric to be commissioned and placed in full-time operation. The system has been installed and awaits commissioning at 16 other airports, and seven others are in various stages of installation.

Generating Nonlinear Functions with



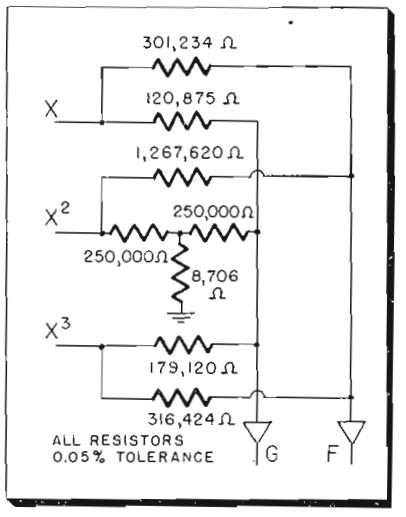


Fig. 1: (l) Power series generator. Fig. 2: (r) Weighting networks corresponding to Table I data

Flexibility of new circuit technique holds promise for military fire control and computing systems. Method challenges use of cams for storing functional data

By HAROLD LEVENSTEIN, Manager Technical Services
W. L. Maxson Corp., 460 W. 34 St., New York 1, N.Y.

ALMOST every manufacturer of military analog computers has had the problem of generating empirical or functional data in his equipment as part of the computing process. In particular, anybody who has attempted to construct a reasonably sophisticated fire-control system has found need for storing the ballistic properties of the projectile by some mechanical or electrical means.

The most common construction employs mechanical cams, which can be flat, spiral, or three dimensional. While these are effective, cams can be expensive to construct and check, accuracy is difficult to maintain, and the system is generally inflexible.

For these reasons, we have been investigating a variety of electrical means for performing this task. While the art of manufacturing shaped potentiometers has progressed considerably, and a great variety of functional forms can be obtained to a high degree of precision, the requirements of our equipment suggested that we take the following precept as our guide:

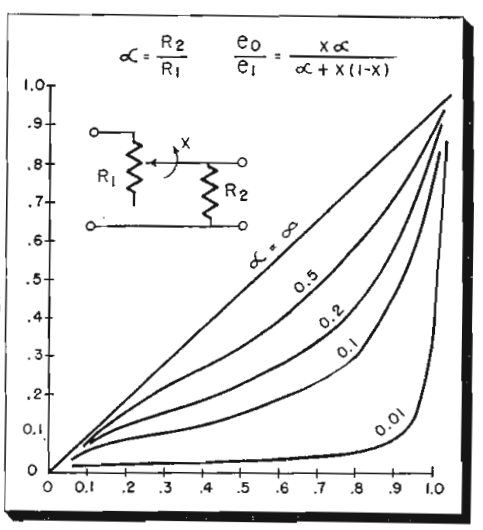
a. The basic design of the circuits should lend themselves to ready modification to permit reasonable accommodation to changing data needs.

b. The elements of the circuits should use minimal electronics, though not necessarily none.

c. Since variable elements will be required, it is preferable that these be linear potentiometers only.

d. They should lend themselves to design by a reasonably simple design procedure.

The procedures we have developed, while not remarkable, appear to be effective and successful. In addition, a rather complete theory of circuits, consisting of fixed resistors and linearly varying potentiometers (really rheostats), has been evolved.



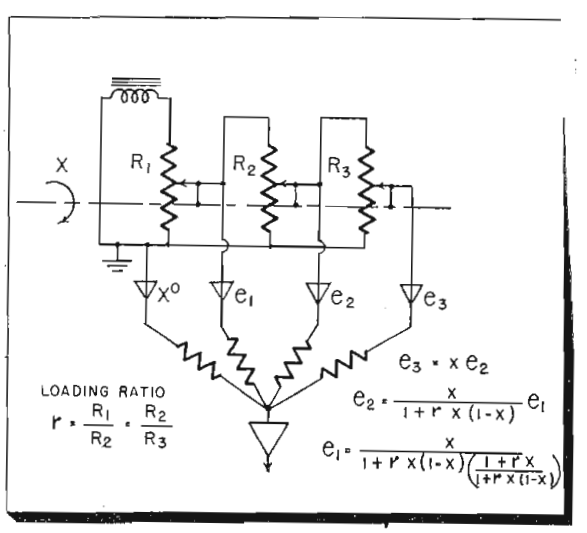


Fig. 3: (1) Curves for loaded potentiometer. Fig. 4: (r) Cascaded potentiometer circuit

Power Series Generation

The first method, which we have employed rather widely, originates from basic interpolation theory employing polynomial curve-fitting methods.

Obviously, in a practical computer, the number of terms in the polynomial must be limited by practical considerations. It has been our experience that a cubic series is almost always adequate for our purposes. Once in a while a quartic is required.

Fig. 1 shows the circuit arrangement most commonly used. The circuit consists of three or more potentiometers driven by a common shaft representing the input variable X. The first potentiometer is excited from a reference voltage V; the output of each potentiometer is fed to an isolation amplifier, which then provides the next potentiometer with its excitation. In addition, weighting resistors, connected to the outputs of the amplifiers and joined in a summing point, provide a junction at which a voltage proportional to the weighted sums of the powers of X is available to represent Y, a desired function of X. Generally, we make up this weighting network as a plug-in assembly so that we can change the series easily. In addition, if we require more than one function of X, a not unusual situation, we can provide other weighting networks, driven from the isolation amplifiers. Obviously, by varying V as a function of a third variable, Z, we can also obtain functions of the form

$$Y = F(X)G(Z) \qquad (1)$$

The mathematical problem of determining the weighting coefficients is the problem of finding real numbers A, B, C, and D such that

$$Y = A + BX + CX^2 + DX^3 \qquad (2)$$

is a sufficiently accurate approximation to a specified function F(X).

There are two methods of doing

Linear Potentiometers

this. One is to make use of standard interpolation formulas, such as those of Lagrange, for a four-point fit to F(X). If F is given as numerical data, the process is direct. If F is given as a specified function, the numerical values at the points of fit must first be calculated. It is generally convenient to normalize the range of X so that X varies from zero to one. Note that in this process the points of fit must be selected arbitrarily, and there is no assurance that the fit is "best" in any sense.

The most useful alternative to this process is a least squares technique. In this case, the error between Y and F is formed, squared, summed, or integrated over the range of X, the result differentiated partially with respect to the weighting coefficients and the partial derivatives set equal to zero, to form a set of linear algebraic equations in the weighting coefficient. These can be solved for the coefficients. The results will provide a function for Y with minimum squared error over the range of X. Below is a recapitulation of this process with explicit solutions for A, B, C, and D worked out in literal terms.

Given:

X: $X_0, X_0 + t, X_0 + 2t, \ldots X_0 + 6t$

Y: $Y_0 \quad Y_1 \quad Y_2 \quad \ldots \quad Y_6$

Define:

$$Z = \frac{X - X_0}{t} - 3. \qquad \text{Then}$$

$Z_0 = -3 \quad Z_1 = -2 \quad Z_2 = -1 \quad Z_3 = 0$

$Z_4 = 1 \quad Z_5 = 2 \quad Z_6 = 3$

Then

$$Y = A + BZ + CZ^2 + DZ^3$$

where $$A = \frac{Q_0}{3} - \frac{Q_2}{21}$$

$$B = -\frac{397\,Q_1}{8092} + \frac{7Q_3}{578}$$

$$C = -\frac{Q_0}{21} + \frac{Q_2}{84}$$

$$D = \frac{7Q_1}{578} - \frac{Q_3}{578}$$

and $$Q_0 = \sum_0^6 Y_i$$

$$Q_j = \sum_0^6 Z^j Y_i$$

Table I represents data we were required to generate. Two functions, F and G, were to be generated as functions of the independent variable X. The functions determined to be suitable fits are listed at the bottom of Table I. The circuit for developing these functions is shown in Fig. 2. The performance of the circuitry is shown in Table II.

Five Sets of Data

Since five different sets of data were to be handled by this equipment, it is considered to be an extremely compact and efficient design.

In passing, it is worthwhile to note that the least square process is most effective in reducing peaks of errors over the entire range of X. If, for some reason, it is desired to have particularly good performance in some portion of the range, it is possible to weight the errors in this range more heavily than those in the rest of the range, when determining the sum of the squared errors. This is done, of course, at the expense of the average squared error. For example, if it is desirable to have smaller errors near the origin of the range, while still maintaining the full range of X, one might weight the errors in the range $0<X<0.5$ to be twice as important as those in the range $0.5<X<1$.

A logical extension of the above method lies in the observation that if the potentiometers increased sufficiently in their resistance it would be unnecessary to provide isolating

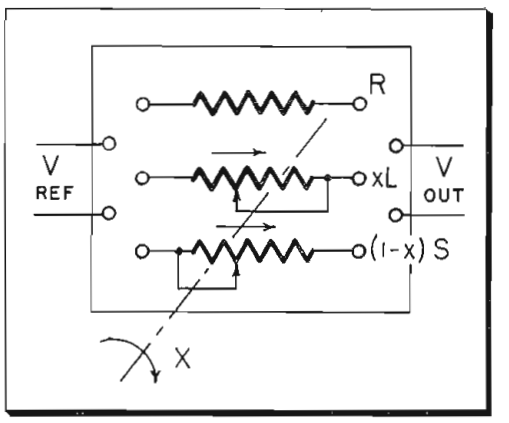


Fig. 5: General variable resistance network

TABLE I: EXAMPLE OF TYPICAL DATA FITTED BY POLYNOMIAL

X	F (calc)	F (data)	Error	G (calc)	G (data)	Error
1	1.7	1.7	0	0.42	0.40	0.02
2	3.6	3.6	0	0.88	0.84	0.04
3	5.7	5.8	–0.1	1.32	1.32	0.00
4	8.3	8.3	0	1.84	1.85	–0.01
5	11.2	11.2	0	2.43	2.45	–0.02
6	14.7	14.6	0.1	3.11	3.12	–0.01
7	18.8	18.6	0.2	3.88	3.88	0.00
8	23.6	23.4	0.2	4.78	4.77	0.01
9	29.3	29.3	0.0	5.81	5.79	0.02
10	35.0	36.9	–1.0	6.99	7.01	–0.02

$F = 16.598412X + 3.9444X^2 + 15.3175X^3$; $\quad G = 4.1365X + 0.06511X^2 + 2.79142X^3$

TABLE II: MEASURED PERFORMANCE OF A TYPICAL FUNCTION GENERATOR

Function	Input, arbitrary units	Output, arbitrary units		Error
		Calculated	Measured	
No. 1	1	3.48	3.42	–0.06
	2	7.18	7.15	–0.03
	3	11.22	11.23	0.01
	4	15.72	15.74	0.02
	5	20.83	20.80	–0.03
	6	26.67	26.63	–0.04
	7	33.36	33.35	–0.01
	8	41.05	41.05	0.0
	9	49.86	49.80	0.06
No. 2	1	3.88	3.86	–0.02
	2	8.03	8.02	–0.01
	3	12.40	12.37	–0.03
	4	16.92	16.88	–0.04
	5	21.53	21.45	–0.08
	6	26.15	26.08	–0.07
	7	30.74	30.67	–0.07
	8	35.21	35.16	–0.05
	9	39.52	39.45	–0.07
	10	43.59	43.52	–0.07

amplifiers. One potentiometer could be connected directly to the output of the preceding one, and we would still obtain voltages which would approximately represent the powers of X, voltages which could be summed in a weighting network as in the previously mentioned circuitry.

Of course, it might not be so convenient to obtain the signs of the coefficients, but the reduction in circuit complexity could be considerable.

Power Series

Some further thought on the subject leads to the conclusion that there is nothing sacrosanct about power series. In fact, any functions which can be conveniently generated by linear potentiometers, and which can be employed as terms of approximating functions, would suit our needs admirably.

Probably every engineer has made the observation that by suitably loading a potentiometer he can obtain quite a variety of relations between shaft rotation and output voltage. Some of these are shown in Fig. 3.

The circuit shown in Fig. 4 is a descendant of our previous observation and this notion of employing loading to modify potentiometer output. Each potentiometer in this cascade is 1/r times the resistance of the preceding potentiometer. r may vary from numbers smaller than one to numbers greater than one. When r is as great as ten, the functions depart only slightly from the power series functions.

Let us define the output of the first potentiometer as e_1, the second as e_2, and so on. Then we will seek to establish coefficients A, B, C, and D such that the desired data F (X) is approximated by a function Y, where

$$Y = A + Be_1 + Ce_2 + De_3 \quad (3)$$

To simply the computation we have prepared tables of e_1, e_2, and e_3, for different values of r. Representative tables are presented in Table III.

The methods employed here correspond to the methods used for finding coefficients of the power series. Once the member of terms has been selected (i.e., the order of the approximating polynomial), you may select coefficients to provide a fit at specified values of X, or you may use a least squares approach with error weighting if desired. The principal difference is that the data employed are completely numerical.

The selection of loading ratio, on this basis is essentially a trial and error procedure. Generally, calculations are made for a couple of loading ratios. You may then select what appears to be the best compromise ratio, or you may plot the sum of the squared errors as a function of

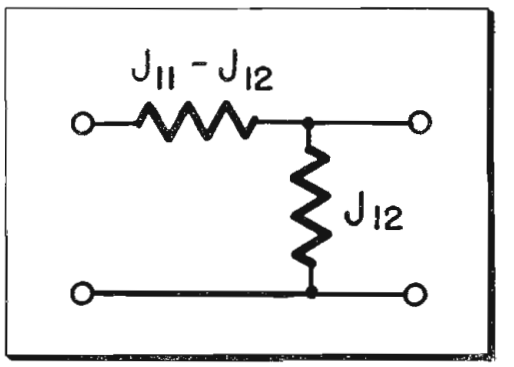


Fig. 6: Circuit of L network

loading ratio, and graphically determine the best loading ratio.

The resistors making up the weighting networks will load the function potentiometers if care is not taken. Generally, it is desirable to make these resistors as large as possible. However, this may be difficult if a high potentiometer loading ratio is used.

Either of two methods may be used to alleviate this situation. If the network is not too involved, the networks may be designed as if there were no interaction with the potentiometers and then corrections to the coefficients can be calculated. Alternatively, the adjustment may be made experimentally.

A rather more elaborate method is to assume the design that is desired, after preliminary calculations have shown it to be within reason, and to develop a function-fitting technique which leads not to coefficients, but to direct design values for the summing resistors. This appears to be too complicated to be practical.

Variable Resistance Networks

The previous work has indicated that some economy in equipment may be achieved by making deliberate use of the interactions between potentiometers and resistances to develop a network with a ratio of voltage output to voltage input (transfer function) which varies in a specified way with some common potentiometer shaft rotation. The general network which we should like to consider is the two-terminal pair of classical network theory, a black box containing fixed resistances, resistances which increase linearly with shaft rotation, and resistances which decrease linearly with shaft rotation. We shall designate the impedance of these elements by R, XL, and (1—X)S, respectively. Obviously, X is the parameter of shaft rotation, the input variable, and runs from zero to one, as before. See Fig. 5. The (1—X)S element corresponds to replacing the

(*Continued on page* 177)

TABLE III: CASCADED POTENTIOMETER OUTPUT FUNCTIONS

X	e_1	e_2	e_3
	Loading Ratio 1:10		
0.1	0.0991072	0.0098223	0.0009822
.2	.1968382	.0387477	.0077495
.3	.2937763	.0863202	.0258961
.4	.3904820	.1525320	.0610128
.5	.4875148	.2378121	.1189061
.6	.5854551	.3430401	.2058241
.7	.6849263	.4695871	.3287110
.8	.7866212	.6193868	.4955094
.9	.8913340	.7950451	.7155406
1.0	1.0000000	1.0000000	1.0000000
	Loading Ratio 1:1		
0.1	0.0916737	0.0084104	0.0008410
.2	.1715976	.0295858	.0059172
.3	.2447741	.0606878	.0182063
.4	.3147208	.1015228	.0406091
.5	.3846154	.1538462	.0769231
.6	.4581281	.2216749	.1330049
.7	.5405233	.3126994	.2188896
.8	.6408840	.4419890	.3535912
.9	.7779540	.6423474	.5781127
1.0	1.0000000	1.0000000	1.0000000

Flexible TV Studio Intercom System

Intercommunication traffic flow during rehearsals and programs point up operational requirements. Crossbar circuit adaptable to any studio layout

By R. D. CHIPP and R. F. BIGWOOD
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A TV studio intercommunication system has many and varied 9 on 10 x 13 textype 8271953 requirements, which depend upon the complexity of the operation and the number of people involved in it. Typical of a simple program is a boxing or wrestling match utilizing perhaps two cameras and two fixed microphones. In this case, the simple carbon system that is built into TV field equipment very adequately serves for intercommunication. Fig. 1 shows such a system which can provide two-way communication between all connected locations. The headset and microphone assemblies are plugged into jacks in the video control unit and the pickup camera. The intercom circuits are carried through as a part of the camera cable. The program director in most cases passes instructions to the cameramen through the switcher or technical director. If the audio man is not physically located adjacent to the program director, cues are given to him through this same circuit. If one-way communication is desired, it is obtained quite simply by providing a headset without microphone at those locations that need to receive only.

Note the toggle switch shown at each video control unit. This switch isolates the control unit and its associated camera from the order circuit. It has been found to be extremely useful in the event that there is camera trouble while on the air or in the event there is need for camera repair or adjustment during rehearsal. By isolating the camera in this manner, the video control operator and the cameramen can talk to one another without disturbing those who must simultaneously use the regular order circuit for normal communication.

Complex Operation

A more complex operation is one which might involve a studio operation combined with film facilities. In the studio of the DuMont station, WDTV, in Pittsburgh, the standard carbon circuit, with the addition of a three bus amplifier talk system has proved to be particularly useful. See Fig. 2. Any one of the three busses can be selected manually by the technical director, the audio operator, and the video control operator. During rehearsals the program director, who sits next to the technical director, will use the studio address bus, while the technical director and the video control operator will use the amplified carbon system. The audio operator can cut into the carbon system if he wishes to talk to the mike boom operators. When cues are passed to the projection room, the technical director switches from the carbon system to the projection room bus. The projectionist has a separate talk back circuit to acknowledge instructions and report readiness to roll film, etc.

When on the air, the program director passes instructions or cues to the technical director. In turn, the technical director will select either the amplified carbon bus or the projection bus. The studio address bus is then used only for playback in the event that the program requires it. As is the case with the single system previously discussed, talk back from the studio to the control room is made available where needed.

As we progress to a still more complex operation, such as projected for the New York DuMont Tele-Centre at 205 E. 67 St. the need for increased flexibility is evident. Consider an operation in which we have an elaborate studio program, portions of which may originate in the field and other portions of which may originate in a distantly located projection room. In the studio we may have an orchestra, back projectionist, numerous stage hands and stage electricians, and other special effects personnel. We have made a study of the flow of traffic required for intercommunication purposes. It is immediately apparent that the requirements during rehearsal and during the actual program are quite

Fig. 1: Standard camera chain intercom system can provide two-way communications between all connected locations

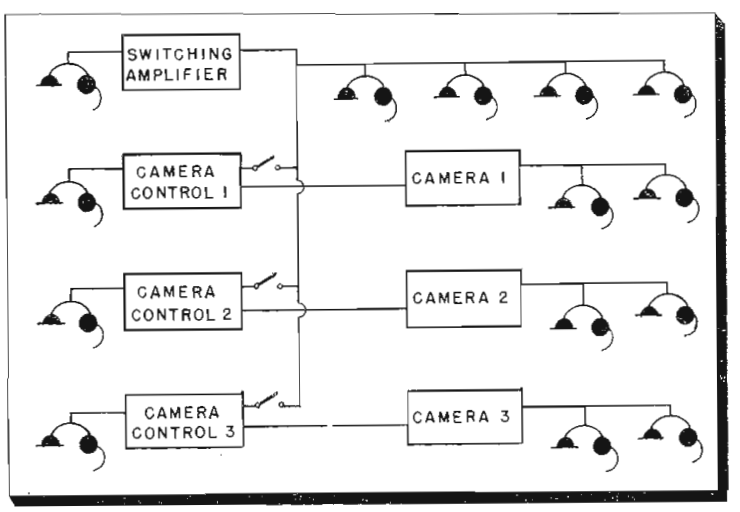
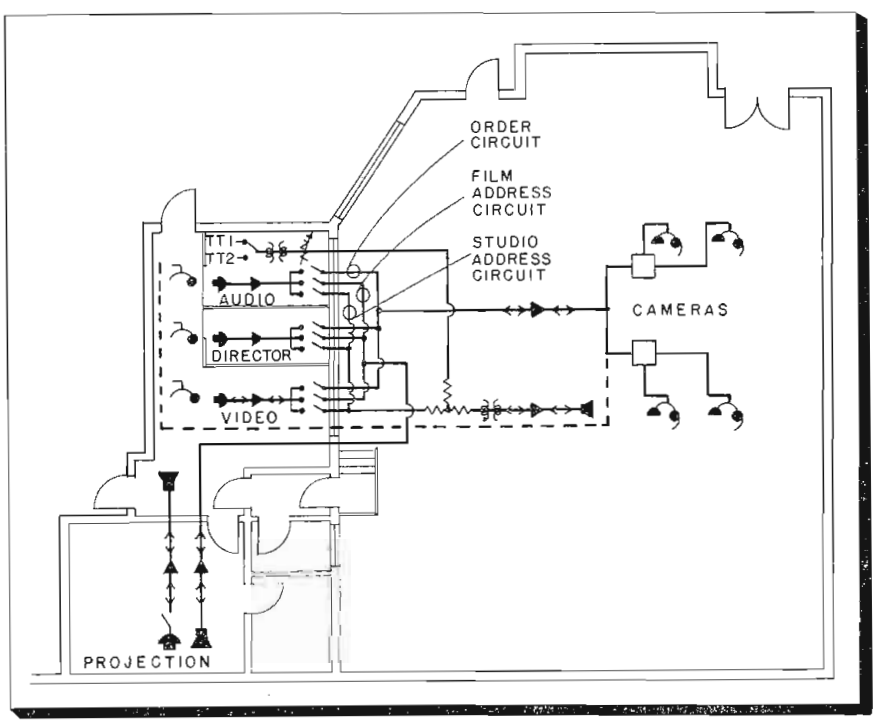
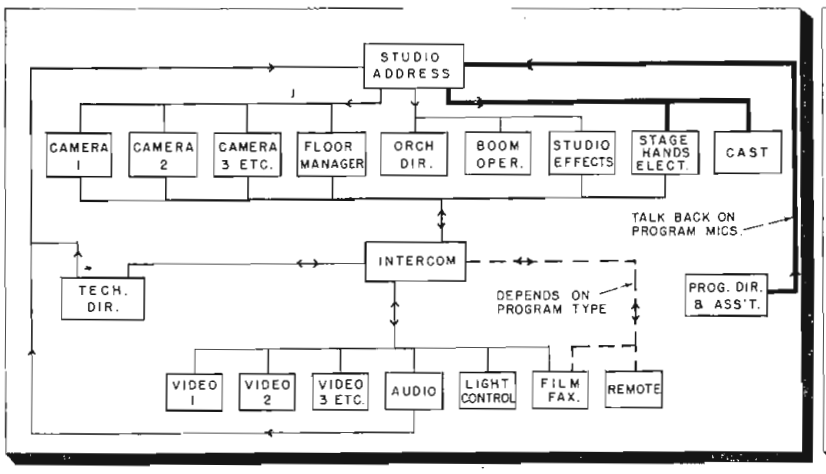


Fig. 2: Studio operations with film facilities at WDTV





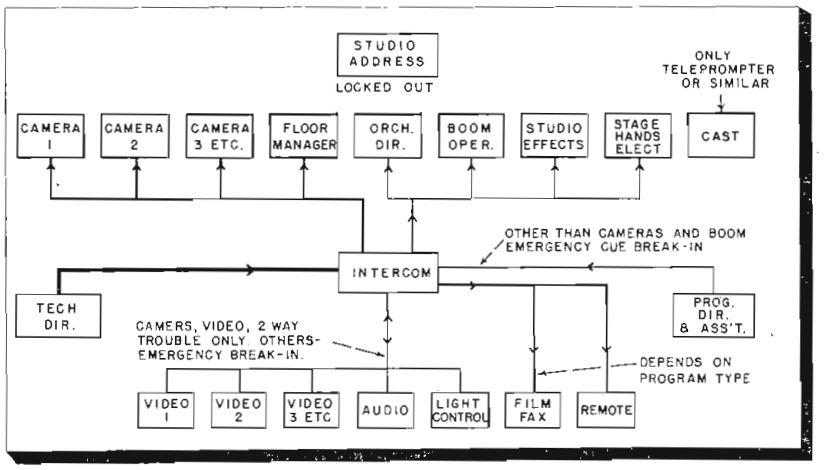


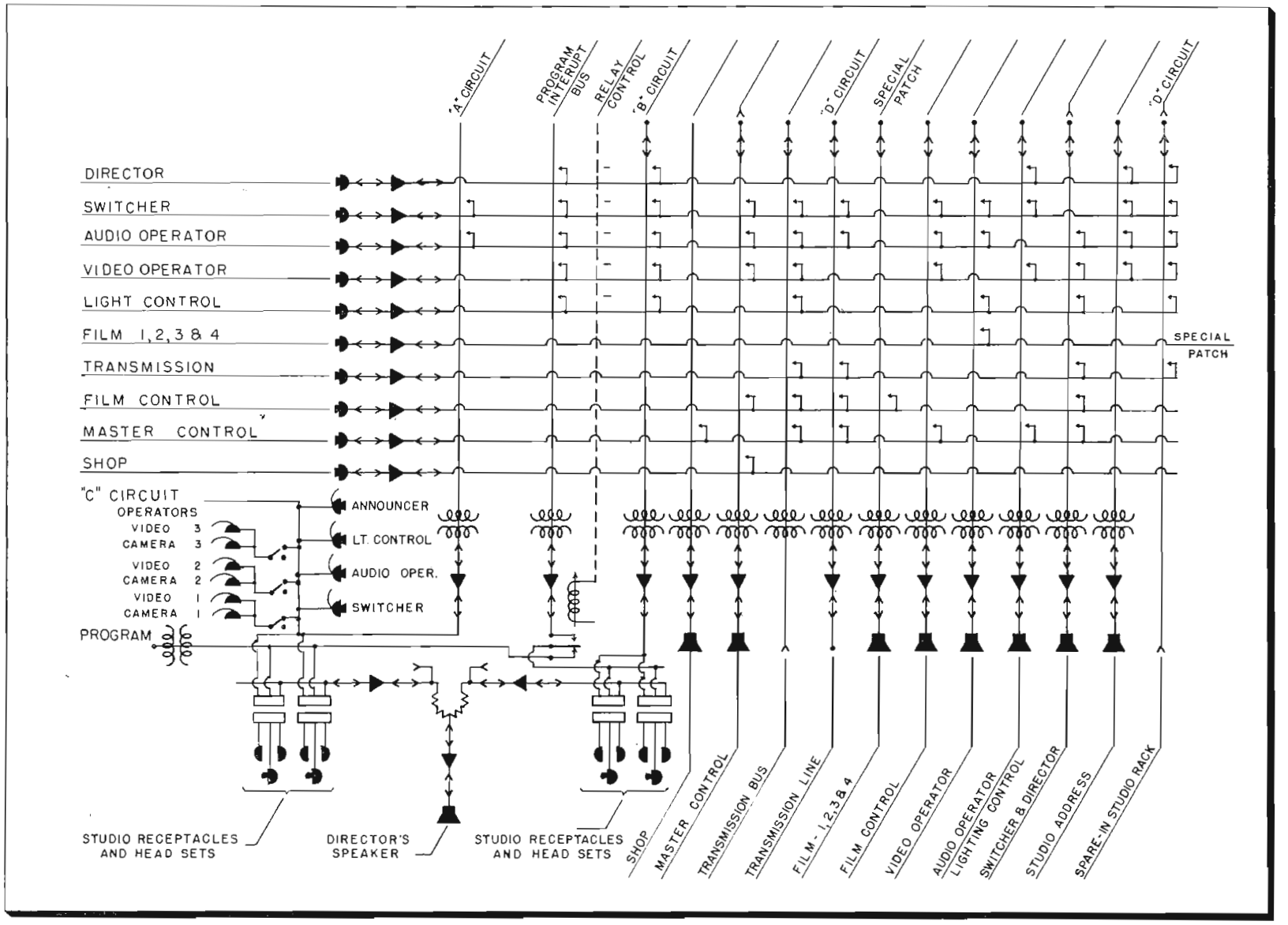
Fig. 3: (l) Intercom traffic flow during rehearsal. Fig. 4: (r) Intercom traffic flow during program. Width of line is proportional to traffic volume

different. Fig. 3 shows in schematic form the flow of traffic during a rehearsal. The width of each line is approximately proportional to the volume of traffic, and the arrows indicate the direction of flow. Maximum volume is from the program director to the floor via the studio address system. Although the volume is light on other circuits, they are of great importance when needed. Fig. 4 shows the traffic flow during the program. Most instructions are now passed through the technical director, although there is still the same need for important supplementary circuits to other locations.

Traffic Requirements

The problem is to design an intercom system that will meet these traffic requirements. Prime system considerations are basic simplicity with maximum flexibility. These requirements have been met by utilizing a type of cross bar arrangement, which is shown in generalized form in Fig. 5. Although this system design fits any type of studio layout, it will be discussed in connection with proposed use in the standard DuMont split control booths at the New York Tele-Centre. Fig. 6 shows a floor plan of this standard control booth, wherein the program director and assistants, plus the technical director, are located separately in the front section. Directly in back and raised two feet are the audio operator and the light control operator. These men can see all monitors over the heads of those in the director's booth. To the left is

Fig. 5: Crossbar intercom arrangement may be adapted to any studio layout. Prime design considerations are simplicity with maximum flexibility



the video control section. This split booth arrangement has proved to be extremely satisfactory. (See Tele-Tech & Electronic Industries, Oct. 1952, page 48.) Some of the reasons are:

(1) It separates functions—program direction, video operation, and audio control.
(2) It isolates audio monitoring, which, if at a satisfactory level for the audio operator, often disturbs the director or video operators.
(3) The various instructions and sometimes prolonged discussions between the occupants of one room do not distract others.
(4) In case of video trouble, a cameraman and video operator may converse at low level without disturbance from audio monitoring or director's and switcher's orders.

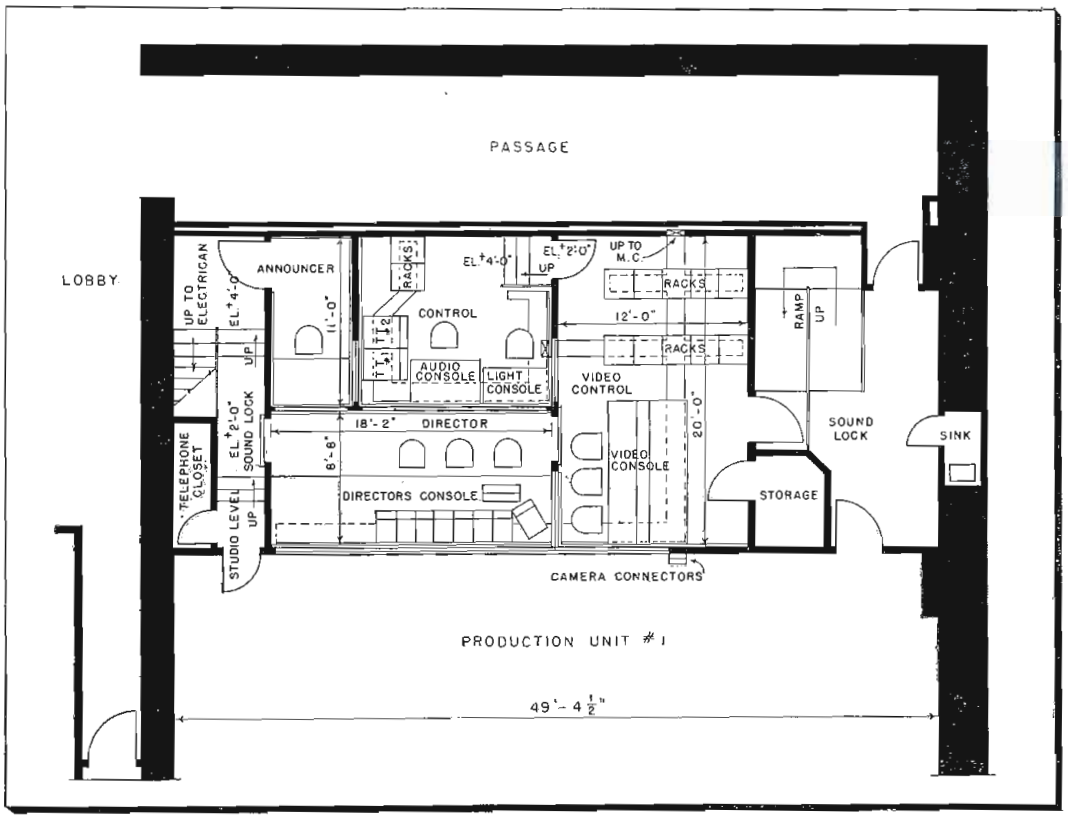


Fig. 6: Floor plan of control booth. Program direction, video and audio functions are separated

Basic Circuits

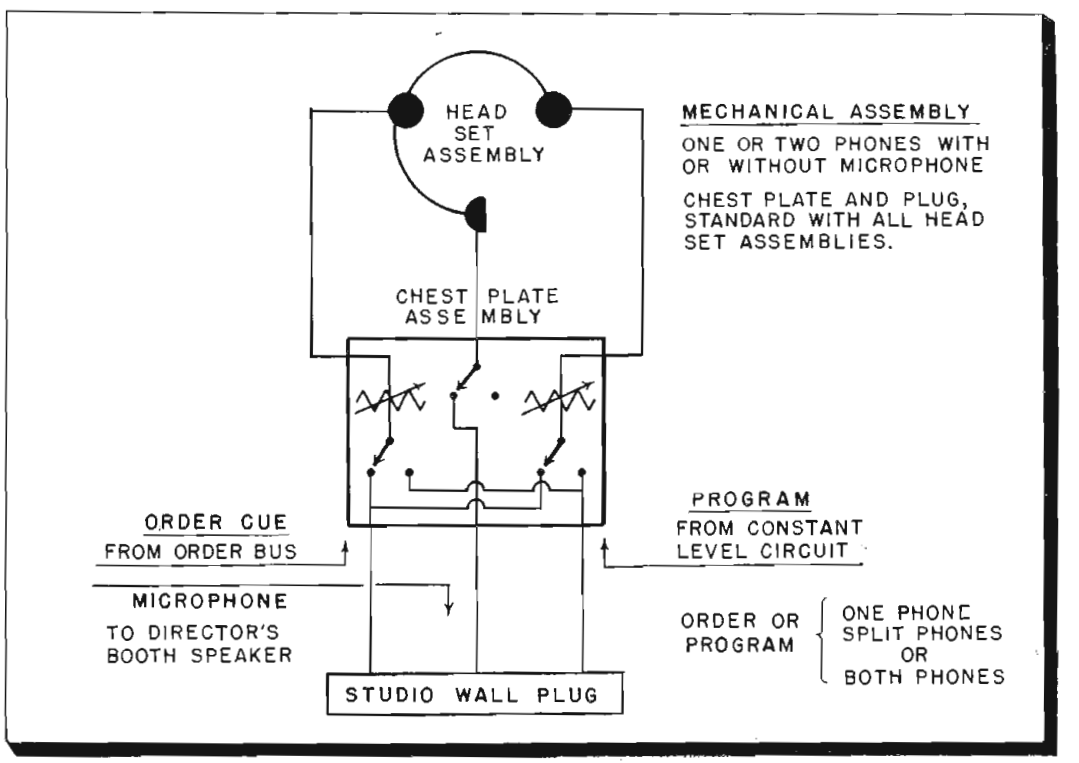
Referring again to Fig. 5, there are five basic circuits that form a part of this system. What is called the "A" circuit carries non-interrupted program cue, the order circuit, and the microphone circuit for return talk. The "B" circuit, which appears on a separate set of receptacles in the studio, is similar to the "A," except that the program cue may be interrupted for instructions by the technical director, the program director, or the audio control man. A standard headset assembly may be plugged into either "A" or "B" circuit receptacles. The "C" circuit is the carbon system associated with the cameras. A "D" circuit, while not an individual system, is an extension of the audio operator's, technical director's, or director's source circuit, which appears in a patch field in the transmission bays at Master Control, and can be routed as required to external locations. Similarly, remote incoming order circuits can be patched into the intercom loudspeaker in the director's booth of any studio. The "E" circuit is the studio address system, which is normally used during rehearsal for instructions to the cast and floor personnel. The public address system for audience coverage and the playback system for film and turntable sound in the studio are separate from the intercom and are not shown in Fig. 5.

The building blocks that make up this system are essentially sources and loads. The sources are microphones, preamplifiers, and keys or relays for selecting the desired load or loads. The loads are bridging amplifiers feeding either loudspeakers or the standard intercom headset assembly used by floor personnel. We have minimized the number of different components and have developed a number of standard units. For example, the preamplifiers are identical in construction to the program preamplifiers, with the exception that the input and output transformers have been modified to limit the frequency response, and considerably lower the cost. The bridging amplifiers are also identical in construction to the program amplifiers with a similar transformer change.

The standard headset is an assembly, specially fabricated for this application, shown in sketch form in Fig. 7. The general construction follows lightweight aircraft practice and various headset and microphone combinations are interchangeable. The headbands will take a single or a double headphone combination, and a microphone can be supported by either a right or left earphone. The control unit is intended to be supported at chest level, and contains transfer switches for connecting either earphone to either the program feed or the order

(*Continued on page* 186)

Fig. 7: Standard intercom headset assembly for floor use. It is not a part of camera carbon system



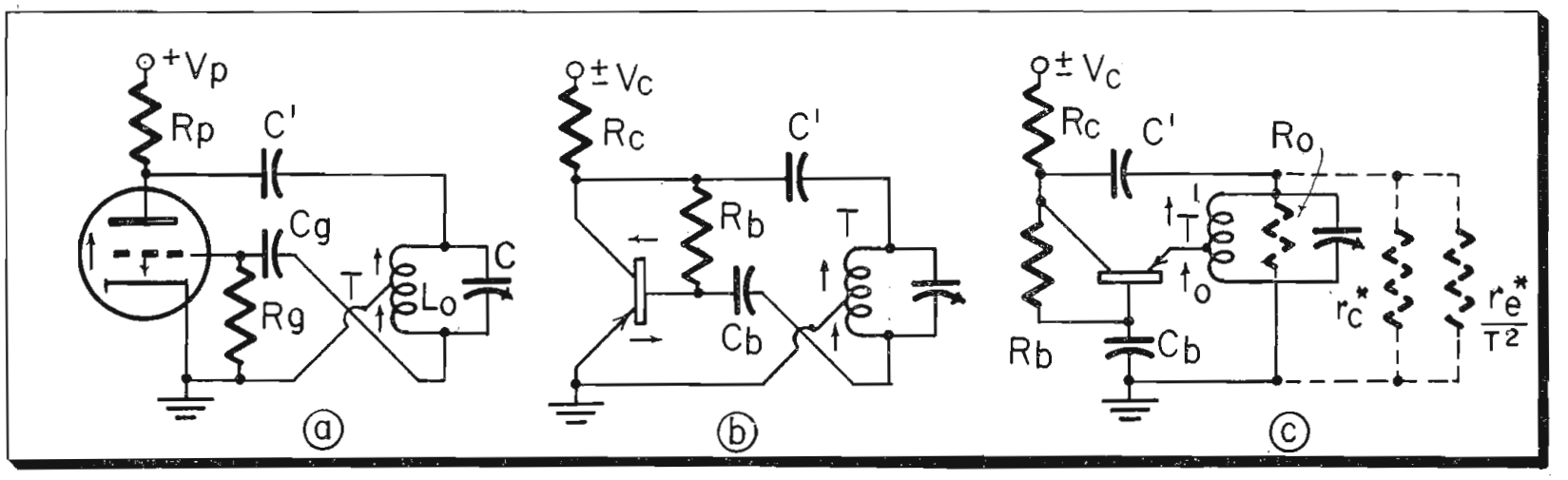


Fig. 1: Hartley oscillator with (a) vacuum triode; (b) transistor grounded-emitter connection; and (c) transistor grounded-base connection

Transistor

By DR. HANS E. HOLLMANN
U. S. Naval Air Missile Test Center
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THE simplest tube oscillator is the Hartley circuit. Feedback is produced by feeding the grid with a suitable voltage taken from a portion of the tank circuit's coil. Reference is made to Fig. 1a according to which the phase opposition between plate and grid voltage requires the coil to be an attenuator with opposite polarity of input and output voltages. Therefore, the two lower connections between coil and tube cross over.

The principle of duality requires a transistor to be treated equivalent to a vacuum tube when in grounded-emitter connection. Consequently, we replace the tube in circuit (a) with a grounded-emitter transistor and obtain the Hartley transistor oscillator diagrammed in Fig. 1b. As long as we deal with a closed loop, there is no difference between a grounded-emitter, a grounded-base, or a grounded-collector connection. Hence, the circuit (b) can easily be redrawn in the form illustrated in Fig. 1c. Seen from the base, emitter and collector voltages are in phase so that the autotransformer must have a positive attenuation V_e/V_c expressed in terms of the turn ratio or tapping T. Hence, the characteristic overcrossings disappear.

Supply Voltages

In all three circuits, the supply voltages are fed via suitable r-f chokes or resistors R_p and R_C while the r-f energy passes the blocking capacitors C'. The grid potential in Fig. 1a adjusts itself via the grid leak R_g whereas the base potential of the transistors is free floating or kept at a suitable value via the base leaks R_b.

The conditions of self-excitation in transistor and tube oscillators differ by the fact that the autotransformer is loaded with the emitter impedance r_e^*. (In order to distinguish between the customary constant-current parameters and the constant-voltage values according to a previous paper,[1] the latter are written with asterisks.) Since the purpose of the following considerations is the presentation of a qualitative insight rather than the development of an exact theory, effects of secondary order may be neglected. More accurately, the emitter impedance may be assumed to be large as compared to the coil inductance ωL_o. With this restriction in mind, the tank circuit can be described in terms of three equivalent resistors. First, there is the equivalent parallel resistance R_0 of the free tank circuit proportional to the quality factor $Q = R_o/\omega L_o$. Furthermore, the tuned circuit is shunted by two resistances of the transistor, namely by the emitter resistance r_e^* transformed into the primary windings in the form r_e^*/T^2, and by the collector impedance r_c^*. All three resistances must be combined by merely adding their conductances, in analytical form

$$Y_T^* = \frac{1}{R_o} + \frac{1}{r_c^*} + \frac{T^2}{r_e^*} \qquad (1a)$$

Self-excitation occurs as soon as this sum becomes zero and this requirement can only be fulfilled if one of the terms is negative.

From tube oscillators, it is well known that the plate resistance must be negative and thus the denominator term in Fig. (1a) is the collector impedance, $r_c^* = V_c/i_c$. The collector current is related to the emitter current by the formula $i_c = -\alpha i_e$ where α denotes the current amplification factor of the transistor. On the other hand, $i_e = V_e/r_e^*$ so that the combination of the three formulas gives the collector impedance offered to the tank circuit in the closed loop

$$r_c^* = -r_e^*/\alpha T$$

As a result, Fig. (1a) assumes the form

$$\frac{1}{R_o} + \frac{T_{cr}}{r_e^*} - \frac{\alpha T_{cr}}{r_e^*} = 0$$

or after a simple rearrangement

$$T^2_{cr} - \alpha T_{cr} + \frac{r_e^*}{R_o} = 0. \qquad (1b)$$

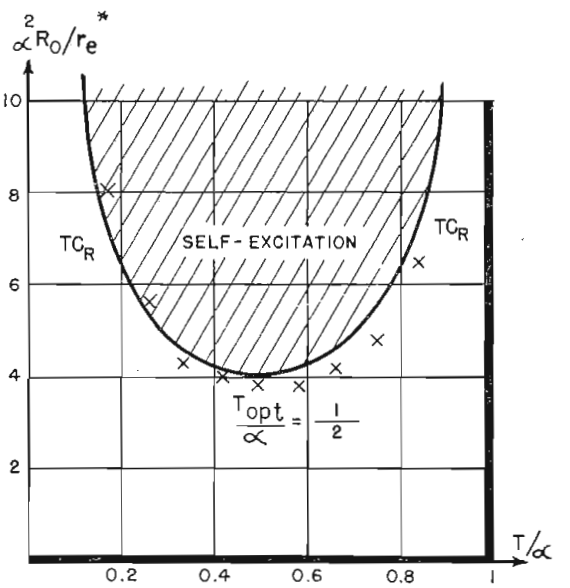


Fig. 2: Critical condition for self-excitation of a Hartley oscillator using a transistor

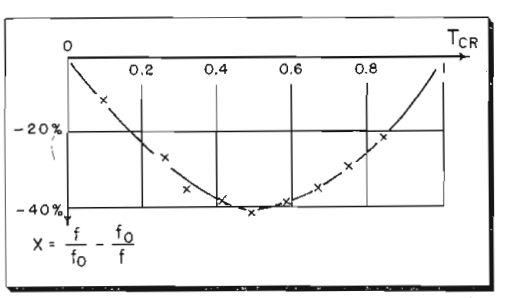


Fig. 3: Frequency shift of Hartley transistor oscillator vs. its autotransformer tapping

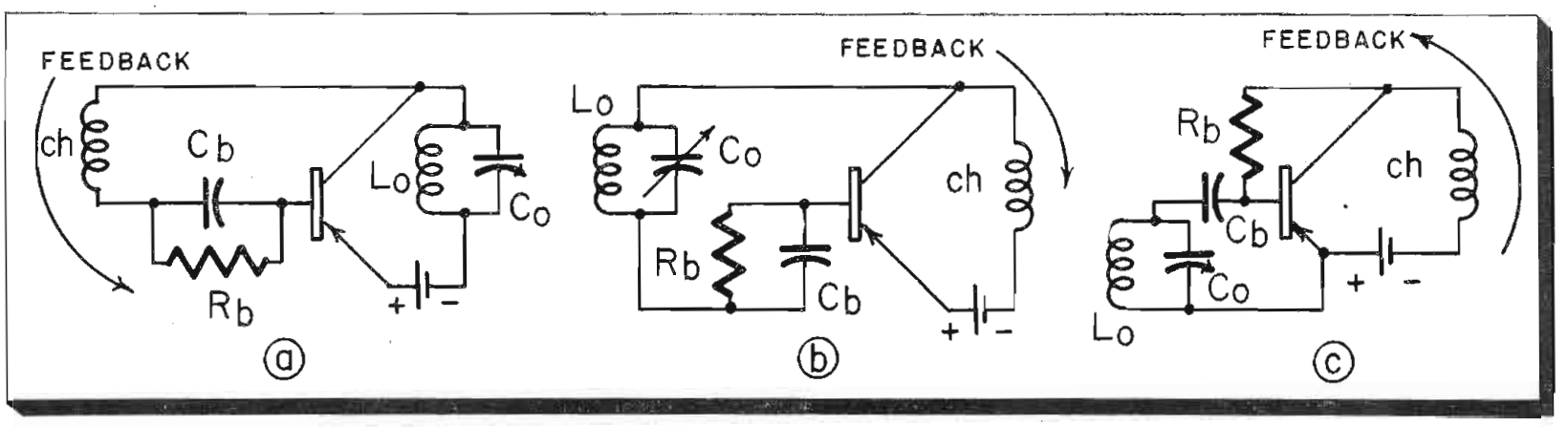


Fig. 4: Different transistor oscillator circuits with negative output impedances. Note direction of feedback

Oscillators

Experimental and analytical results of pioneering investigation of the transistorized Hartley circuit. "Circular frequency multiplication" permits VHF operation

The solution of this quadratic equation gives the critical tapping at the verge of self-excitation

$$T_{cr} = \frac{\alpha}{2}\left[1 \pm \sqrt{1 - 4\frac{r_e^*}{\alpha^2 R_o}}\right] \quad (2)$$

The simple formula permits the plotting of $\alpha^2 R_o / r_e^*$ versus T/α is illustrated in Fig. 2. Optimum feedback occurs when the oscillator overcomes the maximum load, i.e., when the parabola exhibits its minimum. This is the case when the roots disappear thus giving an optimum tapping

$$T_{opt} = \alpha/2 \quad (3a)$$

and a maximum load or a minimum parallel resistance

$$R_{o_{min}} = 4r_c^*/\alpha^2 \quad (3b)$$

In order to corroborate this analytical result, a test oscillator was built whose inductance consisted of an iron-cored coil with 12 tappings. The coil was shunted by a capacitor of 0.15 μf, thus giving a tank circuit resonating at approximately 11 kc. The circuit was driven by a Raytheon CK 721 transistor whose characteristic constant-voltage parameters, at a collector voltage of —1.5 volts, were measured with the transistorbridge [1] as

$$\mu_c = 120;\ r_c^* = 31 \text{ kohms};$$

$$r_e^* = 225 \text{ ohms};\ \alpha = \mu_c \frac{r_e^*}{r_c^*} = 0.86.$$

The tappings were increased in steps from 0 to 12 and, at every step, the oscillator was damped by additional resistances $R_d \ll R_o$ until the limit of self-excitation was reached. The measured values $\alpha^2 R_d / r_e^*$ are indicated in Fig. 2 and confirm the analytical curve.

The practical implication of our considerations is the fact that a Hartley type of transistor-oscillator operates with high efficiency with a center-tapped coil provided α is very close to one.

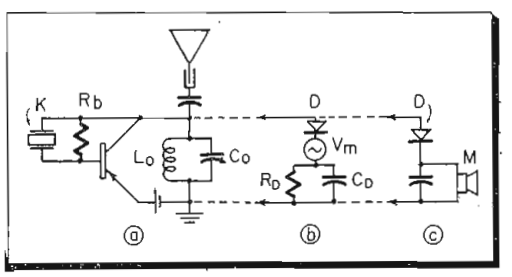


Fig. 5: (a) Stabilized transistor oscillator. (b, c) Circuits for producing Q-modulation

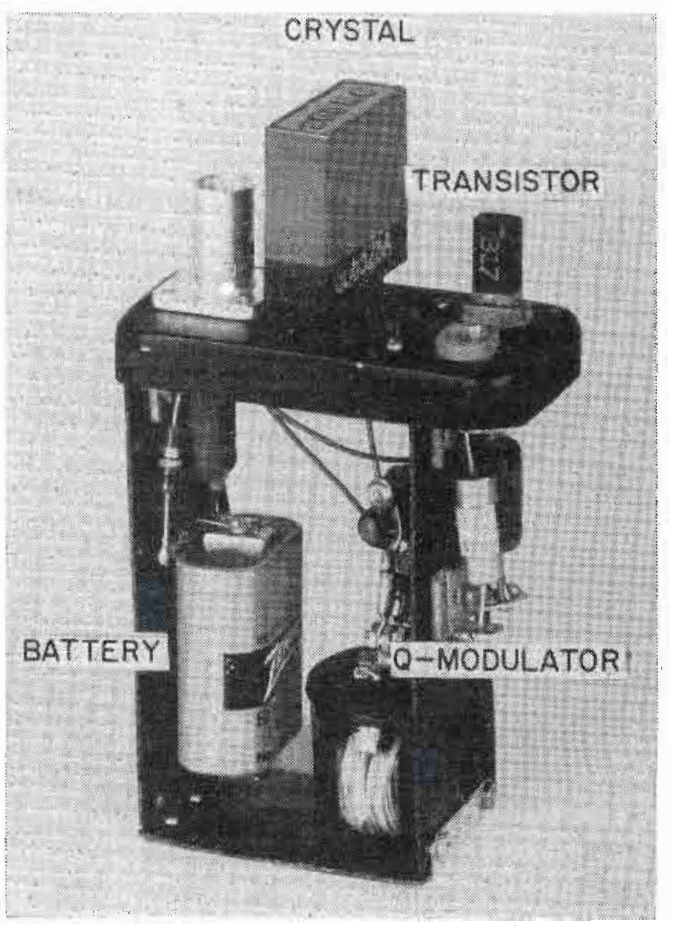
Adjustment of Tappings

The change and adjustment of the tappings is accompanied by a noticeable frequency shift. The emitter voltage and the collector impedance have an inductive phase which is compensated for by a capacitive phase of the tank circuit so as to reduce the oscillator frequency below the resonant frequency f_o of the free tank circuit. The accurate evaluation of this frequency shift requires a complicated analysis but a qualitative picture can be obtained in the following way:

If we consider the tank circuit shown in Fig. 1c disconnected from the collector but still loaded with r_e^*, e.g., the loop interrupted by C′ = 0, increasing tappings produce an imperfect short-circuit of an increasing portion of the coil. Consequently, the effective inductance decreases and the frequency increases. Turning back to the oscillator by closing the loop, e.g., by making C′ very large, causes the collector resistance to become negative as described. Instead of a negative collector impedance, however, the emitter resistance r_e^* can be assumed to be negative, in which event Eq. (1) is merely multiplied by (—1). This analytical procedure bears no influence on the self-excitation, but reveals increasing portions of the coil to be shunted with a negative resistance. The tuning effect then is reversed and the oscillator frequency

(*Continued on page* 171)

Fig. 6: Laboratory model of crystal-controlled Q-modulated transistor oscillator for 400 KC



Time-Base Generator for Control

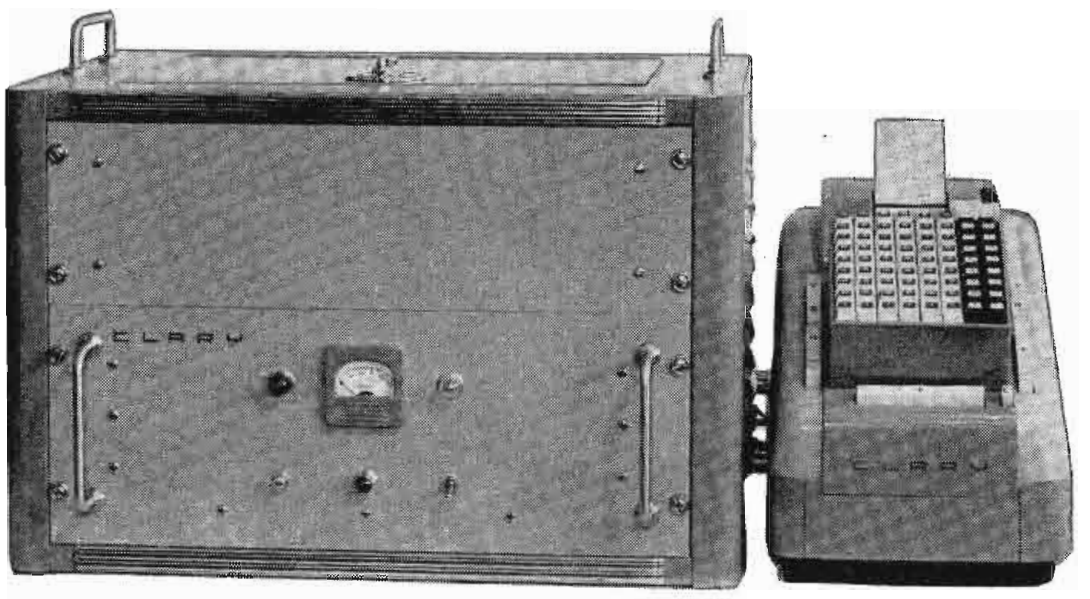


Fig. 1: Complete time measuring device, including printing unit

Precision preselect counter is capable of generating, measuring or recording short time intervals. Unit used in analog-to-digital converter also can be applied to controlling industrial equipment

By EBRAHIM NUBAN,
Clary Multiplier Corp., 408 Junipero St., San Gabriel, Calif.

GENERATION and measurement of relatively short time intervals with extreme accuracy has become of more and more importance in recent years in the development of most of the industrial electronic control equipment and laboratory measuring devices.

The Clary Multiplier Corp. has recently developed a precision time-base generator. (See Figs. 1 and 2.) It is a preselect counter, counting pulses generated by a standard pulse source. It is capable of either generating, or measuring and recording relative short time intervals, of few milliseconds up to few seconds, or minutes. The unique switch design assures reliable and accurate operation of the gating system which in turn assures the system of high accuracy.

A definite time interval is required for a preselected counter to count pulses generated by an accurately controlled pulse generator of fixed repetition rate. In other words, in order to count a determined number of pulses "n" from a pulse source of repetition rate of "p" pulses/second, it will take a time $t = n/p$ second. This basic principle was used in the development of this time-base generator.

The pulse source is of low repetition rate, 500 pps, making it suitable to work into the low power, reliable cold cathode gas tube counters.

The switch is of a unique design in this respect that it operates the gate only *immediately following a pulse.* This will eliminate error caused by random opening of the gate between pulses.

The counters are cold cathode gas tube binary coded decade counters. Selection of the desired number for each decade is achieved by a special diode selector matrix.

Briefly the operation of the time-base generator can be described as follows (See Fig. 3):

The desired time interval is set up by proper selection of the diode selector switches, one for each decade. Then at the initiation of a start signal the electronic switch will open the gate and allow the pulses from the pulse source to be counted by the preselected counter decades. When the selected number is counted by the decades, a stop signal is fed back from the counters to the switch which will immediately close the gate and prevent flow of pulses into the counters. Thus the time between start and stop is of predetermined duration.

In order to achieve an extremely accurate and stable pulse source a 100 KC crystal controlled oscillator was designed to operate a multistage astable multivibrator divider. (See Fig. 4.) The dividers are designed so as to produce an output of square wave shape of repetition rate of 500 pps. Thus the stability and accuracy of the pulse source will depend on the accuracy and stability of the crystal used.

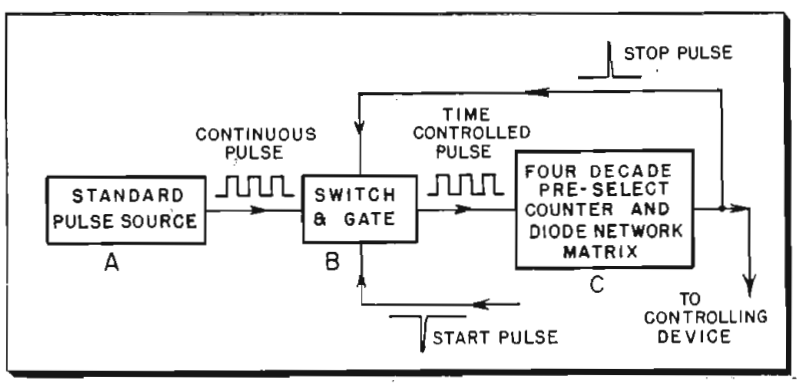
The output pulses are available both at the rates of 500 pps and 100 pps. Pulse magnitudes are of about 180 volts.

Gating Interval

The switch controls gating interval. It will allow the age gate to open only immediately following a pulse, after the initiation of start signal. The gate will remain open for the interval τ which is the selected time interval and controlled by the preselect counter. (See Fig. 5.)

The switch primarily consists of two stages of cascaded bistable multivibrators. The operation of the switch can best be described with the help of Fig. 6.

The switch has two distinct states,



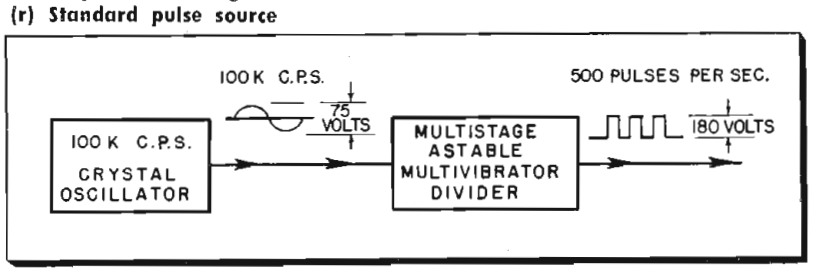


Fig. 3: (1) Block diagram of completed unit. Fig. 4: (r) Standard pulse source

and Measurement

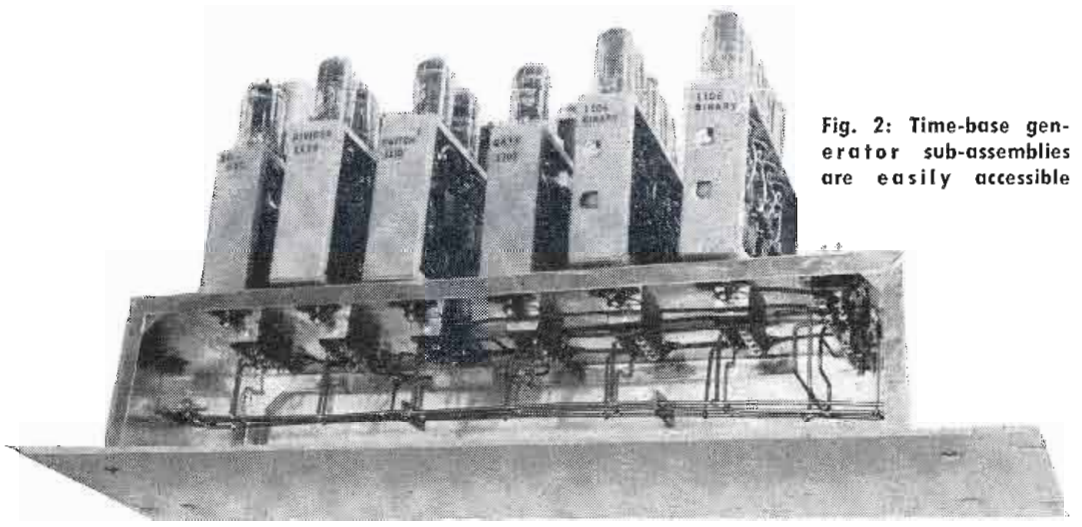


Fig. 2: Time-base generator sub-assemblies are easily accessible

ON state and OFF state. During the OFF state the first multivibrator is biased such that the pulses applied to the grid G_1 will have no effect, and plate voltages of first and second stages, as shown on the diagram, are P_1=175, P_2=65, P_1'=65, P_2'=175 volts. When start signal is applied (which is a negative trigger) the first multivibrator will change state and assume its second stable position. When in this condition voltage at P_1 will drop to 65 volts and P_2 will rise to 175 volts. However, rise of plate P_2 and the consequent positive pulse applied to G_1' will have no effect on the second multivibrator (due to biasing condition).

First multivibrator now will remain in this state until the fall of the pulse immediately following the start trigger signal. At the fall of this pulse, first multivibrator will resume its initial state (P_1 at high potential and P_2 at low potential). Consequently, through the coupling capacity "C" and due to the fall of plate voltage P_2, a negative signal is applied to G_1' which will cause this bi-stable multivibrator to shift its state. This will result in rise in potential of P_1' and fall of potential of P_2'. Thus the positive step voltage of 110 volts is generated by P_1' and is used to open the gate which admits the flow of pulses into the counters.

It is clear from the diagram and above discussion that the trigger signal could have appeared at any time between t_1 and t_2, but nevertheless, the second multivibrator will change state only at t_2. This feature prevents random operation of the switch and confines it only to shift state when the pulse immediately following start trigger is terminated.

The second multivibrator will remain in this state, until the time when the stop trigger is applied. This time interval is indicated by τ on diagram and is determined by the preselected counters. When the counters count up to and including the preselected number, a positive trigger is initiated from the diode selector matrix and applied to the switch. This will cause second multivibrator to resume its initial state (P_2' high, P_1' low). This terminates the positive step voltage applied to the gate and causes the closure of the gate.

Decade counters used are cold cathode gas tube counters. (See Fig. 7.) These decades are binary coded. Advantage of using cold cathode gas tubes lies in the fact that extremely low power is required for operation. Each decade using five #5823 cold cathode gas tubes has an average power dissipation per decade of about 1.5 watts. Speed of these decades is the only limitation. They work reliably up to 1,000 counts per second. But for this particular purpose, this factor is not of impor-

(*Continued on page* 144)

Fig. 5: Operation of switch and gate units. Preselect counter controls time gate remains open

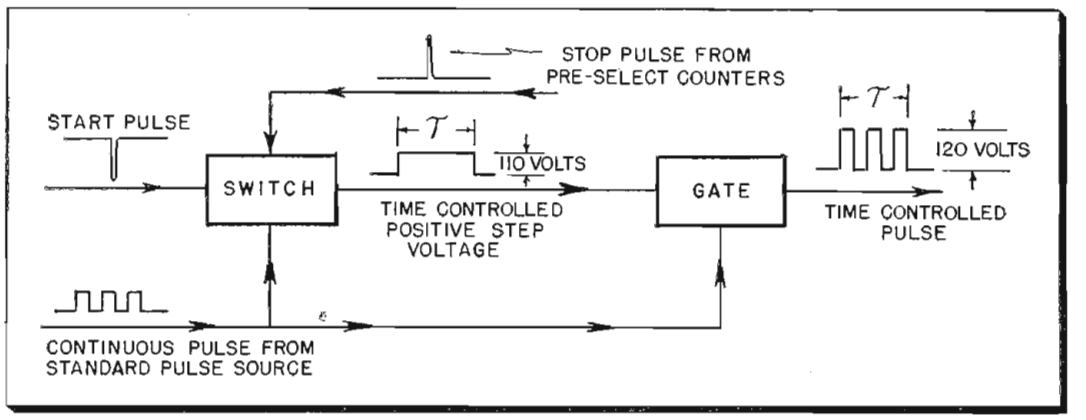
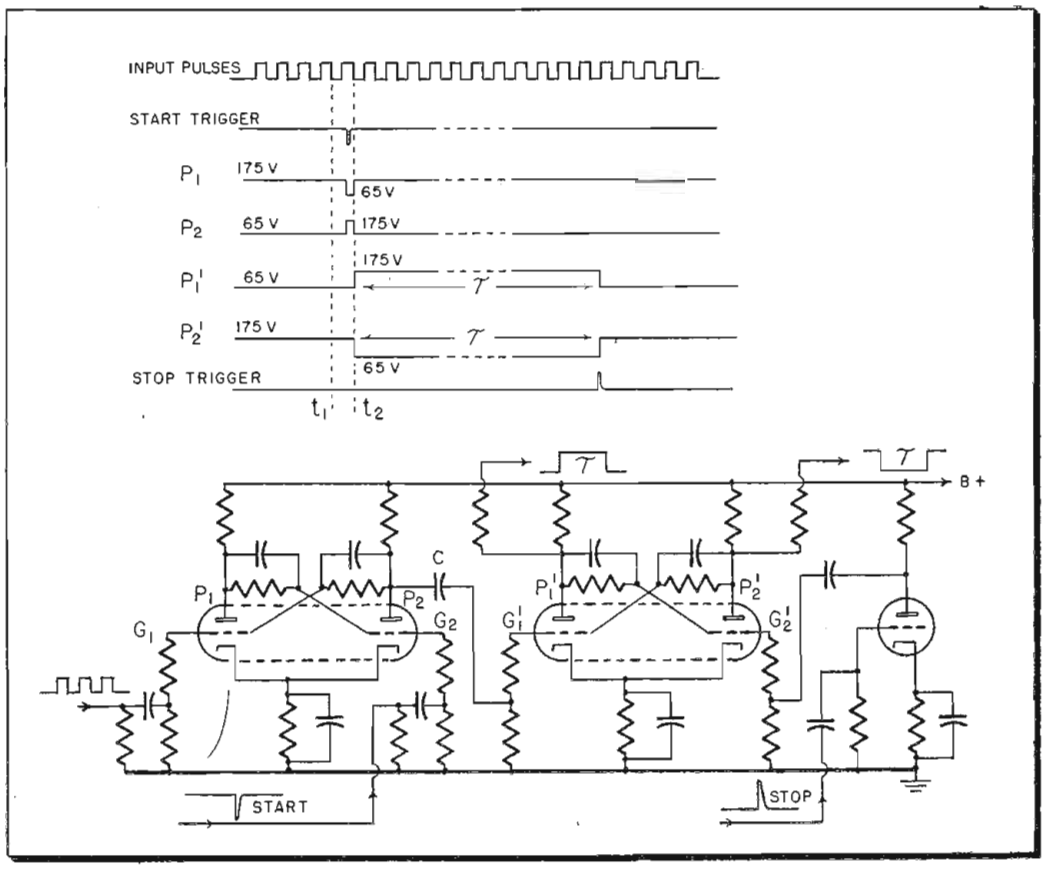


Fig. 6: Switch unit schematic. Positive and negative step voltages are available for auxiliary devices



Evaluation of High-

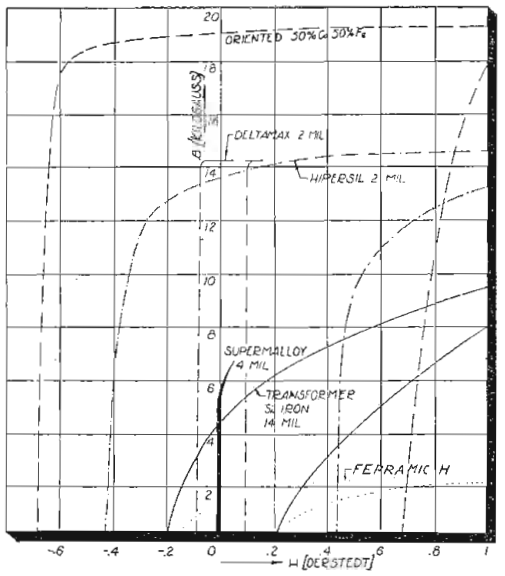


Fig. 1: Half dc hysteresis loops of various core materials, including grain-oriented types

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PART ONE
Of TWO PARTS

THE comparison and evaluation of magnetic core materials present problems because of the wide variety of both materials and characteristics. This is particularly true in the field above power frequencies where different kinds of materials such as thin laminations, powdered irons, and non-metallic ferrites are competing. Except for early compilations of data on dc characteristics[1,6,11], the available information on magnetic materials, which would aid in selection, is scattered throughout numerous publications and frequently does not lend itself to the making of comparisons and evaluations.

The purpose of this article is to present a survey of magnetic materials and to derive and present characteristics in a form which is suitable for comparison and evaluation. No attempt has been made to cover as many materials as are available. Emphasis has been placed on presenting data on high performance magnetic materials which are commercially obtainable in the U. S. A few experimental and foreign materials which exhibit interesting or outstanding characteristics have been included.

Designers who are not too familiar with magnetic materials are cautioned about the wide variations which may be encountered in the characteristics of magnetic materials. All figures presented herein are to be understood as approximate. Deviations between material samples can exceed 100%, particularly in such characteristics as permeability, coercive force, and others.

The large number of metallic core materials is arranged according to composition in Table I. This arrangement automatically shows identical or similar materials even though they may have entirely different trade names.

Since iron is the most important component of magnetic alloys, the dc characteristics of a pure iron sample are presented as the first item in Table I. Iron, if carefully purified and prepared, has very good magnetic properties. However, a shortcoming of pure iron is its low resistivity which is detrimental in all ac applications. The resistivity of pure iron can be increased by the addition of small quantities of silicon.

INDEX of SYMBOLS

A	Sectional area of core
B	Flux density in core
D	Power factor
cosφ	Dissipation factor
E	Voltage
δ	Loss angle (see Fig. 9)
H	Magnetizing force
H	Rotative operator
L	Inductance
l	Mean length of toroidal core
μ	Permeability (see also Table III)
N	Number of turns on core
ω	Circular frequency 2πf
Q	Quality or storage factor
R	Resistance
tanδ	Loss tangent
Z	Impedance

SUBSCRIPTS

C	Refers to coil
L	Denotes inductive component
m	Refers to magnetic core
R	Denotes restive component
r	Denotes relative component
V	Denotes equivalent series component
S	Denotes vacuum component

Silicon-iron was the first special alloy developed specifically for use as a magnctic corc material. Because of its relatively low cost and its satisfactory performance in a wide field of applications, silicon-iron has dominated the field in the electrical industry.

There are more than 10 manufacturers producing more than 100 brands of magnetic silicon-irons in the U. S. alone.[15] Many of these brands are identical in silicon content and performance. This class of material, which ranges in silicon content from less than 0.25% up to approximately 5%, is not covered in detail in this report. The differences in performances are small in comparison with the differences encountered in this survey. Data on a 4% silicon transformer iron are given in Table I as an example and as an aid in making comparisons.

Single crystals of magnetic materials are, generally, anisotropic. This means that the characteristics depend upon crystal orientation. Single crystals of magnetic materials have not yet been used beyond the laboratory, but grain-orientated materials, which have a preferred orientation of the crystals in a suitable direction, already play an important role in commercial materials. Proper grain-orientation results in a more rectangular hysteresis loop and in a higher operating flux density. Half hysteresis loops of various materials, including those with grain-orientation, are compared in Fig. 1.

Cobalt and Nickel

Cobalt and nickel, the other two important ferromagnetic elements, have no significance as magnetic materials in pure form; however, they are the most important alloying elements. The addition of cobalt to iron substantially increases the saturation of iron, as in the case of Permendur and Hyperco. The advantage of higher saturation of these materials is partly overcome by higher losses. Reductions in size and weight can be obtained only in some power applications. Furthermore, cobalt is a "critical" material.

Other alloys, designated by the trade name, Perminvar,[9] have a smaller cobalt content than does Permendur and Hyperco and also display unique magnetization curves. The Permendur alloys have constant permeability and almost no hystere-

Performance Magnetic Core Materials

Selection of proper material for desired application facilitated by the development of a "figure of merit." Suitability of ferrites for high frequencies shown

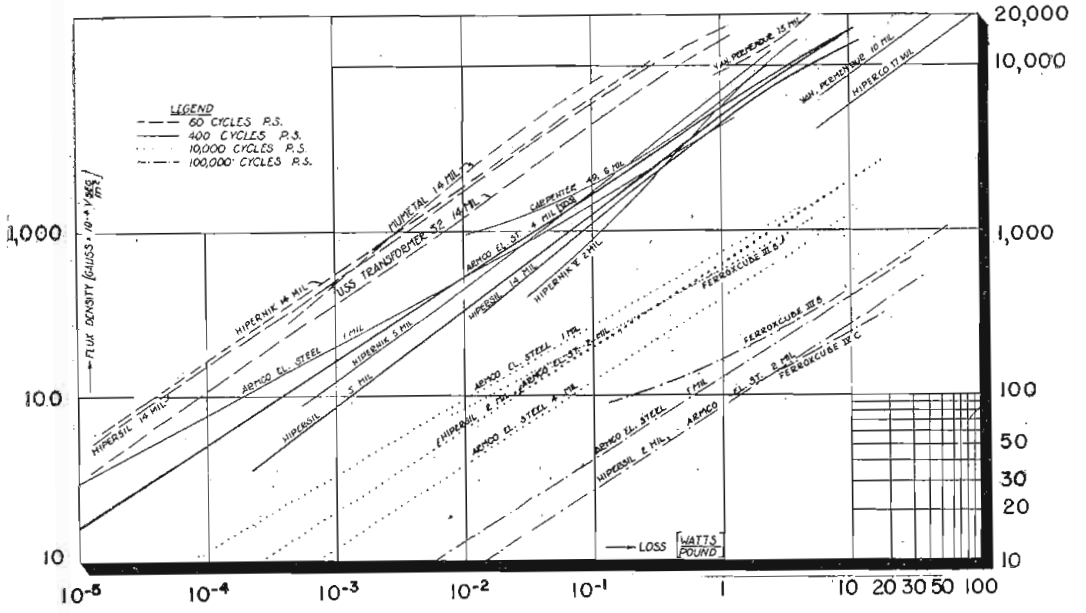


Fig. 2: Core losses in watts/lb. Frequencies, materials and thicknesses are parameters

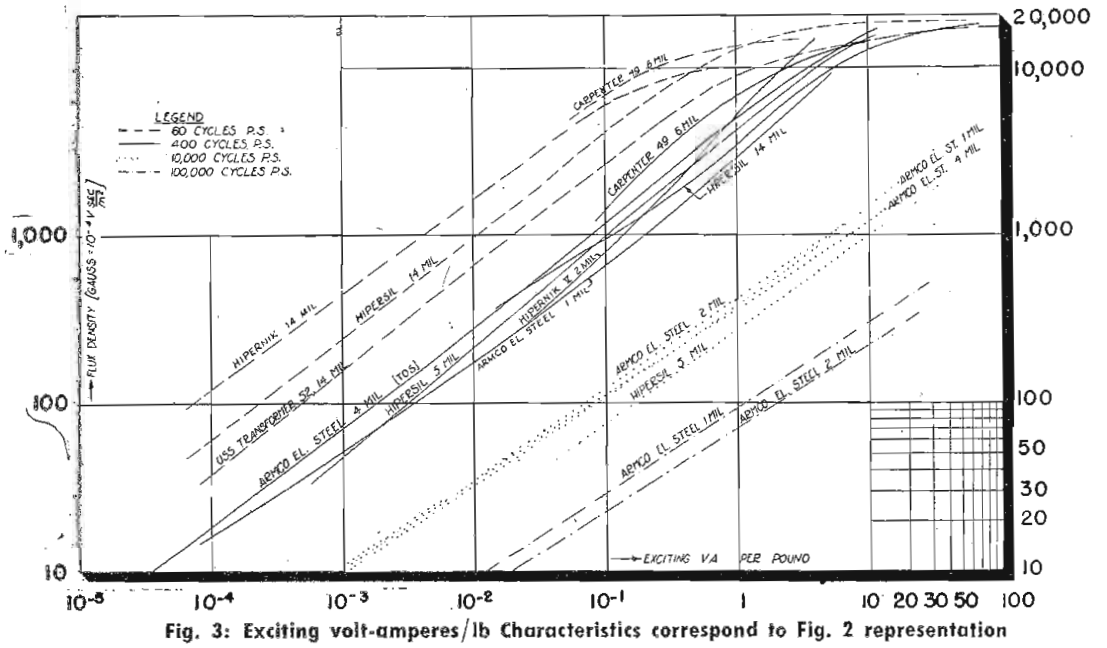
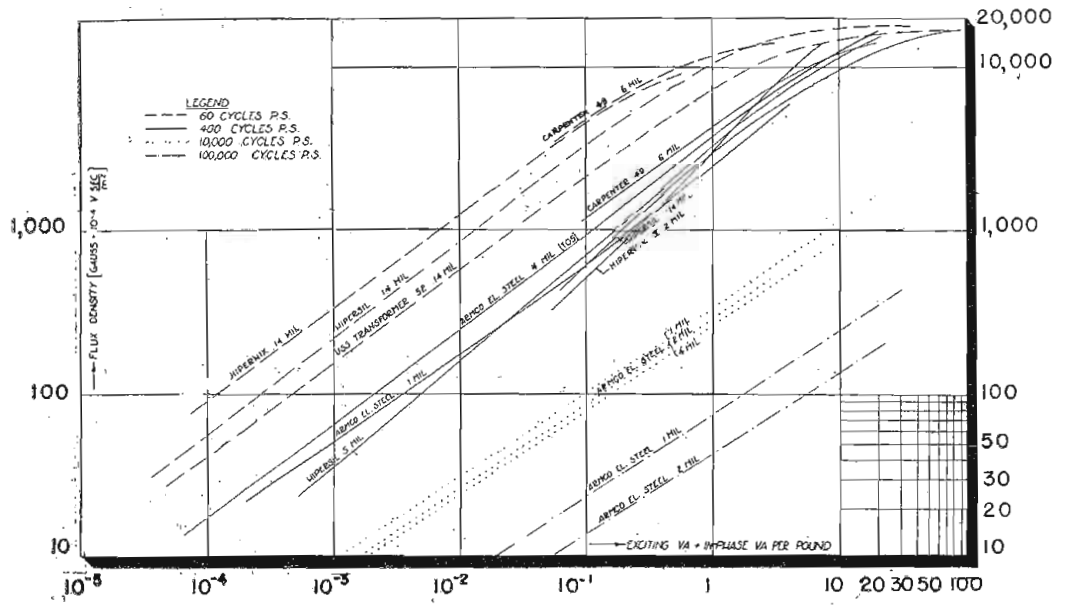


Fig. 3: Exciting volt-amperes/lb Characteristics correspond to Fig. 2 representation

Fig. 4: A figure of merit is derived from exciting volt-amperes plus volt-amperes/lb.



sis up to flux densities of 1,000 gauss. Even at still higher flux densities, residual magnetization and coercive force remain practically zero. The permeability of Perminvar, however, remains constant only as long as high magnetization is avoided. Other materials which have constant permeability are Conpernik, Isoperm, and powdered irons.

Nickel is of great significance as an alloying component in high performance core materials. Iron-nickel alloys are characterized by high permeability if properly processed. The saturation flux density, however, is reduced by nickel. Commercial iron-nickel alloys can, for the purposes of this report, be divided into two groups. This rough division groups together those alloys which contain 45% to 50% nickel and places in the other group those alloys which have a nickel content of from 65% to 80%.

Higher Saturation

The 45-50% nickel alloys display a higher saturation and generally a higher resistivity than do the alloys with higher nickel content. Small quantities of other alloying elements and special processing can produce desirable variations in characteristics. Examples in this group are Sinimax in which the resistivity has been increased, to 90 microhm/cm and Isoperm from which low ac distortion and low high-frequency losses have been obtained. Alloys in the 45-50% nickel group have a great significance in the grain-orientated form in which they display rectangular hysteresis loops (see Deltamax[7] Fig. 1) which are desirable in magnetic amplifiers, magnetic pulse generators, computers, mechanical rectifiers, harmonic generators, etc.

As compared to the 45-50% group, the materials with higher nickel content have higher permeabilities, lower coercive forces, but much lower saturation. Unique characteristics of the alloys in this group are low magnetostriction and low anisotropy. Supermalloy[4] is the latest development in this group and can be rated as the most advanced among the iron-nickel alloys. The hysteresis loop of Supermalloy condenses into one line if plotted for comparison with other materials. (See Fig. 1.)

The interesting characteristics of

TABLE I: DC DATA on METALLIC CORE MATERIALS

METAL OR ALLOY	MATERIAL OR TRADE NAME	COMPANY	COMPOSITION IN PERCENT (REST IRON)	CHARACTERISTIC PROPERTY OR APPLICATION	PERMEABILITY		SATURATION [K GAUSS]	RESIDUAL IND. [KG.]	COERCIVE F. [OERST.]	RESISTIVITY [MICROHM cm]	CURIE TEMP. [°C.]
					INITIAL	MAXIM.					
	Purified Iron		0.02 Imp.	Low Resist.	25,000	275,000	21.5	13.6	0.05	10	770
SILICON-IRON	Silicon-Iron	see ref. 4	4 Si	Transformer Grain Oriented	400	7,000	20	12	0.5	60	690
	Hypersil	Westinghouse	3.5 Si	Grain Oriented					0.1		
	Trancor 3X	Armco	3.5 Si	Grain Oriented	1,500	35,000	20	13.7	÷0.3	50	750
	Silectron	Allegheny-Ludlum	3.5 Si	Grain Oriented							
	Sendust	Japanese	9.5 Si 5.5 Al	HF Powder	30,000	120,000	10	5	0.05	80	
COBALT-IRON	Hyperco	Westinghouse	35 Co 0.5 Cr	High Saturation	650	10,000	24	>13	>1	28	970
	2V Permendur	Western Electric	49 Co 2V	High Saturation	800	4,500	24	14	2	25	980
NICKEL-IRON	45-25 Perminvar	Bell Telephone Laboratories	45 Ni 25 Co	"Constant" Permeability	400	2,000	15.5	3.3	1.2	20	715
	7-70 Perminvar	Bell Telephone Laboratories	70 Ni 7 Co	"Constant" Permeability	850	4,000	12.5	2.4	0.6	15	650
	Conpernik	Westinghouse	50 Ni		1,500	2,000	16			45	
	36 Isoperm	German	36 Ni 9 Cu	High Frequency	60	65				70	300
	50 Isoperm	German	50 Ni	High Frequency	90	100	16			40	500
	45 Permalloy	Western Electric	45 Ni		2,700	23,000	16.5	8	0.3	45	440
	"4750"	Allegheny-Ludlum	47 - 50 Ni	Combine	9,000	50,000	16	6.2*	0.08*	52	430
	Armco 48	Armco	48 Ni	Good Permeab. and Flux D.			16				
	Nicaloi	General Electric	49 Ni	Good Permeab. and Flux D.			16				
	High Perm 49	Carpenter	49 Ni	Good Permeab. and Flux D.	5,000	50,000	16	6.5	0.03	43	475
	Hipernik	Westinghouse	50 Ni, Si, Mn	Good Permeab. and Flux D.	4,000	100,000	16	8*	0.03*	45	500
	Monimax	Allegheny-Ludlum	47 Ni 3 Mo	High Resist.	2,000	38,000	15		0.06	80	390
	Sinimax	Allegheny-Ludlum	42 Ni 3 Si	High Resist.	3,500	30,000	11		0.1	90	290
	Permenorm 5000Z	German	45 to 50 Ni	Rect. Hyst. Loop	400	40,000	15.5	13	0.2	40	450
	Permenite	I.T.E. Circ. Br. Co.	45 to 50 Ni	Rect. Hyst. Loop	÷1,700	÷100,000	÷16	÷15	÷0.4	÷50	÷500
	Deltamax	Arnold Engr. Co.	45 to 50 Ni	Rect. Hyst. Loop							
	Hypernik V	Westinghouse	45 to 50 Ni	Rect. Hyst. Loop							
	Orthonik	Armco	45 to 50 Ni	Rect. Hyst. Loop							
	Orthonol	Navy Ordn Lab.	45 to 50 Ni	Rect. Hyst. Loop		250,000					
	65 Permalloy	Bell Tel. Lab.	65 - 68 Ni		1,500	÷600,000	13	13	0.03	20	600
							*Bmax = 10,000 Gauss				
	1040 Alloy	German	72 Ni 14 Cu 3 Mo		40,000		6	2.5	0.02	55	290
	Mumetal	Allegheny-Ludlum	77 Ni 5 Cu 2 Cr		20,000	100,000	8	6	0.05	60	400
	78 Permalloy	Western Electric	78 Ni 0.6 Mn	Highest Perm.	9,000		10.7	6	0.05	16	580
	4-79 Mo-Permalloy		79 Ni 4 Mo	Perm.	20,000	75,000	8	5.5	0.05	55	
	Supermalloy	Arnold Engr. Co.	79 Ni 5 Mo	Low Sat.	55,000	500,000	6.8		0.002	65	400
					÷150,000	÷10^6	÷7.8		÷0.05		
	Hymu 80	Carpenter	80 Ni		10,000	100,000	8		0.06	58	÷460

65% Permalloy are obtained by an anneal in a magnetic field which has an effect on the hysteresis loop similar to that which results from grain-orientation. With magnetically annealed 65% Permalloy, almost perfectly rectangular hysteresis loops have been obtained.[8]

The ferromagnetic ferrites, listed in Table II, represent a different class of materials. Their fundamental differences, as compared to the materials which have been discussed so far, are their non-metallic properties such as high resistivity and low weight. Ferrites are ceramic materials composed of certain divalent metal oxides among which is Fe_2O_3. Unfortunately, the term "ferrite" also denotes a particular α crystal phase of pure iron with which the ferrites under discussion herein should not be confused. Though known for a long time (German patents in 1909), practical ferrites did not become available until after World War II.

Low saturation and low permeability of ferrites exclude them from most low frequency applications but their high resistivity makes them superior at medium and high frequencies as is shown in the section entitled, "Alternating Current Characterization and Evaluation." The Curie temperatures of ferrites are, generally, lower than those of metallic materials. At present, high permeability can only be obtained at low Curie temperatures. Maximum permeabilities up to 9,000 coupled with Curie temperatures of approximately 80°C have been reported. Manufacturers can supply far more ferrite materials with desired combinations of characteristics than are listed in this report. Also, compounds with highly rectangular hysteresis loops have been announced. For more information on ferrites see references.[3,5,17,18,19]

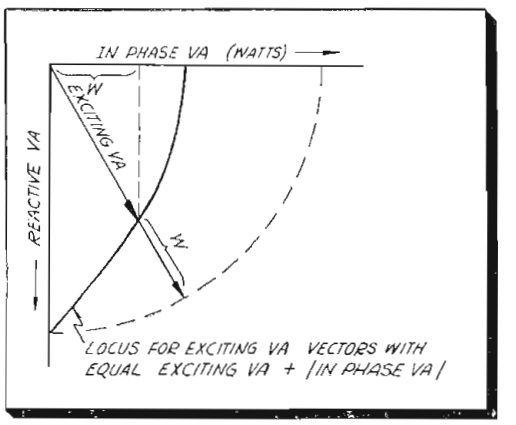


Fig. 5: Vector locus resulting in equal figure of merit for given flux density and frequency

(*Continued on page* 154)

TABLE II: FERRITE CHARACTERISTICS—Data Refers to DC Unless Otherwise Stated

TRADE NAME	COMPANY	RECOMMENDED FREQUENCY RANGE OR APPLICATION	PERMEABILITY		SATURATION [K GAUSS]	RESIDUAL INDUCTION [K GAUSS]	COERCIVE FORCE [OERSTEDT]	RESISTIVITY [OHM cm]	CURIE TEMP. [°C]	TEMP. COEFF. OF IN. PERM. [%PER °C]
			INITIAL	MAXIM.						
Ceramag 5N	Stackpole	see graph	560	1,840	2,300	1,400	0.4	10^3	170°	
7	Carbon Co.,	see graph	540	4,600	2,460	1,750	0.2	1.8×10^4	170°	
8	St. Marys,	see graph	450	1,700	2,850	2,100	0.6	2.1×10^4	190°	
	Pa.									
(all data referring to 60 cps)										
Ferramic A	General	see graphs	15	97	0.84	0.61	3.7	10^9	280	0.65
B	Ceramics	see graphs	95	183	1.9	0.83	3	2×10^5	260	0.04
C	and	see graphs	220	710	3.8	2.7	2.1	2×10^3	330	0.4
D	Steatite	see graphs	410	1,030	3.1	1.3	1	3×10^7	165	0.3
E	Corp.,	see graphs	750	1,710	3.8	1.9	0.65	4×10^5	160	0.25
G	Keasbey,	see graphs	410	3,300	3.2	1	0.25	1.5×10^8	160	1.3
H	N. J.	see graphs	850	4,300	3.4	1.4	0.18	10^5	150	0.66
I		Const. Perm.	900	1,000	1.5	0.6	0.4	2×10^5	70	0.3
J			330	750	2.9	1.6	0.8		180	0.22
			at 1 megacycle							
Ferroxcube 3	Ferroxcube		1,000	1,200	3		0.2	10^3	140	
3C	Corp. of		900	1,100	3.5				160	
For more compounds see figure 7	Am., 50 E. 41st St. New York, N. Y.									
Lavite FIS	D. M.		1,000	3,000					250	
FX-6S	Steward	20-200 MC	8-11	100	0.6	0.5	3.7	10^6	200	0.03
FX-22S	Manuf. Co.	1-20 MC	15-20	120	0.9	0.6	3.7	10^6	200	0.03
FX-15S	Chattanooga	High Sat. to Transf. 150 KC	250	3,000	5	1.9	1	10^6	200	0.45
FX-27S	Tenn.	High Sat. to Transf. 150 KC	850	4,000	3.5	1.5	0.25	10^6	150	0.5
FX-18S		Ant. Rod 1 MC	300	750	3	1.6	0.8	10^7	200	3.5
High Perm.		1-150 KC	1,000	5,000	4	1.5	0.15	10^6	150	0.1

Measuring Reflection from CRT

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Since the development of the frosted face plate to reduce specular reflections resulting from light sources outside of a television receiver, the question of how to measure and evaluate the residual reflected light has been under consideration.

Control of the degree of frost on the face plate and thus of the reflected light is extremely important to the performance of the picture tube. If the frost is excessive, the plate becomes very diffusing and high definition transmitted picture information is impossible. If the frost is insufficient, the specularly reflected light is disturbing and the value of frosting is lost.

The optimum condition is therefore when specular reflections are minimized appreciably but with no apparent deterioration in picture quality. The acceptable range of values of this residual reflected light flux must be determined experimentally for any given type of frost. In any measurement method of this nature, the primary goal is to correlate instrumental results with those apparent to the eye.

Several factors contribute to this "visual appearance" and must be accounted for in the measurement method. The face plates for various types and sizes of tubes have different radii of curvature and different thicknesses. Some face plates have the frosting on both inner and outer surfaces while others have frosting on only one surface, either inner or outer. The method with which the frosting is applied may also influence the reflectance characteristics since some methods diffuse the residual reflected light while others produce a subdued specular reflection.

Geometrical Conditions

The general layout of an optical instrument for this purpose with its important geometrical conditions, is shown in Fig. 1A and 1B, where "i" is the angle of the incident beam, "r" is the angle of the reflected beam, α is the angle subtended by the receptor window at the center of the sample area, and β is the angle subtended by the image of the source in the plane of the receptor window at the center of the sample area. The receptor is, of course, arranged so that all the flux accepted by the window falls on the sensitive surface of the photocell.

Since it is necessary to account for reflections from both the back and front surfaces of the plate, the receptor must collect all of the light flux from both of these surfaces and the angle "i" should be small as shown in Fig. 2. Here it may be seen that at small angles a given size receptor window will accept all of the light flux whereas as the incident angle, and consequently the viewing angle, since we are dealing with specular or mirror reflection, is increased, a greater portion of the light reflected from the back surface is lost. This lost flux is represented as the shaded area in the figure.

Goniophotometer

Early in the investigation of the frosted face plates, a simple goniophotometer was constructed and used to determine the most feasible angles of incidence and reflection. The goniophotometer is an instrument consisting of a collimated incident light beam with a variable angle to the normal, and a receptor usually consisting of a photocell behind a given size acceptance window also with a variable angle to the normal. With this instrument, therefore, the size and shape of the incident and reflected light beams are constant and the angles of incidence and of view for best visual correlation may be determined.

Preliminary measurements with the goniophotometer appeared to in-

Fig. 1: (A-top) Collimated-beam type reflectometer and (B-bottom) convergent-beam type reflectometer

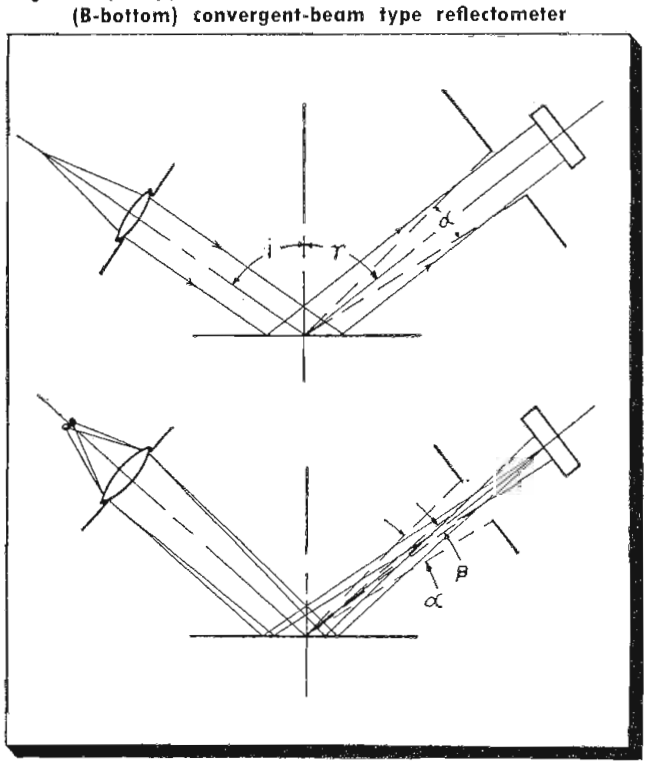


Fig. 2: How reflected light flux is lost when large angles of incidence and reflection are used. Shaded portion represents light not measured by receptor

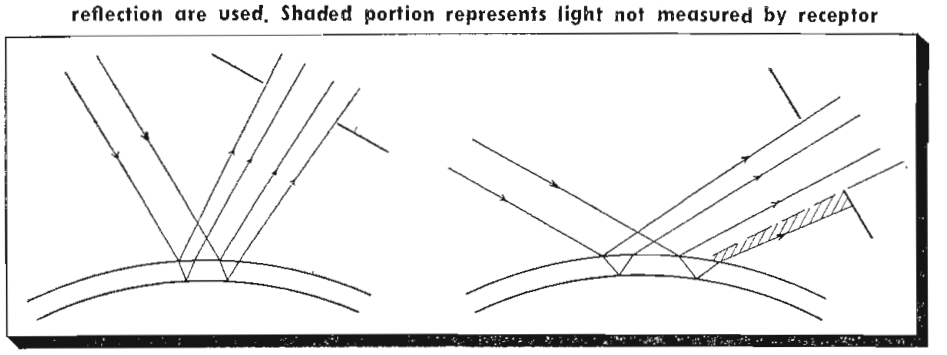


Fig. 3: Dependence of reflectance on size of receptor window (each curve for one sample)

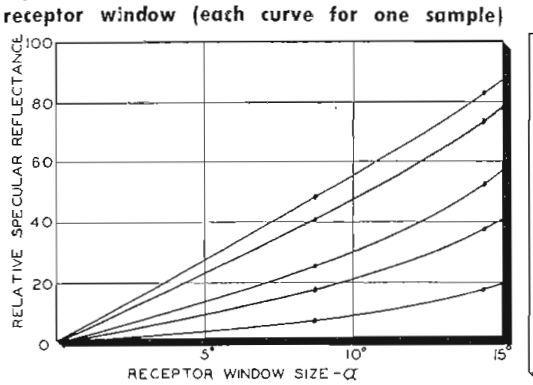
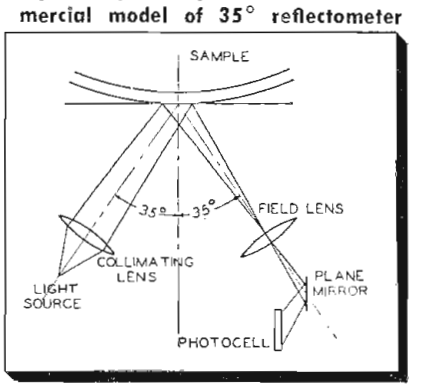


Fig. 4: Optical system of first commercial model of 35° reflectometer



Face Plates

Amount of light reflected from curved picture tube surface measured with convergent-type reflectometer. Method has been accepted as standard practice by RETMA

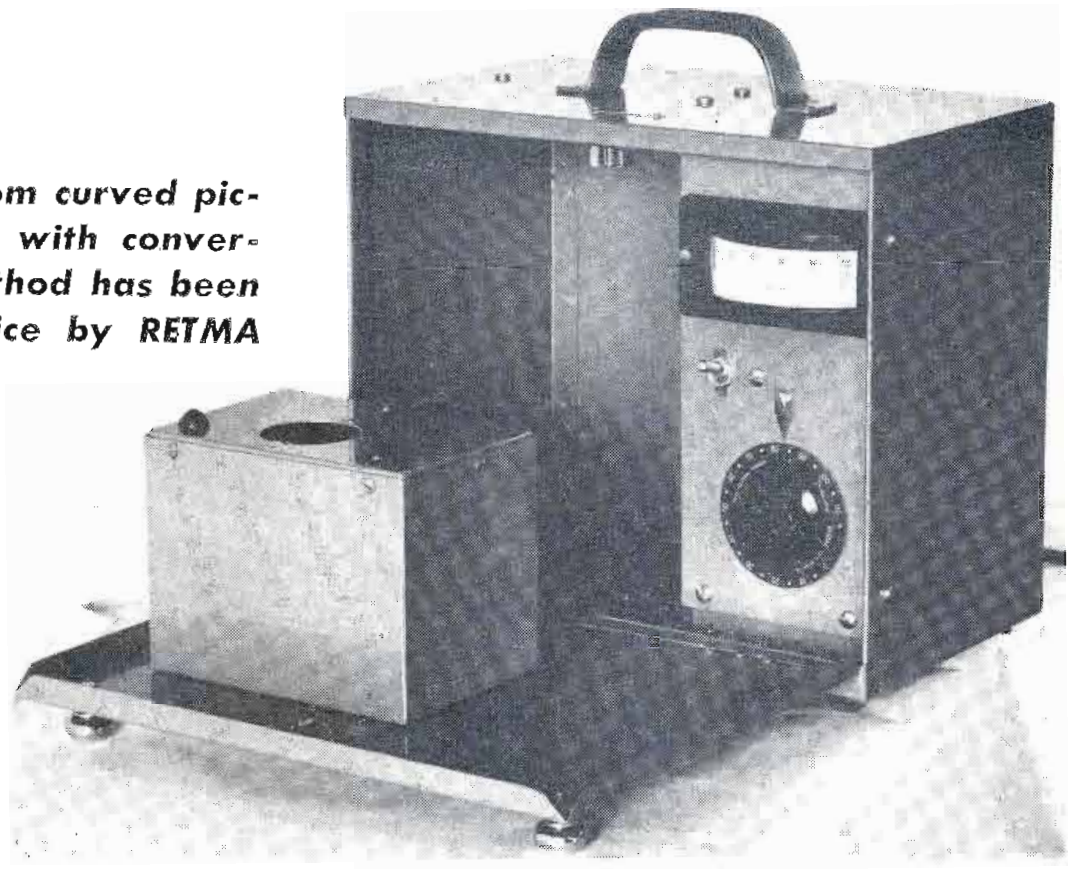


Fig. 5: First commercial model of the 35° reflectometer

dicate that the most informative angle would be between 20° and 45°. A survey of commercial instruments revealed that glossmeters measuring at both 20° and 45° were available. They were not readily adaptable, however, to this particular application since they could not accommodate curved surfaces of different radii of curvature and were quite cumbersome to use in the required manner.

Further more accurate goniophotometric data were taken on sample frosted face plates which had previously been examined visually and classified as good, fair, and poor in terms of reflection-reducing qualities. The greatest differentiation in reflectance among the samples was shown at an incident angle of 35° and a reflection angle in the direction of specular reflection or 35° to the normal at the center.

Acceptance Angle

Second in importance to the angles of incidence and reflection is the acceptance angle or the solid angle subtended by the receptor window shown as α in Fig. 1. Here again a compromise must be reached. A large window does not differentiate small changes in reflectance since the phosphor coating may account for too much of the reflected flux whereas a small window will not accommodate all of the radii of curvature desired. The samples mentioned above were measured with two convenient sizes of receptor window. The results as shown in Fig. 3 indicate that the best differentiation between samples occurs with the larger of the two receptor windows whose acceptance angle is 14.4°. In other words, one can find more difference in readings on two given samples with this window than with the smaller, and smaller variations can therefore be detected. This window is still large enough to accommodate face plates having radii of curvature as small as 12 in.

In accordance with the geometrical conditions indicated, a reflectometer was designed and constructed. The optical system for this meter is shown in Fig. 4. It is essentially a convergent-type instrument with the field lens added to collect the displaced light flux from the rear surface for the wide variety of curvatures and thicknesses.

Since there is no spectrally selective property to the specimens under test, no particular precaution as to the color temperature or spectral distribution of the light source need be taken. It is important that the image of the source formed on the receptor window subtends an angle β of no more than 7° at the test surface. With this condition and the receptor window angle of 14.4° $\pm$0.2°, the readings on the meter are consistent to one unit which would correspond to 0.1% specular reflectance.

In cases where the inner surface is coated with phosphor, a correction for the diffuse reflectance will be necessary. This may be determined experimentally from current production samples or may be computed by the formula below provided all the factors are known.

$$\text{Amount to be subtracted} = \frac{0.0003\omega_v \cos V R_d}{\pi}$$

where ω_v is the receptor field area in degrees squared and V is the angle of the viewing beam or 35°, R_d is the diffuse reflectance of the sample. In measuring face plates on finished tubes in production, it would be impossible to know the exact value of R_d since this depends on the transmission of the face plate which in turn depends on the thickness of the face plate and varies from tube to tube. Since the diffuse reflectance of the phosphor is approximately 0.80 and the transmission of the plate averages approximately 0.70, a value of 0.40 for R_d (0.80×0.70^2) may be assumed. The diffuse correction would amount to only 5.1 or 0.51% and so may be neglected in normal production checks or may be applied arbitrarily with results within the range of the instrument accuracy.

This method with the geometrical conditions outlined herein has been accepted as standard practice for measuring the reflectance from picture tube face plates by the Committee on Cathode-Ray Tubes of the RETMA.

Commercial Model

The first commercial model of the instrument is photographed in Fig. 5. It is mechanically arranged so that the optical head is somewhat portable and can be placed inside or outside of any face plate which will accommodate it. The procedure is merely to calibrate the meter in terms of a standard reflectance sample supplied and replace the standard with the test sample. The microammeter reading is then the specular reflectance of the test sample except for the diffuse correction as stated above.

The writer is indebted to Mr. Richard S. Hunter and the Henry A. Gardner Laboratory for their comments and for the design and construction of the first commercial model of the reflectometer.

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Level Control Amplifier

ROBERT R. BREEDING, Chief Engineer, KGAR, Garden City, Kans.

BROADCASTERS often have difficulty maintaining a high level of modulation, when the program level varies a great deal. Since constant "gain riding" is impracticable in most cases, it is preferable to do it automatically.

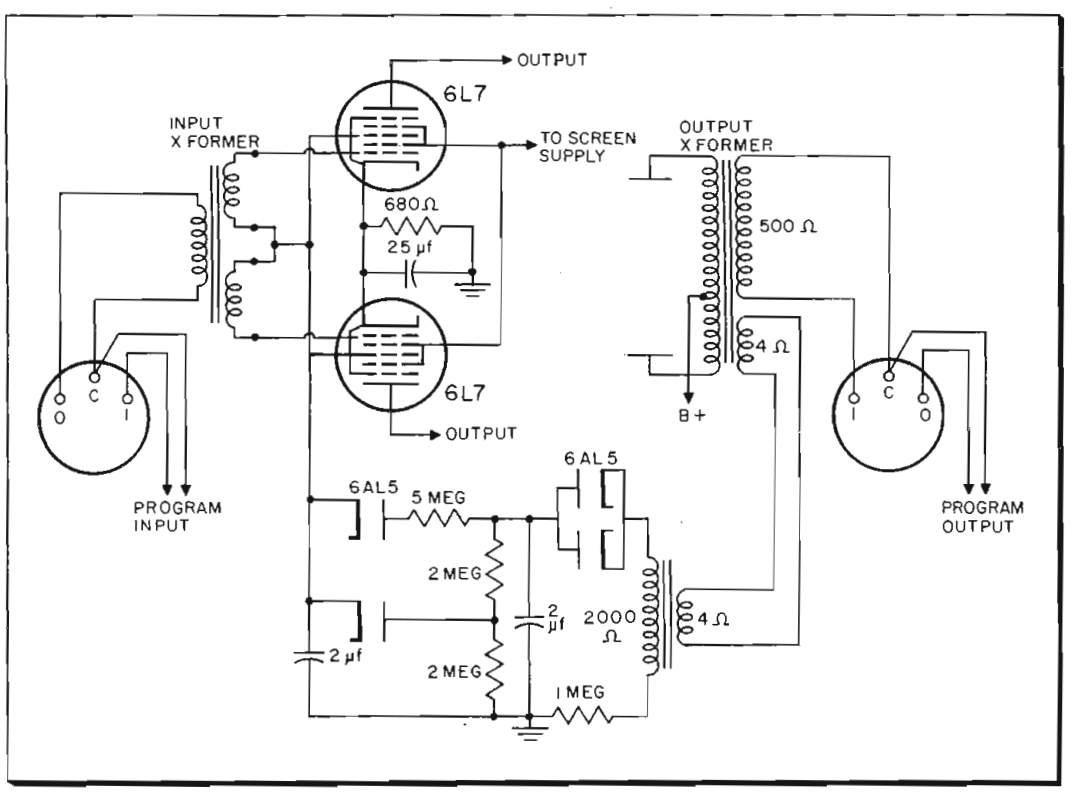
A regular program line amplifier can be converted into a level control amplifier. The gain of this amplifier is varied in inverse proportion to the level of the program. High level programs will decrease the gain rapidly, but there is a 6 to 8 second delay before the gain will increase. This takes care of slight pauses in program material without producing changes in the overall level of the program.

Type 6L7 tubes were used because it was much easier to obtain control with the variable bias applied to both grids of these tubes. However, it should be remembered that the transconductance of these tubes is lower than pentode types such as 6J7's and this must be taken into consideration if they are substituted for high gain types in the design of your amplifier.

It will be found that the extraneous noise level will come up when the level control amplifier is at maximum gain, but for the usual program level the noise is far below 50 db. Input and output attenuators are provided for greater flexibility. Although this unit has a certain limiting action, it does not take the place of a limiter because the action is too slow.

Imput to console (db)	% of Modulation with Level Control	% of Modulation Without Level Control
-64	80	80
-66	80	75
-68	79	65
-70	77.5	56.5
-72	76.5	45
-74	75	33.5
-76	73.5	23
-78	72	14
-80	69.5	5
-82	64	-
-84	64	-

Maintaining high level modulation without manual "gain riding" by use of level control amplifier



$$$ 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 requested. Our usual rates will be paid for material used.

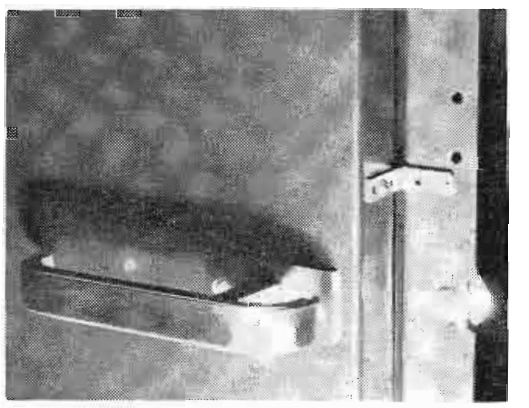
Insuring the Interlock

EDWARD J. WHITE, WMAS, Springfield, Mass.

RECENTLY, WMAS received its new RCA BTA 250M transmitter. One of the first things that we noticed was the ease with which the doors could be opened. About all that was necessary to go "off the air" was to have someone lean on the door handle and pull slightly. Since an ounce of prevention is worth a pound of cure it was decided to improve the doors and the interlocks.

Most transmitter installations use two BR-84 cabinets—the BTA 240M transmitter being enclosed in one—and the other BR-84 rack being used for the monitoring equipment. Normally the racks are side by side and bolted together, with the doors so arranged that they open opposite, that is, the left hand door swings left and the right, right.

The device used to minimize accidental "off the air" periods, is a small right angle bracket fastened to the edge of the transmitter door and positioned so that the door of the monitoring rack will close over it. Now, before the transmitter door, and the interlock, can be opened it is first necessary to open the monitor rack door. As two doors must be opened the chances of experiencing accidental "off the air" periods are practically nil.

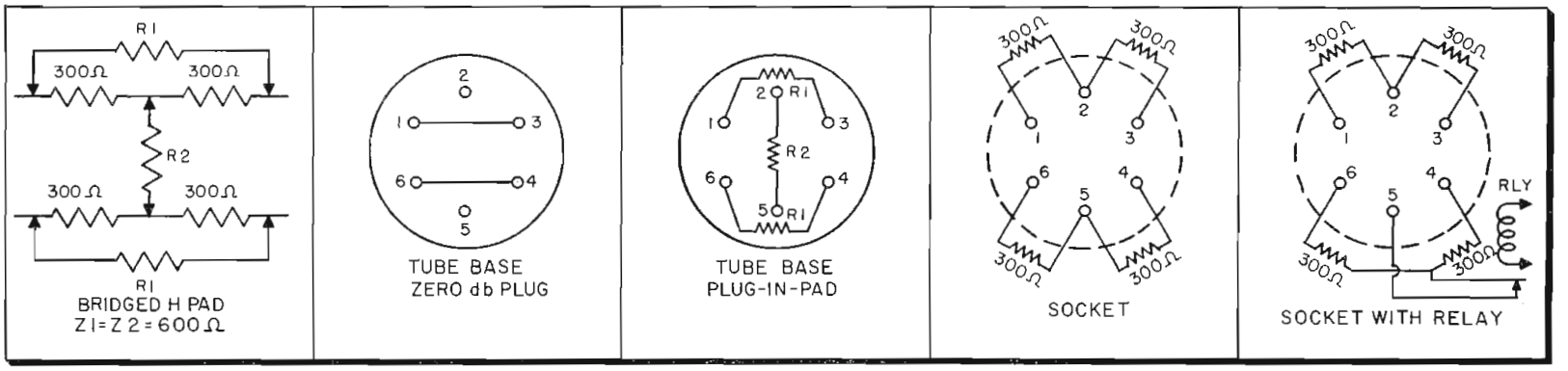


Small right angle bracket fixed to transmitter door eliminates open interlock risk

Plug-In Pads

OLAF N. GABRIELSON, Chief Engineer, KFGO, Fargo, N. Dakota

BECAUSE no patch panel has space for a wide variety of pads, plug-in pads are very useful. The type used at KFGO is essentially a bridged "H" pad for a 500 to 600 ohm line with the 300 ohm resistors permanently installed on the socket terminals and changes in the loss obtained by plugging in the other three resistors. With no plug in the socket, the circuit is maintained by



Plug-in pads made from half-watt resistors, tube sockets, and six-pin tube bases are always useful around small, or large, stations

the 300 ohm resistors—thus the circuit is never broken. Zero db loss is achieved by shorting the 600 ohms in each leg by jumpers in the plug.

We use six pronged tube bases for plugs and six prong tube sockets; but any combination of six or more prongs can be used. A relay can be included in series with R_2, to remove the shunt for line reversals such as feeding cue on single pair remote feeds. Standard ½ watt resistors are used. After the resistors are soldered in the tube bases, the bases can be filled with compound and labeled.

Loss, db,	R_1 Ohms	R_2 Ohms	Loss, db,	R_1 Ohms	R_2 Ohms
1	36.6	4918	10	648.5	277.5
2	77.7	2316	11	764.5	235.5
3	123.9	1452	12	894	201.3
4	175.5	1025	13	1040	173.1
5	233.4	771.2	14	1204	149.6
6	298.5	603	15	1387	120.8
7	371.7	484.3	17	1824	96.68
8	453.6	396.8	20	2700	66.66
9	545.5	329.9			

Microphone Concealed in Telephone Base for TV

WARREN C. JAYNES,
WHSA, Brule, Wisc.

A "standard" prop in a modern TV studio is the telephone. Confronted with the problem of achieving good sound pickup without the obvious presence of a microphone to distract the viewer, we decided to mount a high quality broadcast microphone inside a telephone desk set.

The microphone selected was the new RCA pressure type BK-1A. Small physical size, moderate cost and the fact that when mounted horizontally its pattern is semi-directional were the considerations which led to the choice. A standard dial type, rectangular base, desk set was obtained and stripped of its internal mechanism, including the dial unit. To make certain that the hand set would not be accidently knocked off during a telecast as well as to provide a handy means of carrying the unit, a hole was drilled in the center of the cradle support and in the handset. The latter hole was tapped for a #6-32 x 1 in. machine screw. A machine screw, secured by a lockwasher, was passed up through the base and tightened into the handset.

The lower section of the BK-1A, including the swivel joint and socket, was removed, leaving the mounting plate and stud assembly exposed. A saddle was fashioned from ordinary #18 insulated wire. The ends of the wire were passed through the two lower holes in the base holding the dial in place. This saddle held the front of the microphone in the opening formerly occupied by the dial. By drilling a hole in the rear of the base, the #8-32 x 2 in. screw that held the swivel joint and socket assembly on the lower section of the microphone can then be passed through the shell and into the stud assembly. With this screw in place the saddle was adjusted to align the microphone in the center of the dial opening and the ends of the wire saddle crimped over to secure it in place.

To eliminate any cavity effect the base was tightly packed with *Kimsul* packing material. Rock wool could also be used for this purpose. The BK-1A cord was brought out through the rear slot in the base usually provided for the telephone cord. The handset cord was replaced in the slot provided for it and held in the base by hooking the "S" clamp on the stud from which it was removed. The cavity around the front of the mike was sealed with 3-M electrical tape to prevent the packing from coming out, as well as to dress up the assembly.

No attempt was made to disguise the front of the microphone as it normally faced the speaker. A dial could be reproduced on thin muslin and placed over the dial opening should it be necessary to show the front side on camera.

Recording Clock

JOSEPH ZELLE,
WERE, Cleveland, Ohio

IN small broadcast stations, recording sessions for delayed broadcasts can achieve a certain flexibility by the use of a separate studio clock. A large dial electric clock can usually be found in the station's shop, and can be placed in the studio most often used for recording.

A minute or two before a recording session is scheduled to begin, this clock is started with the hands set for the actual broadcast time. Hence, the recording can get under way at any time convenient to the participants. The actual time of the broadcast appearing on the "recording" clock adds to the atmosphere of a real broadcast appropriate to the airtime of the program.

Low Cost Attenuator System

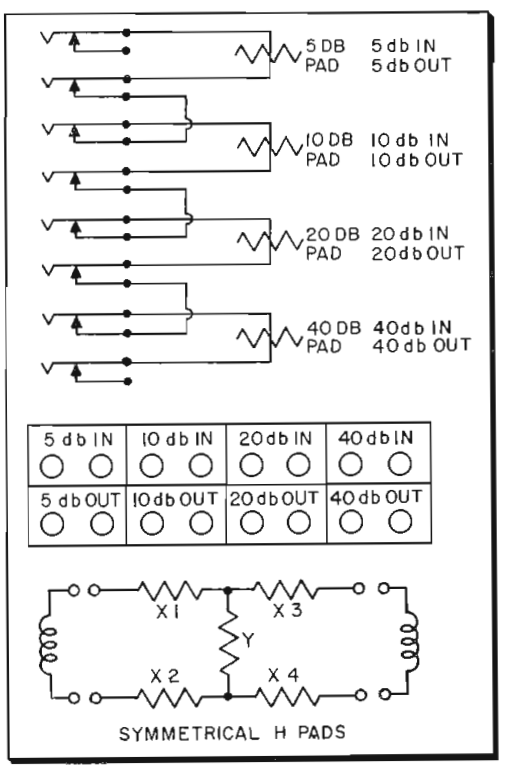
STEPHEN J. STANLEY,
WTRY, Albany, N. Y.

FOR a station with a budget which will not allow an expensive attenuator panel, a substitute system which we devised will provide a dependable, inexpensive and flexible method of attenuation.

Eight double jacks and four H-type pads are used. The pads are made up from ½ watt carbon resis-

(*Continued on page* 122)

Half-watt resistors make low cost pads



Electronic Time

Long delay device finds use in aircraft control and be obtained conveniently with passive elements is

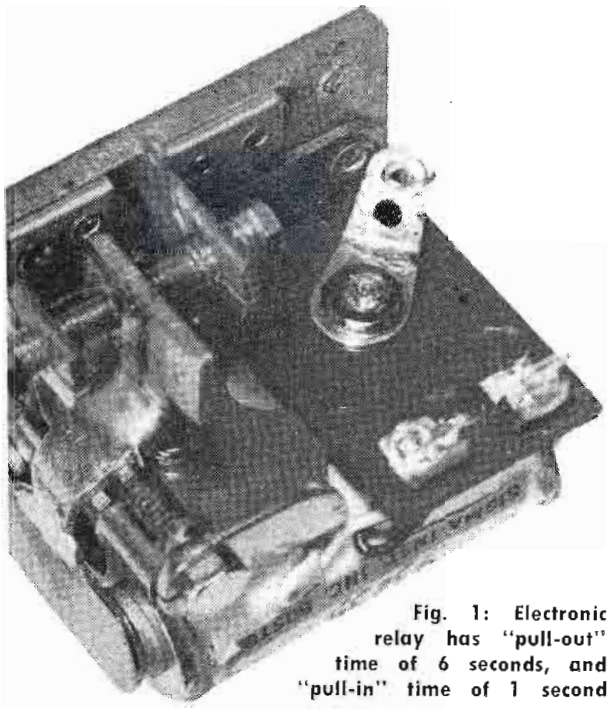


Fig. 1: Electronic relay has "pull-out" time of 6 seconds, and "pull-in" time of 1 second

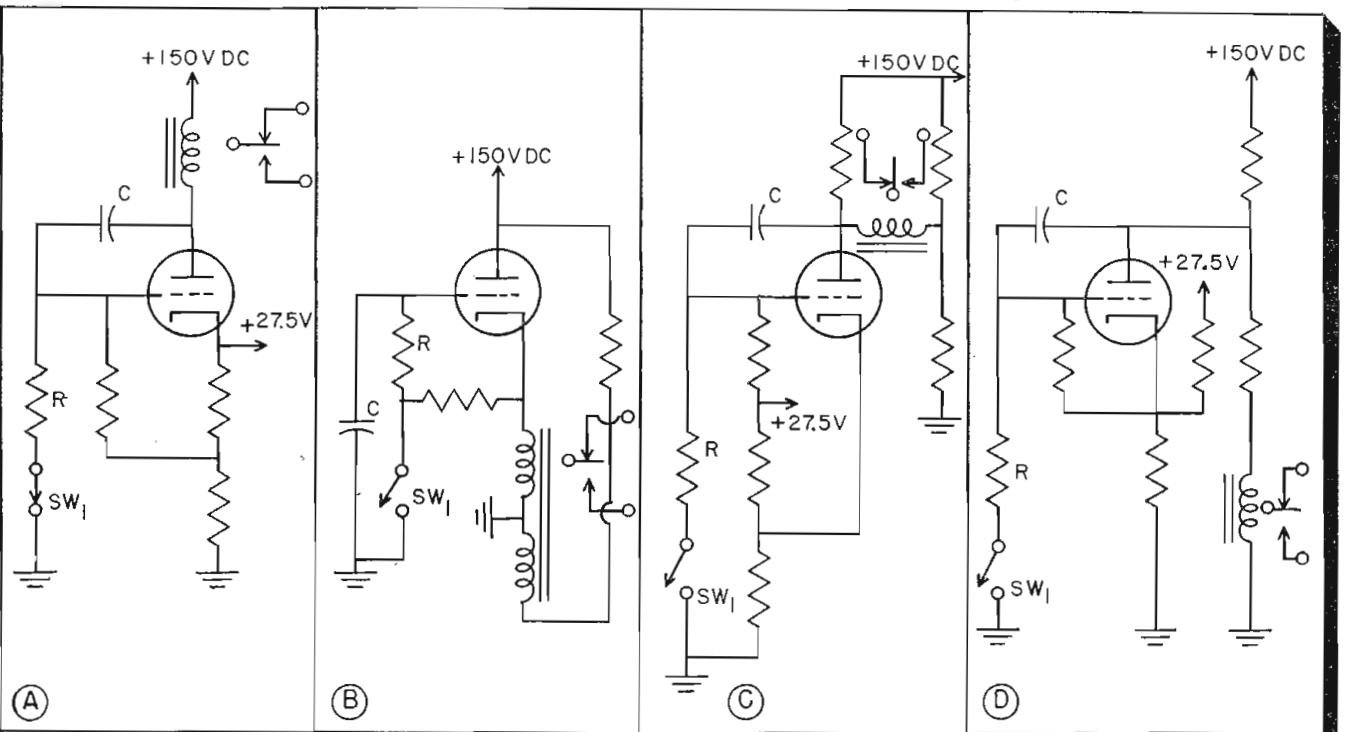
OF particular interest in aircraft control applications, is the problem which arose, requiring a relay having a "pull-out" time of 6 seconds ±1 second, and a "pull-in" time of one second ±0.5 second. The first solution was accomplished by use of a 100 μf capacitor shunting the high resistance coil of a sensitive relay. The "pull-in" time delay was obtained through the series 39,000 ohms resistance which limited the charging rate of the shunt capacitor. The "pull-out" time delay was obtained by the discharge of the stored energy in the shunt capacitor through the high resistance coil of the sensitive relay. The relay contact positioning was used to adjust the circuit to the exact times desired and compensated for the variations due to wide tolerances in the values of the circuit. (See Fig. 2.) A layer of resistance wire was wound about the capacitor and a thermostat switch was enclosed in the assembly. This was necessary to insure operation of the capacitor at very low temperatures.

Capacitor failures occurred soon after life tests began. The problem was brought to the attention of several manufacturers and their samples were tested and rejected. At high temperatures the resistance of the coil winding and the capacitance of the capacitor increased. This resulted in a large increase of the "drop-out" time delay. The back emf of the relay coil during the discharge period altered the characteristics of the capacitor foil and caused drifting in the magnitude of the capacitance with age. During operation, the adjusted values of "drop-out" delay were subject to the length of time allowed for charging the capacitor. As a result, an investigation of circuits containing more reliable and available components led to the use of a vacuum tube as a multiplier of component magnitudes.

Circuit Selection

Several circuit configurations were considered and constructed in breadboard form. They may be seen in Fig. 2 with tabulations of some features which were considered important for selection of the most desirable circuit. The capacitor was a 0.47 μf hermetically sealed, oil-filled paper type with a 125°C rating. The tube was a 5670 (reliable 2C51)

Fig. 2: Circuits investigated for use with delay relay. Circuit B was chosen. It remains operative with 20 megohm leakage, and has fewest components



CIRCUIT	A	B	C	D
NO. OF RESISTORS	4	2 1/2	7	6
NO. OF CAPACITORS	1	1	1	1
NO. OF TUBES	1/2	1/2	1/2	1/2
TUBE FAILURE	RELAY CONTACTS OPEN	RELAY CONTACTS REMAIN CLOSED	RELAY CONTACTS REMAIN CLOSE	RELAY CONTACTS REMAIN CLOSE
20 MEGOHMS GRID-TO-PLATE	CIRCUIT FAILURE	CIRCUIT OPERATIVE	CIRCUIT FAILURE	CIRCUIT FAILURE
SWITCH CONTACTS	NORMALLY OPEN	NORMALLY OPEN	NORMALLY OPEN	NORMALLY OPEN

Delay Relay Circuit

indication systems. Six-second "pull-out" which can not achieved by vacuum tube which "multiplies" values

which was chosen for its physical as well as its electrical characteristics. (See Fig. 3.) The relay was retained from the previous capacitor delay circuit and consisted of two coils each having about 8000 ohms of dc resistance. The "pull-in" power required is about 11 mw. (This relay may be seen in Fig. 1.) Since the circuit is used twice in the overall application, the ½ quantity for re-

By
GEORGE H. BATEMAN
Lear, Inc.
110 Ionia Ave.
Grand Rapids 2, Mich.

sistors refers to those which are shared by the twin circuit. This is also true of the vacuum tube envelope.

Circuit B was chosen by necessity and, fortunately, had the least number of components. It was the only circuit in which the relay contacts would remain closed with tube failure and with 20 megohms of leakage resistance between grid and plate. Furthermore, it did not require the alteration of the switch contacts from normally closed to normally open operation. (Since the switch contacts were very delicate it was not desirable to switch large currents as was necessary in the capacitor—relay circuit.)

Capacity Multiplier

Circuit A is a capacity multiplying device while circuit B effectively multiplies the resistance in series with the charging capacitor. (See a, Fig. 4.) The latter circuit consists of a negative feedback process which detects the current charging C from an increasing source e_k. The voltage drop across R makes the grid more negative with respect to the cathode. The time t that is necessary to charge c to a voltage e_k' increases by a function A times more than it would have been necessary to charge c, to the same voltage e_k', through R from a fixed source E_b, where $A = \mu R_k/(r_p + R_k)$.

The circuit operates as follows: Switch 1 is normally closed. (See Fig. 4b.) The grid is at ground potential, the cathode current i, is at its minimum value and i_3 is sufficient to close the relay contacts. When switch 1 is opened, i_1 slowly increases and creates a magnetomotive force opposite to that of i_3. The relay contacts open when the differential forces are not large enough to hold the relay armature in the closed position. The long time delay of 6 seconds is thus obtained by a predetermination of the magnitude of i_1 at a time t_1 and adjusting the relay spring tension and armature-to-pole-face spacing to provide drop out at this point. When switch 1 is closed, the capacitor discharges through R and i_1 is reduced until the differential force is large enough to close the relay contacts. The short time delay is thus obtained by adjusting the proximity of the armature to permit it to "pull-in" at a predetermined value of i_1 at t_2. The cathode in this operation follows the grid and there is no amplification function performed.

Production and Field Service

The addition of a tube in most circuits also introduces an element having wide tolerances. The tolerances of the resistors may easily be held to 1%, and the capacitors to 5%, as purchased. The relay adjustments may be used to take up these variations. However, if tubes are to be replaced in the field, some means of adjustment or selection must be provided. The unit housing the relays is hermetically sealed making adjustment of the relays an undesirable solution.

A basis for selecting tubes was the magnitude of plate current which was available for a given plate voltage and grid bias. This was superior to that of the transconductance measurement as may be seen on Fig. 5. The reason for this is probably due to the final voltage reached by the cathode which is higher for high current tubes. The time variation is inversely proportional to the logarithm of the voltage variation and therefore is significant. The μ is fairly consistent among tubes.

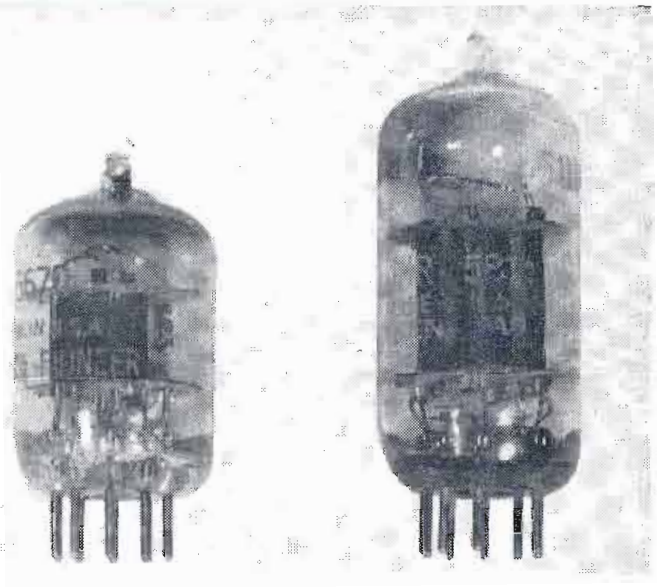


Fig. 3: Tube selected is 5670 at left, which is the reliable version of the 2C51

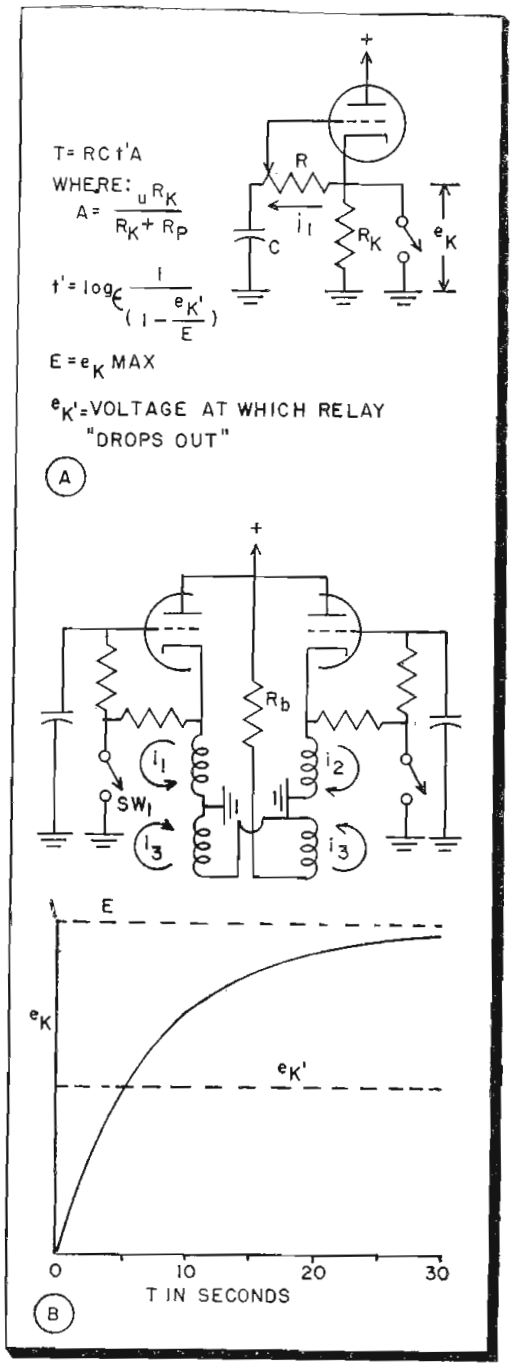
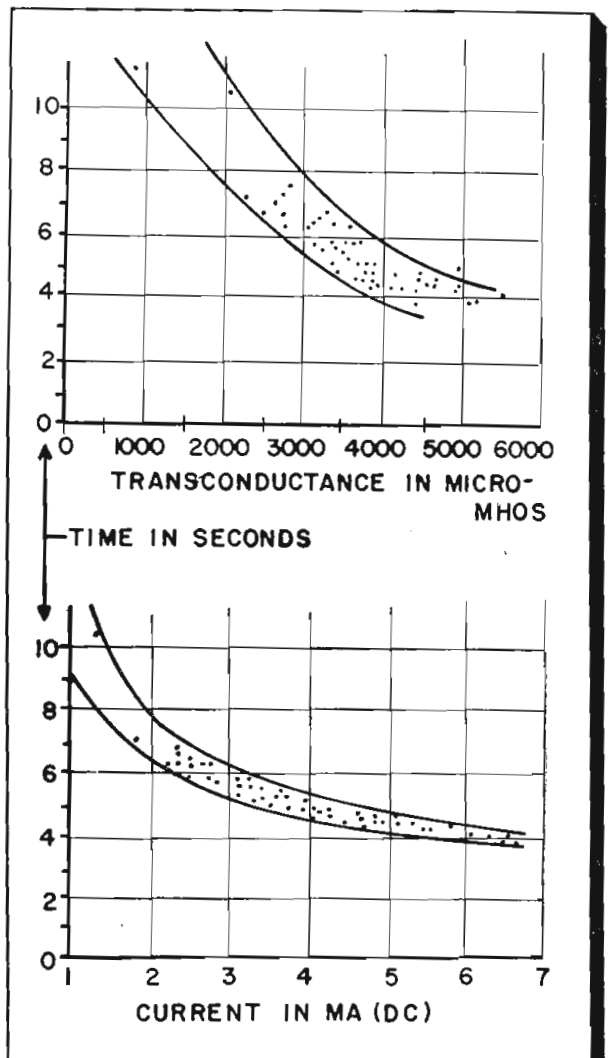


Fig. 4: Circuit B of Fig. 2 detects charging current through negative feedback process. Long time delay is obtained by predetermining i_1 at time t_1 and adjusting spring tension

Because of the desire to use JAN limit tubes an additional control is now being contemplated which will allow the circuit to operate satisfactorily without selection of tubes. The control consists of a variable cathode resistance (shown in Fig. 6) which allows both the gain and the



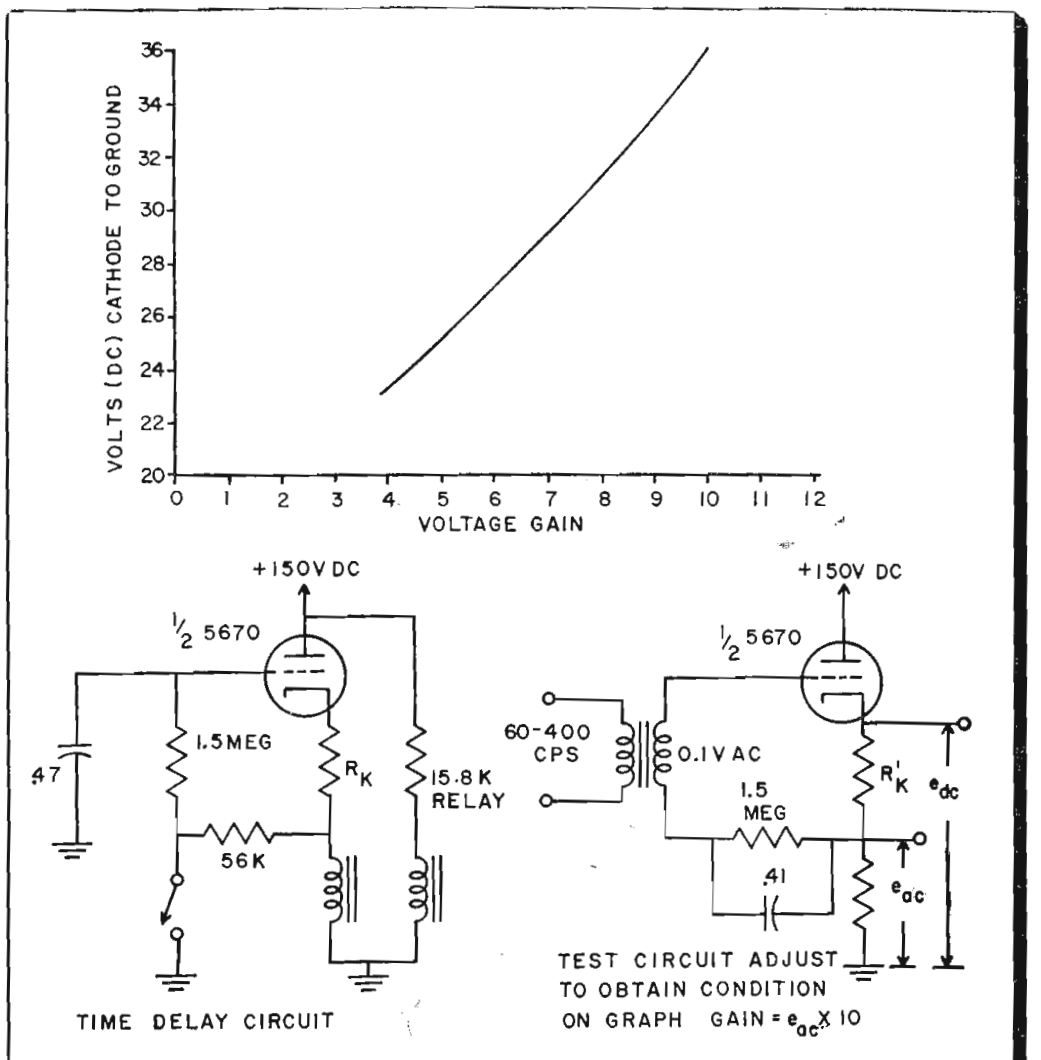
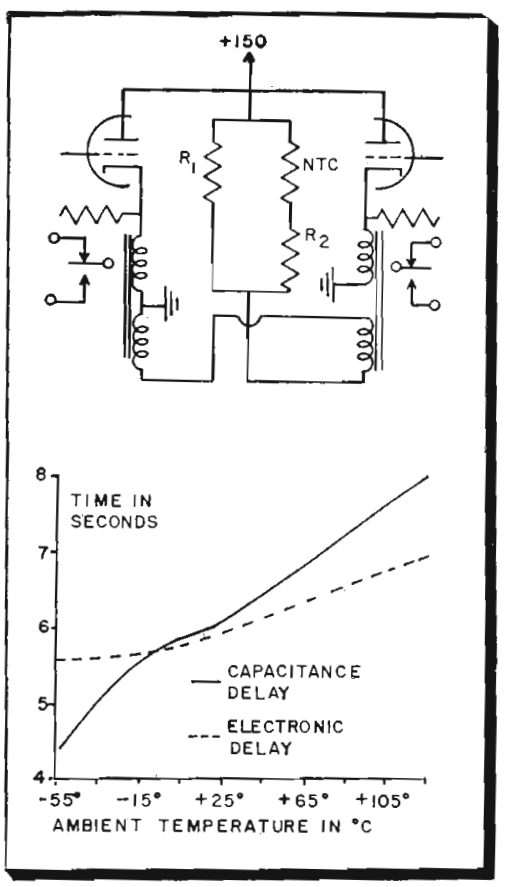


Fig. 5: (l) Selection of tubes made on basis of plate current proved superior to evaluation according to transconductance. Fig. 6 (r) Variable cathode resistance control will permit circuit operation without special tube selection. Gain and maximum cathode voltage may be adjusted for each tube

maximum cathode voltage to be modified. The control is adjusted for each tube, and the exact value may be determined for each tube by the method shown in Fig. 6.

Fig. 7: Temperature characteristics of the electronic and capacitor relay delay circuits



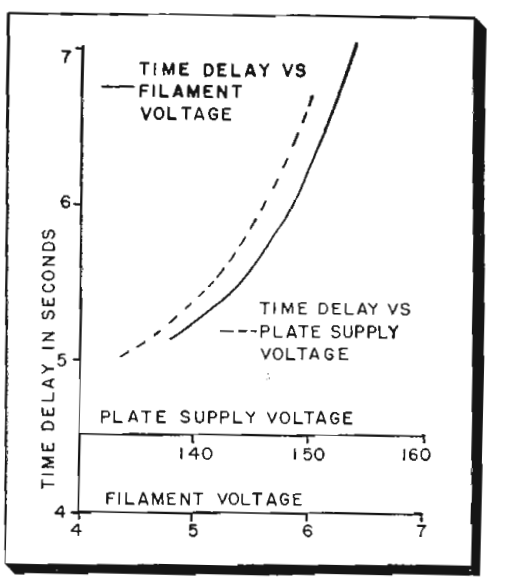
The temperature characteristics of the circuit are primarily controlled by the copper reisistance of the relay windings. As the temperature increases, the resistance increases and the current decreases. The two functions add to decrease the time of the delay since the smaller value of i_3 reduces the differential current necessary to drop out the relay and the maximum value of cathode voltage is increased. A negative temperature coefficient resistor placed in series with the relay secondary windings may be used to compensate for this change. Fig. 7 compares the result with the original capacitor-relay delay delay circuit.

The relay is another element which requires special attention. During the time when the capacitor delay was being considered, it was discovered that the relay contact spacing was changing during temperature cycling. The contacts were mounted on a laminated paper phenolic-impregnated terminal board. This effect was greatly minimized by substituting a mycalex terminal board. The problem of sticking relay armature bearing was solved by a run in of 30,000 operations, during which time a grease used in Lear gyro bearings was used for lubrication. This grease is pliable at —80° C.

The current drain from the high voltage dc supply is about 7 ma

(*Continued on page* 158)

Fig. 8: Time delay characteristics as a function on plate supply and filament voltage changes



Page from an Engineer's Notebook

No. 23 — Rectifier Regulation Chart

By REUBEN LEE, Westinghouse Electric Corp. Baltimore, Md.

THIS chart concerns the first two of the three components of rectifier regulation with choke-input filters: IR drop, and IX drop, as distinct from capacitor effect. It will be assumed here that the choke L, Fig. 1, is large enough to prevent capacitor effect at the lightest load. This requires that choke L maintain continuous current flow at all times, even when the load resistance reaches its highest value. Under this condition the output dc voltage is the average value of the rectified wave. Regulation is then reduced to IR and IX drops only. The IR drop is well understood, but the manner in which transformer IX contributes to overall rectifier regulation is not so widely known as it might be.

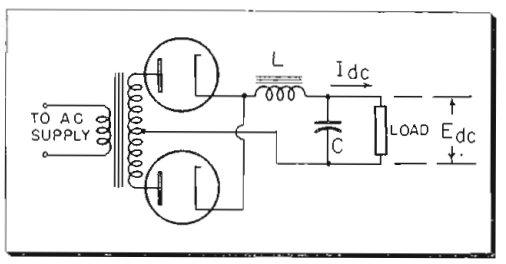


Fig. 1: Single-phase full-wave rectifier

Referring to Fig. 2, leakage reactance prevents instantaneous commutation from one rectifier to another. It thereby introduces a commutation angle θ during which all or part of the plate transformer secondary winding is short-circuited, so that the rectified voltage is reduced by the cross-hatched area shown. This area is proportional to (a) the transformer reactance effective during the commutation period and (b) the output direct current I_{dc}. It has an average value of $(I_{dc}X)/(2\pi)$ volts.

This IX drop subtracts arithmetically from the dc output voltage, in contrast to the quadrature relation with an ac resistive load.

Thus IX drop, considered alone, subtracts directly from the dc output voltage. So does the IR drop. In small rectifiers the IX drop is negligibly small because of the small transformer dimensions. For example, in a rectifier rated at 350 volts, 400 ma output, the dc resistance of the plate transformer, tube and filter choke total 193 ohms, so that IR = 77 volts. The plate transformer has $(I_{dc}X)/(2\pi) = 3$ volts drop.

In large rectifiers, all rectifier components have low losses to prevent power wastage or overheating and the IR drop is a very small percentage of the total. At the same time, the large transformer requires careful design in order to keep the IX drop reasonably small. Therefore, in large rectifiers the IX drop is the dominant cause of regulation. An example with 55 kva rating has 0.7% IR drop and 6% IX drop.

In meduim-size rectifiers the IR and IX drops may be of equal or at least comparable, value. In such rectifiers these two components of regulation do not add arithmetically together for this reason: Commutation interval θ, Fig. 2, depends on the short-circuited reactance when resistance is negligible, but if resistance is appreciable θ is related to the ratio X/R according to the exponential equation:

where i_1 = the instantaneous current in the outgoing anode at time t, in amperes
I_{dc} = the load current in amperes
E = RMS voltage applied to each anode
p = number of anodes (p = 2 for single phase full wave rectifier)

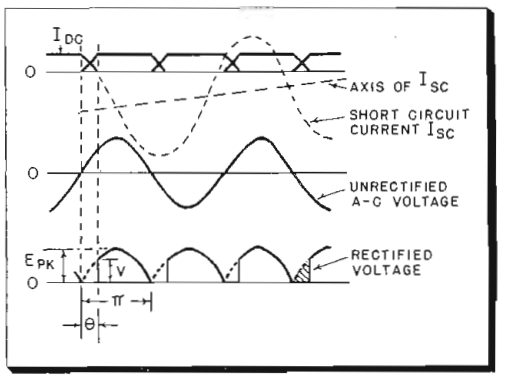


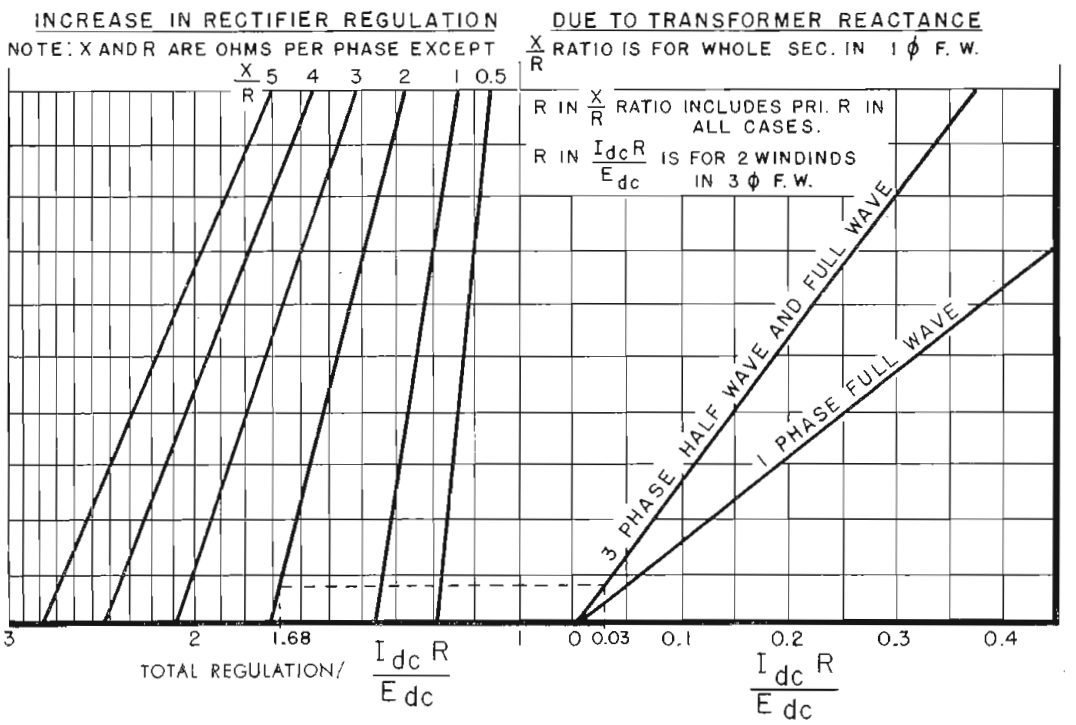
Fig. 2: Rectifier current—voltage waveforms

$\omega = 2\pi$ x the line frequency
t_1 = starting time of commutation
X = leakage reactance of plate transformer (ωL)
L = transformer leakage indusance per anode, in henrys
R = tube resistance + equivalent transformer resistance per anode
t = time
e = 2.71828

The starting time, t_1, is taken as zero. The equation is then solved for t when $i_1 = 0$. An interesting feature of this solution results from the fact that potentials of inactive windings are unaffected by resistance. For this reason, commutation begins at a time t_1 slightly in advance of the time at which open-circuit voltages are equal. Inasmuch as the equation is a transcendental function, it cannot be solved directly,

(*Continued on page* 176)

Fig. 3: To obtain regulation factor, project $I_{dc}R/E_{dc}$ vertically to 1-phase or 3-phase line. Project this point to left to proper X/R line. Abscissa at left gives factor



The "N-A Beam"

Binaural, as well as monaural, sound reproducing systems may be checked for intermodulation distortion with test record made by Cook Labs

Easy-to-make test permits evaluation of audio system components without use of signal generator. Just play test record and listen; dot-dash it's all right, dash-dot it isn't

By EMORY COOK
Cook Laboratories
Stamford, Conn.

ONE of the last remaining frontiers in audio is the matter of intermodulation distortion at high frequencies. Most broadcast engineers as well as serious collectors of music recognize that a "clean top-end" is rare.

The worst sources of trouble in producing such high frequency intermodulation are transducers. Record cartridges with high mass-controlled motional impedances (albeit high spring "compliance") are prime offenders. So are loudspeakers with undamped metallic domes; loudspeakers and high frequency horn drivers with voice-coil rub. The voice-coil rub in the HF unit of a two- or three-way loudspeaker system often passes undiagnosed. We have no opportunity to flex driver diaphragms.

HF Intermodulation

Many of our current amplifier designs stumble surprisingly in high frequency intermodulation due to two basic causes: (1) "Sing suppressor" capacitors to ground interstage; and (2) the ubiquitous high leakage reactance output coil, for "wide range" enclosed in a feedback loop. They are incapable of more than a fraction of their rated power at high frequencies.

The convenient, practical and direct method of analysis is the constant-difference frequency method of intermodulation testing, wherein two "carrier" frequencies (always 1,000 CPS apart, for instance) are stepped or swept through the range desired.

The method has a direct application as a widespread universal test medium except for two obstacles: (1) A method of quantative and comparative measurement must be available; and (2) the annoyance and encumbrance of setting up the signal generators.

Defective Cartridges

For the very good reason that one of our prime offenders is the cartridge, it is logical to pursue the matter further by establishing a test record as the vehicle for the original signal. In this way we have ruled out objection (2). In order to make it as easy as possible for the uninformed and uninstrumentated observer to evaluate the sad news, a quasi-quantitative method of measurement has been employed in the Series 50 Test Record—the "N-A Beam" technique.

Retired aircraft pilots will perhaps recall the old CAA N-A beam. "On course" you hear the steady tone (with clicks); off course to one side, the "N" (dash-dot) emerges; on the other side the "A" comes in. Of course the dot-dash and dash-dot neatly complement each other's interstices to bring the steady on course tone.

While in the process of sweeping the carriers in intermodulation testing, a synthetic 1,000 CPS "A" is constantly coded. See Fig. 1. It serves first as a reminder to the listener of the pitch of the difference frequency, and it also serves as a comparison. It forms a basis for comparison because if the recorded volume level of the coded "A" is such that it corresponds to 2% of the average envelope of the carrier, and if the difference frequency is the same as the coded synthetic "A," we have attained a fine and sensitive reference.

In listening, then, the signal "A" means "all right," but if things are *not* all right, the overriding distortion will symbolically write out the letter "N." Furthermore, every time the "key" is closed to make the synthetic *A*, one carrier is removed, in order to prevent any potential distortive addition to the coded *A*.

Standard of Reference

Two percent of the average value of the equivalent modulated envelope was chosen as a standard of reference because a certain percentage of equipment meets this standard (it is an attainable goal with present manufactures), and because the combined difference product of the recording, processing and pressing is generally well below the 2% reference.

Due to the fact that trouble in cartridges and speakers sometimes appears suddenly at very discrete frequencies, the test record was made by slowly sweeping in synchronism

Test for Intermodulation Distortion

20,000—4,000 and 19,000—3,000 cps, with frequency announcements made by voice. The sweeping process is much more difficult than stepping, but much more useful; the function of records is to make widely available desirable sounds. Approximately three minutes are required for a sweep, and three sweeps are placed on one side of the record so that first playings of strange cartridges can be confined to one band. In the event the point should be worn, or the cartridges so bad as to plough up the sensitive 2% calibration, the record is not then a total loss.

Residual Distortion

From time to time the very natural question will arise as to how can we be sure that it is not residual distortion *on the record* which cause that annoying "N" at 12,000 CPS. Thus in order to allow a freely realistic unrationalized appraisal of such conflicts, a 78 RPM band reiterates on the inside of the record the two 33 RPM working sweeps. "N's" which crop up, say, at 12,000 CPS and environs may then be resolved by quickly shifting 78 speed to 33; whereupon if the *N* changes to an *A*, it can't be the record. They are the same grooves, the same cartridge, the same signal level, only the frequencies changed.

The reverse side of the record is intended for use with a standard binaural arm. It keeps separate the two high carrier frequencies on opposing channels, so that intermodulation measurements of amplifiers and speakers may be made conveniently, regardless of the cartridge distortion. If the basic high frequency response of the cartridge is adequate, the inherent distortion does not matter, because the mixing takes place later, electrically.

Perhaps one of the most remarkable things about this whole idea is that a record with such a low residual high frequency intermodulation can be made at all, but the best modern equipment and methods make it a reality. As a medium for testing of quality components, it has great potential in a widely neglected area of performance requirement. The correlation between subjective listener reaction (rejection or acceptance) and the constant-difference-frequency method of intermodulation measurement is much better than for any other method of measuring distortion.

Difference Products

This is perhaps because this method simulates what actually happens in practice in a channel carrying the infinitely varied components and overtones of speech and music. Unfortunately, the difference products of two or more high frequency musical overtones fall more often than not into the range of maximum ear sensitivity.

The Fletcher-Munson characteristic makes significant the selection of a 1,000 CPS difference (quadrature) frequency, since intermodulation difference products which fall into the range of high power sensitivity of the ear are important out of proportion to complex products which fall elsewhere.

High Moving Mass

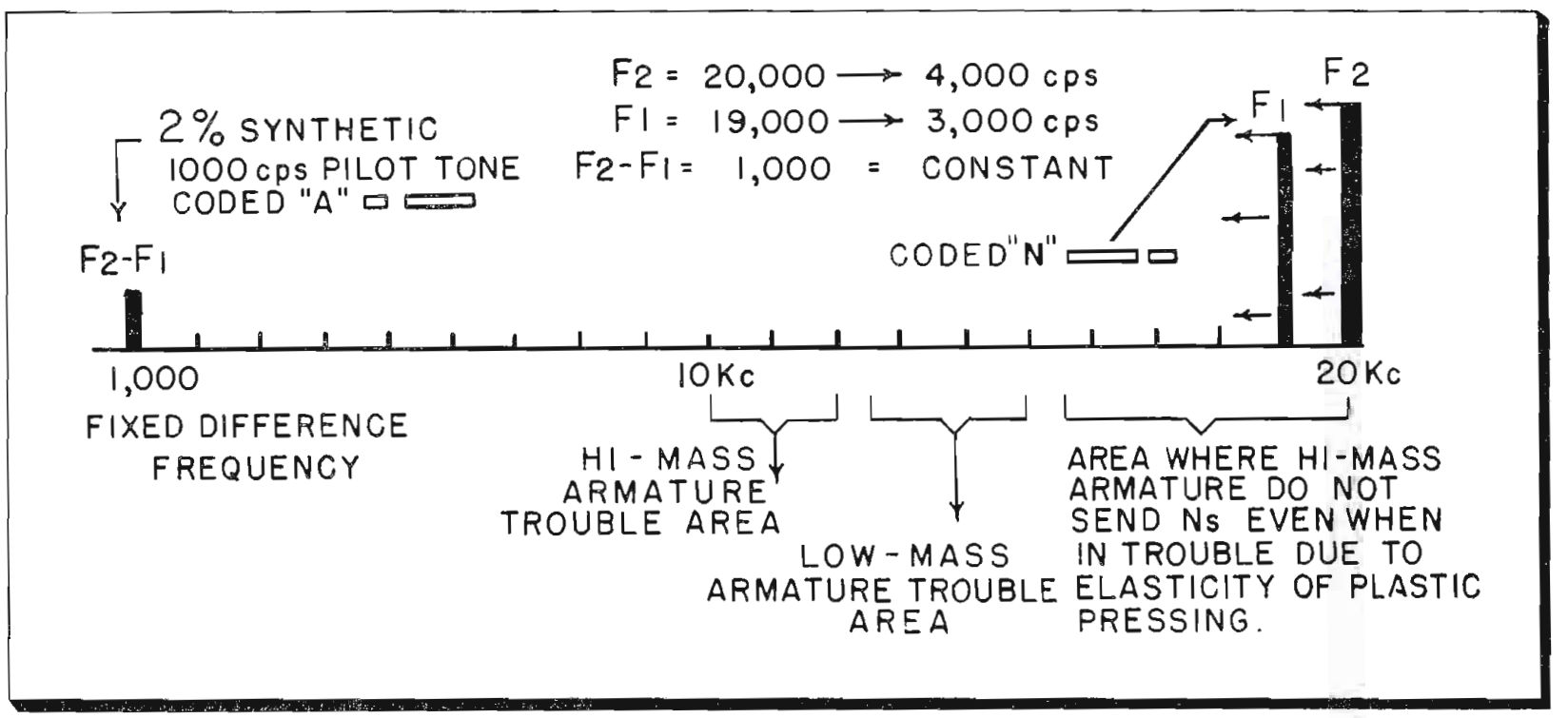
Cartridges with relatively high moving mass will often not produce "N's" when they should, because of the happy faculty of brushing aside as they pass the high frequency carrier cycles. Two high frequency tones in combination appear as a modulated carrier, and the modulation *rate* depends on the difference frequency. The modulation percentage" will be 100% if the amplitudes (velocities) of two discrete original frequencies are equal. (See Fig. 2.)

Amplitudes of successive individual half-cycles in an amplitude-modulated carrier are continually changing in order to produce the envelope observable by demodulation. Therefore, when such a wave is present in a recorded groove, a mild degree of transient response is required of the transducer in order to reproduce it. A cartridge with high moving mass can not possibly produce *A*'s at the highest frequencies without simultaneously ruining the record.

Contact pressures for microgroove records are measured in tons to the

(*Continued on page* 175)

Fig. 1: Audio range is swept by two frequencies 1000 CPS apart. Intermodulation product coded "N" is audibly compared with fixed tone coded "A"



DC Selsyns and Annunciators

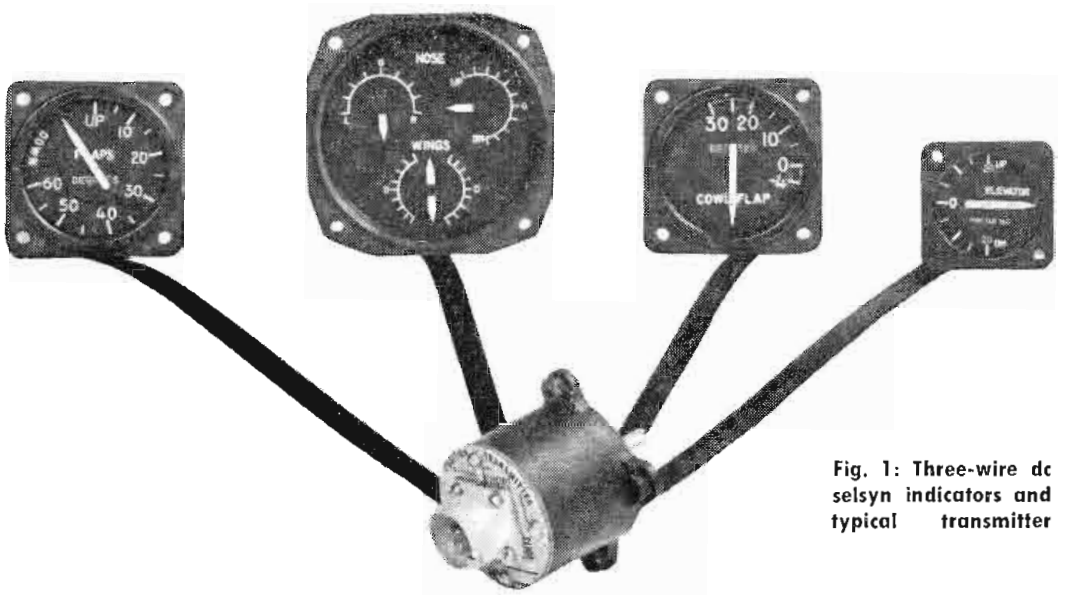


Fig. 1: Three-wire dc selsyn indicators and typical transmitter

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SIMPLICITY, high accuracy, reliability, small size, and light weight are factors which make dc selsyns and annunciators readily adaptable to many remote indications on modern aircraft. Consequently, the armed services, in their efforts to simplify the highly complex instrument panels in aircraft were quick to adopt these instruments for telemetering purposes. Some of these applications include the position indication of landing wheels, flaps, and bomb-bay doors, as well as indications of pressure, temperature and fuel quantity.

Three-Wire DC Selsyn

A transmitter, an indicator, a dc power source and interconnecting leads make up this system which is capable of indicating 360° brush rotation. (See Fig. 2.) The transmitter consists of a continuous single layer toroidal resistance winding, tapped at each 120°, on which rotates a pair of diametrically-opposed brushes. Twenty-eight volts dc power is supplied to these rotatable brushes, thereby applying dc across any diameter of the toroidal winding. The indicator consists of a laminated ferromagnetic field structure around which are wound three field coils spaced 120° apart, a polarized permanent-magnet rotor to which is attached a pointer, and a copper damping ring positioned in the air gap between the rotor and the stator. The three field coils are connected in delta and the interconnections wired to the three taps on the transmitter element.

When the transmitter brushes are in the position shown, currents in two adjacent indicator coils flow in such a direction that they set up opposing fields in the laminated ring. The current in the third coil is zero. As a result, instead of the flux travelling around the ring, it is forced out of the ring and across the space occupied by the rotor. This is shown by the dotted lines in the schematic diagram. The polarized rotor consequently aligns itself with this flux and its pointer produces an indication of the position of the brushes on the transmitter. As the transmitter brushes are rotated by the motion which is being remotely indicated, the indicator pointer follows them directly throughout the 360° of their rotation. Since there are no springs or restraining forces exerted on the rotor, its movement is independent of supply voltage. Likewise, since the coils are arranged symmetrically, the rotor position is not affected by changes in coil resistance occurring with changes in temperature.

The operating torque of a complete transmitter as described above ranges from two to three in.-oz. If the coil and brush assemblies are used without their usual protective housing as shown in Fig. 1, then less than one quarter of an in.-oz. is required to rotate the brushes on the coil.

In this type of transmitter the output voltage passes through 360 electrical degrees for each revolution of the brushes so that the ratio of angular motions of the indicator and transmitter is unity. If a ratio greater than unity is desired, then

Fig. 2: Schematic diagram of dc selsyn three-wire three-coil system

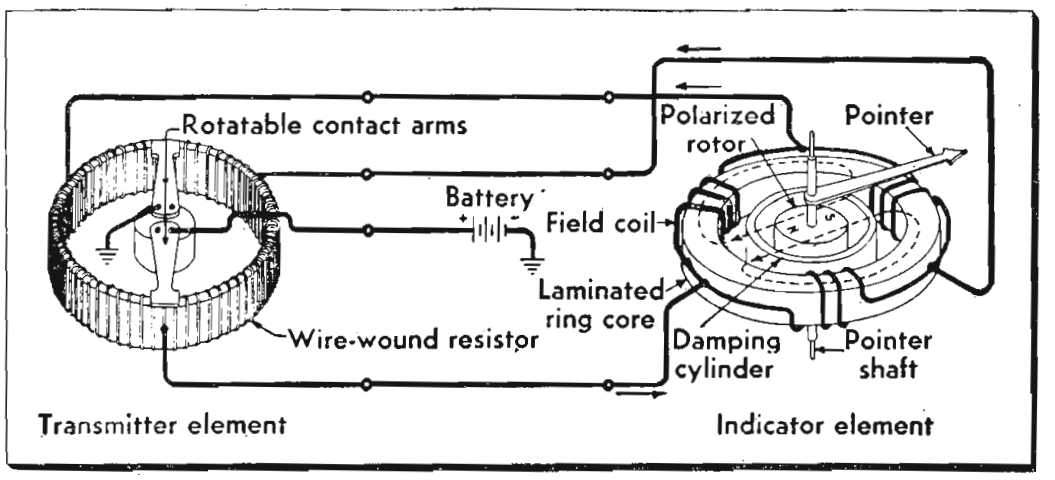
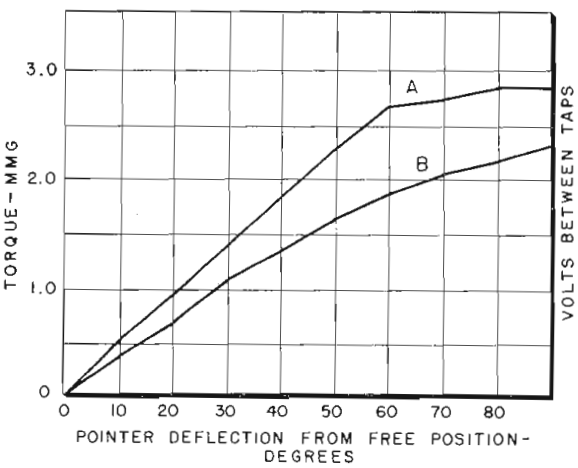
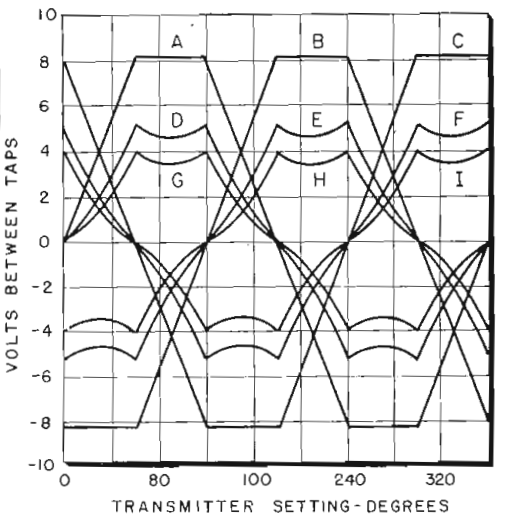


Fig. 3: (1) DC selsyn torque characteristics
Fig. 4: (r) Three-wire selsyn voltage curves A-C, no load; D-E, 1 indicator; F-I, 2 indic.





for Aircraft

Highly reliable and accurate telemetering devices simplify complex instrument panels. Compact three-wire and two-wire systems described

the number of evenly-spaced taps must equal 3n, where n is defined as the ratio of indicator revolutions to transmitter revolutions in whole numbers. To utilize the full capacity of the transmitter winding, 2n brushes must be used with the brushes of opposite polarity 180 electrical degrees of 360/2n angular degrees apart. Thus, whole number ratios between indicator revolutions and transmitter revolutions greater than unity can be developed to satisfy various remote motions without being required to supplement the one-to-one ratio system with gearing or linkage mechanisms. Two or more indicators may be operated in parallel.

Because there is no torque acting on the indicator when the power is off, the pointer will remain fixed at its last indicated position. Therefore, in those applications where an indication of power failure is desired, the indicator is provided with a small fixed permanent magnet which attracts the rotor magnet to a position where the pointer is pulled off the calibrated scale and does not indicate a measurement. Obviously, this introduces torque while the power is on and causes some shift in the follow-up (or indicator) accuracy curve with an accompanying non-linearity of scale distribution. Some voltage error is also introduced but this amounts to less than one angular degree of error for a variation of 10% in supply voltage.

Each indicator element weighs less than 1 oz. and can be mounted in a 1¼ in. diameter circle. The power required by a transmitter and indicator system is 1.8 watts. The power required for two indicators connected to one transmitter is 2.2 watts.

The torque for the standard system is shown by the curves in Fig. 3. Since the slope of the torque curve is a criterion of indicator friction, it is desirable to have as steep a slope as possible for a minimum friction error. The dc selsyn torque curves shown here have their steepest slope at zero degrees of pointer deflection, which accounts in part for the low friction error of this system. Jewel bearings and a high ratio of torque-to-weight are the other factors responsible for low friction. The desirable high ratio of torque-to-weight obtainable with this system is due primarily to the use of a light weight permanent magnet rotor of high coercive force.

Fig. 5: Schematic diagram of two-wire dc selsyn system. Tape used in liquid level gages

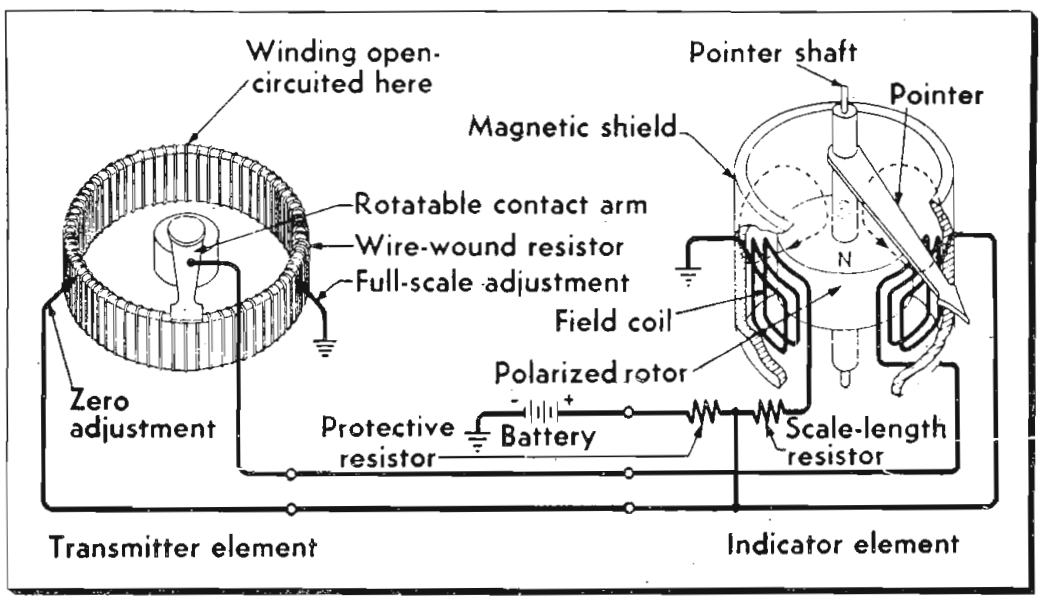
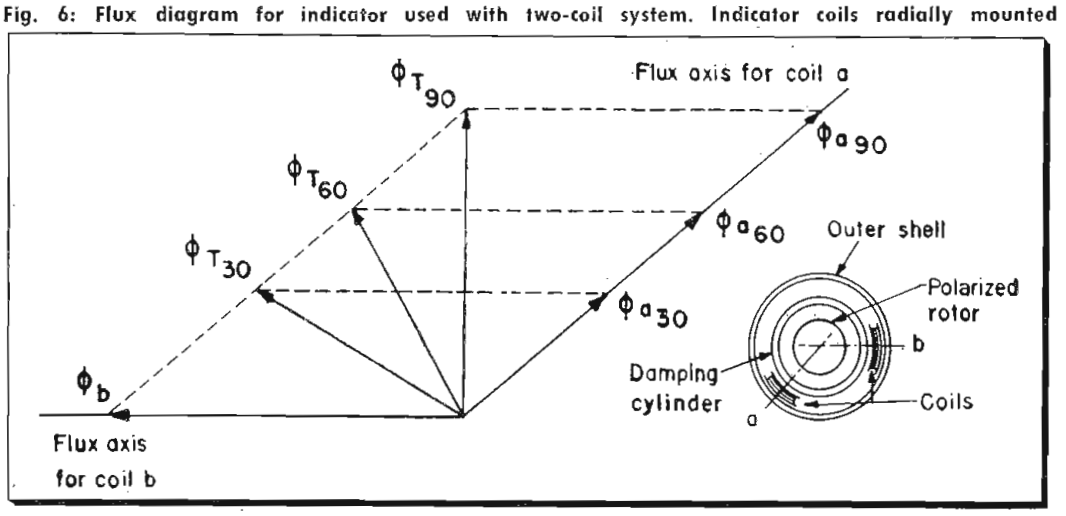


Fig. 6: Flux diagram for indicator used with two-coil system. Indicator coils radially mounted



Voltage Waveform

The voltage waveform existing between taps of the transmitter is shown in Fig. 4. At no load, the form is triangular with the tops cut off flat. With load, the sides and tops of the form bend inward as shown. The change in form is such that at any given point the ratio of voltage between one pair of taps to that between another pair of taps does not change with the load; therefore an indicator connected to a transmitter will not vary in calibration when another indicator is connected in parallel with it.

However, this particular voltage waveshape introduces a variable error and prevents the indicator from following the transmitter linearly. The voltage wave shape and natural resultant error arise from the fact that the transmitter resistance is a linear function of the transmitter brush angle. It has been determined that the error has a maximum peak of 1.1° and that these peaks occur every 30° around the transmitter winding. This error can be overcome by designing a non-linear transmitter resistance.

The major portion of the applications for three-wire dc selsyn systems is for remote indication of the position of control surfaces on aircraft. Typical ones include the position of flaps and nose wheel, the horizontal stabilizer position, and trim tab positions on elevators, rudders and ailerons.

It may be of interest to note, however, that this system is not limited to short distance remote indication as found on aircraft. The transmitter and indicator may be located many miles apart without appreciable effect on system accuracy. Tests show

(*Continued on page* 162)

Applying Pulse Magnetrons to

PART TWO
OF TWO PARTS

Design errors underlying current reliability difficulties traced to understanding of absolute ratings. Switching, life, mismatch and physical environment are also evaluated

By CHARLES V. LITTON, *Chairman of the Board*
and *PAUL W. CRAPUCHETTES,* *Dir. of Engineering, Vacuum Tube Dept.*
Litton Industries, San Carlos, Calif.

OF all the limitations to magnetron operation discussed, mismatch is probably the most prevalent in systems, especially tuned ones, and is the least susceptible to cure. All systems are terminated in an antenna which presents some (usually variable) mismatch to the magnetron at various phases due to rotation of the antenna and/or change in frequency. In the usual case the magnetron is located many guide wavelengths from the antenna, either by poor design of the system or its required location in the aircraft. This length of line becomes very important to the magnetron as will be shown.

The magnetron is principally a high power oscillator tube for use at microwave frequencies. The chief difference between the magnetron oscillator and other power sources with which circuit engineers are familiar is the fact that with the magnetron the load is coupled directly to the tuned circuit of the oscillator. Consequently, a change in lead can detune the oscillator. In the case of most other power sources a buffer amplifier is used to isolate the load from the tuned circuit.

Matching

The ability of a magnetron to operate into a mismatch is dependent on several factors all of which are related. Systems and tube engineers know them by several different names, including:

A. Magnitude of mismatch
B. Phase of mismatch
C. Distance from magnetron to mismatch (the long line effect)
D. Location of "sink"
E. Region of non-oscillation on Rieke diagram
F. Relative loading of π mode and higher order modes
G. Ability to start
H. Location of TR and ATR

It should be obvious that we have said the same thing in many different ways throughout this listing. The first three items in the list are causes, and the remaining are essentially effects, as shown below:

A. *Magnitude of Mismatch:* Magnitude of mismatch generally defines in terms of standing wave ratio the degree of discontinuity into which the magnetron is expected to operate. The magnitude of the mismatch has at least two effects on the magnetron. One is on starting and the other is on operation.

A magnetron may be said to start most easily when no resistive load is present. Thus when the output of the magnetron is shorted at the output slot, a magnetron starts most readily and will accept the maximum rate of rise of voltage. Of course, no useful power is delivered to the load under this condition and it is of interest only to the magnetron designer. As the resistive component in the load is increased, starting becomes more difficult and acceptance of rate of rise of voltage decreases. This is common to most velocity modulated devices as well as the transit time oscillators all of which can be loaded to the point where failure to start results. The magnetron also suffers this incapacity, and at some finite value of resistance the magnetron fails to start at all.

Litton

Crapuchettes

The second effect of mismatch is that the magnetron has difficulty driving a heavy load. This can be shown most easily by looking at a generalized E vs. I plot for a magnetron. (See Fig. 6.)

Under normal loading the magnetron operates in such a fashion that at the maximum value of i_b, e_b is still lower than the voltage of the next higher mode. As loading is increased the slope of the E vs. I line increases (this says that E/I increases, as the load increases and thus is defined the modulator impedance of a magnetron) up to the point where e_b for maximum i_b is greater than the voltage at start of the next higher mode, and the trace then follows the load line of the power supply to the higher mode, and consequently mode shift occurs. This would appear as a mid-pulse mode shift, with the familiar short lines rather than missing lines on the spectrum analyzer.

B. *Phase of Mismatch:* So far as reflecting to the magnetron the phase of the discontinuity, phase of mismatch is important. In one phase the mismatch is reflected as a low resistance and the magnetron starts easily and operates without difficulty. In other phases discontinuity can result as the magnetron sees reactive or capacitive components, and 180 electrical degrees from the low impedance the magnetron will see a highly resistive component which can result in mode shift or failure to start.

C. *Distance from Magnetron to Mismatch:* This is the so called "long line effect" which is well known to magnetron designers. It is of equal or greater importance to the system engineer, for it is here that the magnetron first fails due to loading. In other words a magnetron which has been tested to 1.5 to 1 VSWR at the manufacturer's can be operated in the field in such a manner as to give poor performance at 1.5 to 1 VSWR by looking at this discontinuity through a longer line. An indication of this effect is that at certain phases of the load the spectrum will be observed to dissolve and re-appear at a nearby frequency with only a small change in phase. It is ever possible that the magnetron will go from one frequency to the other during the same or alternate pulses, giving two distinct but irregular spectra. This malfunction is known as "twinning."

It may be stated however that there are three general approaches to the cure of this phenomenon:

(1) A reduction of the pulling figure of the magnetron with its associated loss of efficiency. (This no one will buy.)

(2) Elimination of the cause of the reflection or matching out the reflection very near its source.

(This is a system problem, and is certainly a desirable target, but achievement would be difficult on tunable systems.)

(3) Elimination of the line between the magnetron and the termination. This of course is an obvious solution, but would require a high echelon decision on location or re-location of the equipment. Certainly it is a desirable goal.

D. *Location of "Sink":* This is a relative newcomer to the written specification of magnetrons, and is now being established to aid in the location of TR and ATR boxes. The sink represents the phase of the region of nonoperation of the magnetron with high impedance reflected there. In the case of the tube specifications, phase of the sink is given as the phase of the first minimum measured in guide wave-lengths from the output flange. Thus a high impedance located at this point (or any integral number of half-guide wavelengths from this point) will cause trouble.

E. *Region of Non-Oscillation on Rieke Diagram:* It seems that system engineers are familiar with the Rieke diagrams, although tube manufacturers and tube engineers now use a system of specifying pulling figure, pushing figure, efficiency, etc., to completely describe tube operation.

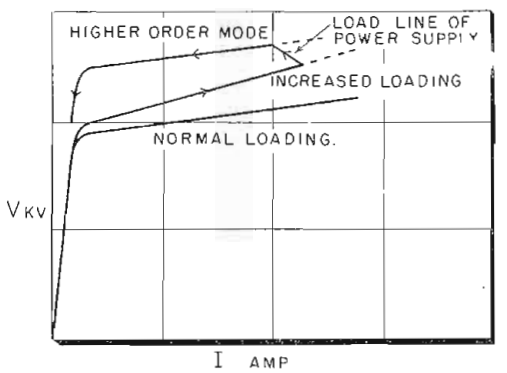


Fig. 6: Effect of heavy load on magnetron

The region of non-operation on a Rieke diagram corresponds precisely to the location of the "sink" specified above, and is some integral number of half-wavelengths away from the location of the "sink."

F. *Relative Loading of π Mode and Higher Order Modes:* This of course comes about in a fashion described in paragraphs A and B above. Loading the magnetron through a length of wave guide may be in such phase as to make starting on π mode at a given rate of rise difficult, but may be at the same time in a phase to make starting in a higher mode easier. Thus when the magnetron misses π mode it starts readily in the next mode. The reverse can also be made to occur, and reduction of moding can take place in this fashion in a fixed frequency tube.

G. *Ability to Start:* This has been adequately covered in previous paragraphs.

H. *Location of TR and ATR Boxes.* TR and ART boxes have two sets of characteristics depending on whether or not they have fired. Fired they are simply a small loss in series with the load. Unfired they are a resonant cavity of moderately high Q; connected in series with the load, the reactance of the unfired cavity becomes the determining impedance of the low level system. The location of this impedance relative to the "sink" must be adjusted so that the most favorable conditions for build-up of oscillations exist. By the time that the amplitude of the oscillations is great enough to fire the gap, the operating magnetron mode will have been established.

Thus, starting requirements of the magnetron determine the best location of TR and ART relative to the magnetron. The usual criteria determining their location relative to the receiver are not altered or disturbed by this additional limitation.

Environmental Conditions

Packed under the heading of physical, electrical and mechanical environment are a multitude of possible causes of tube failure. Suppose we first consider the physical environmental conditions and see what unexpected effects on the magnetron occur. Fig. 7 shows a life cycle test set-up for the 4J52 magnetron. Fig. 8 points out potential trouble points.

A. *Temperature and Pressure:* In vacuum tube specifications there is frequently given a maximum value of anode or shell temperature as a part of the absolute ratings. Additionally, it is necessary that temperature elsewhere on the tube be held to reasonable values. Failure to do so will lead to poor life due to outgassing of metal, porosity of some metals to hydrogen from water vapor at temperatures near 200°C and due to evaporation of condensed materials from the glass. And, in evaluating the adequacy of a cooling system, it must be recognized that a system which gives adequate cooling under standard conditions of temperature and pressure may fail to do so under abnormal conditions which, however, may be expected to occur during operation. For example, if air cooling is being used, it will become less effective as the pressure drops and may cease to do the job required. Likewise the reduction in cooling of a pressurized container at high altitudes may result in a very high internal ambient temperature within the pressurized system.

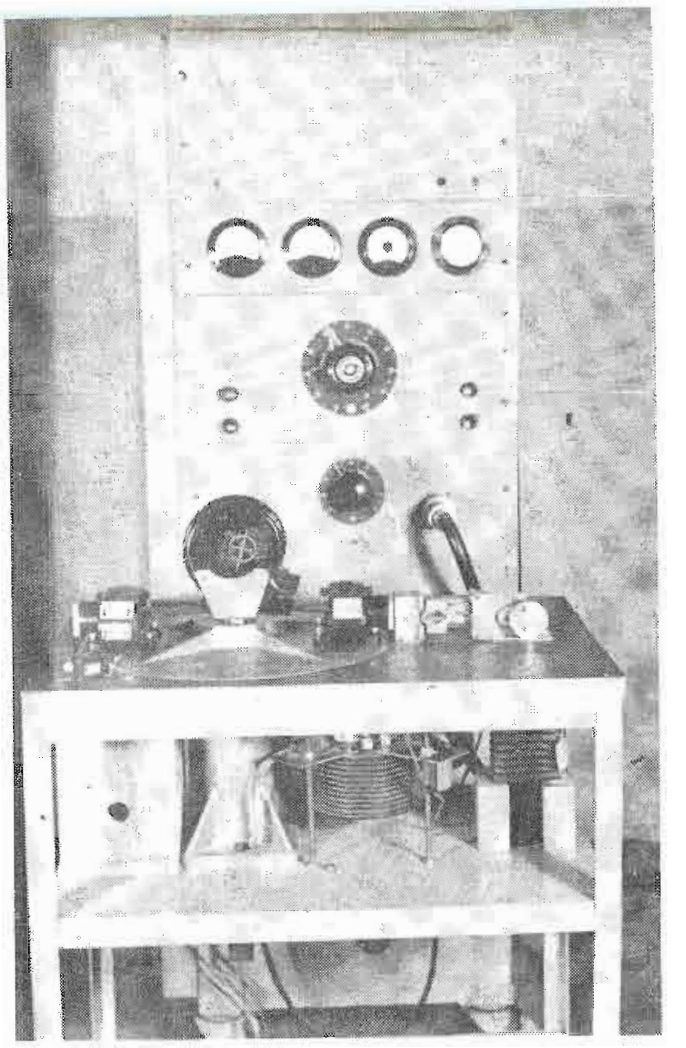


Fig. 7: 4J52 magnetron life cycle test set-up

B. *Cathode:* There is usually a high voltage drop between the cathode and filament terminals and the body. Sufficient insulation must be provided and maintained. Care should be taken that the glass or ceramic insulation forming part of the stem is not exposed to salt spray or other dirt or contamination which will unduly reduce the insulation provided. Corona may exist under some conditions of temperature and pressure and voltage and adequate means to cope with it should be provided.

Although connections to the filament leads should be firm enough to avoid sparking, they should not be rigid, to avoid the transmission of stress to the adjacent glass seal. The filament terminals are likely to operate at a somewhat elevated temperature, and provision must be made for the necessary expansion.

The connections to the filament

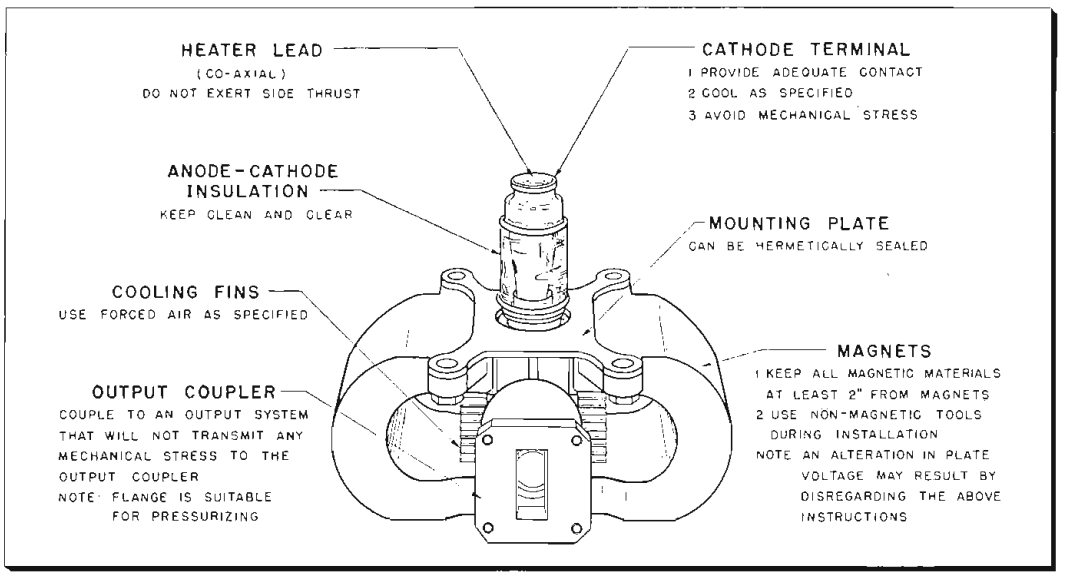


Fig. 8: Mechanical considerations affecting magnetron operation indicate susceptible trouble spots. These include cathode terminal, output coupler, anode-cathode insulation and magnets

terminals should be so made that plate voltage supply return is connected to the cathode side—which is usually specified in the data sheets or on the outline drawings. Otherwise the plate current and associated transients will pass through the filament and may cause burnout.

The heater and cathode terminals should be connected by a suitable capacitor to limit the voltage difference between them. This should be done at the terminals, or as close as possible, to limit transients from developing across the filament.

Cathode Stem Radiation

In many tubes some r-f power is radiated from the cathode stem. Although the amount may be small compared to the energy delivered by the tube, yet it is likely to be sufficient to interfere with or damage other components of the system. It is usually desirable to provide efficient shielding around the cathode stem.

D. *Output:* Connections to the output must be made sufficiently tight to avoid arcing. On the other hand, it is also necessary to avoid stressing the output section which would either deform the metal or break the glass or ceramic vacuum seals. It is therefore necessary that any pressure be applied uniformly to it. Before making the connection, the glass or ceramic vacuum seal should be inspected to determine that it is not dirty.

E. *Regulation:* If the primary power is not completely regulated, the effect of this on the tube should be directly studied. This may be serious since, if the filament voltage holds at too low a value and the cathode is operated at too low a temperature, the consequent reduction of emission may lead to arcing or other instability. On the other hand, if the filament reaches too high a temperature, the filament and cathode life may be seriously reduced.

F. *Primary Frequency:* In considering the effect of the supply voltage, consideration should also be given to its frequency. In general, this will not affect the plate voltage, but may have a serious effect on the filament. The filament has a natural period of mechanical vibration. If the filament voltage is applied at a frequency sufficiently near this resonance, coupling may occur leading to the rapid destruction of the filament.

G. *Filament Current:* It is necessary, in general, to make some provision to limit the current surge at the start of operation. When cold, the total resistance of the filament is quite low and an excessively high current may be drawn initially. Since the resistance of the welds is still relatively high, the starting current may cause burnout. Further, the magnetic reaction between the heater and the applied magnetic field caused by the high inrush current may break the heater while it is cold and brittle. The limit on inrush current in percent of operating current varies from 250% (for small wires), for low current (2 a) to 150% for mode-rate filament current (30 a) to very little surge allowance for large filament currents.

H. *Heater Schedule:* Many magnetrons during operation require reduction of the filament power. This is because an appreciable fraction (3 to 20%) of the plate power input appears on the cathode due to back bombardment from the space charge. This effect is known as back heating and, if the filament power is not reduced, may cause the cathode to reach an excessively high temperature during operation. In many tubes, in fact, this effect is one of the major limiting factors in the tube operation. The final test of satisfac-factory heater schedule is that the cathode surface temperature during operation shall be approximately the same as during standby. When the tube is to be subjected to varying duty some servo system must be devised to maintain the cathode surface temperature. As far as we know a photo-electric device with filters would be required.

Mechanical Considerations

This leaves only mechanical considerations which always result in a mechanical failure even though it may be to an electrical component. Chiefly here we have:

I. *Shock and Vibration:* While most tubes are built to stand reasonable shock and are, in fact, tested under conditions equivalent to what is expected in normal operation, care must be taken to avoid unusual exposure. It can happen that the tube in its mount has a mechanical resonance which coincides with one vibration component. When this occurs, even a minor vibration can build up to a very destructive amplitude. Further, precautions must be applied to the cathode and radio frequency connections. The tube often is required to withstand high forces of impact and vibration and is usually rigidly mounted in the equipment by means of a base plate or flange provided for this purpose.

J. *Magnets:* While in the strictest sense magnetic phenomena may not be a mechanical consideration, at least most of the difficulties which arise from magnets is due to some "mechanical" act. Tubes which are supplied with a magnet must be stored in such a way as not to cause degradation of the magnetic field. Care must be taken to prevent excessive interaction of the magnetic fields of two or more magnetrons. Except where otherwise noted in the applications, it is generally a safe rule to allow not less than six inches between stored tubes.

Under no circumstances, should the magnets be removed from an integral magnet tube. In general, such tubes contain internal pole pieces which form a part of the magnetic circuit.

Removal of the magnets will therefore modify the circuit and increase its reluctance. The magnets will be partially demagnetized by their removal.

TV Station Timetable

Latest state-by-state round-up of stations expected to be on the air during the coming year. Starting date, call letters and channel given

State and City	Call Letters	Channel No.	Date On Air
ALABAMA			
Birmingham	WJLN-TV	48	10/53
Decatur	WMSL-TV	23	Spring 54
ARIZONA			
Phoenix	KOOL-TV (Time Shared)	10	10/53
Phoenix	KOY-TV (Time Shared)	10	10/53
Tucson	KCNA-TV	9	Fall 53
ARKANSAS			
Little Rock	KARK-TV	4	2/54
Pine Bluff	KATV	7	10/53
CALIFORNIA			
Fresno	KJEO	47	10/53
Los Angeles	KPIK	22	Late 53
Sacramento	KBIC	46	11/53
San Bernardino	KITO-TV	18	10/53
San Francisco	KBAY-TV	20	11/53
San Jose	John A. Vietor	48	10/54
Stoekton	KTVU	36	10/53
Tulare-Fresno	KCOK-TV	27	10/53
COLORADO			
Denver	KLZ-TV	7	11/53
Denver*	KRMA-TV	6	1954
Grand Junction	KFXJ-TV	5	4/54
CONNECTICUT			
New Haven	WELI-TV	59	Summer 54
New London	WNLC-TV	26	12/53
FLORIDA			
Fort Lauderdale	WITV	17	11/53
Fort Myers	WINK	11	12/53
Jacksonville	WJHP	36	10/53
Tampa	WFLA-TV	8	Early 54
GEORGIA			
Columbus	WDAK-TV	28	10/53
Savannah	WTOC-TV	11	11/53
Valdosta	WGOV-TV	37	11/53
IDAHO			
Boise-Meridian	KBOI	2	12/53
Boise	KTVI	9	10/53
Idaho Falls	KIFT-TV	8	4/54
Meridian-Boise	KBOI	2	12/53
Pocatello	KISJ	6	11/54
Pocatello	KWIK-TV	10	3/54
Twin Falls	KLIX-TV	11	5/54
ILLINOIS			
Bloomington	WBLN	15	10/53
Danville	WDAN-TV	24	12/53
Harrisburg	WSIL-TV	22	11/53
Rockford	WREX-TV	13	Fall 53
Springfield	WICS	20	10/53
INDIANA			
Evansville	WFIE	62	10/53
Fort Wayne	WKJG-TV	33	11/53
Indianapolis	WJRE	26	10/53
Indianapolis	WNES	67	10/53
Princeton	WRAY-TV	52	10/53
Waterloo	WIN-T	15	11/53
IOWA			
Cedar Rapids	Cedar Rapids TV Co.	9	2/54
Des Moines	KGTV	17	Fall 53
Fort Dodge	KQTV	21	10/53
KANSAS			
Pittsburg	KOAM-TV	7	11/53
Topeka	WIBW-TV	13	11/53
LOUISIANA			
New Orleans	WCKG	26	Winter 53
New Orleans	WCNO-TV	32	1/54
New Orleans	WJMR-TV	61	11/53
MAINE			
Lewiston	WLAM-TV	17	12/53
Poland	WMTW	8	4/54
Portland	WCSH-TV	6	12/53
MARYLAND			
Baltimore	WITH-TV	60	1/54
Frederick	WFMD-TV	62	Winter 53
Salisbury	WBOC-TV	16	10/53
MASSACHUSETTS			
Boston*	WGBH-TV	2	10/54
Fall River	WSEE-TV	46	10/53
New Bedford	WNBH-TV	28	Fall 53
North Adams	WMGT	74	10/53
Northampton	WNOH	36	Spring 54
Pittsfield	WMGT	74	Fall 53
Springfield	WACE-TV	36	12/53
MICHIGAN			
Cadillac	WWTV	13	12/53
East Lansing*	WKAR-TV	60	1/54
Flint	WTAC	16	10/53
Jackson	WIBM-TV	48	12/53
Muskegon	WTVM	35	3/54
MINNESOTA			
St. Cloud	WJON-TV	7	10/53
St. Paul	WCOW-TV	17	11/53
MISSISSIPPI			
Gulfport	WGCM-TV	56	10/53
Jackson	WSLI-TV	12	1/54
MISSOURI			
Columbia	KOMU-TV	8	10/53
Festus	KACY	14	10/53
St. Louis*	KETC	9	1/54
St. Louis	KSTM-TV	36	10/53
St. Louis	WIL-TV	42	Late 53
Sedalia	KDRO-TV	6	1/54
MONTANA			
Billings	KOOK-TV	2	10/53
Missoula	KGVO-TV	13	7/54
NEBRASKA			
Kearney	KHOL-TV	13	11/53
NEW HAMPSHIRE			
Mt. Washington	WMTW	8	4/54
NEW JERSEY			
Asbury Park	WRTV	58	12/53
NEW YORK			
Albany	WROW-TV	41	11/53
Elmira	WECT	18	10/53
Ithaca	WHCU	20	12/53
Poughkeepsie	WEOK-TV	21	1/54
Rochester	WHEC-TV (Time Shared)	10	11/53
Rochester	WVET-TV (Time Shared)	10	11/53
NORTH CAROLINA			
Charlotte	WAYS-TV	36	11/53
Durham	WCIG-TV	46	11/53
Greenville	WNCT	9	10/53
Hendersonville	WHKP-TV	27	Early 54
Mount Airy	WPAQ-TV	55	10/53
Wilmington	WMFD-TV	6	Spring 54
Winston-Salem	WSJS-TV	12	Late 53
NORTH DAKOTA			
Bismark	KFYR-TV	5	11/53
Valley City	KXJB-TV	4	Early 54
OHIO			
Cleveland	WERE-TV	65	Fall 53
Lima	WIMA-TV	35	1/54
Massilon	WMAC-TV	23	10/53
Steubenville	WSTV-TV	9	11/53
OKLAHOMA			
Oklahoma City	KLPR-TV	19	10/53
Oklahoma City	KTVQ	25	10/53
Oklahoma City	KWTV	9	Late 53
Tulsa	KCEB	23	10/53
OREGON			
Eugene	Eugene TV Co.	13	10/53
Portland	KOIN-TV	6	10/53
Salem	KPIC	24	10/53
PENNSYLVANIA			
Harrisburg	WCMB-TV	27	12/53
Hazelton	WAZL-TV	63	12/53
Lancaster	WWLA	21	Late 53
Lebanon	WLBR-TV	15	10/53
Pittsburgh*	WQED	13	1/54
Pittsburgh	WTVQ	47	Fall 53
Scranton	WARM-TV	16	Fall 53
York	WNOW-TV	49	10/53
SOUTH CAROLINA			
Camden	WACA-TV	15	1/54
Columbia	WIS-TV	10	10/53
Spartanburg	WSCV	17	1/54
TENNESSEE			
Johnson City	WJHL-TV	11	10/53
Knoxville	WROL	6	10/53
Knoxville	WTSK	26	10/53
Nashville	WSIX-TV	8	11/53
Old Hickory	WLAC-TV	5	Early 54
TEXAS			
Dallas	KLIF-TV	29	4/54
El Paso	KEPO-TV	13	Fall 53
Galveston	KTVR	41	Fall 53
Lubbock	KFYO-TV	5	Late 53
Lufkin	KTRE-TV	9	Late 53
Midland	KMID-TV	2	11/53
Temple	KCEN-TV	6	10/53
Tyler	KETX	19	10/53
Waco	KANG-TV	34	10/53
Weslaco	KRGV	5	11/53
UTAH			
Salt Lake City	KUTV	2	Spring 54
VIRGINIA			
Danville	WBTM-TV	24	10/53
Newport News	WACH	33	10/53
WASHINGTON			
Seattle	KOMO-TV	4	12/53
WEST VIRGINIA			
Fairmont	WJPB	35	1/54
Wheeling	WLTV	51	10/53
Wheeling	WTRF-TV	7	10/53
WISCONSIN			
Eau Claire	WEAU-TV	13	11/53
Neenah	WNAM-TV	42	10/53
WYOMING			
Cheyenne	KFBC-TV	5	12/53
ALASKA			
Anchorage	KFIA	2	12/53
Fairbanks	KFIF	2	12/53
PUERTO RICO			
San Juan	WKAQ-TV	2	1954

* Non Commercial—Educational

Television News Bulletin

NETWORK CONNECTIONS

Further expansion of the Bell System's 8500-mile radio relay facilities have made available nationwide network service to 161 stations in the U. S.

COLOR TV

On Sept. 8, the FCC deadline for interested parties to file comments on the proposed standards for color TV, Dr. W. R. G. Baker, Chairman of the NTSC, submitted 52 lbs. of technical documents in support of the Committee's petition for adoption of the standards. FCC approval is expected within a few months.

Dr. Baker presents data to FCC Chairman Hyde

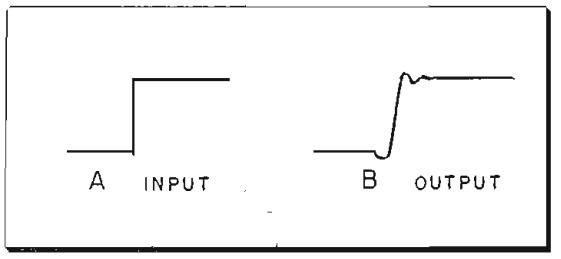


Fig. 1: Effect of limited frequency response on the waveshape of a step function input

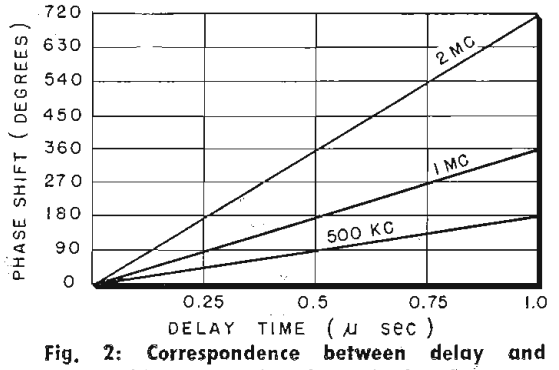


Fig. 2: Correspondence between delay and phase shift as a function of the frequency

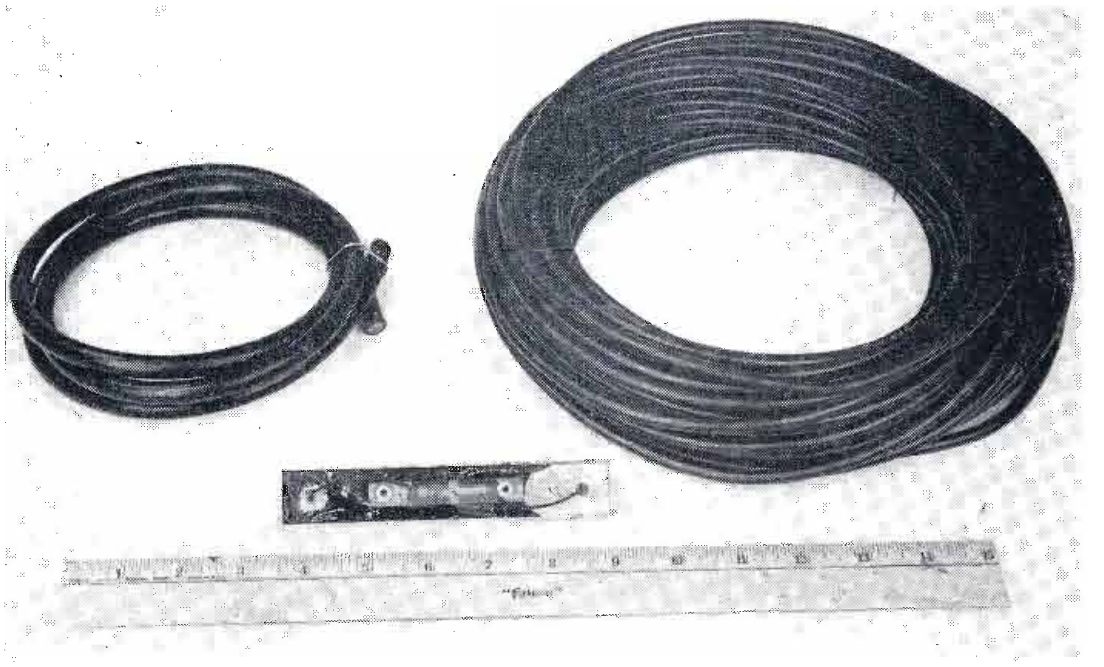


Fig. 3: Delay of 0.1 μsec by (l to r) coax delay cable, lumped constant line, and standard coax

Delay Lines for

Application of coaxial delay cables and lumped-ory circuits described. Devices also find use as com-

One prime application of delay line circuitry is in radar equipment. In this application, it provides a fixed-time differential between outgoing pulse and returning target echo, a differential which operates relatively independently from random noise pulses. The resultant noise pulses are reduced in amplitude and target echoes are reinforced.

The need for precise measurements of high-speed pulse phenomena has created still other uses for delay lines in the instrument field. Computers and electro-mechanical analyzers also take advantage of delay line theory. An obvious example is the use of delay lines in memory circuits.

In general, a delay line may be defined as a phase-shift device in which the relative change of phase is proportional to frequency. If sine waves are impressed upon the input, the resulting sine waves across the output terminals will exhibit phase shift.

Ideal Delay Line

If it were possible to have an ideal delay line, that is, one in which phase shift would be proportional to frequency for all frequencies from zero to infinity, and if there were no losses, any signal of any wave shape impressed across the input terminals would be identically reproduced across the output terminals. The output signal would occur at some time interval, T, after the input signal. If both input and output signals were plotted against time with the same zero time, the time interval from any point on the input signal to the corresponding point on the output signal would be a constant; and since this ideal line would have no losses, corresponding points on the input and output signals would be of equal amplitude.

In a practical delay line, some frequency exists beyond which phase shift is no longer proportional to frequency. With a delay line having a finite limit frequency (as have all practical lines), an input signal containing frequency components higher than the limit frequency will appear at the output terminal in a distorted manner. If the input signal contains no frequencies lower than the limit frequency, delay time for each frequency will be different, and the output signal will be badly distorted. Fig. 1 is a representation of the effect upon a step function (a signal in which the voltage level changes abruptly, and contains a number of frequencies higher than the limit frequency.) When this function is applied to the input terminals, the output signal will have a wave shape as shown in Fig. 1b. The damped oscillations are due to phase-shift nonlinearity of the higher frequency components in the step function.

Practically, we are not as interested in the phase characteristics of a delay line per se as we are in the actual time (expressed usually in microseconds) that a pulse will be delayed. We are still very much interested in the limit frequency, but the phase shift of any individual

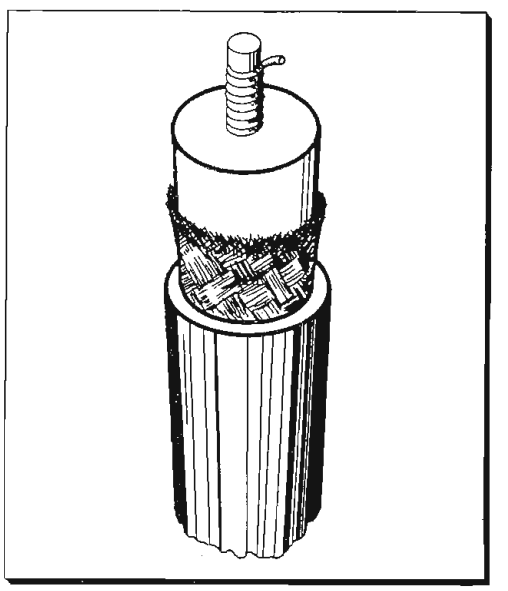
Cole

Murphy

By BYRON M. COLE
Chief Electronics Engr.
and MELVIN H. MURPHY
Project Leader

Brubaker Mfg. Co., Inc.,
9151 Exposition Drive
Los Angeles 34, Calif.

Fig. 4: Construction of coaxial delay cable



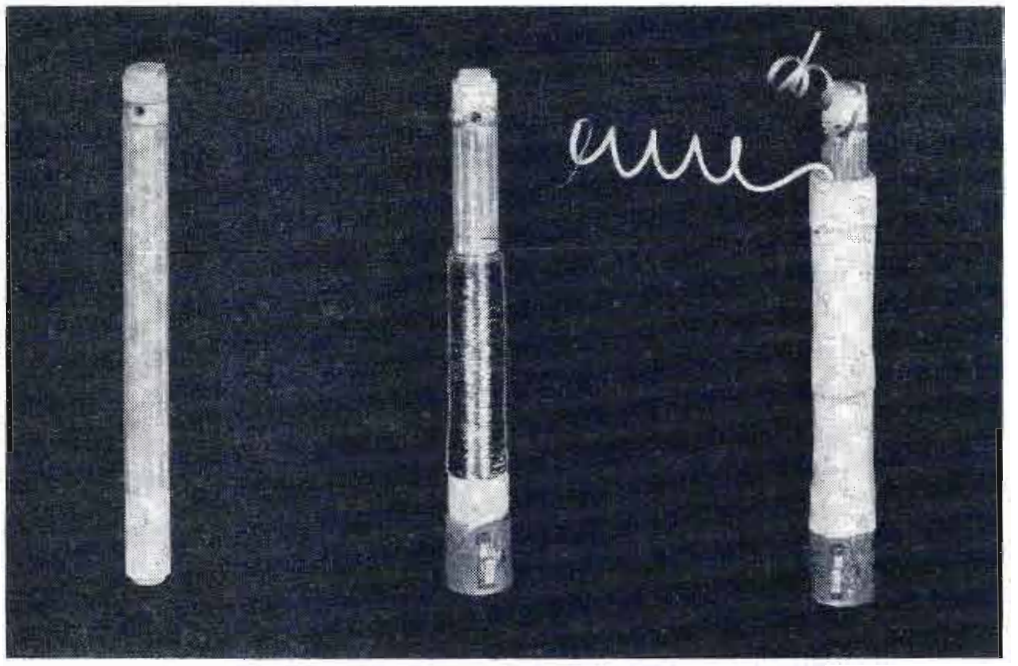


Fig. 5: Typical distributed constant delay line showing construction

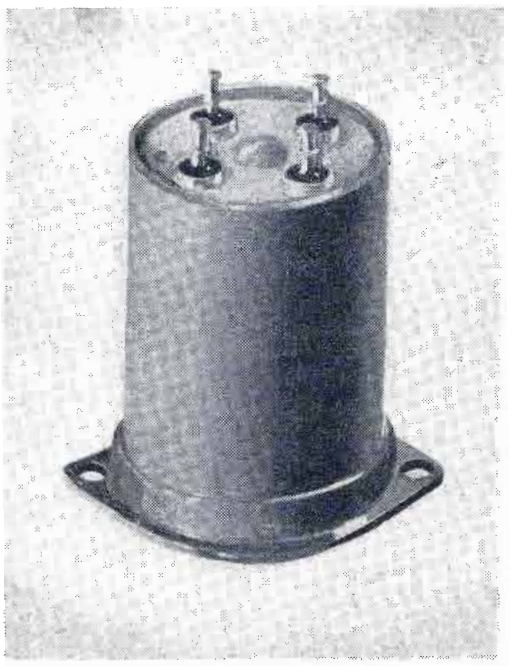


Fig. 6: Sealed lumped constant line

Radar and Computers

constant lines to pulse forming networks and mem- pensation in NTSC filters and oscilloscope set-ups

component frequency is rather difficult to work within a practical sense. Fig. 2 illustrates in a graphical form the correspondence between time delay in microseconds, and phase shift as a function of frequency. The curve for each frequency is plotted to show the linear relationship between phase shift and delay time. As indicated in the figure, a 1-MC sine wave delayed for 1 μsec is retarded in phase 360°. If, however, we use a 500-KC sine wave, a 1 μsec delay corresponds to only 180° at this frequency. Hence, in order to get perfect reproduction, the delay line must delay a 500-KC signal by 180°, a 1-MC sine wave by 360°, and a 2-MC sine wave by 720°. In each case the actual delay time is identical, but the amount of phase shift in degrees varies, because phase shift in itself is a function of frequency.

Types of Delay Lines

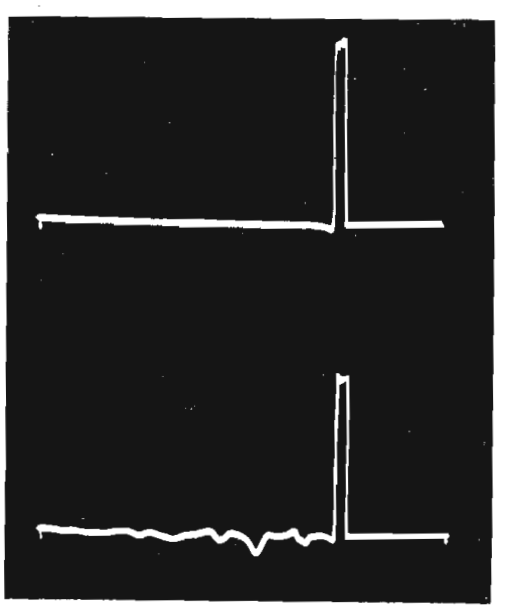
The simplest type of delay line is transmission line, an example of which is coaxial cable. RG-59/U, for instance, has a time delay of approximately 0.0015 μsec/ft. Thus, 1 μsec delay would require 650 feet of cable. The major difficulty in using transmission lines for delay purposes is the large physical size required for any appreciable time delay. In order to overcome this size problem, it is possible to construct artificial transmission lines which will give equivalent delay times in far smaller volumes. As a first step, it is possible to increase the delay of a coaxial-type cable by making the center conductor much longer than required. This is done by winding the center conductor coil-fashion about an insulated core, thus increasing the inductance, and hence, the delay, per foot of cable. One type of coaxial delay cable of this construction, RG-65/U, has a delay of 0.042 μsec/ft., so that 24 feet of cable are required per μsec of delay. Fig. 3 is a photograph showing normal coaxial cable RG-59/U compared to RG-65/U delay cable. Each cable has a delay of 0.1 μsec, as has the lumped-constant line also shown. Fig. 4 illustrates the construction of coaxial delay cable.

The so-called "distributed delay line" represents a second step toward a line of small volume. In this

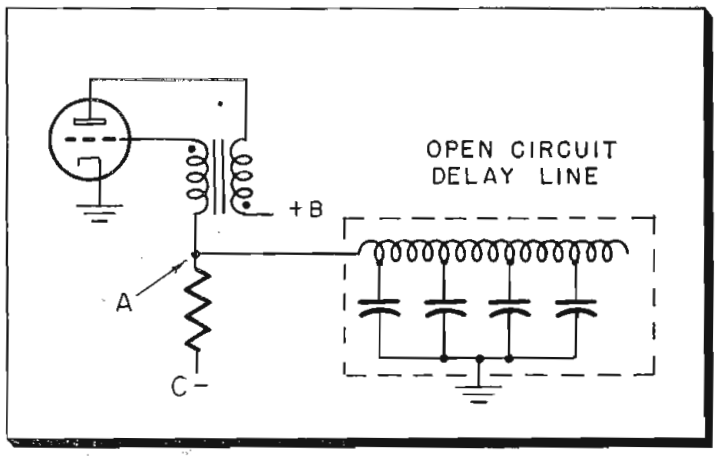
TABLE 1: COMPARISON of DELAY LINE CHARACTERISTICS

	Impedance range		Insertion loss per μs		Relative volume per unit delay
	from	to	from	to	
Coaxial delay cable	950Ω	2200Ω	3db	6db	large
Distributed delay line	800Ω	3000Ω	1db	3db	small
Lumped contant delay line	75Ω	1000Ω	0.5db	1.5db	medium to small

Fig. 7: Delay line input with no discontinuities (top) and with discontinuities (bottom)



DELAY LINES



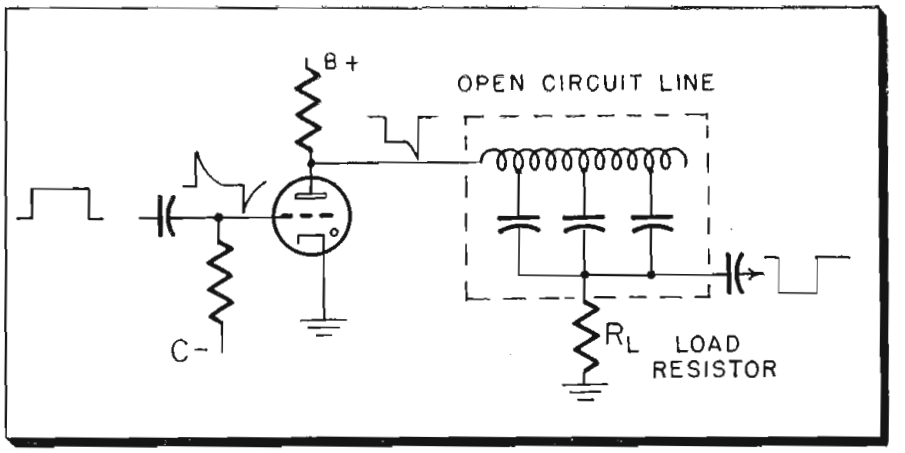


Fig. 8: (l) Open circuited delay line controlling pulse width of blocking oscillator. Fig. 9: (r) Delay line controlling gas tube generator pulse

type of line, the signal-carrying conductor is most often wound around a coil form on which silver strips have been plated. The equivalent capacitance of the coaxial cable is provided by grounding these strips. Some manufacturers use a phenolic coil form with a parallel wire grid similar to a Faraday Shield. A typical distributed delay line is shown in Fig. 5.

Lumped-Constant Line

The lumped-constant line is another type of delay line. A typical lumped-constant line is shown in Fig. 6. In this particular line, large delays are obtained by increasing the capacity to ground as well as increasing the inductance of the line. In delay-line cable, the capacitance per foot between the center conductor and the outer shell is substantially the same as in a coaxial cable transmission line. The additional delay is provided by the increased length of the inner conductor, the result of coiling. In lumped-constant lines, on the other hand, the conductor length is not increased, comparatively speaking, as much as the effective capacitance to ground.

Although coaxial transmission line is electrically a perfectly good delay network, its one major disadvantage, large volume per unit delay, usually rules it out in most applications.

Since coaxial delay cable is available in impedance ranges from approximately 950 to 2200 ohms, it is considered a high-impedance network. This type of delay line may be adjusted to a desired delay time by varying the length of the cable. The insertion loss, the loss caused by the attenuation factor of the line, is approximately 3 to 6 db μsec, depending upon the range of frequencies present. Although the volume per unit delay is much less than that of coaxial transmission lines, it is still rather large compared to distributed-and lumped-constant lines. Coaxial delay cable is often used with excellent results when a high-impedance network is required and the delay time is not exceedingly large. Delay lines up to 10 μ sec are not uncommon where the large insertion loss and physical size can be tolerated.

Distributed-constant lines are also considered to be high-impedance networks, ranging from 800 to 3000 ohms. Their major advantage is small volume per unit delay. The insertion loss of the distributed type line is approximately 1 to 3 db/μsec. A delay line of this type is rather difficult to adjust to precise delay values and it is almost impossible to cascade two or more sections of this type line without obtaining impedance discontinuity. Fig. 7 illustrates the effect of impedance discontinuity or mismatch between sections within a delay line.

Lumped-constant lines are considered low impedance networks, normally ranging from 75 to 1000 ohms. This type of line can be built with relatively small volume per unit delay. Insertion losses run lower than any other type of line and range from 0.5 to 1.5 db/μsec. The simple construction of lumped-constant lines permits adjustments to relatively precise delays with a minimum of impedance mismatch effects.

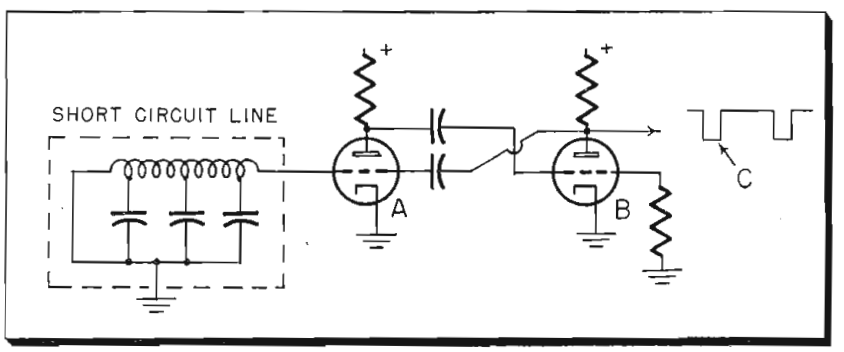
Table 1 tabulates some of the more important characteristics of the above type of delay line.

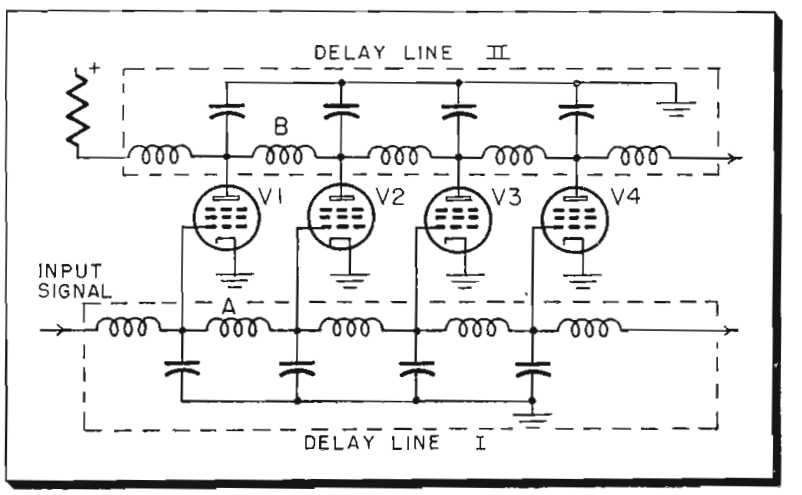
Effect Upon Rise Time

When using delay lines for pulse delay, one important characteristic of the line is its effect upon the rise time of the pulse, determined by its bandwidth. As in any type of video amplifier, the wider the bandwidth the faster the rise time of transmitted pulses. Engineers familiar with video amplifier circuits are continually faced with the problem of obtaining wideband amplification with high impedance loads. In general, as the bandwidth of the circuit is increased, the load im-

(*Continued on page* 148)

Fig. 10: (l) Multivibrator using delay line to control output width. Fig. 11: (r) Distributed amplifier

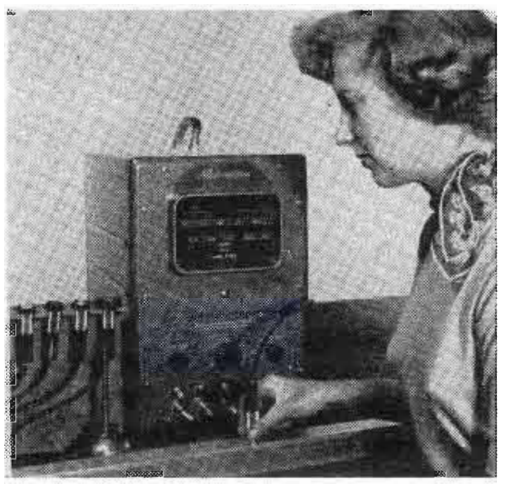




New Test & Measuring Equipment

ULTRASONIC METROSCOPE

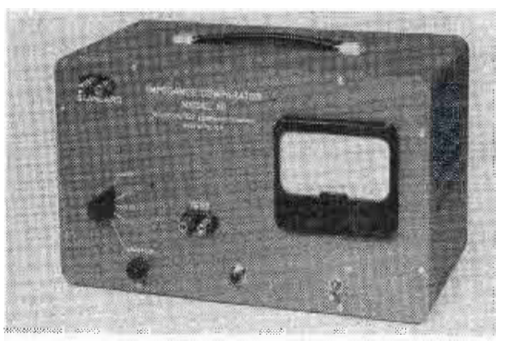
Model MS-101 metroscope, for the non-destructive measurement and test of metals and other materials, is an improvement on Model MS-101. The new instrument is useful for making tests or thickness measurements from one material side, as is required in forming or



fabricating propeller blades, cylinders, pipe, or other formed or drawn shapes. It also finds defects in laminations, clad metal bonds, switch contacts, bearing liners, and cutting tools, etc. **Photocon Research Products, 421 N. Foothill, Pasadena, Calif. Sole distributors, J. W. Dice Co., 1 Engle St., Englewood, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

IMPEDANCE COMPARATOR

Model 60 impedance comparator, designed to test resistors, capacitors, and inductors on the production line, reads the percentage of deviation of the component under test from a standard component on a large meter. Four ranges are provided: 1%, 5%, 10%, and 20% full scale. One simple linear scale serves all range. No zero adjustment is required and the range calibration is performed by a built-in standard. Necessity for push-button or relay operation is eliminated. Impedances can



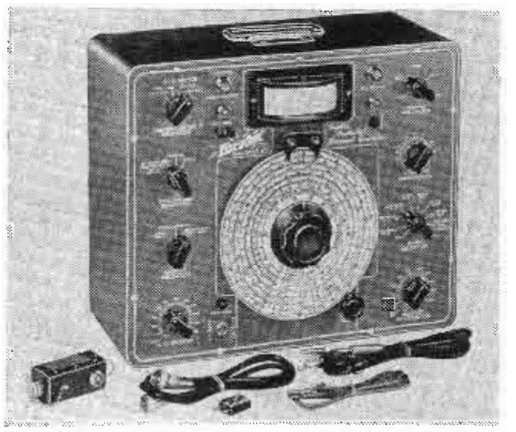
be compared from 1 ohm to 5 megohms at 60 cps. A built in regulator permits line voltage variations from 105-125 v., 60 cps. Dimensions are 9 x 15 x 8 in. **Industrial Test Equipment Co., 55 East 11th St., New York, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TRIPLE CHANNEL OSCILLOSCOPE

Three NTSC color signals are presented on the face of a single cathode ray tube-enabling instantaneous three-color comparison at a glance by model H33 triple-channel oscilloscope. Also, the tube design insures that the sweep time-base of the three color signals will be the same, which eliminates re-checking and simplifies monitoring. The unit employs independent wide-range vertical amplifiers and a common horizontal amplifier. The former have a frequency range from 10 cps to 4 MC± db with a deflection sensitivity of 0.10 v. per in. The latter has a response from 0 to 500 KC±db. The linear sweep generator is continuously variable from 0.02 secs. per in. to 2 μsecs per in. with a sweep lag of 0.1 μsecs. max. Trigger requirements are 0.5 to 50 v. peak for outside triggering; signal under deflection producing an 0.2 in. min. deflection for internal. **Electronic Tube Corp., 1200 E. Mermaid, Lane, Philadelphia 18, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SIGNAL GENERATOR

Model 292 XAL microvolt signal generator is announced as the only one of its kind to provide continuous coverage from 125 KC to 165 MC. on fundamen-

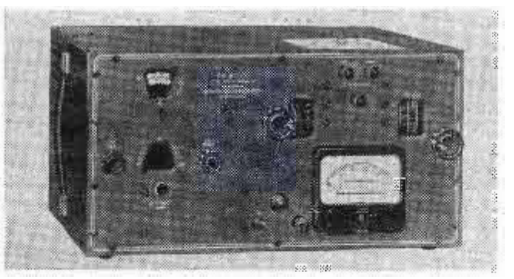


tals. The unit provides complete coverage of the aircraft band, including all the necessary i-f frequencies, and covers all r-f frequencies with calibrated output. It can be externally modulated from 15 to 10,000 cps, and measures both input and output of units under test. Its easy-to-read scale has a scale length of over 100 in. The unit is free from wave distortion and has no spurious signals in the output system. **The Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MORE NEW PRODUCTS
for the electronic industries
on the following pages

RX METER

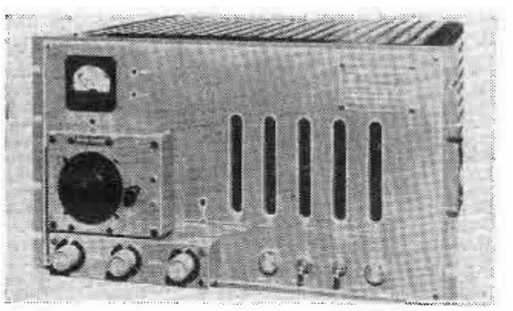
The 250-A RX meter comprises a continuously tuned, bridge and local oscillators, a modified Schoring bridge, an unbalance or i-f amplifier, and a null



indicator with automatic gain control. The instrument has a frequency coverage of 500 KC to 250 MC in eight ranges, a resistance range from 15 to 100,000 ohms, and a capacitance range of +20 μμf to minus 100 μμf. Resistances from 0 to 15 ohms can be determined by indirect means, and the capacitance range can be increased to 0 to 120 μμf by auxiliary resonating coils. The 28-in. resistance scale requires no reading corrections. The capacitance scale consists of a main dial calibrated in 10 μμf units and a vernier dial calibrated at 0.1 μμf intervals. **Boonton Radio Corp., Intervale Rd., Boonton, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

VARIABLE MASTER OSCILLATOR

Type 173 variable master oscillator provides a continuously variable r-f source with a stability of approx. 1 cycle per MC in the range of 2 to 4 MC. The unit requires no curves, interpolations, or calculations of any kind in use. Frequency is set to the desired value by the oscillator dial. The last 3 digits of the frequency pull into the pre-set switch value automatically and hold. The oscillator also provides a crystal-controlled beat frequency for use in single or diversity receiving systems to obtain stabilized BFO injection to the receivers. Also, an output is provided

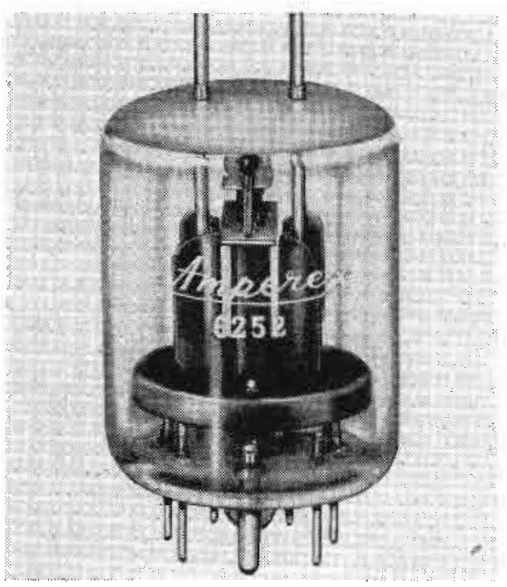


to make available 100 KC frequency for use as a secondary standard. The stability of this output is 1 part in 5 million over any 12-hour period. **Northern Radio Co., Inc. 147 West 22nd St., New York, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Technical Products for

TWIN TETRODE

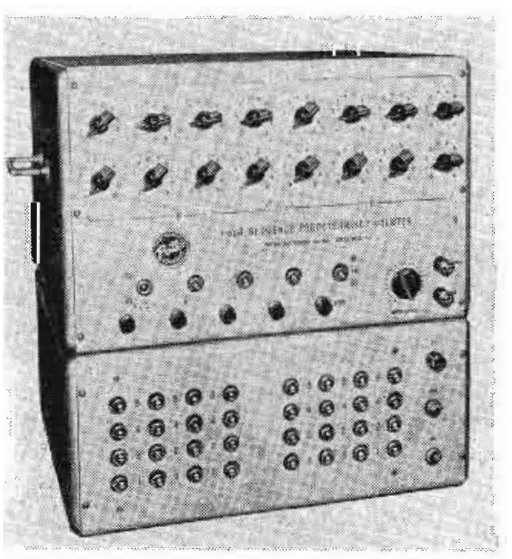
A new twin tetrode tube, type 6252, a lower power version of the Amperex 5894/AX9903, has a plate dissipation rating of 20 w. under ICAS conditions



and works efficiently with a power output of 12 w. at 600 MC. The new tube is said to be particularly suitable for low-drain mobile transmitters and multiplier chains. Only 3 in. in overall height, it is slightly less than 1¾ in. in max. diam. **Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

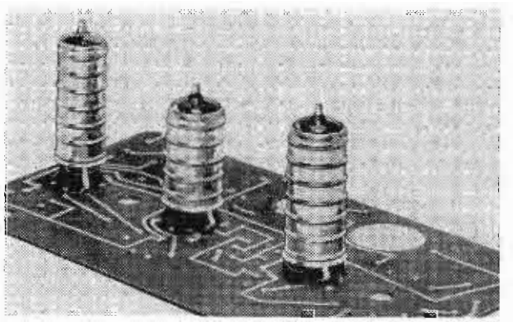
PREDETERMINED COUNTER

The new predetermined counter is designed for use wherever precise, multiple-sequence manufacturing is required in terms of lineal measurement, shaft revolutions, quantity, volume, or weight of operation speeds as high at 60,000 per min. Since the new true-count method (as against machine cycles referenced against time) is unaffected by speed-changes, shut-downs, etc., the new counter offers precise control not otherwise possible. The 4-sequence counter illustrated is one of a line available for one or more sequences. Each channel can be preset for any number from zero to 9,999. Switching through the four channels is automatic at the end of the preset count. Separate relay outputs for each channel provide a voltage pulse for each channel at the end of its count. **Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.



TUBE SHIELDING

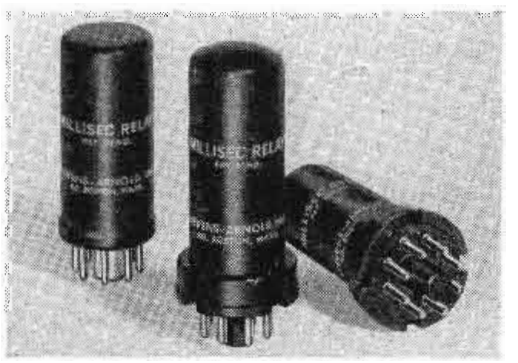
The "400 Series," is especially designed for shielding miniature tubes in printed circuits. A flared bottom passes the shield over the ground lug



of the printed socket and holds the shield in place to assure contact between shield and ground. The unit minimizes vibration, provides cooler operation, and presents a neater appearance. **The Staver Co., Inc., 41-51 North Saxon Ave., Bay Shore, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

RELAYS

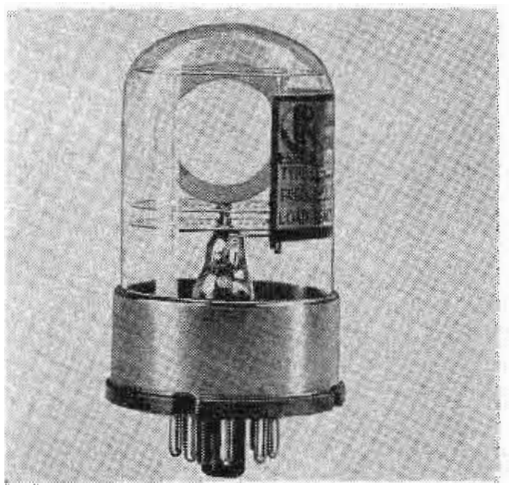
"Millisec" relays are now available with a choice between gold contacts and platinum-rhodium contacts. Gold to cover the range 0-¼ amp. at 0-110 v. dc; platinum-rhodium to cover the range 0-½ amp. at 10-110 v. dc. The units are designed for ultra-high speeds



up to 200 μsecs and are available in two general types: one for military use at —65° C. to + 85° C., the other for the ambient temperature range 0° C. to 43° C. **Stevens-Arnold, Inc., 22 Elkins St., South Boston 27, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

STABILIZED CRYSTAL

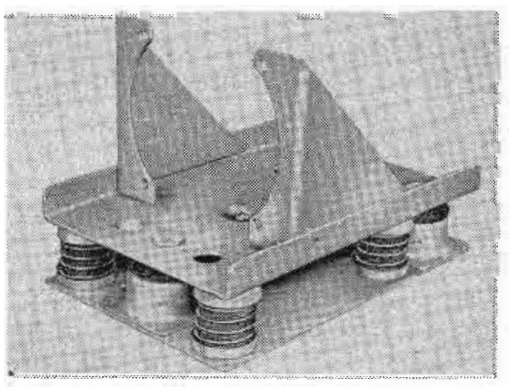
The JK G-12 stabilized crystal will handle applications in the "difficult" 500 kc to 1,500 kc range. Electrodes are deposited directly on the large, pre-



cision-made, quartz plate and shock-mounted in an evacuated glass envelope. Crystal can be designed for a min. temperature coefficient from 0° C. to 50° C.; or, for temperature-controlled operation at 60° C. with a JKO7E-115 v. oven. The JK G-12 is 2¾ in. high above the chassis and has a max. octal base diam. of 1¾ in. **James Knights Co., Sandwich, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CUSHION MOUNTING UNIT

Model 980-1 single stage mount incorporates an all-metal fabricated cushioning material which provides permanent protection against vibration

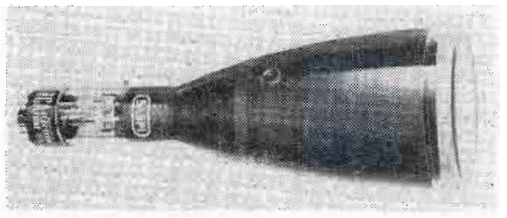


and shock of cylindrical instruments, such as sensitive aircraft air speed indicators. It is said that this type of engineered mounting system is being used to produce maximum flight stability during flight maneuvers and hard landings; and that use, in many instances, permits airborne instruments to be "de-ruggedized" and lightened to reduce overall aircraft weight. **Robinson Aviation, Inc., Teterboro, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

the ELECTRONIC INDUSTRIES

OSCILLOGRAPH TUBES

A new series of 5-inch, flat-face, cathode ray tubes utilize electrostatic focus and deflection and post-deflection acceleration. These RCA 5ABP types



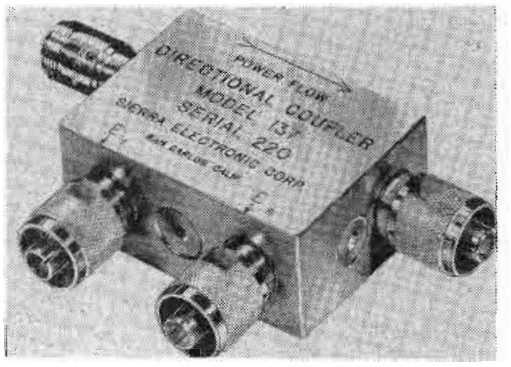
differ only in the spectral-energy emission and persistence characteristics of their respective phosphors, P1, P7, and P11. The pair of electrodes provided for vertical deflection have exceptionally high sensitivity and low capacitance which suits them especially for operation from wide band amplifiers. The pair of horizontal deflection electrodes has higher sensitivity than similar previous types, but retains full-screen scan. The small size and brilliance of the fluorescent spot make it possible to "see" more, even with high-speed phenomena. **Tube Dept., Radio Corporation of America, Harrison, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RELAY

A new series of relays, covered by file 8200, will close several circuits on the application of dc voltage. The case of the contact housing, mounted above the actuator, and the rotor carrying the contacts, are made from glass-reinforced alkyd plastic which provides high impact strength over a wide temperature range. The relays are made with four normally-open, double-break bridging-type contacts, one or two of which can be supplied for heavy current ratings up to 150 amps., 28 v. dc. The others are rated at 25 amps., 115 v. ac. High current contacts are designed for heavy inrush currents present in starting dc rotating equipment rated at 1,500 to 2,500 va. Construction is such that the relays permit switching full load currents at altitudes of 65,000 ft., function at 30 G vibration up to 500 cps., and in ambient temperatures from −65° C. to 165° C. **Price Electric Corp., Frederick, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DIRECTIONAL COUPLERS

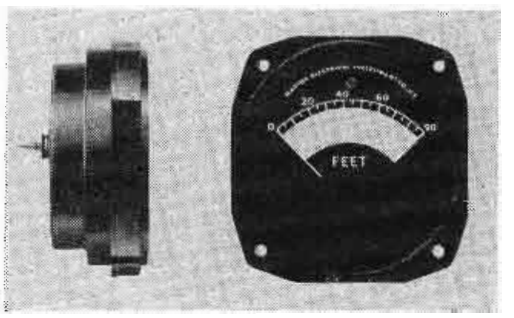
Four new wideband directional couplers, models 137 and 138 for 51.5 ohm coaxial line with coupling factors of 70 to 35 db and 59 to 24 db, respec-



tively, Models 137A and 138A for 50 ohm cable, but otherwise identical, are designed for power, impedance, or match measurements between 30 and 1500 megacycles. All are built in solid anodized duraluminum blocks with type N fittings. **Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PANEL INSTRUMENT

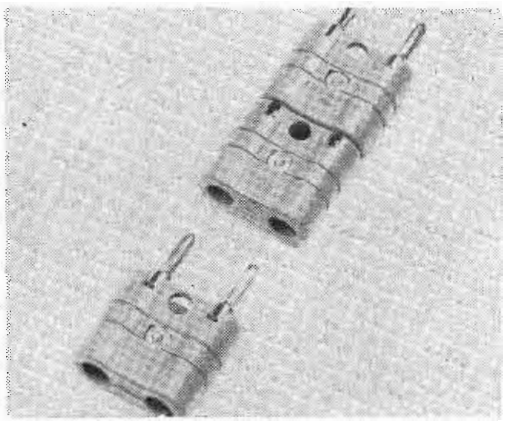
The model AN3 panel instrument, single-element type, is completely ruggedized in accordance with MIL-M-



10304, including internal shock-mounting, and meets Army-Navy Aeronautical Design Standard AND 10401 for 2¾ in. dial instruments. In addition to enclosing a Marion ruggedized D'Arsonval movement, the unit is hermetically sealed—single-seal, glass-to-metal. **Marion Electrical Instrument Co., Manchester, N.H.**—TELE-TECH & ELECTRONIC INDUSTRIES.

BANANA PLUG

The FWT banana plug, molded of mica-filled bakelite in accordance with JAN specifications, is designed for easy gripping. Leads can be brought directly



from the base of the prongs, or through a hole at the bottom of the plug. The top of the plug can accept additional plugs. All contacts and screws are made of nickel plated brass. **Components Div., National Co., Inc., 61 Sherman St., Malden, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MAGNETIC AMPLIFIERS

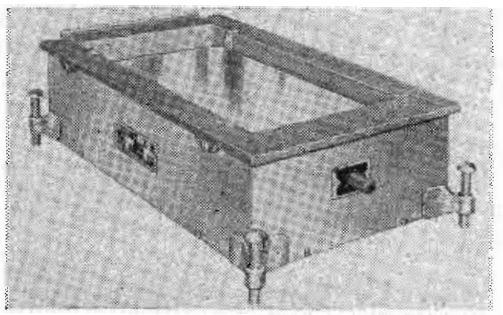
Several high performance magnetic amplifiers have been developed for standard 400 cps servo motors. The units employ no rectifiers, and are designed to meet high temperature requirements. Output wave is sinosoidal, 400 cps ac, phase-reversing, corresponding to the input, the signal of which can be ac or dc. All models are controlled by a 12AU7 type tube which serves as a demodulator for ac input signals also. Model No. MA-3.5-400 delivers 3.5 w., 115 v. Frequency response is from 0 to 55 cps. Housing is a GP-4 deep-drawn steel with a 7 pin header. Weight is 12 oz. No. MA-15-400, with similar specifications, is rated for 15 w. output. No. MA-40-400 is a 40 w.

unit that delivers 220 v. and has a frequency response from 0 to 10 cps. Housed in a MIL-T-27 HA can with a 7 pin phenolic header, the unit weighs 4 lbs. 2 oz. **Magnetic Research Corp., 318 Kansas St., El Segundo, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Laboratory & Plant Equipment

PC SOLDER POT

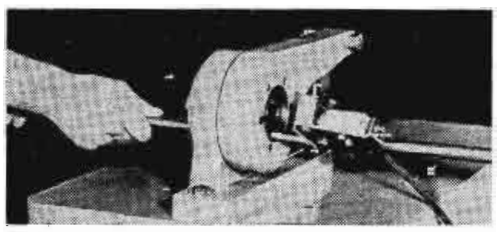
Model 88 solder pot is designed specifically for printed circuit work. A plated copper panel prevents the alloying action of solder, and acts as a



thermal condenser to discharge heat into chilled areas. Immersed 5/8 in. below the solder surface, the panel also distributes heat within the 10¾ x 5½ in. controlled area. A thermostat, coupled to the panel, operates the heating element corresponding to the temperature variations. Uncontrolled heating elements are affixed to the crucible to provide minimum operating temperatures. Surface temperature is precise. Temperature range is from 300° to 600° F. Power: 110 v. ac, 800 w. The pot has a detachable dross receptacle. **Dee Electric Co., 1101 N. Paulina St., Chicago 22, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CUTTING GAUGE

The Micro-matic gauge enables more than 9,000 cuts per hr. to be made in bar stock with the Di-Acro Power Rod Parter. The operator sets the gauge for the desired length, then inserts the



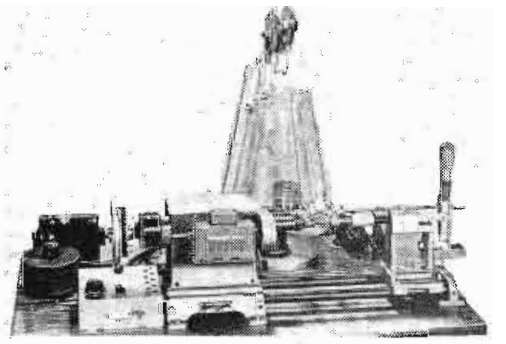
material through one of ten holes which accomodate stock from 1/16 in. to 5/8 in. in diameter, and pushes it flush against the gauge. The contact thus made is relayed to a solenoid which trips off the cutting action and allows the cut length to be ejected. **O'Neil-Irwin Manufacturing Co., 624 Eigth Ave., Lake City, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

HARD WIRE PLIER

Developed to cut tungsten filaments, and hard wire, the No. 053-L plier operates on a shearing principle that eliminates need for regular cutting knives. No adjustment or sharpening is required—even if the tool is accidentally nicked. **Mathias Klein & Sons, 32000 Belmont Ave., Chicago 18, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

AUTOMATIC WINDER

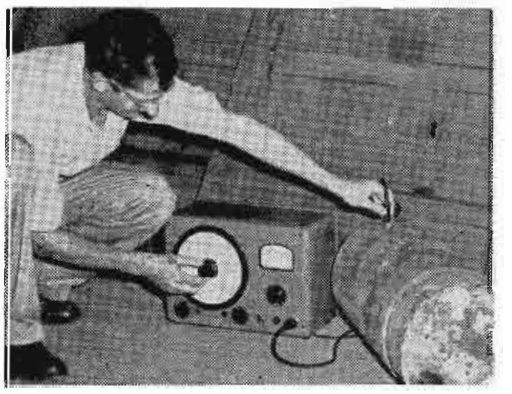
An improved universal winder, Model 121-AM, automatically winds from the rear to provide easier access to the coil. A positive stop magnetic brake makes the loss of coils impossible and the operator's attention unnecessary during the winding cycle. An automatic counter resets the cycle by the touch of a lever. The equipment winds self-supporting, lattice-wound, universal coils and r-f chokes, single or Pi-wound. More than two universal coils can be wound simultaneously. A new yoke winds coil sizes up to 1⅛ in. wide and 3 in. O.D. Cam sizes range from 1/32 in. to 1.0 in. in 1/64 in. steps. Gears range from 20 to 100 teeth. The motor equipment con-



sists of a ¼ H.P. ac-dc, 5000 rpm variable-speed motor and a foot-operated speed control for 115 v. operation. **Geo. Stevens Mfg. Co., Pulaski Rd. At Peterson, Chicago 30, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CONDUCTIVITY METER

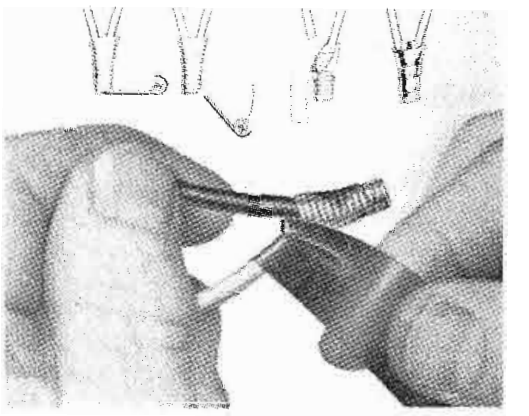
Conductivity measurements are made quickly by the Magnatest FM-100. The unit eliminates need for wire-like samples or parts cross-sectioning. To obtain absolute conductivity measurements, the operator merely places a simple hand probe on the part under test and reads the dial. All that is necessary is a relatively flat probe area about 3/8 in. in diam. Other than indent hardness tests and the process and quality control of heat treatments, small samples can be drawn and quenched and the unit can be used to control the melt purity of non-ferrous metals and



alloys. The FM-100 is portable and operates from any 110-120 v. ac supply. **Magnaflux Corp., 7300 West Lawrence Ave., Chicago 31, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

WIRE SPLICE

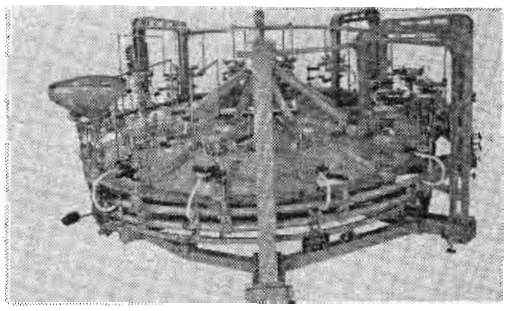
"Scotchlok" electrical spring connectors and "Scotch" plastic electrical tape No. 33 facilitates the rapid splicing of two electrical wires into a safely-insulated, compact connection. The con-



ical, spring-steel, spiral connector is thrust over the two wire ends, as shown, and twisted by the terminating winding stem. Spring tension holds the wire ends tight and the winding stem is snapped off. The electrical tape is started on the connector and brought forward between the wires to seal its bell end. Then, wrapped around the connector until it extends ½ in. beyond the small end of the connector, the tape is folded back and further wound toward the bell end. **Minnesota Mining & Mfg. Co., St. Paul 6, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CRT SEALER

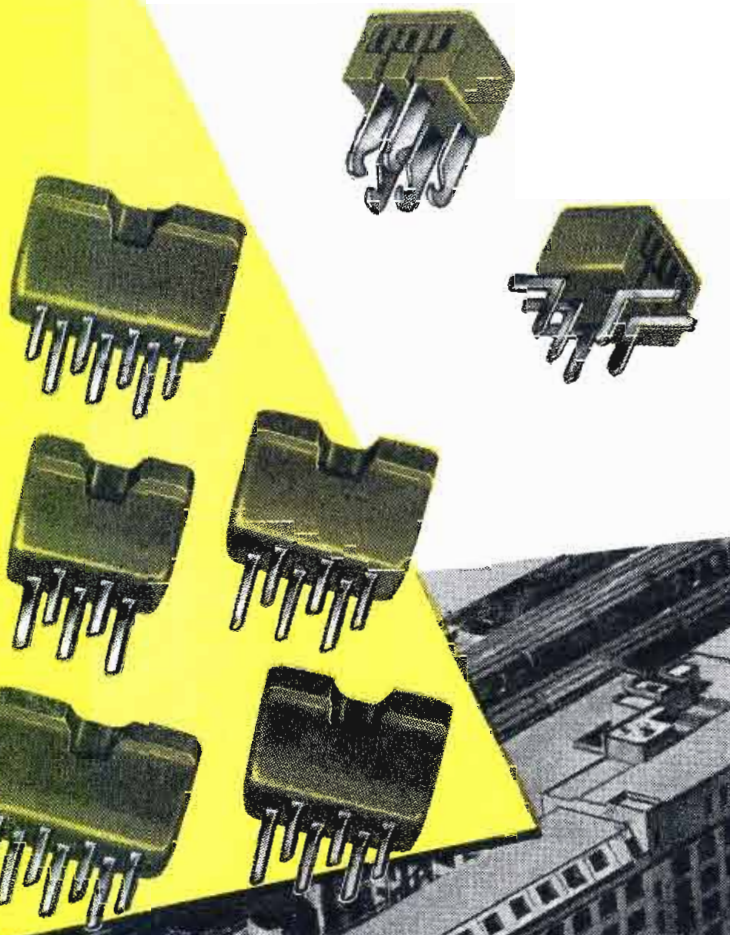
Possibly the largest cathode ray tube sealing machine built by the industry to the present time is the 14-ft. diameter, 16 head indexing machine shown. The equipment takes all tube sizes up to 27 in. in diameter or diagonal with all heads filled. Production on 27-in. tubes is approx. 140 per hour. The head speed

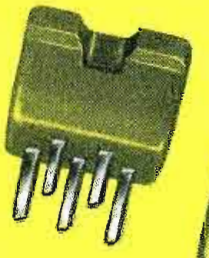


remains constant in operation, even when indexing. Dual-motor driven, heads and indexing, mechanisms operate independently, and the mount rods raise and lower independently of each other. The electrical stem preheater is synchronously driven by the machine. No mechanical change is required when tube types are changed. **Kahle Engineering Co., 1307 7th St., North Bergin, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

QUANTITY PRODUCTION OF LOW LOSS MICA COMPONENTS...*QUICKLY*

. . . exclusively a CINCH feature, and a factor in the choice of CINCH electronic components as STANDARD. CINCH constantly demonstrates ability to hold tolerances on Mica moldings . . . to mold high dielectric powders, and Mica . . . to meet the most exacting requirements in small metal plastic assemblies for components of higher quality materials held to closer tolerances.





SUB-MINIATURE SOCKETS SHOWN ENLARGED TWICE

CINCH components are available at leading jobbers — *everywhere*

The CINCH sub-miniature socket insures positive electrical contact, holds tubes securely in place, permits easy maintenance and replacement, yields maximum insulation resistance and minimum high frequency loss. And provides manufacturers of electrical controls, transmitters, receivers, trans-ceivers, airbourne equipment, etc., and hearing aids . . . a labor saving chassis installation which serves terminal board functions while permitting designers to obtain maximum space afforded by the standard flat base tubes. For mounting perpendicular tubes, retainer rings and saddles are available, when socket cannot be staked. Contacts silver plated beryllium copper.

Sockets are available in quantities because of CINCH'S extensive and modern molding facilities for mica filled low loss bakelite.

For the Standard sub-miniature socket in *quantity, quickly,*

CONSULT CINCH

CINCH MANUFACTURING CORPORATION

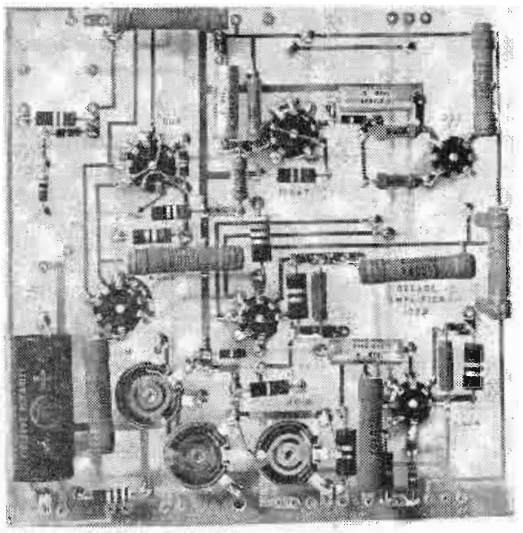
1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

New Electronic Equipment

DECADE AMPLIFIER

The Model 102B decade amplifier is a general purpose pre-amplifier with stabilized gains of 40 db and 60 db, and max. gain of approx. 80 db. An input cathode follower and compensating at-



tenuator are not used; the system switches amplifier gain. And, there is no dependence on compensating capacitors. Feedback on 40 and 60 db range is in excess of 20 db. Gain on 80 db range is between 79 and 82 db. Max output is 50 v. RMS into 20 k ohms or higher load; 40 v. RMS into 5 k ohms load; 10 ma RMS current into low impedance. Power requirements are 105 to 125 v., 60 cps, 75 watts. **Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

DC AMPLIFIER

The Model 220 wideband dc amplifier is designed to increase the sensitivity of cathode-ray oscilloscopes with extended lf response, and extend the range of vacuum tube voltmeters, frequency analyzers, etc. The new amplifier obtains good stability and low drift by push-pull amplification and a cross-coupled circuit. The unit acts as a differential amplifier when two different signals are applied. The difference appears push-pull at the output terminals. dc terminals connect directly with the input attenuators; ac terminals connect

through coupling capacitors to the DC input posts. Maximum amplifier gain is adjusted to approx. 100. The input attenuators reduce this gain to approx. 10 and 1 (40,20,0 db). **Furst Electronics, 3322 W. Lawrence Ave., Chicago 20, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

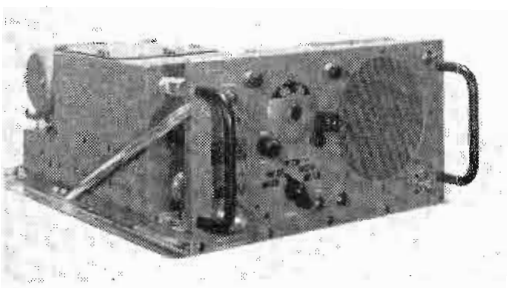
FM XMTR-RECEIVER

The new "Multi-Master" FM transmitter-receiver is complete with controls, associated power supply, antenna, and microphone in a single housing. Designed for 152-174 MC band single or dual channel operation, the portable unit can be used either as mobile or fixed station equipment. The MRT-6 is available in 2 to 60 watt rf output and for ac or dc operation from any of the following power sources: 6, 12, and 64 v. dc, or 117 v. ac. These models pro-

vide a choice among 2, 10, 25, or 35 watt r-f outputs for either ac or dc. The 60 watt r-f output is available for ac only. **Bendix Radio, Div. Bendix Aviation Corp., Baltimore 4, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES.

AIR-GROUND RADIO

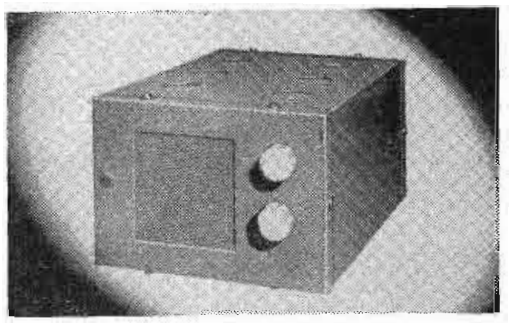
The Type 12, VHF 118-148 MC, 2-way ground-air communicator, born of Korean military experience, consists of



the A.R.C. R-19 VHF receiver and either a T-11B or a T-13A transmitter; all widely used units in Army, Navy, and Air Force light aircraft and helicopters. With aircraft between 3,000 and 10,000 ft. and the ground antenna at 30 ft. the distance range is 50 to 100 miles. Receiver input power is 3 amps, 24-28 v. dc. Transmitter power is 3 amps, 24-28 v. dc. The unit is equipped with a sectionalized, vertical antenna microphone, headset, and speaker. **Aircraft Radio Corp., Boonton, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FM RECEIVER

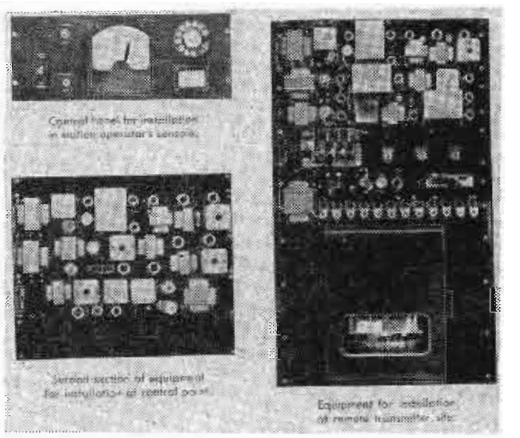
Model FMC1-L receiver is a new crystal-controlled, fixed-frequency unit for frequencies between 30 and 50 MC.



It replaces Model No. M-51, a tunable mobile unit for 6 and 12 v. power sources. Sensitivity is better than 1 μv. and a narrow band width is provided to assure max. performance. It is designed for municipal departments, industry, and power utilities where there is need to supplement existing two-way communication systems with inexpensive units. **Radio Apparatus Corp., 55 N. New Jersey St., Indianapolis, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES.

XMTR REMOTE CONTROL

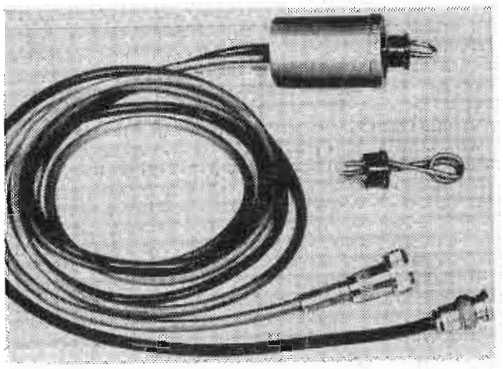
A control system for unattended broadcast transmitters has been designed and built in accordance with the



recently announced FCC regulation. The system consists of three separate sections: a control panel for installation at the operator's control panel, comprising a telemeter indicator, a dial telephone, and other controls; equipment installed at the control point, consisting of a number of audi-frequency tone transmitters and receivers; and, equipment installed at the remote broadcast transmitter, consisting of audio-frequency tone generators, selective amplifiers, telemetering, transmitter, the control selector, and alarm keying mechanism. The system is for use with unattended transmitters. **Hammarlund Mfg. Co., 460 West 34th St., New York 1, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RESONANCE INDICATOR

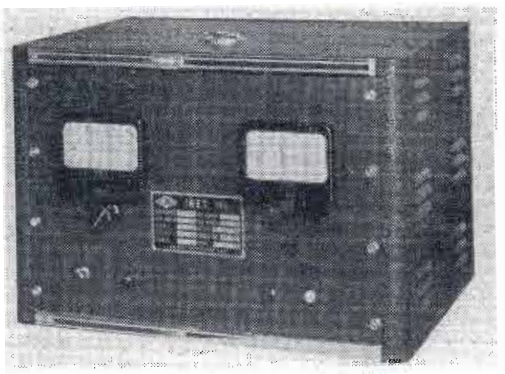
Model 60 resonance indicator is a new type of measuring instrument that is intended to correct the major deficiencies in current commercial grid meters. The



unit measures the parallel-resonant frequency of circuits from below 10 MC to above 1,000 MC. Signal generators and a microammeter are used as accessories. The resonant frequency can be measured to the accuracy of the frequency calibration of the associated signal source. With laboratory-type signal generators, an accuracy of ½% can be achieved. Dimensions are 1-½ in. dia. x 2-¼ in. long; exclusive of the two lengths of connecting cable and the four probes used to cover the range from 10 to 1,000 mcs. **Dynamic Electronics—New York, Inc., 73-39 Woodhaven Blvd., Brooklyn 27, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

SELENIUM RECTIFIER

A new type of high-performance ac to dc regulated selenium rectifier, with magnetic amplifier control, provides closely-regulated dc power for a variety



of electronic and electrical applications that require a dc source. Regulation is better than ±1% from no load to full load with ±10% ac line variation. Response is faster than 0.2 sec. under extreme load conditions. Ripple is less than 1% R.M.S. DC output ratings: 1.2 to 30.0 vdc and 2.5 to 40.0 amps. full load. AC input: 115 v., single-phase, 60 cps. All static components eliminate expendable elements, such as vacuum tubes or other moving parts. **Inet, Inc., 8655 South Main St., Los Angeles 3, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New — Semiconductor Devices

GERMANIUM DIODE

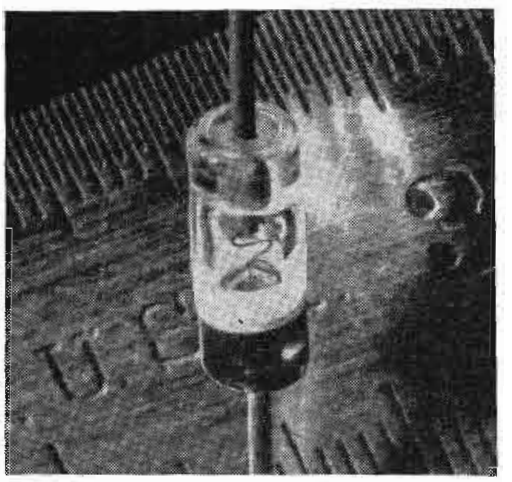
The rectifying action of the N. U. Union diode is performed by a small-area junction rather than by a point contact. The electrical junction connections, being rigid, do not depend on the surrounding structure to maintain contact. As the junction area is much smaller than the corresponding area designed for power rectification, the unit exhibits rapid switching action and good hf characteristics. The protective plastic capsule is molded and thermoset after the diode is fabricated. Shape indicates polarity, and the RTMA color code system designates the type. Flexible leads enable circuit connection by soldering or other means.—**National Union Radio Corp., Hatboro, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

SWITCHING TRANSISTOR

Hermetically sealed Type T-1 transistor is designed for switching circuits with large signals (over 1 ma). Maximum ratings are: $V_c = -50$ v, $V_e = -30$ v, $P_c = 80$mw, and $P_e = 25$ mw. Body dimensions are 0.187 x 0.337 x 0.285 in. Also available is the Type T-2 for use in circuits where a moderate power gain is desired. **Hydroaire, Inc., Burbank, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DIODES

Eight new high-conductance germanium diodes are said to possess all the advantages of regular subminiature types and pass forward current minima of 10 ma. and 20 ma. at +1 v. The new



types provide combinations of high peak inverse voltage, high back resistance, and low forward resistance. Glass-to-metal seals prevent "creep" of the supporting metal parts. No solder is used in the structure. Component softening below 300° C. has been avoided. As the glass expands, the whisker expands a like amount to maintain constant pressure at the rectifying contact. Each unit is temperature cycled and then tested to assure that the operating temperature is limited only by the characteristics of the germanium itself. The glass enclosures of these moisture proof units is approx. ¼ in. long and less than ⅛ in. in diam. **Semiconductor Sales Dept., Hughes Aircraft Co., Culver City, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

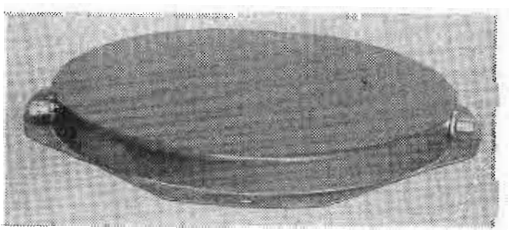
TRANSISTORS

Type TI Nos. 200 and 201 germanium, hermetically-sealed, n-p-n junction transistors are triode units designed for high-gain, low-level audio applications. The electrical insulating coat of the metal case prevents shorting circuit components. Case and leads are separated by a glass-to-metal seal. The base has three "in line" leads that are 1.5 in. long and 0.017 in. in diam. Base max. dimensions are 0.450 x 0.235 x 0.415 in. Average characteristics: collector voltage, 5 v.; emitter current, 1 ma; base resistance, 150 ohms; emitter resistance, 30 ohms; collector cut-off current, 10 μa; collector capacitance 12 μμfd; noise factor, 22 db; min. collector resistance, No. 200, 0.2 megohms, No. 201, 0.4 megohms; min. current amplification factor, No. 200, 0.90, No. 201, 0.95. **Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New — Delay Lines

SOLID DELAY LINES

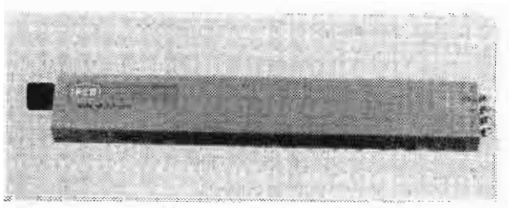
LFE fuzed-quartz, solid delay lines are now available for video integration, computer, and time marker applications. The units can provide 1—3,000 μsecs delay time with a high degree of ac-



curacy. Frequency range specifications are 5-100 MC. Spurious response is up to 60 db. below the desired signal. **Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DELAY LINES

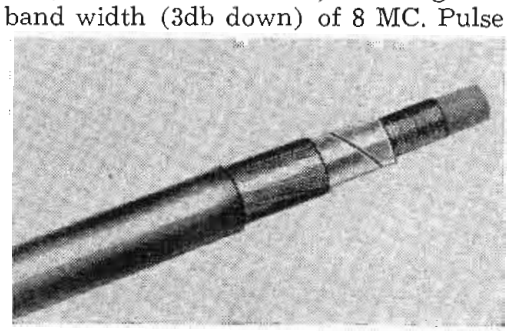
The first of a series of continuously variable, distributed, constant delay lines are designed to provide a continuously variable time delay of 0 to 0.5 μsecs with a rise time as low as 0.05 μsecs at full delay. Now available are internally-terminated delay lines of 500



ohms nominal characteristic impedance. Lines with impedance up to 1500 ohms can be supplied on special order. The lines measure 7½ x 1¼ x ½ in.—**PCA Electronics, Inc., 2180 Colorado Ave., Santa Monica, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DELAY CABLE

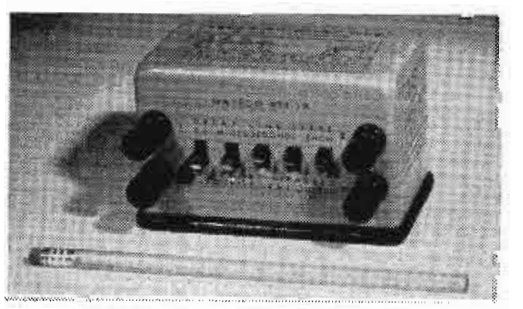
The flexible, Type HH-2500 delay cable is built around a low-loss magnetic core. Attenuation for a delay of one μsec. is 0.6 db at 1 MC, 1.3 db at 4 MC, and 2.2 db at 6 MC, resulting in a band width (3db down) of 8 MC. Pulse



rise time is 0.06 for a delay of one μsec. **Columbia Technical Corp., 5 East 57th St., New York 5, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PRECISION DELAY LINE

This lumped-constant type laboratory delay line is variable in additive increments of 0.02 μsecs. With a total maximum delay of 1.0 μsecs measured at ½ amplitude with a rise time of 0.05 μsecs

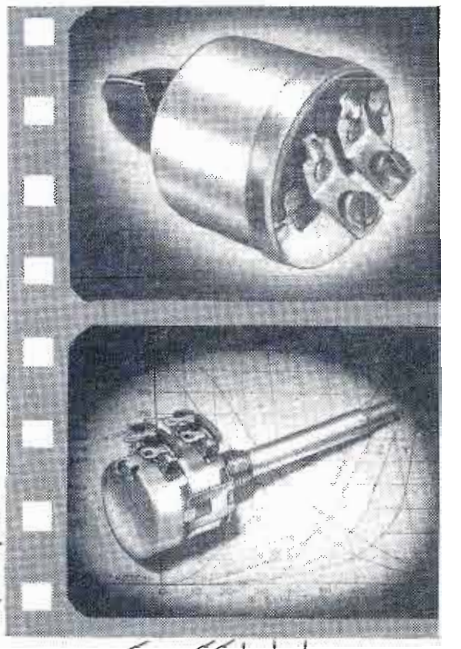


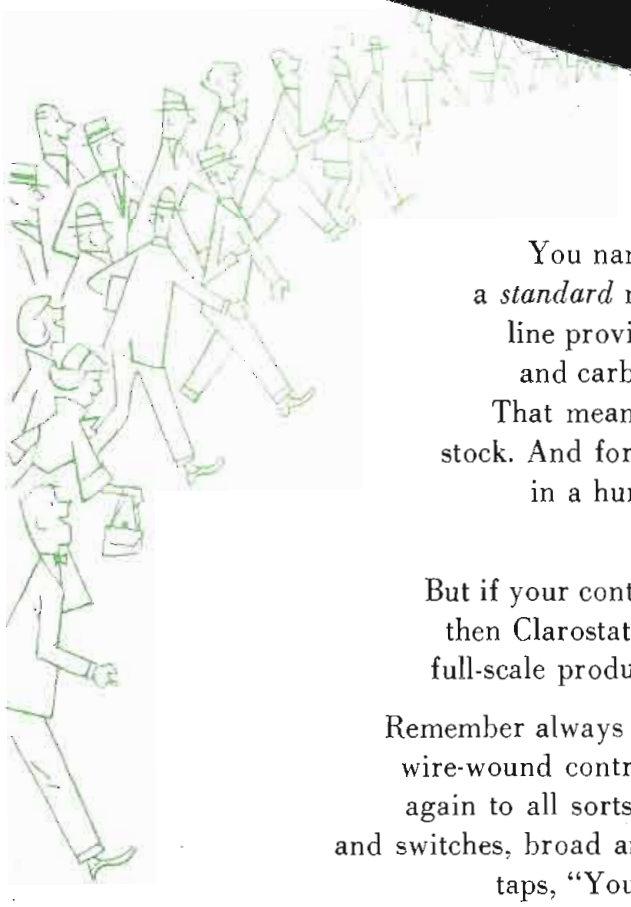
at 10% and 90% amplitude, the characteristic impedance is 50 ohms and the maximum peak voltage is 500. The unit is so constructed that each switch controls a step of 20 coils and 20 capacitors (1% mica). Overall dimensions are 2½ x 3 x 4½ in.—**May Engineering Co., 6055 Lankershim Blvd., N. Hollywood, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

when the circuit reads

come to

WIRE-WOUND and CARBON CONTROL HEADQUARTERS

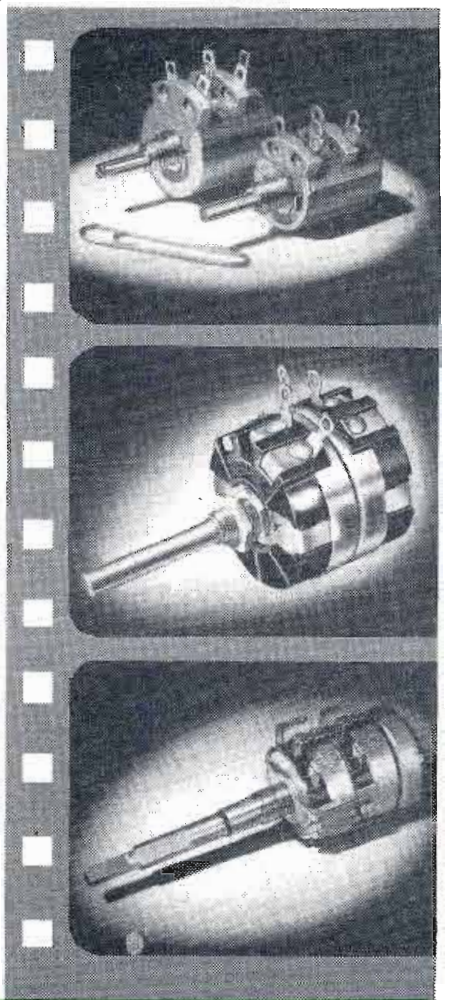




You name it — we supply it. Most likely it's a *standard* number, for Clarostat's outstanding line provides the widest range of wire-wound and carbon controls in meeting usual needs. That means immediate delivery from factory stock. And for single pieces or small lots, wanted in a hurry, your local Clarostat distributor carries a representative inventory.

But if your control requirements are extraordinary, then Clarostat can design, tool-up and swing into full-scale production on your *specials*, in jig time.

Remember always that, from miniaturized carbon and wire-wound controls, to standard-sized controls, and again to all sorts of single and tandem units, shafts and switches, broad and tight tolerances, any tapers and taps, "You Can Stand Pat with Clarostat" for your simple or difficult control needs.



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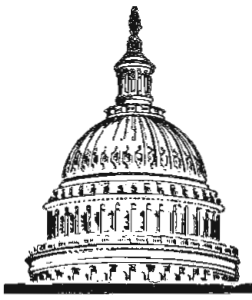
Clarostat Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE

In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario



WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

TV SPEED-UP—Issuance of its revised city-by-city priority list for the processing of television station applications by the FCC has meant an expediting of the determination of new TV station authorizations. The priority list breaks down station applications into two groups. Group A comprises cities with no existing TV service and Group B contains cities with one or more stations. In both groups the greater population cities rank first. Competitive applications will be handled by hearings before examiners. The priority list is to be revised every two months—the first revision will be around the latter part of October.

FCC STARTS ON COLOR TV—September was a significant milepost in the progress of color television. Comments have been filed by the different segments of the television industry on the proposed compatible color specifications by the National Television System Committee. Comments on the NTSC's specifications were submitted by Sept. 8 and then in the latter part of the month counter comments were filed. It is believed that the FCC's rule making for color TV can be achieved through the written statements of the industry, and any hearings would be to a large extent pro forma. At such hearings the major purpose will be to wrap up the loose ends and to coordinate the industry's views into a uniform plan.

TV PROBLEMS—The new "babies" of television—subscription, satellite, booster and community antenna TV services—present a headache for the FCC in its classification of these services into the category of either common carrier or broadcasting. In its future blueprinting of rules and standards the FCC is expected to rely principally upon comments from the industry on these services rather than the hearing procedure. Subscription and community antenna TV services might well be classified in the common carrier field along with the public telephone and telegraph services since the TV viewers would be paying rates for the use of the video service. The satellite and booster method of distributing video programs is regarded as a broadcasting operation. In the case of subscription and community antenna television the FCC might place these services in a new category for regulation in a sort of "never-never" land of its jurisdiction.

WORLD PROGRESS—Improvement and standardization of radio and electronic flight aids on the air routes of the world is being achieved rapidly with the systems installed being largely of the American-developed and ICAO (International Civil Aviation Organization)-sponsored common system types of navigational aids. The major installations are very high frequency omnidirectional radio range (VOR) and instrument landing systems (ILS). All schedules U.S. international airlines and a large number of foreign airlines are utilizing the VOR and ILS standardized equipment. By the end of 1953 it is planned that more than 100 ILS systems will be installed or definitely committed at international airports throughout the world. VOR last year was expanded all over the free world with nearly two score of installations and in Canada with 50.

DEFENSE PRODUCTION—More than $7 billion has been allotted for procurement of military electronics communications equipment during the government's 1954 fiscal year which ends next June 30. This total of over $7.1 billion is composed of more than $6.5 billion in unexpended funds authorized for the Defense Department in previous years plus approximately $644 million in new obligational authority for the current fiscal year. The Army Signal Corps in new funds had $138.8 million and the Navy $103.5 million. The Air Force received $318 million in new funds for electronic-communications equipment. TELE-TECH learned from the Budget Bureau that the reduction in new obligational authority for the current 1954 fiscal year should result in a basis for lower spending in future years since it means a reduction in spending commitments during the current fiscal year which will have to be met in later years.

OFFICE OF DEFENSE MOBILIZATION has appointed Washington attorney William A. Porter as Assistant Director for Telecommunications. He will assume the duties formerly handled by Haraden Pratt, Telecommunications Advisor to the President, and recently transferred to ODM by executive order. The Assistant Director will be responsible for coordinating in the executive branch of government the development of telecommunications policies, as well as plans and programs designed to assure maximum security. He will also coordinate the assignment of radio frequencies to government agencies through his direction of the Interdepartment Radio Advisory Committee. (See "Congress and the Spectrum Grabbers" on page 73 of this issue.)

LEGISLATION—Little of specific interest to the communications field went on the statute books during the first session of the 83rd Congress, but the 1954 session could well be a most important one. One item of interest was the introduction of a measure on the last day of the session. It is a "bill to raise questions rather than provide answers," which could lead to exploration of the whole field of government telecommunications policy. The bill, introduced by Charles A. Wolverton, Chairman of the House Interstate & Foreign Commerce Committee, would set up a Telecommunications Policy Committee, consisting of representatives of various federal departments.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

Tidewater Virginia's Powerful UHF Station

WVEC-TV

chooses GPL cameras

for Flexibility and Performance

■ Focus of nationwide attention is NBC's new UHF outlet at Hampton, Va., which blankets the rich Norfolk market. With a test pattern on the air in advance of Fall network programming, UHF converters sold at over 1,000 per day in this area.

"For our local programs, which come from both our studio and surrounding towns," says WVEC president Thomas P. Chisman, "we had to pick cameras for flexible, portable use. We chose two General Precision camera chains, with remote control of iris, lens change and focus. We can take these GPL's in and out of a field truck easily, and in the field the remote controls are especially useful. In our film studio we're using two GPL Projectors."

WVEC-TV picks GPL for portable flexibility. Networks pick the same cameras for sheer quality. New or existing stations can have both, with GPL equipment, covering every requirement from cameras to transmitters.

Write for data, and compare.

During studio construction, station president Chisman and chief engineer William C. King, Jr., examine GPL camera. "Heat, dust and dirt really gave this camera a beating," says King, "but it never showed it."

General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK

GPL

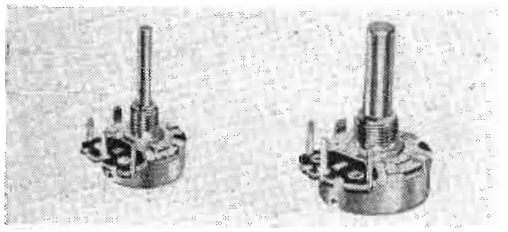
Export Department:
13 East 40th St., New York City
Cable address: Arlab

Cable address: Prelab

Camera Chains • Film Chains • Field and Studio Equipment • Theatre TV Equipment • GPL-Continental Transmitters

PC CONTROLS

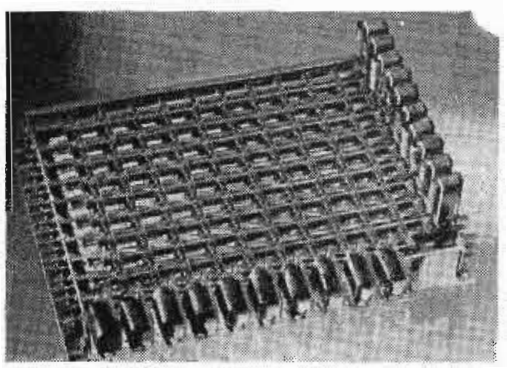
Two new controls for use in printed circuit applications, Types U70 and U45, have each blade-type terminal recessed in a notch in their Bakelite bases. Also,



they save mounting space on the printed circuit panel because their terminals are placed in close to the mounting housing. Adequate clearance for circuit paths is provided by the ample space between the terminals. Both controls are available in ¾ in. and 15/16 in. diameters. **Chicago Telephone Supply Corp., Elkhart, Indiana.**—TELE-TECH & ELECTRONIC INDUSTRIES

CROSSBAR SWITCH

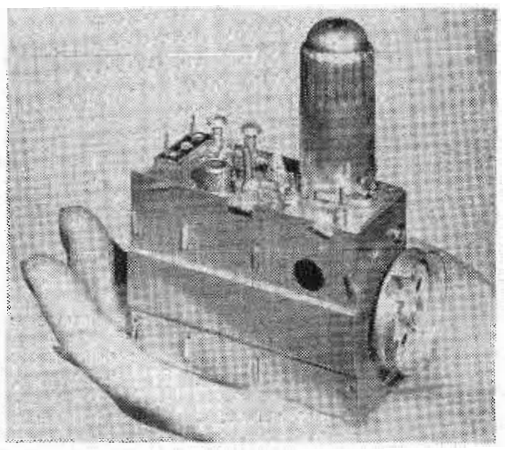
A new type of crossbar switch for multiple-switching audio and video circuits, computer systems, etc., is available with 4 or 10 link levels, and either 10 or 25 line levels. Each circuit can have up to 3 conductors. Transmission is achieved at frequencies as high as 70 MC. Bridging capacitance between adjacent conductors is 15 μμ. Crosstalk level between two circuits with common ground, and adjacent in line and link levels, is down more than 65 db at 10 MC. The switch functions by the action of electromagnets. Any number of connections, up to the max. number of line circuits, can be made to one link circuit by operation of any of the line hold magnets. Each electromagnet requires 200 amp turns, equivalent to 2.5 w., and will dissipate 3 w.



continuously. Coils are available for operation at 12, 24, or 48 v. Control can be by manually-operated keys, automatic control circuits, or by dialed impulses. **James Cunningham, Son & Co., 13 Canal St., Rochester 8, N.Y.**—TELE-TECH & ELECTRONIC INLUSTRIES

UHF FRONT END

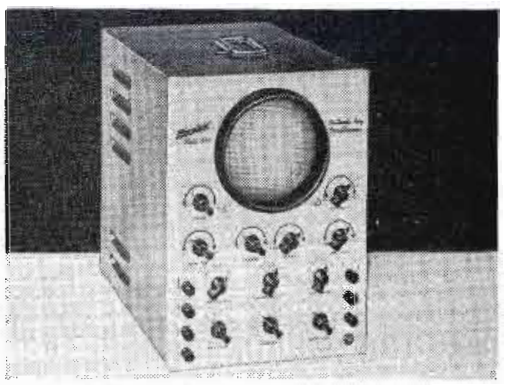
The new UHF TV reception front-end assembly shown will tune all channels from 14 to 83 in a continuous 180° sweep of its single tuning shaft, and can be used with any i-f strip capable of receiving output frequencies of 41.25 MC sound, and 45.75 MC video. Main components are an r-f preselector, oscillator, crystal-mixer, and i-f coil. The preselector is double tuned. The oscillator range is 504-953 MC; normal operating



frequency being 43.5 MC above the incoming signal. Antenna input impedance is 300 ohms, balanced. The unit is available in either clock-wise or counter-clockwise tuning-shaft rotation. Noise figure; 13-16 db (18 db max.); r-f band width, 15-30 MC across the band; i-f rejection, not less than 60 db; gain, 0.3 -0.5 across the band when measured to i-f grid through a 5 MC band width i-f circuit with a 6 db loss pad at the antenna input. **P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES

OSCILLOSCOPE

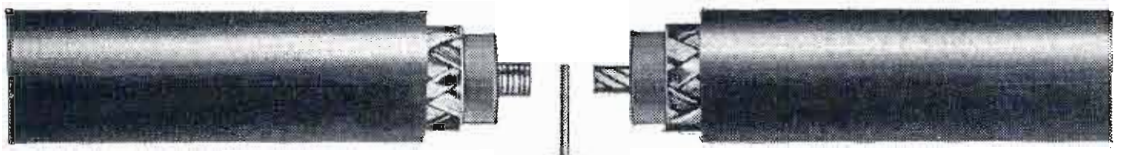
The new 5-inch cathode ray oscilloscope Model 665 has a frequency range from 0.5 cps to 700 kc, down to 3 db. It has excellent stability, no drift, less than

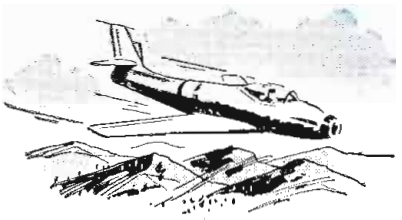


1% tilt, and less than 2% overshoot. Accelerating potential is 1,775 v.; power consumption, 35 w. Square wave response is flat from 60 cps to 100 kc. A dual fuse is provided so that the B-plus line is entirely fused. The scope was designed with push-pull amplifiers with a vertical sensitivity of 0.020 millivolts per inch. Horizontal sensitivity is 0.030 millivolts per inch. Vertical input impedance is 15 μμf, 2.2 megohms; horizontal impedance, 52 μμf, 0.10 megohms. **Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES

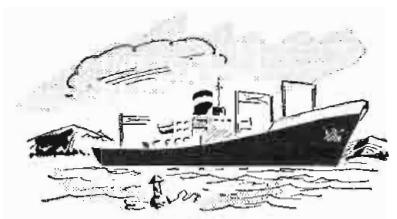
CONTACTS AND BRUSHES

Stackpole silver graphite contacts and brushes, available in sizes from 1/16 in. diam. and upward, can be supplied with pure silver for easy spot welding or brazing directly to supporting arms or springs. They can also be furnished with copper backing, integral rivet, or other device to meet almost any mounting requirement. Standard grades range from 5% to 80% graphite. **Stackpole Carbon Co., St. Mary's Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES





AVIATION

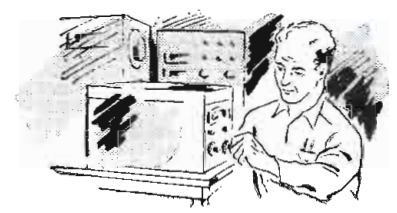


MARINE

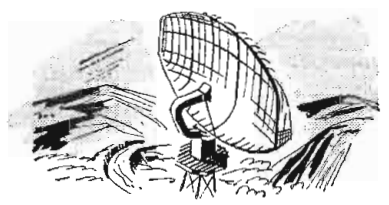
INDUSTRIAL

BROADCASTING

RADIO-TV LEAD-INS



TEST EQUIPMENT



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Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

CUES for BROADCASTERS

(*Continued from page 93*)

tors. The ½ watt resistors are preferred as they can be mounted directly to the jacks. The pads are 5 db, 10 db, 20 db and 40db and may be made up in 500 and 600 ohm impedances. Values for both are shown below.

The jacks are labled "5 db In," "5 db Out," "10 db In," "10 db Out," "20 db In," "20 db Out," "40 db In," "40 db Out." Each pad is wired to the tips of its pair of jacks. The normal springs of "5 db Out" are wired to normal springs of "10 db In." The normal springs of "10 db Out" are wired to normal springs of "20 db In." The normal springs of "20 db Out" are wired to normal springs of "40 db In." This wiring gives a total loss of 75 db from "5 db In" to "40 db Out." Any value of attenuation in 5 db steps may be obtained from 5 to 75 db. Use of shielded patch cords is recommended.

Loss db	Patch In	Patch Between	Patch Out
5	5 in		5 Out
10	10 In		10 Out
15	5 In		10 Out
20	20 In		20 Out
25	5 In	5 Out—20 In	20 Out
30	10 In		20 Out
35	5 In		20 Out
40	40 In		40 Out
45	5 In	5 Out—40 In	40 Out
50	10 In	10 Out—40 In	40 Out
55	5 In	10 Out—40 In	40 Out
60	20 In		40 Out
65	5 In	5 Out—20 In	40 Out
70	10 In		40 Out
75	5 In		40 Out

Economical Secondary Oscillator

D. V. R. DRENNER, Engineer, KGGF, Coffeyville, Kansas

WHILE most broadcasters have laboratory, or quazi-laboratory model audio oscillator, we here at KGGF have found one of the low priced kit models a useful adjunct for trouble shooting on audio equipment. Our oscillator and associated attenuator panel are usually at the transmitter site, and the kit model, and an inexpensive attenuator, are kept at the studio.

The attenuator panel is a simple 2½ x 4 x 4 in. box, with input and output jacks, and plug-in attenuators manufactured from 5% tolerance resistors mounted in 4 prong tube bases. Since one side of the oscillator and, in our case, one side of the console input, are grounded, simple T networks are used.

This gives us a secondary oscillator source of quite good sine wave output, (we found the max. distortion to be only 0.65% at 200 cycles) with some variable matching attenuation, at a very moderate cost.

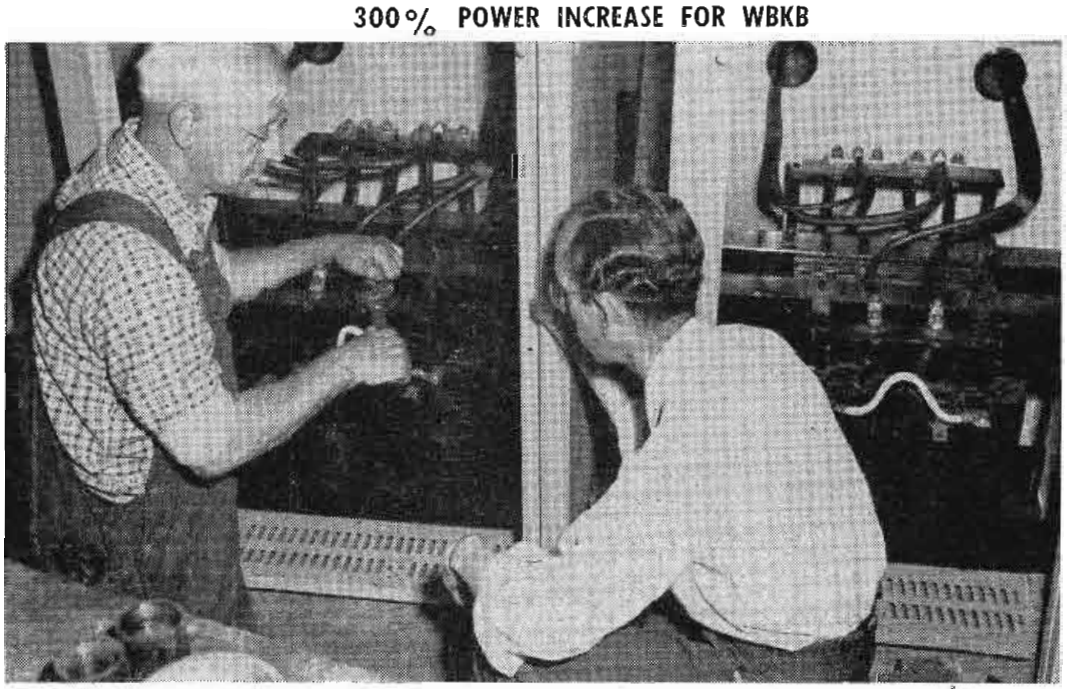
Making Graph Paper

ELTON B. CHICK, Chief Engineer, WQXI, Atlanta, Ga.

IF you are caught with a need for semi-log graph paper and none is available, (such as when making an audio proof at 4:00 AM,) try making your own! An easy way is to use a slide rule scale and an ordinary ruler.

Use the three cycle scale (cube scale K) for marking divisions for three cycle paper. Four cycle paper can be made by marking off another cycle. Use a ruler for the linear scale, ¼ inch make a nice graph and provides about thirty divisions on standard 8½ by 11 in. paper. A Pickett model 902 slide was used and the homemade graph paper closely resembled the Post semi-logarithmetic, three cycle paper no. 558.

300% POWER INCREASE FOR WBKB



ABC engineer Robt. Whitnah (r) supervises adjustment of power transformers by electrician to be used in conjunction with Station WBKB's (Chicago) 300% power increase put into effect Sept. 18

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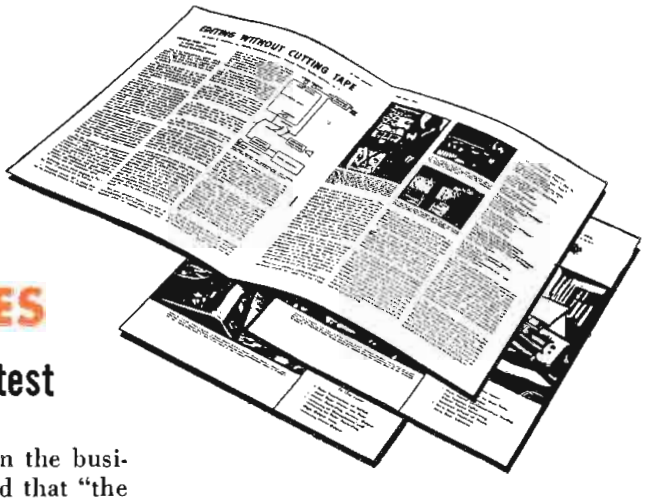


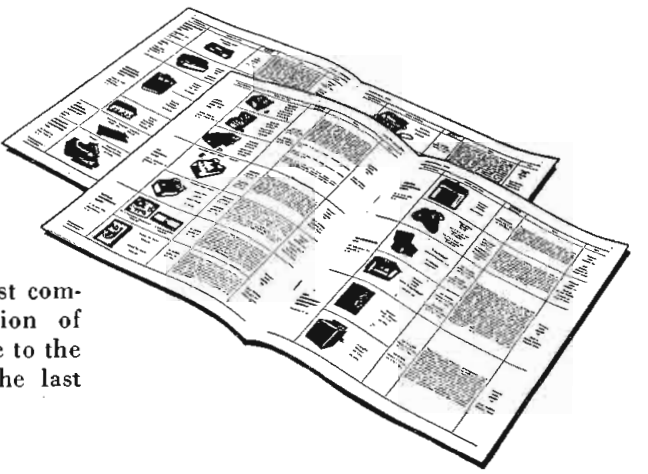
20 PRIZE-WINNING ARTICLES

from Audio's International Sound Recording Contest

Here's a wealth of new ideas on how to use tape and disc recordings to achieve greater economy and efficiency in radio, TV and sound studio operation.

With reference to these articles, one of the contest judges commented as follows: "I have never received so much information which was new and exciting in such a short time in all of my years in the business." And another judge stated that "the information and descriptions of recording operations conducted in small radio stations and recording studios throughout the country has been quite an education."

Contest winners include entries from 11 different States, as well as from Canada and Switzerland. The 20 best articles, which were awarded cash prizes totaling $1400, will be published in the pages of Audio Record. The information thus made available to the industry will be of real value to sound recordists everywhere.



QUICK FACTS ON MAGNETIC TAPE RECORDERS

Each year, Audio Record brings you a complete, up-to-date listing of all makes and models of tape recording machines —with conveniently arranged price and performance data. This directory issue, published in September, is the most complete and authoritative compilation of tape recorder information available to the industry. Over 75,000 copies of the last issue were distributed.

. . . plus many other articles of timely interest to the sound recordist

Audio Record keeps you well informed on all the latest trends and technical developments in all phases of tape and disc recording. It is not an advertising publication and its sole purpose is to render a needed and useful service to the industry.

Audio Record, published 8 times a year, is currently distributed free of charge to a request mailing list of about 35,000 sound recordists in broadcasting stations, recording studios, schools and colleges throughout the country.

IT'S YOURS FOR THE ASKING

A letter or post card will add your name to the Audio Record mailing list. And if you would like to have others in your organization read it also, send their names along, too. Just write to Audio Devices, Inc., using the Dept. No. listed below. All requests addressed to this Dept. will be started with the July-Aug., 1953 issue, so you will be sure to get *all* the prize-winning articles, as well as the 1953 Tape Recorder Directory Issue.

AUDIO DEVICES, Inc.

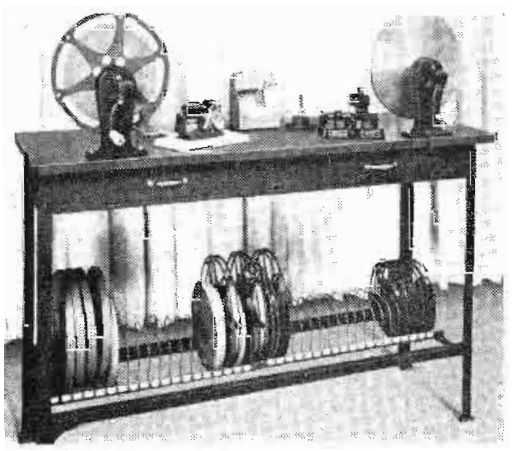
Dept. AR-4, 444 Madison Ave., New York, N. Y.

Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

audiodiscs
audiotape
audiofilm
audiopoints

STUDIO EQUIPMENT

Three new equipment units, a film-editing unit, a dual-disc slide projector, and a large-screen projection TV system are now available to improve TV station studio-programing. The editing equipment includes film splicers, rewinds, viewers, measuring machines, editing tables, film or slide storage cabinets, reels, cans, film polishers, and cleaner. The new RCA Type TB-3A

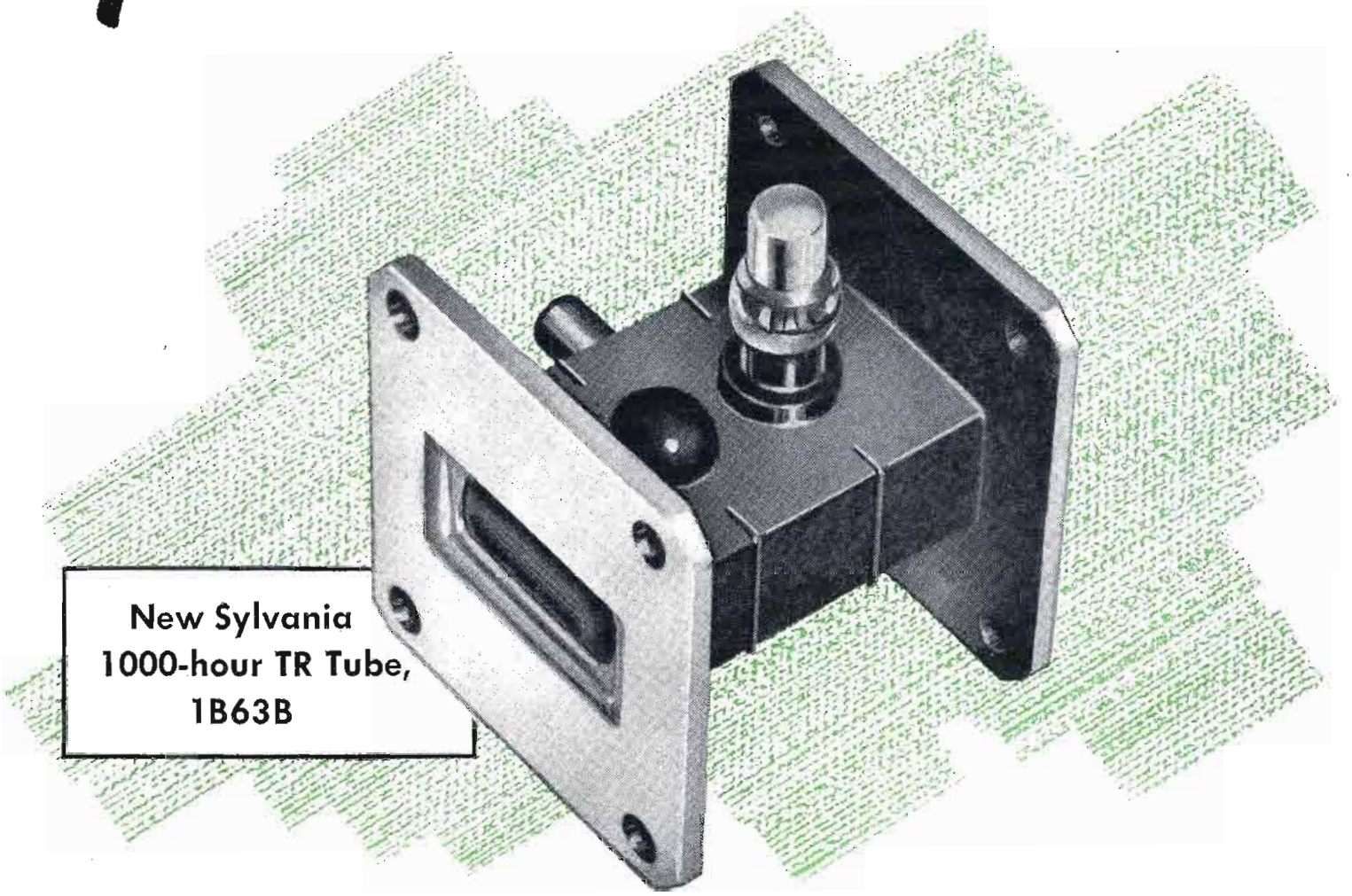


slide projector enables uninterrupted presentation of either glass or cardboard mounted 2 in. square slides. Push button controls enable remote operation from the audio-video console. The slide unit has a 150-watt lamp, two 5-inch. lenses, and two slide turrets that are operated by individual motors. The RCA Type PT-100, large-screen, TV projector overcomes audience view obstruction and enables the program to be followed during set and scene changes. **Broadcast Equipment Sect., Radio Corp. of America, Camden 2, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

NEW VEST BATTERY

Soldier operates handset radio while wearing new U. S. Army Signal Corps (Ft. Monmouth, N.J.) experimental vest. Latter has been designed to keep radio batteries warm and functioning normally in sub-zero temperatures. Vest is flexible, weighs about 3 lbs. and holds 117 pencil-type dry cells. Wire network interconnects batteries to form capacity equivalent of regularly used type. Manufactured by B. F. Goodrich & Co., synthetic rubber employed permits batteries to breathe but not dry out.

Sylvania announces...



. . . the most important advance in TR Tube design in the past 4 years

Sylvania engineers are engaged in a continuing program to provide increased dependability and longer life to their electronic tubes . . . for both commercial and civilian applications.

One of the most important results of this program is the recent development of the cermet ignitor electrode. This new electrode is capable of withstanding extremely high temperatures for long periods of time, thus making possible Sylvania's 1000-hour tube, the 1B63B.

This new ignitor is an important step forward in TR Tube design . . . one more reason why it pays to specify SYLVANIA!

For further information concerning the full line of Sylvania TR and ATR Tubes, simply mail the coupon.

SYLVANIA

LIGHTING · RADIO · ELECTRONICS · TELEVISION

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg.
St. Catherine St., Montreal, P. Q.

Sylvania Electric Products Inc.
Dept. 3E-3010, 1740 Broadway
New York 19, N. Y.

Please send me further data on Sylvania's improved 1B63B Tube. Also new descriptive folder showing the full line of TR and ATR Tubes.

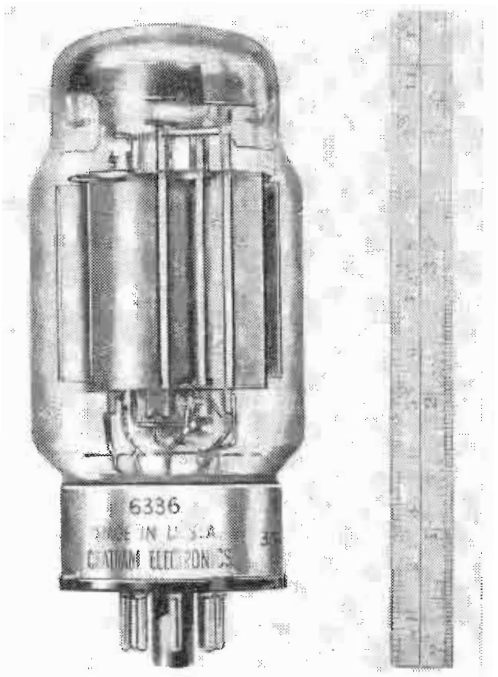
*Name*_____

*Street*_____

*City*_____ *Zone*_____ *State*_____

TWIN TRIODE

A new high-perveance, high-plate-dissipation, twin power triode, Type 6336, is announced for voltage regulation. Used as a series tube, the unit will "pass" a min. of 150 ma per section at



40 v dc $E_{p.}$, and the same current at 200 v. dc E_p. using a grid bias of -60 v. The tube has a hard glass envelope and an 8-pin butt stem with pin connections the same as Chatham Types 6AS7G and 6080. Height is 4.75 in. max. and bulb diam. is 2.07 in. Max. EF is 6.3 v., 5 amps max. Bulb temperature max. is 250° C. Mu is 2.7; Gm is 11,000 micromhos; Rp is 250 ohms. Life 1,000 hrs. min. **Chatham Electronics Corp.. Livingston, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RECEIVING TUBES

Types GL-6111 and GL-6112 subminiature receiving tubes have been added to the "Five Star" line. GL-6111 is a medium-μ twin triode for general purpose amplifier applications which also can be used as a combined oscillator and mixer hf circuits. Each section has an individual cathode, and is electrically independent. In use as a class A1 amplifier, each section has the following characteristics and typical operations conditions: plate voltage, 100 v.; cathode bias resistor, 220 ohms; amplifications factor, 20, plate resistance, 4000 ohms; transconductance, 500 micromhos. The GL-6112 is a high-μ twin triode for use as a voltage amplifier or phase inverter that can be employed at relatively low signal levels. With 100 v. on the plate, the tube has a maximum noise output voltage of 0.025 v.—**General Electric Tube Dept., Schenectady 5, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

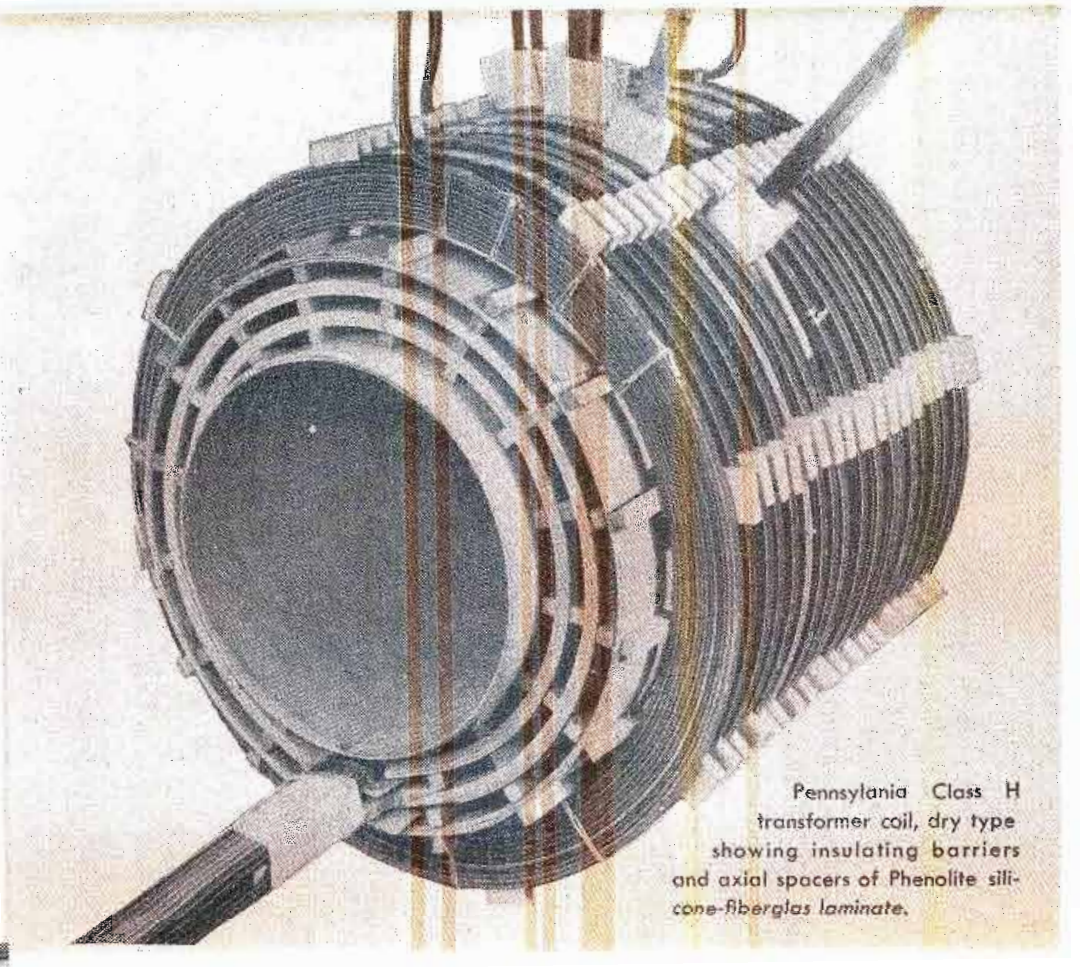
Coming Soon

The complete report on

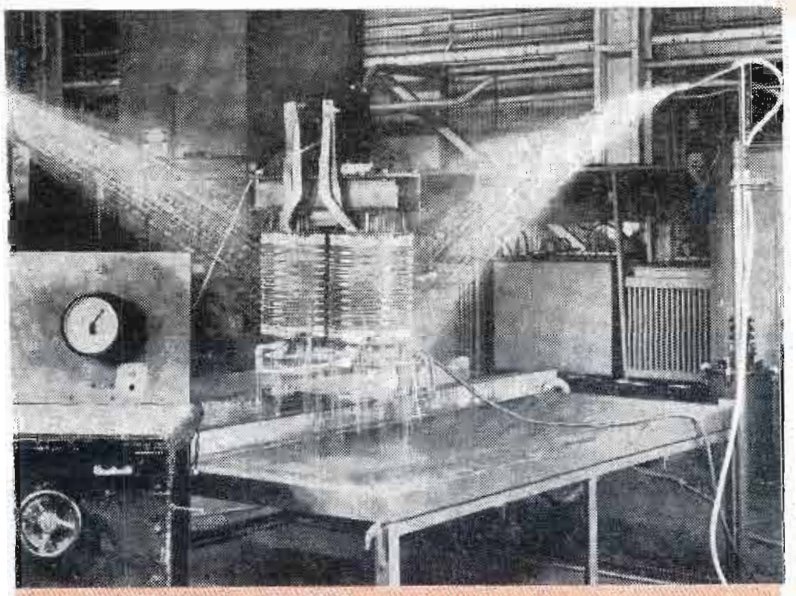
"Industrial Application of Electronic Equipment in the Automotive Industry"

class h insulation by National Vulcanized Fibre Co.

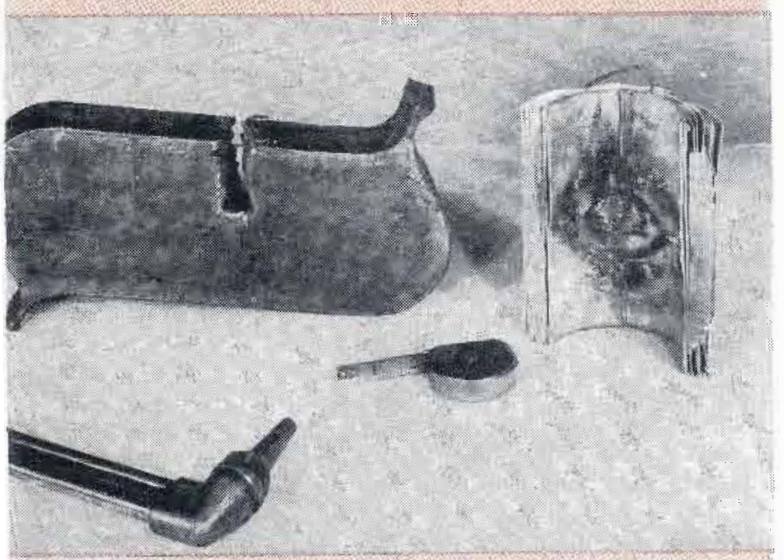
used by Pennsylvania Transformer Co. to build new, safe, and reliable Sealed Dry Type Transformers



Pennsylania Class H transformer coil, dry type showing insulating barriers and axial spacers of Phenolite silicone-fiberglas laminate.



Transformer core and coil assembly under full voltage excitation withstands heavy water shower. The insulation resistance remained at infinity megohms during the entire two-hour water test.



Class H insulation resists fire and combustion. The heat of the 5000° F. Oxygen-Acetylene torch, applied for the same interval, burned through the 2-inch steel plate, yet merely melted some of the glass fabric in the barrier.

Using Class H insulation (Phenolite silicone-fiberglas laminate), the Pennsylvania Transformer Company (a McGraw Electric Co. Division) builds Sealed Dry Type Transformers having many superior and safe operation features. The Class H Insulation eliminates the hazards of fire and explosion, permits up to 50 per cent weight reduction, makes possible efficient operation in humid atmosphere, reduces maintenance, allows operation at high temperatures, and permits frequent overloads. The coil barriers are made from 1/32 inch silicone sheets bonded with silicone rubber. The sheets are rolled directly onto the lathe during the coil winding operation, saving the high cost of a mandrel. Ideal for station auxiliary, unit substation and network service, these Sealed Dry Type Transformers are an outstanding example of National cooperative engineering and research. Perhaps you have an insulating problem where National Vulcanized Fibre Company can give you real help in solving your particular problem . . . economically. Write us—our engineering service is immediately available.

National laminated plastics
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NATIONAL VULCANIZED FIBRE

PHENOLITE Laminated PLASTIC

NATIONAL VULCANIZED FIBRE COMPANY
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Since 1873

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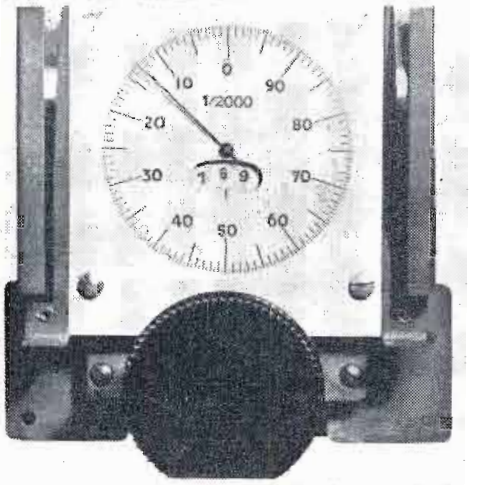
MULTI-TURN DIAL

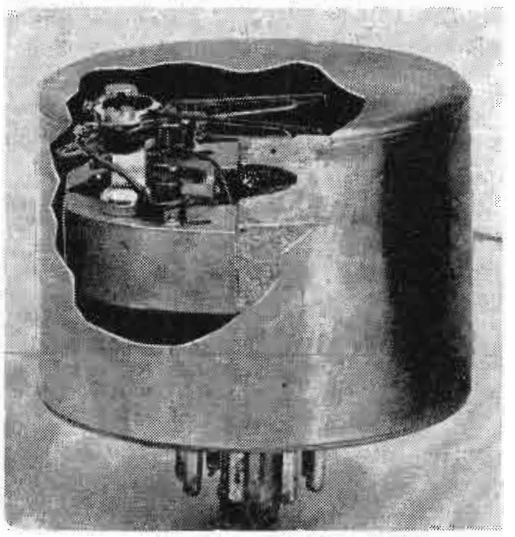
For multi-turn control applications, the Microdual Type 57-360 counting dial permits an unlimited number of 360°



rotations. Up to 20 revolutions of the operating shaft are marked on the inset counting dial. Main dial shows 200 divisions. This in combinations with the turn counting dial enables positioning to 1 in 4000 divisions. Effective scale length is 7.8 in., each small division representing 5.4 minutes of arc. Resetting accuracy is better than 2.7 minutes. Applications include control of variable capacitors. inductances and potentiometers.—**Transradio Ltd., 138A Cromwell Rd., London S.W. 7, England.**—TELE-TECH & ELECTRONIC INDUSTRIES

METER-RELAY

The Model 265 non-indicating meter-relay has a balanced movement, self-locking contacts, and a sensitivity as high as 0.2 μa. Its metal can is furnished with either an octal plug connector or a sealed header. Its jeweled movement is shock mounted. Sensitivity ranges are from 0.2 μa to 50 amps. or 0.0 5 mv. to 500 v. Calibrated in milli-



volts and with bimetal compensation, the unit gives accurate control of temperature or safety alarm when used with standard thermocouples. **Assembly Products, Inc. Main at Bell St., Chagrin Falls, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FOOTAGE COUNTER

The dual model F&B counts the footage of either 16mm or 35mm film, or both, by means of a selector switch. A monitor light indicates the counter in operation. Another selector switches the unit to either "Sync" or the "Line" position. In the former position, the selector by-passes other switches and interlocks with the synchronous power supplied by a projector or a dubber. In the latter position, the unit is started and stopped manually by an "on-off" switch. A 110 v., 60 cps sync line receptacle enables connection with a minute and seconds counter, cueing signal, reading light, or other accessory.—**Florman & Babb, 70 West 45th St., New York 36, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

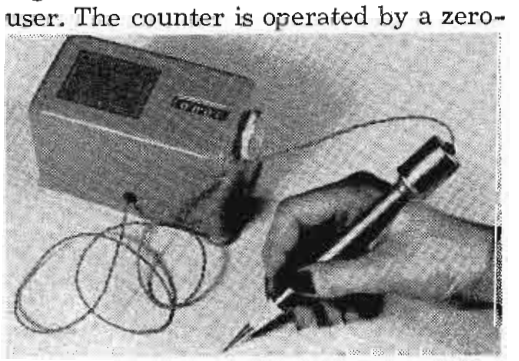
VARIABLE RECORDER

A new instrument records three variables in sequence at 20 different points. The unit can measure any physical quantity of such variables as current, power, strain, humidity, liquid flow or level, speed and displacement. Its switching unit can be set to record from one to three variables, and adapted to record as many as 60 in approx. two minutes. Indentifying symbols are automatically printed as measured values are recorded. Though the instrument can be used to check electrical and air

conditioning systems, it is presently being used with pick-up probes to measure skin temperature, air temperature, and air velocity. **Hastings Instrument Co., Inc., Hampton, Va.**—TELE-TECH & ELECTRONIC INDUSTRIES.

COUNTING DEVICE

The "Mark-N-Count" (patents pending) which performs these operations simultaneously, is a 2 lb. portable device which consists of a standard solenoid-type, four-digit, 100 v. ac, or 6 v. dc, counter; a pencil holder with a built-in microswitch, which operates the solenoid; and a standard pencil which can be removed to accommodate a different color or kind of lead or used as an eraser. A made-to-order rubber stamp is also available which can be used to stamp prices or dates. An audible sound registers each mark in the mind of the user. The counter is operated by a zero-



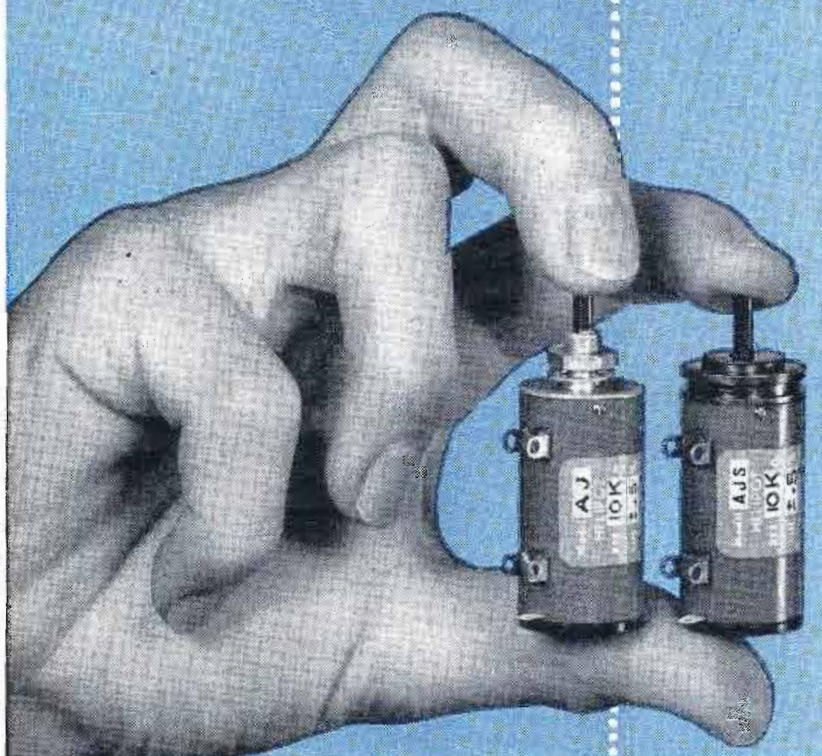
reset knob. The "Mark-N-Count" can be used on any support that has a 110 v. plug receptacle.—**May Engineering Co., 6055 Lankershim Blvd., N. Hollywood, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Now available in **TWO** *versions*

The AJ Series Helipot

...TINY 10-turn Helipots with BIG performance

12 times the resolution of conventional units!



(Left)
Model AJ
Bushing Mounting

(Right)
Model AJS
Servo Mounting

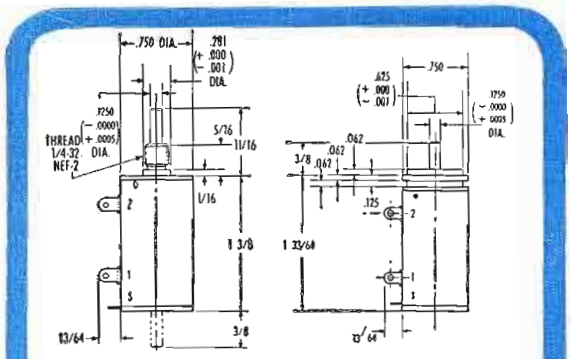
In all airborne and many other modern electronics applications for precision potentiometers, miniaturization, light weight and circuit simplification are key objectives. And you get these features—*and more*—in Helipot's new AJ Models . . . compact potentiometers the diameter of a penny, yet with *12 times* the resolution of conventional potentiometers of the same diameter. Announced only a few months ago, the original AJ has proven so popular that it is now made in two versions to meet the requirements of its many users—the original AJ mounting with a threaded bushing . . . and the new AJS mounting for servo applications. Also, the AJS is available in two bearing arrangements—AJS with *sleeve* bearings, and the AJSP with *ball* bearings.

All units have these important features . . .

SMALL SIZE—LIGHT WEIGHT: All AJ Models are only ¾" in diameter (small as a penny) 1⅜" long—weigh 1.0 oz. They require a minimum of valuable panel space!

HIGH PRECISION—CIRCUIT SIMPLICITY: On many applications an AJ Series will replace two conventional potentiometers, providing *both* wide range and fine adjustment in one unit. The 18" slide wire gives a resolution of 1/3000 in a 100 ohm unit—1/6500 in a 50,000 ohm unit!

RELIABILITY: The AJ models are rugged and simple—built to close tolerances with careful quality control. Their performance and reliability reflect the usual high standards of Helipot quality.



AJ **AJS**

CONDENSED SPECIFICATIONS

Number of turns	10
Power rating	2 watts
Coil length	18"
Mechanical rotation	3600° + 12° −0°
Electrical rotation	3600° + 12° −0°
Resistance ranges	100 ohms to 50,000 ohms
Resistance tolerance	± 5.0%
Linearity tolerances:	
All values	± 0.5% (standard)
5000 ohms and above	± 0.1%
Below 5000 ohms	± 0.25%
Starting torque	0.75 oz. in.
Net weight	1.0 oz.

Advanced Construction

For light weight, unusual compactness, high accuracy and resolution, coupled with utmost reliability, investigate the AJ series . . .

- All types have bearings at *each* end of the shaft to assure precise alignment and linearity at all times.
- Either single or double shaft extensions can be provided to meet individual needs . . . also, ball or sleeve bearings, special shaft lengths, flats, screwdriver slots, etc.
- By means of a unique Helipot welding technique, tap connections can be made to only ONE turn of the resistance winding, and can be provided at virtually *any* desired point on the resistance element.
- New improved terminals are rigidly anchored in place to prevent twisting and coil failures due to fatigue. These anchor-locked terminals are used both at the taps and at the coil ends.

Meet Rigid Helipot Standards

Helipot—world's largest manufacturer of precision potentiometers—has built an enviable reputation for its high design and construction standards, and the AJ models meet these standards in every way.

The resistance elements are made of precision-drawn alloys, accurately wound by special machines on a heat-dissipating copper core.

Each coil is individually tested, then permanently anchored in grooves precision-machined into the case. Slider contacts are of long-lived Paliney alloy for low contact resistance and low thermal e.m.f. . . . and all terminals are silver plated and insulated from ground to pass 1,000 volt breakdown test.

In spite of light weight and compact design, all AJ models are built throughout for long life and rugged service. Potentiometer life varies with each application, of course, depending upon rotation speed, temperature, atmospheric dust, etc. But laboratory tests show that under proper conditions, all of the AJ series have a life expectancy in excess of one *million* cycles each!

Get full details from your nearest Helipot representative—or write for Data File 1003

THE Helipot CORPORATION

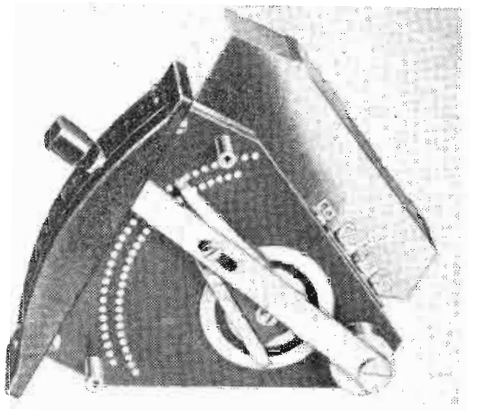
A subsidiary of Beckman Instruments, Inc.

SOUTH PASADENA, CALIFORNIA

Field Offices: Boston, Rochester, New York, Philadelphia, Cleveland, Detroit, Chicago, St. Louis, Los Angeles, Seattle, Dallas, High Point, N. C. and Fort Myers, Florida. In Canada: J. S. Root, Toronto.
Export Agents: Frathom Co., New York 36, New York.

ATTENUATORS

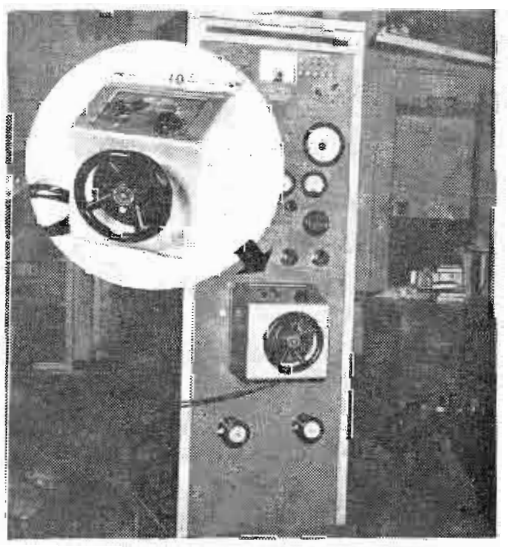
Series 820 and 830 vertical lever type attenuators have a special front-slot baffle plate which prevents extraneous matter from interfering with opera-



tion; and a two-piece shield protects the resistor strips, switch rotor mechanism, and contacts. As the switch rotor is not attached to the lever, it can be moved by remote control without disturbing the pressure of its equalized positive contact. To insure low contact resistance, silver alloy is used for the contacts, collector rings, and switch rotor. Resistor accuracy is ±5.0%. Controls have a flat frequency response of 30 kc. Eleven units can be mounted on a standard 5¼ x 19 in. panel. **The Daven Co., Dept LTA, 191 Central Ave., Newark, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

SERVO CONTROL

The "Servo," a new control for the displacement and acceleration level of shaker tables, maintains displacement on acceleration amplitudes well within JAN



or MIL limit specifications without the constant attention of an operator. It gives constant automatic control of constant acceleration or displacement sweeps over the low alternator range. Also, it controls acceleration sweeps subject to power limitations over ranges above 125 cps with a single setting of the power factor correction. Manual operation is possible without disengaging or detaching the drive. The unit is intended to be used with a signal monitor and a frequency cycler. The force output ranges from 25 to 12,500 lbs. A shaker system consists of a console, power supply, and table.—**The Calidyne Co., Winchester, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

United States Motors Corp. Announces...

MICRO POWER

Communications Standby Power That Operates *With the Main Source.* To Maintain Continuous . . .

UN-INTERRUPTED POWER

Here's NEW . . . Low-Cost . . . Automatic Standby Insurance . . . It's MICRO-POWER, developed by United States Motors Corporation especially for the Communications Industry.

IT'S AUTOMATIC! . . because it operates in conjunction with the main source of power as a line voltage regulator and stabilizer. Dropping voltage is picked-up and maintained BEFORE LOSS OF POWER TO ESSENTIAL EQUIPMENT or complete power failure.

IT'S ECONOMICAL . . . because it replaces one or more units of costly, complicated equipment.

IT'S ESSENTIAL . . . to the communications industry. There are no time consuming load "transfers". No momentary "drags" or dropping voltage. NO POWER OUTAGES, EVEN FOR PRECIOUS SECONDS.

MICRO-POWER PROVIDES COMPLETELY AUTOMATIC, UN-INTERRUPTED SERVICE FOR THE COMMUNICATIONS INDUSTRY.

3KW and 5KW Micro-Power Units available for immediate installation.

Write U. S. Motors Corporation, Oshkosh, Wisconsin for complete details and specification.

SEE MICRO-POWER UNITS
at the U. S. I. T. A. Convention
at the Conrad Hilton Hotel,
October 12, 13 and 14.

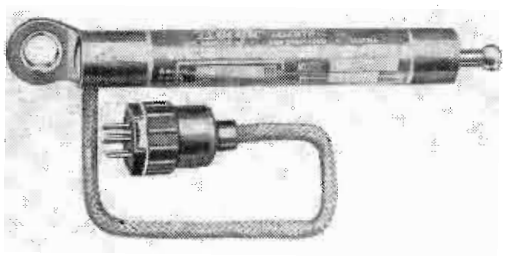
UNITED STATES MOTORS CORPORATION
LIGHT US POWER
OSHKOSH • WISCONSIN

UNITED STATES MOTORS CORP.

OSHKOSH, WISCONSIN

POTENTIOMETER

The new Humphrey-designed linear potentiometer is said to give noise-free performance when subjected to vibra-



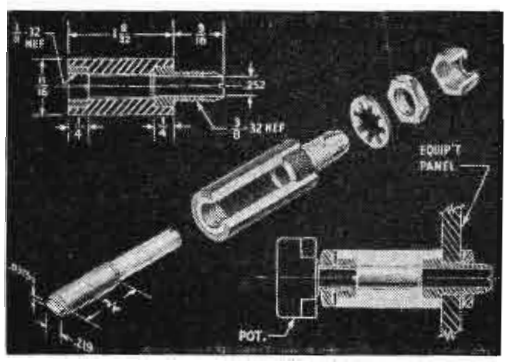
tion, dither, and other environmental conditions, and its dual-element construction to give absolute precision linearity with a clear, sharp signal. The ½ in. diam. size provides strokes up to 3 in. The ¾ in. diam. size is used for strokes over 3 in. with resistance values up to 13,000 ohms/in. Higher values are obtainable in special units. **Pacific Scientific Co., 1430 Grand Vista Ave., Los Angeles, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DC MOTORS

The 1200 series continuous duty, reversible dc motor, without brake, has a voltage input of 24 v. dc, a speed of 10,000 rpm, and a running current of 0.7 amps. Its ambient temperature is — 55°C to + 105°C. The unit is available with or without brake, and can be made to other specifications.—**Motordyne, Inc., 2661 S. Myrtle Ave., Monrovia, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

COUPLERS

The photo shows one of a newly created series of high voltage couplings capable of withstanding 15 kv. Repre-



senting a new approach, the new couplings effect economies by eliminating milling operations and by enabling instant application to any standard potentiometer with a slotted shaft. **Jan Hardware Mfg. Co., Inc., 25-30 163rd St., Flushing 58, New York, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

See NEW PRODUCTS
for the
Electronic Industries
Starting on Page 109

QUALITY TOROIDAL COILS

BY

SICKLES

- High volume winding of toroidal coils to close inductance, balance and "Q" tolerances.
- Design and assembly of precision wave filters or communication networks.
- Quality manufacture of pulse transformers.
- Magnetic memory units.
- Design and production of magnetic amplifiers.

The manufacture of coils must be founded upon a precise engineering base and precise engineering controls for quality mass production.

For 30 years Sickles has specialized in the design and manufacture of coils and coil assemblies. Now Sickles' vast experience and special skills are being applied to the techniques of components which require toroidally wound constructions.

To your problems Sickles brings unexcelled engineering and production techniques, extensive fabrication facilities, unusually complete instrumentation and test equipment, unique and high technical abilities.

More than a quarter of a million toroidal wound transformers by Sickles are already in service.

Write today to:
F. W. Sickles, Dept. 70
P. O. Box 330, Chicopee, Mass.

F. W. SICKLES

DIVISION OF GENERAL INSTRUMENT CORPORATION

CHICOPEE, MASSACHUSETTS

WORLD'S LARGEST MANUFACTURER OF INDUCTANCE COILS

Latest Navy Reliable Tube List

The Navy Department has issued a new reliable tube list, which supersedes the list disclosed in the Bureau of Ships' letter on May 30, 1953. This may be the last revision of the list since its main purpose has been served, particularly as a valuable supplement to the Armed Services Electron Tube Preferred list (MIL-STD-200).

It is expected that the next revision of the Armed Services list will include several additional types that are now listed only on the Navy Reliable Tube List presented below.

Reliable Tube	*Lower Quality Counterpart*	*Source*	*Specification*
OA2WA	OA2, 6073	Hytron, RCA	MIL 9 July 1953
OB2WA	OB2, 6074	Hytron, RCA	MIL 9 July 1953
5R4WGB[1]	5R4GY, 5R4WGA	Chatham	BuShips 13 March 1952
5Y3WGTA	5Y3GT	Hytron, Sylvania	MIL 25 June 1952
5Y3WGTB	5Y3GT	GE	BuShips 4 Feb 1953
*6AC7WA	6AC7, 6AC7W	GE	BuShips 28 Jan 1952
*6AN5WA	6AN5	Raytheon	BuShips 13 March 1952
6AU6WA	6AU6	GE, Sylvania	MIL 13 Jan 1953
6C4WA[2]	6C4, 6C4W	Raytheon	BuShips 4 March 1952
6153[3]	6C4, 6C4W	GE	MIL 13, Jan 1953
6J4WA	6J4	Sylvania, RCA	BuShips 4 Feb 1952
*6J6WA	6J6, 6J6W	Raytheon, Sonotone, Westinghouse	BuShips 21 Nov 1952
6SK7WA	6SK7, 6SK7W	GE	MIL 13 Jan 1953
*6SN7WGTA	6SN7GT, 6SN7WGT	Sylvania	BuShips 13 March 1952
12AT7WA	12AT7	G.E., Sylvania	MIL 13 Jan 1953
5651WA	5651	Chatham, Raytheon	BuShips 4 March 1952
5654	6AK5, 6AK5W	Raytheon, G.E. RCA, Sylvania, Tung Sol, Hytron	MIL 13, Jan 1953
5670[4]	2C51	G.E., Bendix, Raytheon, Hytron	MIL 13 Jan 1953
5686	——	G.E., Raytheon	MIL 28 Feb 1952
5687WA	5687	Tung Sol	BuShips 13 March 1952
5725	6AS6,, 6AS6W	Raytheon, G.E.	MIL 13 Jan 1953
5726	6AL5, 6AL5W	Raytheon, G.E. Hytron, Tung-Sol, Sylvania, RCA	MIL 13 Jan 1953
5727	2D21, 2D21W	G.E.	MIL 5 Feb 1953
5749	6BA6	G.E., Sylvania, RCA, Hytron, Tung-Sol	MIL 13 Jan 1953
5750	6BE6	G.E.	MIL 13 Jan 1953
5751[5]	128X7	G.E., Raytheon, RCA, Tung-Sol, Hytron	MIL 13 Jan 1953
5814A[6]	128U7, 5814	G.E., Raytheon, RCA, Hytron, Sylvania	MIL 13 Jan 1953
5933WA[7]	5933, 807W, 807	Sylvania	BuShips 13 March 1952
6005	6AQ5, 6AQ5W	G.E.	MIL 13 Jan 1953
6072[8]	12AY7	G.E.	MIL 13 Jan 1953
6080[9]	6080, 6AS7G	RCA	BuShips 5 March 1952

* Since neither this tube nor its commercial quality counterpart is on the Armed Services Electron Tube Preferred List (MIL-STD-200), it is not to be used in new Navy equipment designs.

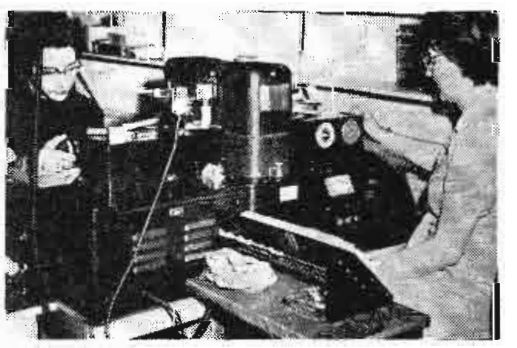
Factors affecting interchangeability:

1. Shape differs from 5R4GY. Same max. dimensions.
2. Bulb is longer than 6C4W, same as 6C4.
3. 6135 draws 1/6 more heater current than 6C4 or 6C4W.
4. 5670 draws 1/6 more heater current than 2C51.
5. 5751 draws 1/6 more heater current. Has lower Mu.
6. 5814A has 1/6 more filament current than 12AU7.
7. Different bulb and larger base than 807.
8. 6072 draws 1/6 more heater current than 12AY7.
9. Different bulb and larger base than 6A7G.

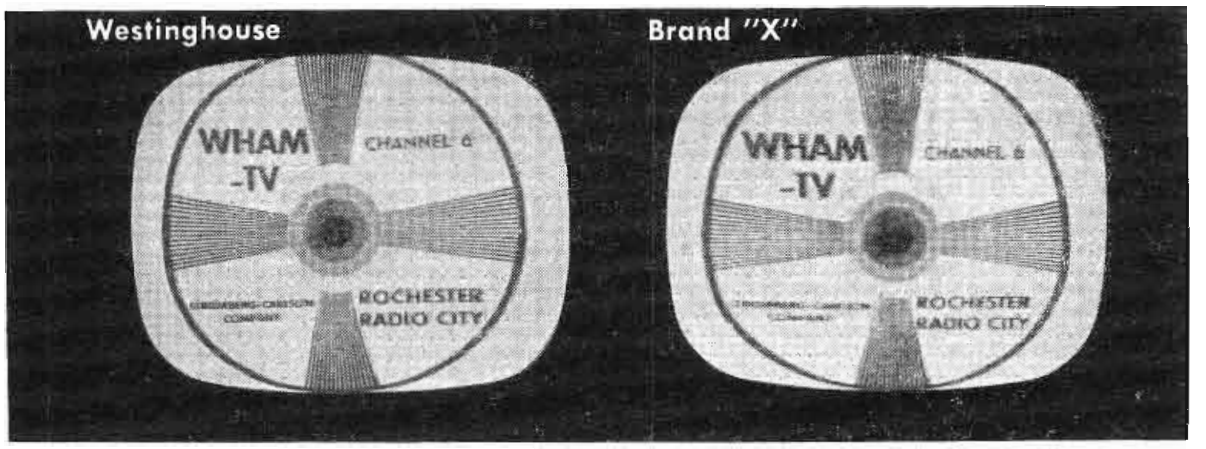
X-Ray Speeds Crystal Production

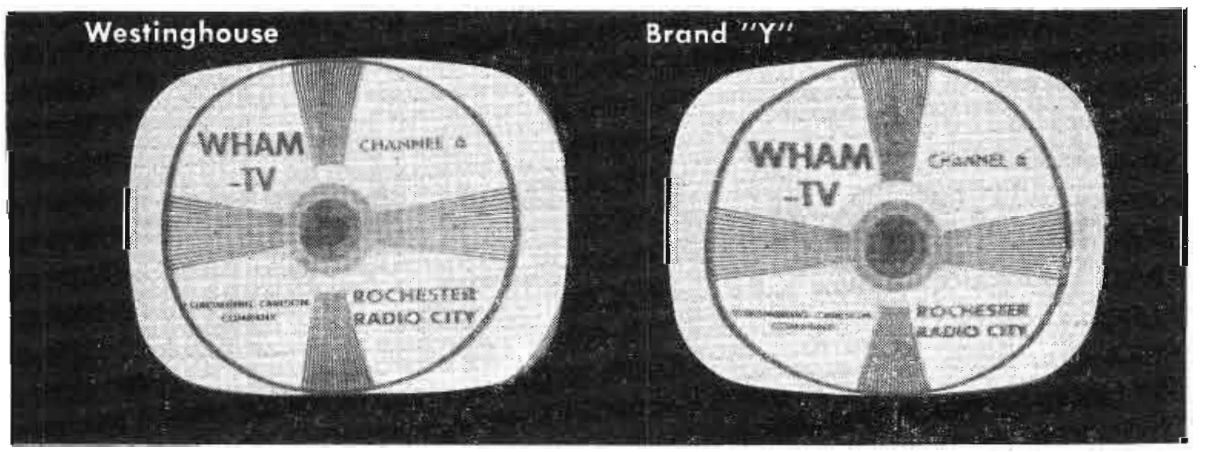
The slightest crystallographic orientation change affects the temperature coefficient of quartz crystal blanks. To classify such blanks, two girls in the Dallons Laboratories, Los Angeles, uses a new dual X-ray orientation unit, developed by North American Philips Co., Inc., which properly feeds the blanks into the X-ray beam at high speed. The blanks are then sorted accordingly to their plus or minus variation from the correct angle.

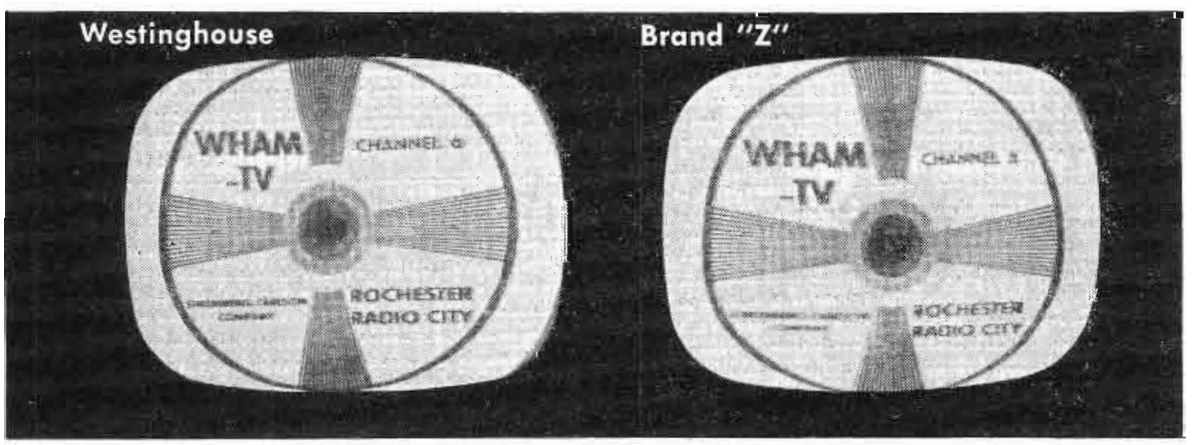
Quartz crystal blanks are classified by two girls in the Dallons Laboratory, Los Angeles, using the new dual X-ray orientation unit developed by North American Philips Co., Inc.



In Westinghouse Electrostatic Picture Tube Gives Better Resolution in Fringe Areas







Check Comparative Resolutions Shown in These Photographs

The greater resolution, finer definition, and better contrast of the Westinghouse tube is obvious on the unretouched photographs on the left. Each photograph shows a Westinghouse tube operating next to a competitive tube in an adjacent chassis. Each pair of pictures is the result of a single photograph with each tube operating under identical conditions.

Westinghouse invites you to perform this or similar tests in any chassis you may choose. Complete data resulting from the Bath, New York, tests on Aug. 15, and Westinghouse laboratory tests is available upon request to Dept. B-210, Westinghouse Electric Corp., Elmira, N. Y.

The following test conditions were maintained throughout all field tests:

Date: August 15, 1953
Location: Bath, New York
Signal: Test pattern from station WHAM-TV, Rochester, N. Y., 70 miles distant.

Tubes Tested: Westinghouse 21YP4 with new electrostatic focus gun and 21YP4's of three other leading manufacturers. All tubes selected at random.

Beam Current: 200 μa
Anode Voltage: 13.5 KV
Screen Voltage: 400 V

ET-95039

RELIATRON™ TUBES

CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

Free Film Available

A new 16-mm sound motion picture entitled "Electronics in Action" is available free of charge from the Raytheon Manufacturing Co., Waltham 54, Mass. The 20-minute film describes the company's activities and many facets of the electronic industry, which developed computers, radar, transistors, guided missiles and home TV receivers. It is narrated by Westbrook Van Voorhis, and shows many action shots. Interested business organizations, schools and club groups should write to Raytheon's Public Relations Department at least 30 days in advance of request date.

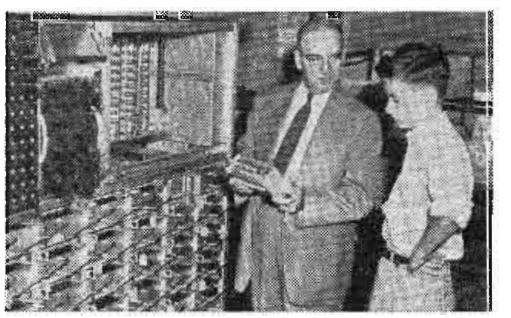
New Battery Eliminates Internal Shorts

A new construction developed by Dr. J. J. Coleman and M. E. Wilke of Burgess Battery Co. promises to provide longer battery life. Batteries of the deferred action type that are activated by contact with liquids tend to short circuit because of local action caused by the activation liquid entering the cell and remaining on the cell surfaces. This forms a bridge between adjoining cells. To overcome this action, open areas are set further apart by staggering every other cell downward, thus increasing the path length that any short circuiting current would have to take.

Cathode Followers for Pulse Type Circuits

Readers of "Designing Cathode Followers for Pulse Type Circuits" by Hollice A. Favors (TELE-TECH, Aug. '53, p. 80) should note the following printer's errors which occurred in the article: diagrams of Figs. 3 and 6 are transposed and diagrams of Figs. 4 and 5 are trans posed.

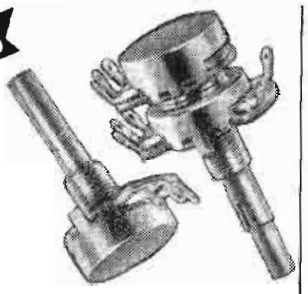
AWARD WINNER



Donald Trumbull, Jr., 15-year-old "Boy genius" of Milford, Conn., who won a national achievement award for building a radio-controlled jeep, is introduced to one of the newest "electronic brains" at Remington Rand's Laboratory for Advanced Research at South Norwalk, Conn., by Jack Herron, assistant to the chief engineer at the Laboratory.

1 VARIABLE RESISTORS

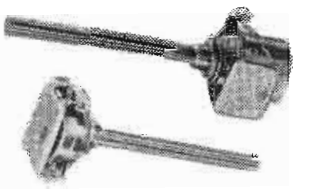
Model 1 Radiohm® Miniature



Model 2 Radiohm

Model 2 Radiohm (including JAN types)

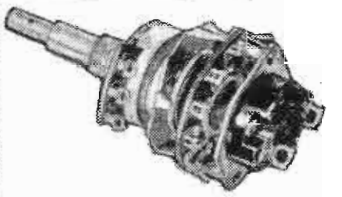
Model 2 EXPRESS (†) for immediate production needs



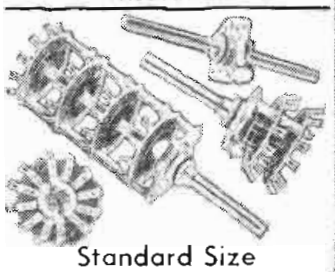
Compentrol (†) Infinitely variable loudness control

2 SWITCHES

Series 20 Miniature Phenolic or Steatite Insulation

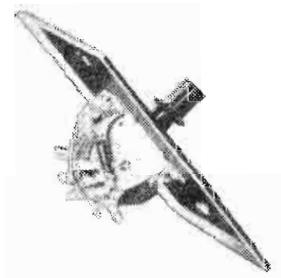


Series 30 Dual Concentric Switches and/or Controls Combinations



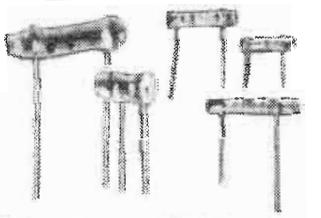
Standard Size Phenolic or Steatite Insulation

Tone Switch



Lever Switch

3 CAPACITORS



BC Tubular TC Tubular

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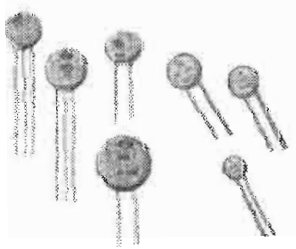
WHETHER you buy electronic components in small lots or by the carload — here's why it's good business to concentrate your five major electronic components problems with Centralab:

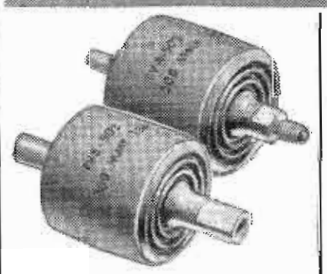
- Centralab has pioneered more electronic "firsts" than any manufacturer in the field.
- Centralab Printed Electronic Circuits offer a new concept in reducing extra parts, assembly-time, errors and costs.
- Centralab ceramics are second to none—available in grade *L5 and L6 Steatite*.
- You can count on the production facilities of *seven* conveniently located plants.
- Continuous CRL product improvement.
- Unequaled engineering assistance for developing specific TV, FM, military and commercial electronic components.

Centralab electronic components are the result of more than 30 years' experience working in cooperation with manufacturers all over the world. For complete performance data and engineering specifications on products shown — check and mail the coupon.

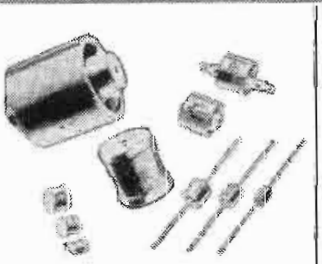
†Trademark



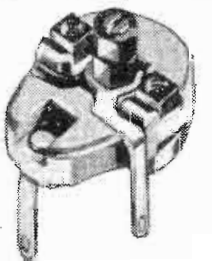
BC Discs TC Discs



TV HI-VO-KAPS®

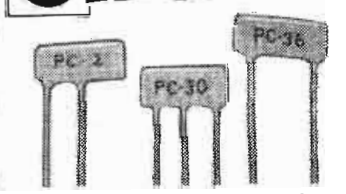


Transmitting Capacitors

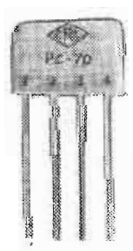


Ceramic Trimmers

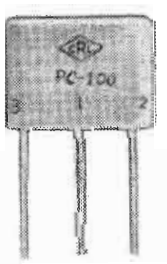
4 P.E.C.



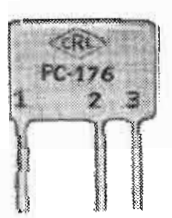
Miniature Resistor and Resistor-Capacitor Units



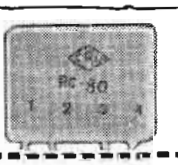
Standard Triode Couplate®

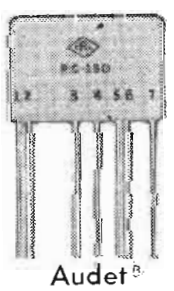


Vertical Integrator



Special Plates to suit manufacturer's requirements





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GE LAB EXPANSION

A $3,000,000 expansion, tripling GE's Electronics Lab, has resulted in new managerial appointments. Key men are (l to r) M. C. Evans, administration; B. R. Lester, advanced products; W. Hausz, techniques and applications; R. N. Gillmor, materials and processes; J. P. Jordan, components; and Lloyd T. DeVore, manager of the laboratory staffed by 278 people

Allied Radio Moves

One of the world's largest plants for the distribution of electronic equipment was placed in operation when the Allied Radio Corp. recently moved into its new $2,000,000 home at 100 N. Western Ave., in Chicago. The two-story structure, with a total area of 147,000 sq. ft., covers a square block in the geographic center of the city. A. D. Davis, president, pointed out that the need for Allied's new facilities was dictated by the phenomenal growth of the electronic parts industry. Allied's 1954 catalog, to be released in September, will list over 20,000 separate items. An increase to 25,000 items is anticipated within a few years. Inventory is controlled by a system of specially designed "Forward" and "Reserve" stock bins. Fully-covered receiving docks at one end of the building can handle four large trailer trucks at once.

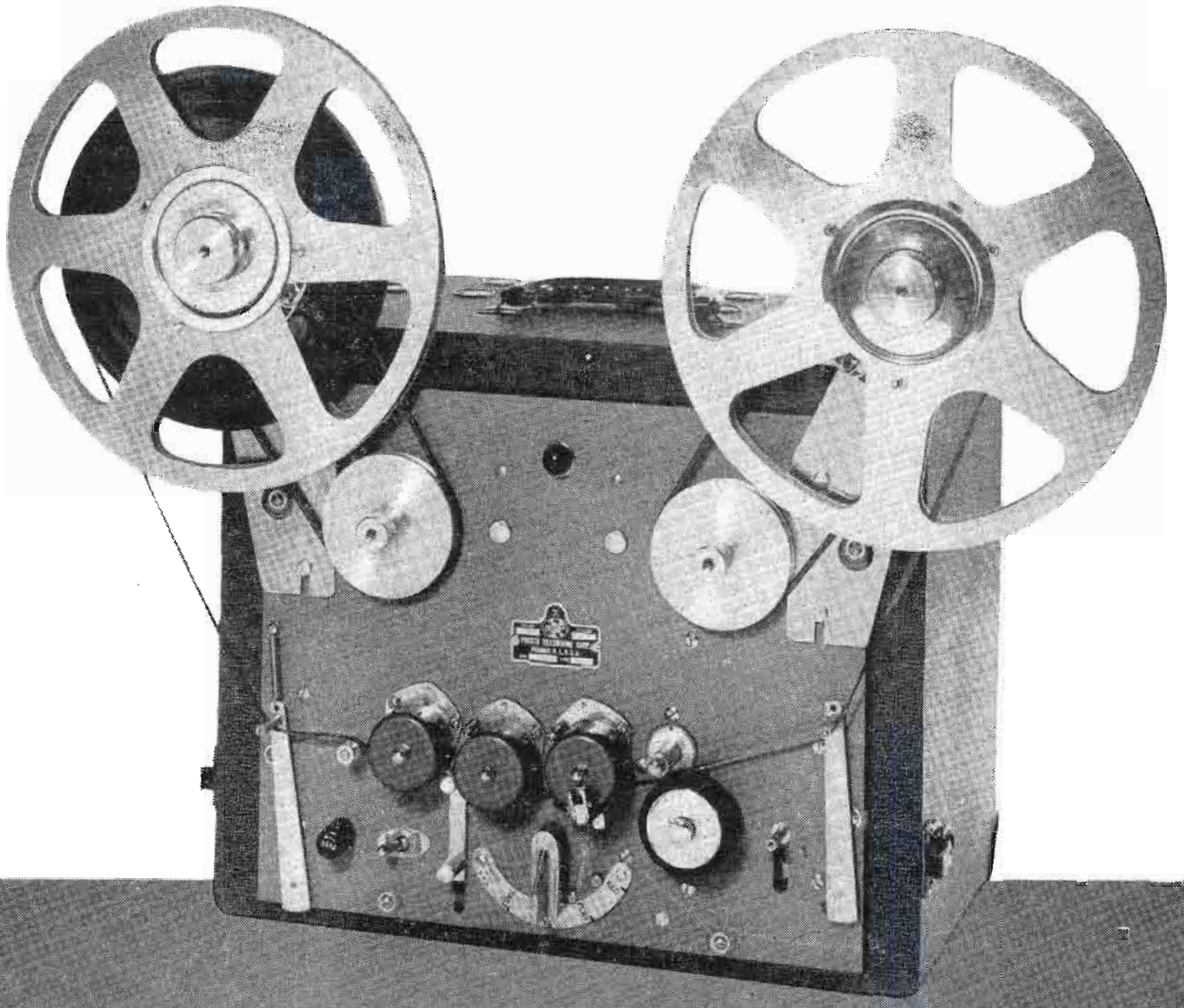
Plant Addition

National Electronics, Inc., industrial tube manufacturers have just completed an addition to the Geneva, Ill., plant that increases the total floor space by 40%. The new building will be used to expand the company's thyratron, rectifier, and ignitron tube production.

New Facilities Available

The F. W. Sickles Div., General Instrument Corp., Chicopee, Mass., are offering new facilities for high-volume toroidal coil winding to tight inductance, balance and "Q" tolerances; the design and assembly of precision wave filters on communication networks; the manufacture of pulse transformers; magnetic memory units, or the design and production of magnetic amplifiers.

you don't buy one of these every day!



PRESTO RC-7 with RA-1 reel adapter

Compare these RC-7 features:

- Instantaneous speed accuracy
- Dynamic range better than 50db. at 3% distortion
- Three-motor drive
- No friction clutch or friction brakes
- Heavy duty construction throughout
- Separate-erase-recording-playback heads
- Twin speed: 7½"/sec. or 15"/sec.
- Frequency response to 15,000 cps.
- Reel size: to 10½" (with RA-1 adapter)

Purchase of a tape recorder is a major investment. And, with so many unproven brands on the market, it simply does not pay to select anything but a recognized, precision built and proven recorder.

The PRESTO RC-7 is just such a unit. Designed and manufactured by the world's foremost producer of precision recording equipment, the RC-7 with RA-1 reel adapter is today's No. 1 buy in fine tape recorders. Here is a unit that is fully portable for field recording, yet with the rugged construction and precision operation characteristic of the finest studio equipment.

If you're planning to replace an existing unit or add an additional tape recorder, your selection of a PRESTO RC-7 will pay long term dividends in faultless service, ease of operation and the genuine satisfaction of owning the best.

Do you own a Presto RC-7? The RA-1 adapter will allow you to use reels up to 10½" diameter. Write for full details and price.

PRESTO RECORDING CORPORATION

PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

Time-Base Generator

(*Continued from page* 85)

tance, since the repetition rate of standard pulse source is 500 pps.

Through the diode matrix selector network any number in each decade can be selected, so that each decade will count up to and including the selected number. The dials are calibrated on the front panel so that the operator can easily select the time interval that he desires.

The time-base generator is presently used as an integral part of the Analog-to-Digital Converter. In this system the time-base generator generates time interval of two seconds.

Slightly modified, the time-base generator can operate as an elec-

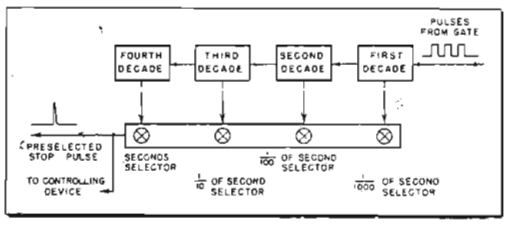


Fig. 7: Counters and diode selector network

tronic timer, for measuring time intervals. To modify the unit to a timer, the start and stop pulse must be supplied externally, either through direct switching or by means of photo cells. The elapsed time (which is the number of pulses counted by the counters) can either be read visually by means of neon bulbs, or scanned and printed on tape by means of scanning and printing devices. This model was exhibited at the Univ. of Southern Calif. Engineering Open House in April 1953.

This electronic timer will be of great value for time and motion study purposes. The unit is not only capable of printing on tape the exact time elapsed for completion of assembly of a certain manufactured part, but in addition, it will automatically record an itemized column of the elapsed time for any detail subassembly of the part.

Also the upper limit of time interval can be increased by addition of more counter decades. For example, by addition of one more counter decade, the capacity can be increased to 100 seconds.

In industrial application the start pulse may come from a predetermined system, and for control purposes, the positive stop pulse generated by the diode network matrix can be used to control or terminate a particular operation under test. It can be used as a controlling device, or, slightly modified, as an accurate time recording unit.

"Color Television"

A special issue containing

• 15 N.T.S.C. Monographs–

The National Television Systems Committee has authorized IRE to publish its long awaited Monographs in the January 1954 special Color Television issue of "Proceedings of the I·R·E" — thus giving them industry-wide distribution for the first time in print.

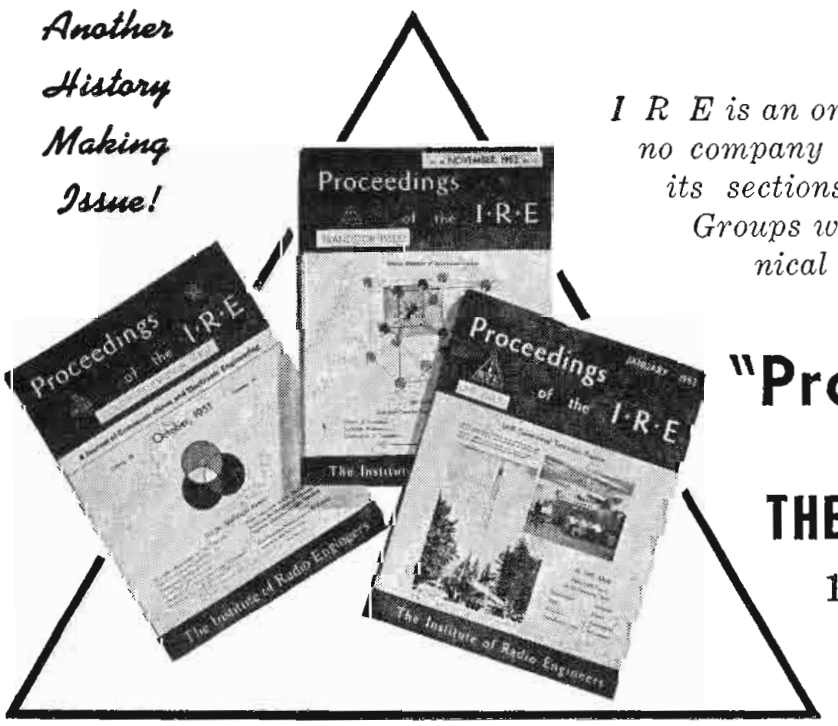
• 25 additional Color TV articles–

will also appear in this issue, which brings the reader up-to-the-minute on the developments of Color Television. Copies of the first Color Television issue are still available and combined with this second Color Television issue will form a complete bibliography of major historical importance. Also included in the January issue will be a complete listing of the N.T.S.C. system specifications as submitted to the F.C.C.; and field test reports on the system's performance.

in "Proceedings of the I·R·E" January '54

Available to non-members for $3.00. Extra copies to I R E members are $1.25. All members get one copy free!

Another History Making Issue!



● ●

I R E is an organization of 33,312 member-engineers. There are no company memberships. Operating continuously since 1913, its sections meet in 78 cities. 21 specialized Professional Groups widen the scope of its member-services and 40 technical committees help the industry.

"Proceedings of the I·R·E"

Published by

THE INSTITUTE OF RADIO ENGINEERS

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Please place orders before December 10th.

Audio Fair Technical Program Set

The annual Audio Fair, which will be held Oct. 14-17 in New York City's Hotel New Yorker, will feature the following technical papers, to be presented at the Audio Engineering Society Convention.

Wednesday, Oct. 14

"Design Factors in Horn Type Speakers"—Daniel J. Plach, Jensen Mfg. Co.
"The Compound Diffraction Projector"—Louis S. Hoodwin, Electro-Voice, Inc.
"Design of a High Frequency Electrostatic Loudspeaker"—Chester Smiley, Livingston Electronic Lab., Theodore Lindenberg, Pickering and Co., Inc., Jerry B. Minter, Measurements Corp.
"Physio-Psychological Factors in Hi-Fi Reproduction"—L. A. DeRosa, Federal Telecomm. Labs.
"CBS Television City Audio Facilities"—Howard A. Chinn, Robert B. Monroe & Charles A. Polmquist, CBS Television.
"New Advances in Language Teaching: The Georgetown University Project"—Morris Lewis Groder, Electrical and Physical Instrument Corp.
"System Design for Multiple Copying of Tape and Disc Program Material"—Robert Winston, Audio & Video Products.

Thursday, Oct. 15

"A New Wide Range Pickup"—John F. Wood, Electro-Voice, Inc.
"Significance of Intermodulation of High Frequencies in Audio Equipment"—Emory Cook, Cook Labs., Inc.
"Effect of High Frequency Pre-Emphasis on Groove Shape"—Jerry B. Minter & Aldo R. Miccioli, Measurements Corp.
"An Analytical Approach to Phonograph Pickup Design"—Walter O. Stanton, Pickering & Co., Inc.
"New Developments and Applications of Printed Circuits"—A. W. Kelley, Jr., Photocircuits Corp.
"New Business Office Dictating Machine with Magnetic Tape as a Recording Medium"—Samuel J. Hyman, Permoflux Corp.
"A New Approach to Professional Magnetic Recording Equipment"—John W. Hines, Magnecord.

Friday, Oct. 16

"A New 30 Watt Power Amplifier"—Frank McIntosh & Sidney Corderman, McIntosh Labs.
"The Design of a High Quality Pre-Amplifier"—Martin V. Kiebert Jr., Consultant to Fairchild Recording Co.
"Audio Automatic Volume Control Systems"—F. W. Roberts & R. C. Curtis, Dictophone Corp.
"The Philosophy of Amplifier Equalization"—H. H. Scott, Herman Hosmer Scott, Inc.
"Decorating the Home with Music"—R. J. Tinkham, Ampex Electric Corp.
"A Composite Recording System for Studio or Hi-Fi Applications"—Oliver Read, *Radio & Television News*.
"Enhancing the Listening Qualities of Highly Damped Small Rooms and Studios"—Paul Weathers, Weathers Industries.
"Audio and Interior Decor"—Jeff Morkell.
"A Preliminary Report of Group Listener Reactions to Binaural Sound Reproduction"—H. T. Sherman, Sherman Studio.

Saturday, Oct. 17

"Stereophonic Realism"—Col. R. H. Ranger, Rangertone, Inc.
"A Sterodynamic Multichannel Amplifier of New Circuit Design for Single or Binaural Input"—John Nigro, Madison Radio-Sound.
"Multi-Channel Sound Reproduction"—Wolter T. Selsted, Ampex Corp.

New Quarters

Audio-Master Corp., manufacturers of three-speed record and transcription players, has moved to larger quarters at 17 East 45th St., New York 17, N. Y.

For Immediate Delivery

Mr. J. D. McCall, vice-president Mitchell Camera Corp., 666 W. Harvard St., Glendale 4, Calif., recently announced the availability of Mitchell professional motion picture cameras for immediate delivery.

WCEMA Award Winner

Thomas L. Davis, Sutter Creek, Calif., has been chosen winner of the first California State Polytechnic College Scholarship established by WCEMA this year. Davis' outstanding high school record, exceptionally high score on the competitive achievement examination and demonstrated interest in radio and electronics, were major factors in making this award. Comprised of over 150 west coast industries producing electronic equipment, the association's scholarship committee chairman Noel E. Porter said, "Cal Poly is doing a grand job of providing electronic engineers for industry. We hope to continue this scholarship program from year to year and have more scholarships available in the future."

Engineers Wanted by Air Force and Army

The Rome Air Development Center has challenging jobs at salaries from $5040 to $9600 a year in all phases of electronic research and development, and in the installation and maintenance of radio, radar, and wire communications equipment. Address Professional and Scientific Recruiter, Rome Air Development Center, Griffiss Air Force Base, Rome, New York, or phone Rome-3200.

At the Signal School at Fort Monmouth, New Jersey, the United States Civil Service Commission announced an urgent need for instructors (guided missiles, radio, wire, radar, and photography). Experience in an appropriate field, or education and experience is required for most positions. For positions paying $3,410 a year, appropriate education alone may be qualifying. No written test is required. Full information may be obtained at many post offices throughout the country, or from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted by the Board of U. S. Civil Service Examiners, Headquarters, Signal Corps Center and Fort Monmouth, Fort Monmouth, New Jersey, until further notice.

ACE & RFI Amalgamate

Ace Engineering & Machine Co., Inc., and RFI Shielded Enclosures Corp., both of Philadelphia, Pa. have announced their amalgamation. Both companies are engaged in the manufacture of shielded enclosures or rooms for use in suppressing r-f interference.

Delay Lines

(*Continued from page* 108)

pedance into which the amplifier works must be reduced. From an analogous viewpoint, it is apparent that low impedance delay lines inherently will permit wider bandwidth circuitry than high impedance lines.

In military applications where equipment must work over very wide temperature ranges, the effects of temperature upon delay line characteristics assume major importance. Poor temperature characteristics stem from variations in inductance and capacitance over the temperature range. Inductance varies due to (a) the coil form diameter changing dimensions and (b) the variation in the effective length of the coil due to wire expansion. Capacitance changes are due to variations of (a) dielectric constant, (b) size of ground plane, and (c) in lumped-constant lines, the basic temperature tolerances of the fixed capacitors use.

In coaxial delay cables and distributed constant lines, all of these factors have an effect, and all are uncontrolled variables. It is very difficult to control inductance and capacitance when these arise as the result of relatively random coil winding techniques and plastic extrusions. In the case of lumped constant lines, the inductance is small and therefore does not vary to the extent of other types. Furthermore, the small ratio of L to C minimizes the effect of variations in L on over all delay.

Capacitors in lumped-constant lines have a very large effect on delay variations with temperature. However, by careful choice of low temperature coefficient capacitors, it is possible to reduce temperature variation effects from this cause to negligible amounts.

Applications

Among the more common applications for delay lines may be included the following:

(a) Pulse-forming networks
(b) Radar delay networks
(c) Signal delays in oscilloscopes and other test equipment
(d) Pulse delays for television synchronizing signal generators
(e) Coincidence and memory circuits in computer operations
(f) Wideband amplifiers of the distributed amplifier type
(g) Pulse delay measuring equipment
(h) Frequency control feedback networks for oscillators
(i) Compensating delays for color TV equipment

(j) Pulse code modulation systems.

Fig. 8 illustrates a delay line used as the control element of a blocking oscillator pulse generator. In this application the pulse width depends upon the delay line rather than tube or transformer characteristics. Using a delay line makes it possible to obtain much more accurate pulse widths than could be made available by other means. Either open circuit or short circuit types of line may be used for this application.

Negative Pulse

In the circuits shown, the grid current due to blocking oscillator action causes a negative pulse to appear at point "A" with respect to ground. This pulse travels down the open-circuited delay line and is reflected back with the same polarity. Therefore, after a period of time corresponding to twice the one-way delay of the line, point "A" abruptly becomes more negative. This negative-going reflection is coupled through the transformer coil to the grid of the blocking oscillator causing it to end the blocking oscillator action. Hence, an output pulse is obtained whose width is exactly twice the one-way time of the delay line.

Fig. 9 is a typical pulse forming circuit utilizing a gas triode. Upon the application of a positive signal to the grid, the triode ionizes, causing conduction. The plate voltage goes negative at a very rapid rate, sending negative pulse wavefronts down the line. Upon reflection from the end of the open-circuited line, the returning pulse wavefront is also negative. When this reflected signal reaches the plate of the gas tube, the summation of the incident and the reflected wave is sufficient to drive the plate below ground potential, causing the gas tube to cease firing. Again, in this case, the output pulse width is exactly twice the one-way delay time of the line.

Due to the firing characteristics of gas tubes, this type of circuit is substantially independent of the signal appearing on the grid of the tube as long as this signal is shorter in duration than the output pulse width desired. Such a waveform may readily be obtained by simple differentiation as shown.

Similarly, at the end of the input pulse, point "B", the vacuum tube is abruptly cut off; thus sending a positive wavefront down the line. This, in turn, is reflected back as a negative front causing generation of pulse C.

Fig. 10 shows a typical multivibrator circuit using a short-circuited delay line. If tube B suddenly starts

conducting, its plate voltage swings negative at a rapid rate, driving the grid of tube A negative. We then have a negative wave front traveling down the short circuit line. As the grid of tube A goes negative, its plate in turn goes positive, coupling a positive wave front to the grid of tube B and accelerating the operation. Normally, tube A would remain cut off for a period determined by its grid resistance and the grid coupling capacitor. However, with the short-circuited line, the negative wave front traveling down the line is reflected as a positive wavefront turns tube A on and again initiates multivibrator action. The waveform at the plate of tube B then is a very accurately timed negative pulse as shown at C.

For some applications, it is desirable to apply trigger pulses to one of the multivibrator grids. In such a condition, the delay line would normally be of the open-circuited type connected in a manner similar to that shown in Fig. 9 for the gas tube type of pulse generator.

Future Uses

One of the most promising future uses of delay lines occurs in wideband distributed amplifiers. Using these techniques it is possible to obtain amplifiers having bandwidths in excess of 200 MC. A typical circuit is shown in Fig. 11.

If a positive pulse is applied to the input of the grid line, delay line 1, V1 will present a negative pulse at its plate. A short time later, equal to the delay of the line section labeled "A", the positive pulse will reach the grid of V2 and it in turn, will have a surge of plate current providing a negative pulse at its plate. At this same instant the negative pulse of V1 delayed by the line section labeled B has just reached the plate of V2 and, therefore, the two tubes have reinforced their plate current signals.

Cascading Amplifiers

By carrying this process on down through the other tubes, it is possible to obtain an output which is N times the gain of the individual stages where N is the number of stages. In this manner it is possible to cascade amplifiers without their internal capacitance reducing the effective load impedance to such a value that the gain is negligible. The capacitance elements of these lumped-constant lines are generally

provided by the tube capacities in shunt with small tunable capacitors. Delay lines for this application must have bandwidths in excess of that required by the distributed amplifier itself.

One application of a delay line to a TV synchronizing signal generator is for accurately determining the width of the serrations in the vertical synchronizing pulse for equalization

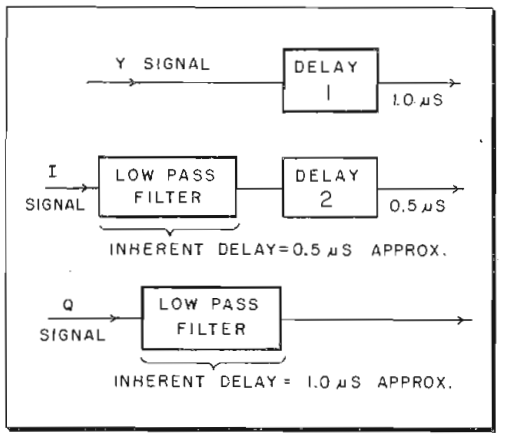


Fig. 12: NTSC color system using delay lines to compensate for inherent filter net delay

purposes. The basic frequency source is used to start the pulses with a delay line used to determine cutoff width.

The use of delay lines for compensation in the NTSC color TV system is illustrated in Fig. 12. In the NTSC color system, the color information is retained within the normal 6 MC monochrome channel. In accomplishing this, use is made of the fact that the eye does not require definition in large color areas in terms of color. It is sufficient to have black and white detail with a color "wash". For this reason the color channels are transmitted in relatively narrow bandwidth channels. In the receiver, filters are used to control these color channel frequency responses. Since all filter networks have delay line characteristics, the color channels do not arrive at the indicator tube at the same instant as the Y or luminescence (black and white detail) channel which has no low-pass filter. For this reason it is necessary to add delays to the Y and I channels to make all three channels appear simultaneously at the output.

The use of a delay line to delay the signal applied to an oscilloscope is illustrated in Fig. 13.

In information transmission systems of the pulse code modulation type, delay lines are frequently used to determine whether a particular group of pulses occur in the correct time relationship.

It is necessary to have a common ground when discussing delay line characteristics. Some specification

and measurement information is required. To simplify the discussion, this section will be concerned primarily with lumped-constant lines.

The most important characteristic of a delay line is the overall delay. In general, delay time means the time it would take for a pulse impressed on the sending end of the line to reach the receiving end of the line. The sending end is defined as the driven end and the receiving end as the termination end. If a short or open circuited reflective line is desired, the overall delay is the round trip time. This, of course, is twice the one-way delay of the line.

The above characteristic would let both the manufacturer and user of a delay line know accurately the value of the overall delay, if the pulses at the sending and receiving ends were both perfect (i.e. both having very short rise times). However, in most delay line applications, the pulses at the terminating end have some form of distortion since no line has infinite bandpass. In general, most reference to delay time is to the time between 50% points of the initiating pulse and the pulse at the end of the line.

Methods of Measurement

Several accurate methods of measuring delay exist. One measuring technique involves the use of a sine wave generator and an oscilloscope. The delay line is driven by the sine wave generator, and the oscilloscope is used to measure the phase shift through the line at a given frequency by use of Lissajous patterns. Since time is a reciprocal of frequency it is only necessary to determine the lowest frequency that is shifted 360° by the delay line, and the reciprocal of this frequency is the delay time.

This test is valid as long as certain precautions are observed. The frequency in question must be within the bandpass of the line, i.e. this frequency must not be higher than 95% of the cut-off frequency of the line. (Note: Phase shift, generally speaking, is linear with frequency up to 95% of the cut-off frequency.)

Another common method for measuring delay involves the use of a pulse generator and oscilloscope. The pulse generator is used to drive the delay line while the oscilloscope is used to examine both input and output pulses. For relatively rough time measurements the sweep calibrations of the oscilloscope may be used. However, due to parallax effect and nonlinearities in the sweep of

most oscilloscopes, accurate time measurement can not be made directly in this manner. These disadvantages may be overcome by the use of an accurate time mark generator. In general, most manufacturers and design engineers prefer to have delay lines designed against a standard which works satisfactorily in their equipemnt.

In lumped-constant lines it is feasible to hold relatively close tolerances. For example, a tolerance of ± 0.01 μsec is readily held on a ¼ μsec line. With a line having a delay in the order of 10 μsec, a tolerance of ± 0.05 μsec is considered normal. Similarly, for even longer lines such as 25 μsec, ± 0.1 μsec is standard. It is possible with lumped-constant lines to hold even closer tolerances than the ones mentioned. However,

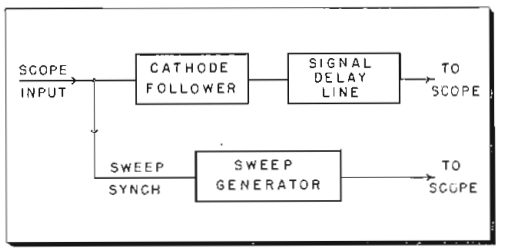


Fig. 13: Oscilloscope input arrangement using delay line so that leading edge may be visible

as the tolerance is tightened, the manufacturing cost of the delay line increases.

The characteristic impedance of a line is defined as that impedance which placed across the end of the line gives the line identical characteristics to one which would be infinitely long. This may be rephrased to say that the characteristic impedance of the line is that impedance, which upon being connected across the output of the line acts to prevent any reflection. This is the condition required for perfect match. Although it is possible to measure the absolute value of the terminating impedance, it is impractical to hold an absolute value. Normally, impedance tolerance is held to $\pm 5\%$.

The minimum required bandwidth must be specified since this factor influences design considerations. It is well to note at this time that the rise time of a line is synonomous with the bandwidth of the line. Minimum required bandwidth (MC) is approximately equal to 0.4 divided by the desired rise time (μsec) of the delay line.

As was stated previously, the delay lines discussed in this article are the basic electromagnetic types. There are numerous other schemes for accomplishing these results, but none has yet attained the status of the basic types described.

Core Materials

(*Continued from page 89*)

Since core materials are generally used in alternating fields, their ac characteristics are more conclusive for evaluation purposes than are the dc characteristics. Alternating current characteristics, particularly, have to incorporate the losses which occur in a material. Core losses of various materials, in watts per pound, are presented in Fig. 2 with flux density as the ordinate. Frequencies, materials, and lamination thicknesses appear as parameters. It should be noted that in this representation, in which losses are given in watts per pound, ferrites are penalized because of their lower specific gravity. A comparison based on the losses per unit volume would make the advantages of ferrite materials at high frequencies more apparent. Even in the comparison on a watts per pound basis shown in Fig. 2, Ferroxcube III B appears clearly superior at 100 kc. This advantage is particularly great at low flux densities.

General Evaluation

Loss figures, alone, do not characterize a material and cannot be used for general evaluation. They have to be supplemented by other data such as exciting volt-amperes per pound. These characteristics are plotted in Fig. 3, which corresponds in representation with Fig. 2.

A suitable combination of both the losses expressed in watts per pound and the apparent watts expressed in exciting volt-amperes per pound can provide a figure of merit which may be used for the evaluation of materials. It should be noted that the smallest possible losses and exciting volt-amperes are desired for a given flux density. Hence, a single figure of merit can be derived by adding the losses of in-phase volt-amperes and the exciting volt-amperes. Such data are plotted in Fig. 4, which corresponds to Figs. 2 and 3 in representation. Materials with the lowest volt-ampere figures for a given frequency and flux density have to be rated highest in this diagram.

Figure of Merit

It must be emphasized that no particular physical meaning is attributed to the figure of merit thus derived. For simplification, volt-ampere vectors ("Phasors") are arbitrarily added as scalers. It should be realized that a figure of merit is, in general, more or less arbitrary

and that its limitations should be studied in order to avoid misleading results. The meaning and possible limitation of the figure of merit, as proposed in the previous paragraph, can be understood better by noting the presentation in Fig. 5 where the locus is depicted for all exciting volt-ampere vectors for which the figure of merit is equal. This locus represents the exciting volt-amperes of all materials which would have to be rated as equal. The intersection of the locus with the reactive axis represents a material without any loss but with a rather low permeability. These conditions can be approximated with powdered core materials. The intersection of the locus with the in-phase axis represents a material with rather high losses but with a permeability of infinity because no magnetizing current is required to give rise to a certain assumed flux density. This type of material can be approximated by a perfectly cut single crystal of pure iron.

Characteristics of those materials which have extremely small or great phase angles are not available and hence could not be incorporated in Fig. 4. Even sufficient data on ferrites are not yet available. The materials which are represented in Fig. 4 differ only slightly in characteristics and the figures of merit plotted there should provide a suitable base for evaluation of laminated core materials.

Total Loss Component

At very low flux densities, such characteristics as are presented in Figs. 2 through 4 are not very practical. Instead of exciting volt-amperes and power losses, reactive and resistive components of impedance are used to characterize inductors and core materials. Expressing the total loss component of an inductor by an equivalent series resistance R_s, the loss tangent $\tan\delta = R_s/\omega L_s$ relates the resistive component R_s to the reactive component ωL_s. The expression for $\tan\delta$ is also denoted as "dissipation factor" D or the reciprocal of the "quality" or "storage" factor Q. At high Q values the power factor

$$\text{Cos } \varphi = 1/\sqrt{Q^2 + 1}$$

becomes equal to the dissipation fac-to,r, hence, it can be written:

$$\tan\delta = R_s/\omega L_s = D = 1/Q \rightarrow \text{Cos } \varphi \quad (1)$$

The total series resistance R_s is composed of a component R_c which represents the effective series resistance originating in the coil and of a component R_m which represents an

CORE MATERIALS (Continued)

effective series resistance that is caused by the losses in the magnetic core. This can be written:

$$R_s = R_c + R_m$$

$$\text{or } \frac{R_s}{\omega L_s} = \frac{R_c}{\omega L_s} + \frac{R_m}{\omega L_s} \qquad (2)$$

It has been shown by various authors that the loss tangent of a ring core is independent of core dimensions and even independent of the inductance L.[12] For this reason, the loss tangent $R_m/\omega L_s$ which is derived from a closed ring core becomes a practical factor for characterizing material losses.

Part Two will appear in the November issue.

Telechrome Expands

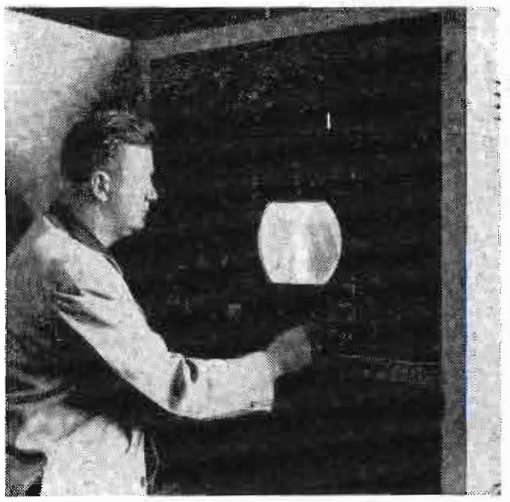
Telechrome Inc., has just opened a second plant to meet the urgent demand for station color TV conversion equipment. According to President J. Raymond Popkin-Clurman, with Color TV programs about to go on the networks, Telechrome is now producing and delivering the equipment necessary to convert network stations for color pick-up and broadcasting."

Industrial TV Speeds Steel Production

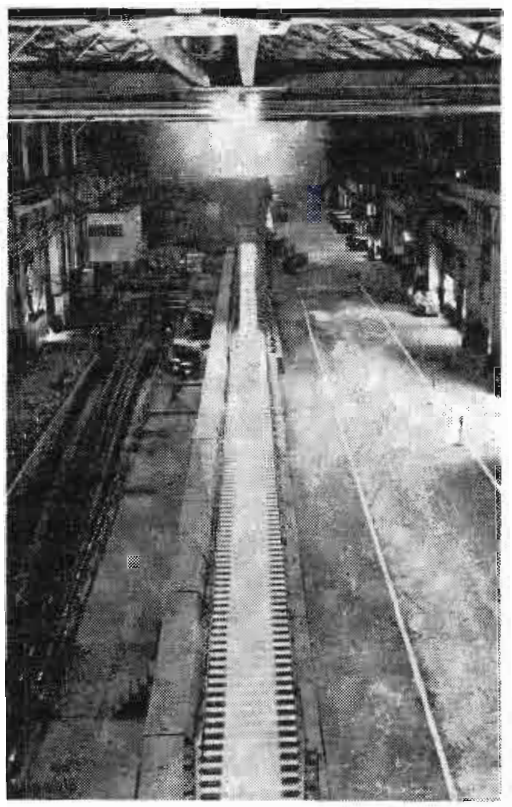
In one of the first installations of its kind, the United States Steel Corp. has set up an industrial TV system in the 80-inch hot strip mill at Gary Sheet and Tin Mill, Gary, Ind. The TV camera is mounted in the rafters 48 ft. above the block-

Operator Raymond Mitchell keeps close check on TV screen for potential production trouble

long runout table, and scans a distance of 395 ft. A continuous picture of the progress of the fiery red



Engineer Irving Pitchford inspects TV monitor which is part of installation at steel plant



TV camera in rafters follows progress of steel strip traveling along block-long runout table

steel strip as it travels from the finishing stand is fed to a 10-inch receiver. An operator watching this screen can spot potential trouble almost instantly.

Assets Purchased

Announcement was recently made that the name and a substantial portion of the assets of The Sealtron Co., manufacturers of hermetic seals and electronic sub-assemblies, has been purchased by Mr. William C. Sage, president of the new Sealtron Corp., 9701 Reading Rd., Cincinnati, Ohio. All manufacturing facilities and executive offices will be located in the new building completed a year ago at the same address.

Time Delay Relay

(*Continued from page 96*)

during the closed switch condition. Since only one unit is ever used at one time, the additional drain during operation is about 4 or 5 ma. The time delay is sensitive to supply voltage amplitude. A dc source of 150 volts regulated by a VR-150 was available. (See Fig. 8.) The time delay is also sensitive to filament variations. A resistor in series with filament reduces the voltage to about 5.5 v. which places the characterisitics in a slightly more favorable position, as well as increasing the tube life. The ±10% filament source variation will give a ±0.25 second change in time delay.

Molded Assembly

A resistance of 250 megohms placed between grid and plate will reduce the long time delay from 6 to 5 seconds. To protect the unit from this effect when subjected to humidity, all the components were molded in a plastic assembly in which the tube socket is imbedded. A metal can is placed over the entire unit with a rubber seal giving

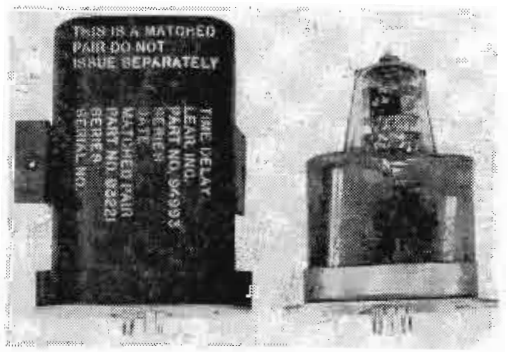


Fig. 9: Metal can protects tube and socket

added protection to the exposed portions of tube and tube socket. See Fig. 9.

Life tests indicate that 1000 hours of operation may be had before the circuit falls out of the acceptable limits.

Conclusion

Any evaluation or comparison of the method selected to obtain the results required should take into account the restrictions of operation which were inherited from the previous method. The space, form factor, power available, and external circuitry were fozen for production at the time the new method was requested. The results indicate that a better solution has been reached. for the majority of the problems of temperature, relay operation and interchangeability remain for other solutions using only passive elements. Furthermore, the switch

contacts are no longer subjected to the currents originally encountered.

The circuit stability may be further insured by use of certain new plastic dielectric capacitors which are free from the "memory" effect evidenced by dielectric absorption. The use of reliable subminiature tubes and a two stage feedback amplifier might increase the usable life and decrease the sensitivity of the circuit to environmental variations without increasing the package size.

GE Resumes "Voice" Broadcasts

Robert B. Hanna, manager of General Electric Co. broadcasting stations, announced that programs beamed at Latin America are being resumed from GE shortwave station KGEI in San Francisco. KGEI suspended broadcasting June 27, after the Federal government curtailed the Voice of America program. The 50-kw station had been America's voice in Latin America and parts of the Far East for 11 years. Programming is being resumed on a three-hours-a-day basis under the non-commercial sponsorship of GE. The company has decided to replace the former government-sponsored programs because of the continued need for good will and understanding among the peoples of the world.

Israel Expands Communications System

Israel's system of communications, which for almost 15 years has functioned without the benefit of new equipment, is being expanded and modernized with the assistance of investment capital derived from the State of Israel Bond Issue. Among the first projects completed was the telephone exchange at Tel Aviv, which brought the total to 66 throughout the country. Israel now has direct telephone communications with 50 nations, compared with four countries in 1948.

Newspapers in Israel will utilize the service of teleprinting equipment, which is being installed in both Jerusalem and Tel Aviv, for the reception and transmission of news items. In addition, the installation of a chain of radio dispatch machines in military and police headquarters has begun.

Another development is the installation of a 50-kw transmitter for the Voice of Israel. The transmitter and other new equipment, such as tape recorders, phonographs and control consoles will be ready in a few weeks.

News of MANUFACTURERS' REPS

Gawler-Knoop Co., manufacturers' representatives, announce the appointment of three new staff members. J. H. Ewing, formerly with Sperry Gyroscope, will work out of the company's Silver Spring, Md., office; William O'Meara, formerly with Allen B. Du Mont Labs., has been assigned to the Wyncote, Penn., office; and Erle Renwick, formerly with Ballantine Labs., will work out of the main office in Roseland, N. J. The new members will specialize on the application of electronic test equipment.

Jack Gaertner, former vice-president of Electronic Corp. of America, has organized the Jack Gaertner Co., with headquarters at 7711 Hawthorne Ave., Miami Beach, Florida. The new concern will specialize in the representation of TV, electronics, and appliance manufacturers.

Kingdom Products, Ltd., 45 West 45th St., New York 36, N. Y. have been appointed exclusive distributors for Lorenz high-fidelity loudspeakers in the U.S.

Clark R. Gibb, 1409 Hennepin Ave., Minneapolis 3, Minn., has been appointed to serve as sales representative for Utah Radio Products Co. He will call on jobbers, industrials and manufacturers, in North and South Dakota, Minnesota, and western Wisconsin.

Kay Sales Co., 3760 Broadway, Kansas City, Mo., is now representing Halldorson Transformer Co., in Iowa, Kansas, Missouri, and Nebraska.

Adolph L. Gross Assocs., Inc., 45 W. 45th St., New York 36, N.Y., have become sales representatives for Wilcox-Gay Corp., Charlotte, Mich., tape recorder producers in the Metropolitan New York area.

Arnold L. Robertson and **J. A. Terpenning** have been named sales representatives for Thor Foundry Products, Borden Company's chemical division, to specialize in bonding and shell molding resins. Mr. Robertson will cover the Ohio area. Mr. Terpenning has been assigned to the New York-Northern Pennsylvania area.

General Instrument and Appliance Corp. announces new regional sales representatives as follows: Milton R. Benjamin, 1746 East 47th St., Brooklyn 34, N.Y. will cover New England and New York State; Albert D. Leban and Wilfred Graham, 218 Lloyd Lane, Phila. 31, Pa. will cover southern New Jersey, eastern Pennsylvania, Maryland; and Washington, D.C. James Podolny, 4716 Coleridge St., Pittsburgh 1, Pa., will serve western Pennsylvania, Ohio, and West Virginia. Eugene Loeb, 5052 North Shoreland Ave., Milwaukee 11, Wis., will cover Wisconsin. William Linz will serve northern Illinois. L. F. Waelterman, 3938 Lindell Blvd., St. Louis 8, Mo., and his associate, A. S. Engelman, 2718 Linwood Ave., Kansas City, Mo.,

will cover southern Illinois, Missouri, Iowa, Kansas, and Nebraska. R. C. Nordstrom, Davis Bldg., Birmingham, Mich., will serve Detroit and all of Michigan. Robert C. Whitesell & Assoc., 2208 East Washington St., Indianapolis 1, Ind. will cover Indiana and Kentucky. James J. Bacher, 2321 Second Ave., Seattle 1, Washington takes over Washington, Oregon, western Idaho, western Montana, and British Columbia.

Earley Sales Co., 10 Hemlock St., Paterson, N.J. has become the exclusive agent for the sale of electrical tapes to electrical wholesale distributors in the five boroughs of New York City, Westchester, and northern New Jersey for the United States Rubber Co.

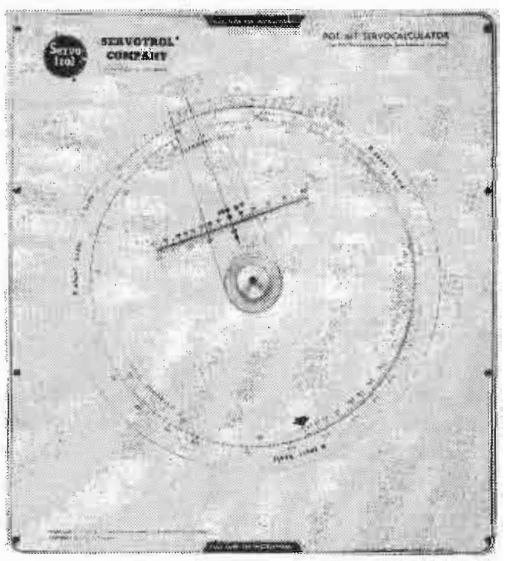
Russell Ragon, presently located at 1406 Idaho Ave., St. Paul, Minn., has been appointed industrial and jobber representative for the United Transformer Co. to cover Wisconsin and Minnesota.

W. T. Brase, 5604 Kentucky Ave., Fort Wayne, Ind. has been appointed exclusive Indiana representative by Astron Sales Corp. to sell capacitors and filters to jobbers and distributors.

Kaelber & Mack, 1270 Broadway, New York, N.Y., will represent the Perma-Power Co., in the Metropolitan New York area and surrounding counties.

Best Electronics Corp., Los Angeles, announces the appointment of the following sales representatives: George Davis Sales Co., So. California, Arizona, and So. Nevada; Sherwood P. French, No. California, and No. Nevada; Frank W. Rauer, Ohio, W. Pennsylvania, and W. Virginia; Fred H. Larrabee Co., Iowa, Kansas, Missouri, Nebraska, and Oklahoma; Gordon G. Moss, Colorado, Utah, Wyoming, and New Mexico; Mac Peterson, Hawaii; Lewis Slubin, E. Pennsylvania, So. New Jersey, Delaware, Maryland, and District of Columbia; Royal A. Stemm, Illinois, Minnesota, and Wisconsin; Walter W. Bieberich, Indiana, and Kentucky.

New Servocalculator



The Servotrol Co. of Chicago announces the availability of a disc calculator for computing the combined potentiometer resistance and shunt resistor values, required in converting a linear potentiometer to a nonlinear function. Further details available from Servotrol's Eastern Branch Office, Framingham Centre, Mass.

DC Selsyns

(*Continued on page* 101)

that the resistance of the leads connecting the transmitter and indicator can be made equivalent to the resistance of 20 miles of #20 AWG wire and the only noticeable effect is a degree or two increase in friction error. Satisfactory remote indication over distances greater than this can be accomplished providing some method is used to mechanically vibrate the indicator and thus remove most of the friction error.

Fig. 1 shows a photograph of a variety of position indicators and a typical transmitter of the three-wire dc selsyn type. The indicator shown with three pointers is used when it is desired to locate three related indications in a single case.

Two-Wire DC Selsyn

There are several variations of the two-wire system in use. but only two will be described here. Fig. 5 shows a schematic diagram of the type of system used in float-type liquid-level gages. The transmitter element consists of a simple resistor wound on a circular form. Unlike the transmitter for the three-wire system, this transmitter element has only one rotatable brush making contact with the winding. It is best described as a potentiometer-type transmitter element with adjustable taps at each end of the usable portion of the winding. These taps are made adjustable so that the calibration of the end-points on the scale can be varied to correspond with the empty and full positions of the float in the liquid which is being measured. The rotatable brush is driven through a suitable gear mechanism by the movement of the float in the liquid.

Indicator Element

The indicator element consists of a magnetized rotor that is surrounded by an aluminum damping cylinder which also serves as the frame for the element assembly. Two actuating coils are mounted on the circumference of the damping cylinder. These coils are spaced approximately 140° from each other with their flux axes radial to the cylinder. The entire element is enclosed by a cylindrical shield of high permeability. The purpose of this shield is to provide a return path for the internal magnetic fluxes and to minimize interference from extraneous magnetic fields. The element operates on the principle of maintaining one coil energized at approximately a constant value and varying the current in the other coil from zero to a maximum value.

With only the one coil energized, the magnetized rotor aligns itself with the magnetic flux produced by this coil. As the transmitter brush rotates, the second coil is energized, and the rotor aligns itself with the resultant magnetic flux which is represented by the vector sum of the fluxes produced by the two coils. (See

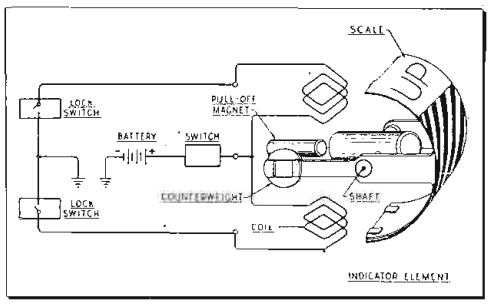


Fig. 7: Three-position dc annunciator

Fig. 6 for vector diagram.) Thus, the pointer moves from the empty to full position as the change is made from a single excited coil to the maximum excitation of the two coils. The resistance in series with the positive lead simply acts as a protective resistor in order to prevent damage to the circuit in the event that any of the transmitter leads are grounded or short circuited. The second resistor determines the scale length. This is evident, since the current through the second coil can be varied by changing the value of this resistor, and the change in current in the coil affects the position of the resultant flux vector by varying the magnitude of one of its components.

Vector Diagram

It is observed from the vector diagram shown in Fig. 6 that the scale length of the indicator is limited to 90°. This fact, coupled with the small size of the indicating element, makes it possible to mount two of them side by side in a 2-in. diameter instrument case.

Flap Positions

The second type of two-wire system is similar to that just described except that the transmitter is an ordinary potentiometer, usually of the 500 ohm size. This system finds general use in indicating flap and trim tab positions. In some aircraft applications, it is necessary to incorporate the transmitter within the actuating unit. Generally, however, space limitations dictate that the actuator be as small as practical and in this instance a potentiometer is frequently used. This is one of the prime advantages of this system and many times is the reason for using

it in preference to other systems. Of course, another advantage lies in the need for connecting only two wires from the transmitter to the indicator.

DC Annunciators

This classification covers a line of indicators which are operated by switches. The transmitting element generally consists of a single-pole double-throw switch. Two leads connect it to an indicating element which is better known as a three-position indicator. A separate indication is made for each of the two switch positions and the third indication is used for power failure or power off. An "indication" in this case is merely the appearance of a flag or a portion of a rotating drum-type scale in a window of the instrument case. This scale is marked with appropriate symbols or lettering to designate the desired information. Fig. 7 shows a schematic diagram of the indicator. Two coils whose common magnetic axis is located perpendicular to the rotor shaft, can be energized individually by the action of the single-pole double-throw transmitter switch. A permanent-magnet rotor is mounted on a shaft which is located midway between the two coils. The drum-type scale is fastened to the ends of the rotor shaft and rotates with the rotor. The entire moving system is balanced to permit operation in any position.

Scale Actuation

The scale is actuated to indicate one end or the other, when the proper coil is energized. The polarity of the energized coil is such that it pulls the longer end of the rotor magnet into that coil. When neither coil is energized, it is desirable to have the scale drum center itself in a position to indicate power off. This is accomplished by the attraction of the rotor magnet by a small "pull-off" magnet located midway between the two coils. The pull-off torque is much smaller than the torque acting when a coil is energized so that it has negligible effect on the normal operation of the indicator.

A typical, but by far the most common application of this system, is the remote indication of landing wheel positions. The scale for this indicator has a miniature wheel pictured for "wheels down" position, the word UP indicates "wheels up" and a diagonally striped center section indicates power off or power failure. Other applications such as tempera-

ture, quantity, pressure, and the position indication of miscellaneous components of an aircraft have similar scales marked pictorially or lettered to represent the functions being indicated.

Cost Factor

One might inquire why precision instruments are used as the indicators of switch-type transmitters instead of signal lights. The answer lies in the significance attached to the configuration of the marking on the dial. The special markings suggest a more definite message to the pilot than that produced by a row of lights. Also, due to the simplicity of construction and relatively high production of this type of indicator, the cost of them is quite small compared

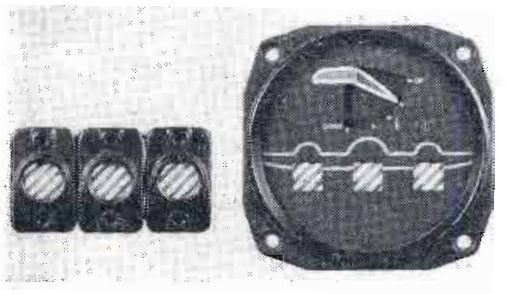


Fig. 8: Three dc annunciators and indicator

to the cost of aircraft instruments in general. In fact, the cost is so low that the armed services have been convinced that this indicator is an expendable item, and no provisions have been made to overhaul or repair them in maintenance depots. The small "match box" size, less than 1⅞ in. long by 1⅛ in high by ⅞ in wide, permits the mounting of a considerable number of them in a small space on the instrument panel. Of course, this small size is accompanied by lightness in weight. The complete hermetically-sealed instrument weighs less than 2½ oz. This type of indication is also available in multiples in a 3-in. diameter case in combination with a two-wire flap position indicator. Fig. 8 shows a photograph of this indicator. Three dc annunciators indicate the position of the right, left and nose or tail wheel of the aircraft, while the two-wire dc selsyn indicates the position of the flaps. This indicator proved to be quite popular in the past, but is now being replaced by individual indicators (three of which are shown in this same photograph for comparison.)

Hermetic Sealing

During the past few years, many of the previously described instruments have been hermetically sealed

to increase or maintain reliability and accuracy under adverse environmental conditions. Dependence upon instrument accuracy and reliability in the successful operation of aircraft is much more prevalent today than it has been in the past. This, in conjunction with the climatic conditions encountered throughout the world, has made it mandatory to protect delicate instrument mechanisms from damage which would otherwise cause malfunctioning of the instrument. Hermetic sealing is the most practical method of providing complete protection against such damage. The instrument mechanism is enclosed in a gas and moisture-tight case which has been thoroughly dried out, evacuated and filled with an inert gas, such as helium. The advantages gained by the use of such a gas are: 1) the elimination of fogging or moisture condensation on the window glass, 2) a reduction in instrument self-heat temperature-rise due to the higher heat conductivity of this gas and 3) the protection from corrosion, due to the inert nature of the gas.

Design Details

Fig. 9 shows the details of a design of a typical aircraft instrument. This figure shows a means for transmitting rotary motion through the hermetic seal which is rather unique. A spring-tempered curved wire is inserted in a flexible metal tube which is brazed to the backplate of the case assembly. The end protruding into the instrument case is closed and mechanically links with the instrument component which must be rotated. As the curved wire is externally rotated by means of a screw driver slot in that end of the wire, the opposite end causes the closed end of the flexible tube to describe a circular motion inside the case. This motion in turn is transferred to the movable instrument component. For dc selsyn indicators, the component generally requiring external adjustment is the dial. One type of dial adjustment consists of varying the scale length for obtaining the proper flap position indication. Thereby, one indicator may be used for the indication of flap position on many different aircraft. An adjustable scale length from 30 to 60° of flap movement is provided. Another adjustable dial indicator has a rotatable sub-dial with four titles which is mounted behind the main dial of the indicator. As the sub-dial is rotated, the titles appear one at a time in a window opening in the main dial. This per-

mits the use of one model for the indication of any one of four related functions.

Leak and Shock Tests

The sealed instruments are subjected to stringent leak and thermal shock tests as well as functional tests of the instrument mechanisms to determine the effectiveness of the hermetic seal. The case design described and illustrated here meets all of the latest military specification requirements for sealing and climatic tests. The advantages gained by hermetic sealing are:

1. Longer instrument life
2. Greater instrument reliability
3. Reduced maintenance
4. Minimizing of window fogging
5. Lower temperature rise

A program of standardization has paralleled the general redesign of most aircraft instruments to hermetic sealing. Appearance and size of most instruments have been made standard so that a minimum number of variations are specified by all branches of the armed services. DC selsyn and annunciator type of instruments fall into four size classifications, namely, 3-in., 2-in., and 1.5-in. diameter cases and a rectangular case with a ½-in. diameter window. These sizes have been selected to permit maximum readability in a minimum amount of panel space. In addition to size standardization, the rotatable dial feature, previously described, is a form of standardization which was instrumental in reducing

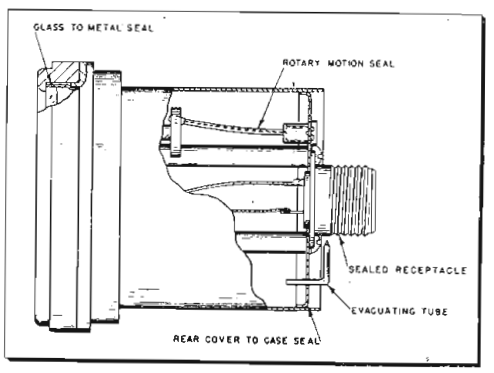


Fig. 9: Hermetically-sealed case design

the number of models necessary to cover flap position indication. The effectiveness of standardization in reducing the number of varieties of aircraft instruments of the dc selsyn type is best illustrated by a comparison of the variety of instruments now offered by the General Electric Company as compared with five years ago. Five types now cover all the applications which formerly required twelve types. This has permitted higher production of fewer parts, which in turn results in lower cost and better service to the cus-

DC SELSYNS (Continued)

tomer. All these are instrumental in giving dc selsyns and annunciators wider applications in remote indication on aircraft.

DC selsyns have been used on aircraft for remote indicating purposes for over ten years with little change in the basic design of the electrical indicating mechanism. Much has been done to change the outside physical appearance of these instruments, but this has had little effect upon the basic selsyn system. The continued acceptance of dc selsyns can only mean that there is no other system which compares with its many advantages. Those factors which have contributed to its success cannot be over-stressed. They are, in the order of their importance:

1. Simplicity—which includes: small number of components, minimum number of connecting leads, small size and light weight components.
2. High accuracy—in general for long-scale indicators, the over-all system accuracy is within 2% of full scale indication.
3. Reliability.
4. Operating position, voltage variation, temperature extremes, and normal vibration and shock conditions found in aircraft have negligible effect on accuracy.
5. Complete freedom from adverse effects of climatic conditions.
6. Low cost.

On the other hand, dc annunciators have found wide acceptance for remote indication only in the past five years. It is true that they have been in use much longer than this, but only to a limited extent. It now appears that there is no limit to the number of applications for which they will be used. There has been a general trend from calibrated dial type of presentation for many remote indicating applications to the annunciator type indication which only differentiates between "satisfactory" and "unsatisfactory" operation. Several factors have contributed to this trend:

1. The complexity of operating modern aircraft has demanded a simplification of the indicating type instruments necessary on an instrument panel.
2. Space limitations on instrument panels dictate smaller indicators.
3. Simplicity, small size and low cost of the dc annunciator system. Probably no other system, other than signal lights, are as simple and require less space than dc annunciators for remote indication on aircraft.

DC selsyns and annunciators have been designed specifically for aircraft application. However, many of the advantages which contribute to the outstanding performance of these systems in aircraft telemetering, also apply to their use elsewhere. Certainly such points as low cost, reliability and high accuracy are desirable regardless of the application. It is also probable that many ac applications could be justified since the equipment required to convert from ac to dc power would be relatively simple for these systems.

Transistor Oscillators

(*Continued from page 83*)

is always below f_o. Fig. 3 illustrates the results of measurements in the form of the detuning

$$X = \frac{f}{f_o} - \frac{f_o}{f} = \left(\frac{f}{f_o}\right)^2 - 1$$

versus T. The curve is extrapolated towards T=0 and 1 where $f=f_0$ but where no self-excitation occurs.

In practice, tapped coils or tapped capacitors, as in the Colpitts circuit, are not convenient. If we confine ourselves to one-transistor oscillators, the simplest way to avoid any tapping of the oscillatory system is the replacement of the feedback attenuation across the latter by an external voltage division. In this way, the various oscillators diagrammed in Fig. 4 can easily be understood. All their tank circuits con-

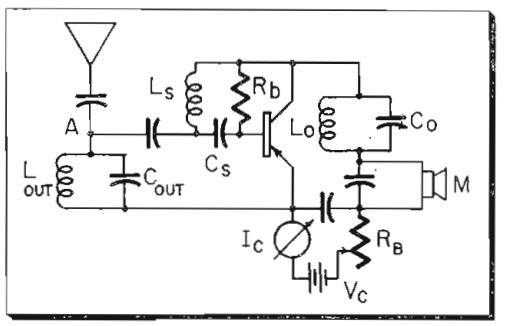


Fig. 7: Transistor FM oscillator for 10.75 MC

tain two-terminal coils L_o paralleled by the capacitors C_o. If the tank circuit is considered to load the transistor between any pair of its three terminals, the feedback attenuator contains the choke (ch) or an equivalent resistor in series with a transistor impedance. According to a circular exchange, the feedback in circuit (a) runs counterclockwise from the collector to the base, in circuit (b) clockwise from collector to emitter, and in circuit (c) from the emitter to the collector. Base capacitors C_b block the dc potentials, and leak resistors R_b improve the transistor efficiency, but are minor refinements which do not effect the basic function.

Without further comments it can easily be seen that the regenerative feedback produces negative output resistances between any arbitrary pair of the transistor electrodes. The simplest example is circuit (c) which exhibits a negative base resistance provided $\alpha > 1$ and provided the choke impedance is below a critical value (ch_{cr}). Similar principles govern the two other oscillators except that α must be in the vicinity of one

and that circuit (b) requires $(ch) > (ch_{cr})$ because of the reversed direction of the feedback current while circuit (a) generates oscillations again at $(ch) < (ch_{cr})$.

In addition, the imaginary components of the feedback channels result in similar out-of-phase conditions as explained in the case of the Hartley oscillator. In case (a) the oscillator frequency is above and in case (b) below the frequency f_0 of the free tank circuit.

The circuits (a) and (b) in Fig. 4 may be combined by the use of two oscillatory systems one between collector and emitter and the other between collector and base. In this case either one may be considered to be the lead while the other provides the feedback path so that the direction of the feedback current is arbitrary. The resulting circuit is particularly useful for frequency stabilization according to the schematic diagrammed in Fig. 5a. Maximum feedback occurs if the tank's resonant frequency f_0 is 10 or 20% below the crystal's frequency.

Modulation Methods

The described oscillators can be modulated in various ways. If a modulating voltage is superimposed upon the collector supply voltage, AM as well as FM occurs. The latter can be understood by reference to the out-of-phase condition, in other words, because the transistor combines the function of an active oscillatory element with that of a reactive control device equivalent to a reactance tube. The described piezoelectric frequency stabilization neutralizes the FM so that only AM remains. Inversely, the reactive action of the transistor can be successfully utilized for an efficient FM without additional elements such as saturable reactors or ferroelectric capacitors.

Fig. 6 shows the laboratory model of a crystal controlled transistor oscillator provided with a CK 722 junction transistor and a 400 kc crystal. An extremely simple and sensitive AM is produced with the aid of a diode D in Fig. 5b shunting the tank circuit. Under the influence of the modulating voltage V_m, the diode impedance changes and this produces a Q-modulation. The large capacitor C_D and its high-ohmic bypass resistor R_D introduce a self-adjusting bias, automatically grant a sensitive point of operation, and thus provide an automatic volume control.

The developed Q-modulation can be simplified in the following way.

Instead of modulating the diode with an external modulation source, the rectified r-f energy can be utilized to feed the carbon microphone M in Fig. 5c. The mike modulates the self-adjusting bias and this, in turn, the diode impedance. In other words, the nonlinear diode resistance transforms the fluctuating microphone resistance into the tank circuit and thus produces the Q-modulation without the mike being subjected to r-f energy.[2] Although the feeding of the microphone from the transistor battery via the r-f energy and the subsequent rectification is very uneconomical as compared to a direct dc supply, the elimination of a bulky microphone transformer makes the Q-modulation very practical, in particular with respect to subminiaturization. The illustrated model, fed by two 1.5-volt batteries, permits a 40% AM. In a similar way, FM can be produced by introducing a reactance in series with the diodes but, of course, without the piezoelectric resonator. In general, such an RX-modulation is combined with a parasitic AM which can be neutralized in two different ways: First, the modulator operates with the time—constant one and the associated power loss is tolerated. Second, two RX-modulators operate in push-pull so that the individual FM's superimpose whereas the individual AM's cancel each other.[2]

All the described transistor oscillators operate below their alpha cut-off frequency. On the other hand, however, it is well known that transistors function above their alpha cut-off as detectors and mixers. This phenomenon has been utilized in the circuit portrayed in Fig. 7 for an efficient and extremely simple production of harmonics. The transistor therein performs a triple action: First, it generates a fundamental frequency f_o in the vicinity of its alpha cutoff. Second, it acts as a frequency multiplier and drives the output circuit, $L_{out}C_{out}$, at a harmonic as high as the tenth or twentieth order. Third, the transistor is its own reactance modulator. In contrast to a frequency multiplication via one or more nonlinear elements

(*Continued on next page*)

MMM Glass Fiber Plastics

Minnesota Mining & Manufacturing Co., makers of "Scotch" brand tapes, has acquired Gustin-Bacon patents relating to the manufacture of glass fiber reinforced plastic pipe. The two companies will cooperate in developing a line of pipes, fittings and couplings, which is expected to replace metal pipes in many uses.

in subsequent stages, the present harmonics originate from a circular multiplication around the feedback loop. This is possible because the entire oscillatory system is highly nonharmonic[3] which means, its frequency determining parameters vary with frequency. This phenomenon manifests itself in the form of multiple resonances equivalent to those of a superregenerator. Although the collector tank circuit L_oC_o as well as the feedback circuit L_sC_s are tuned to f_o, the feedback loop is closed for all those harmonics which coincide with side-peaks whereas all harmonics in between are suppressed.

Utilizing the new principle of "Circular Frequency Multiplication," a transmitter of the type in Fig. 7 was built around a junction transistor. The frequency of the master oscillator was adjusted at 1.2 MC while the output circuit resonates at the 9th harmonic of 10.75 MC. Fig. 8 illustrates the frequency spectrum in the form of the output voltage at point (A)—with the output filter removed—versus the order n of the harmonics, but only the powerful spectral lines are plotted whereas the numerous weaker lines between are omitted. The fact that the multiple resonances are symmetrical to f_o causes a few spectral lines below f_o, i.e. subharmonics of a very low energy level.

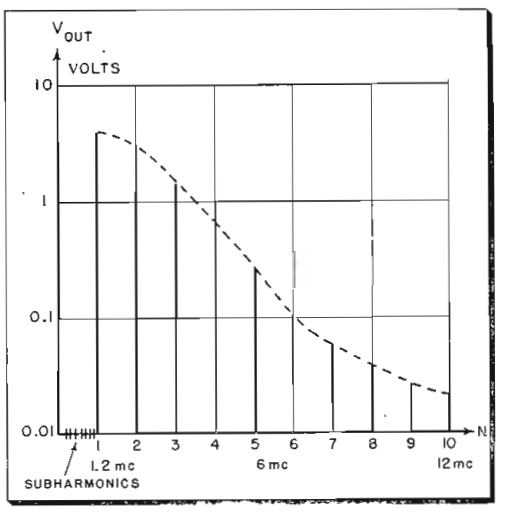


Fig. 8. Frequency spectrum of test oscillator.

The test oscillator is frequency-modulated by means of the collector voltage as explained before. The output frequency of 10.75 MC is received by the i-f amplifier of a conventional FM tuner. A 100% FM equivalent to a frequency swing of ±1 per cent requires a modulating voltage as low as ±1 volts, which can easily be produced in the form of the voltage drop across a carbon microphone M in the collector circuit. In addition, the variable preresistor R_B in the

battery circuit permits a convenient fine adjustment of the carrier frequency. Moreover, an automatic control of the collector current by means of a reference discriminator or receiver makes an automatic frequency control possible.

There is evidence that the described circular frequency multiplication may permit entering the VHF and microwave field, which cannot be reached below the alpha cutoff, at least not at the present stage of transistor development.

1. H. E. Hollmann, "Transistors in Terms of Vacuum Tubes," *Tele-Tech & Electronic Industries,* May 1953, pp. 74-75, 124-125.
2. H. E. Hollmann, "Nonlinear Elements and Applications in AF and RF Circuits," *Tele-Tech & Electronic Industries,* April, 1952, pp. 46-47, 127; May, pp. 56-57, 122-128; Proc. Nat. E. Conf., vol. 7, 1952, pp. 130-140.
3. H. E. Hollmann, "Frequency Feedback," *Tele-Tech & Electronic Industries,* March 1953, pp. 91-93, 126-134; Proc. Nat. El. Conf., vol. 8, 1953, pp. 577-587.

Distortion

(*Continued from page* 99)

square inch. On the other hand, when a cartridge with high moving mass fails to produce an *N*, it is because the modulated wave envelope is not being produced. An evaluation of the "meter reading" (steady-state), or oscilloscope observation will always reveal the truth in such a case, although the same result can be had by adjusting tracking pressure to the manufacturer's own precise specification, playing the record several times in succession. New and obscurely related audible frequencies will then begin to appear at certain specific areas of the spectrum, buffeted permanently into the groove walls by the non-track stylus.

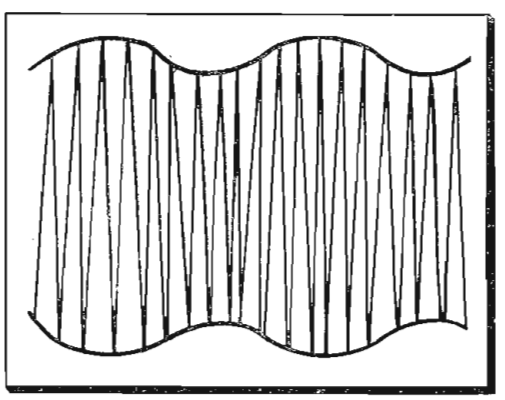


Fig. 2: CCIF groove resembles a modulated carrier. For 19—20 KC condition, equivalent is a 19.5 KC carrier, 100% modulated at 0.5 KC

In the process of straightening out the cartridge question, it may well be found that the *N* is even heard on needle-talk alone. After the cartridge is cleared, then of course the source record is ready to unleash on amplifier and loudspeaker.

Regulation Chart

(*Continued from page 97*)

but must be solved for i_1, with various values of t, and the lowest value of t for which $i_1 = 0$ found by graphical interpolation. This value of t is the commutation time. In this equation also, the difference between two large quantities is involved, so that considerable care is necessary. The results obtained are plotted in terms of dc output voltage E_{dc} in Fig. 3. Here the regulation of three widely used rectifiers (single-phase full-wave, three-phase half-wave, and three-phase full-wave) are given in a manner which enables one to proceed directly from the IR component of regulation to total regulation. An example is indicated by the dotted line. In this example, the rectifier is 3-phase, full-wave.

$E_{dc} = 2000$ volts
$I_{dc} = 1$ amp
$R = 60$ ohms
$X = 120$ ohms

$$\frac{X}{R} = 2$$

$$\frac{I_{dc}R}{E_{dc}} = \frac{60}{2000} = 3\%$$

Total Regulation $= 1.68 \times 3$
$= 5.04\%$

If the regulation has been figured separately for IX it would be nearly 6%, and the calculated regulation would be nearly 4% higher than actual.

RETMA Re-Appointment

Robert C. Sprague, chairman of the board of directors of the Radio-Electronics-Television Manufacturers Association re-appointed Leslie E. Woods, Raytheon Manufacturing Co., as chairman of the association's Industrial Relations Committee—one of RETM's largest and active standing committees—for the ensuing year.

Name Change

At their last regular meeting, the board of directors of the Ampex Electric Corp. voted to change the firm name to the Ampex Corp. According to George I. Long, general manager, the term, "Electric" was no longer descriptive of the company's expanding business.

Pyroferric Expands

Pyroferric Co. recently announced the purchase of the building housing its manufacturing plant at Bronx Blvd. and 216th St., New York City. The additional space will enable the company to increase its production of iron cores and other powdered metal products.

Nonlinear Functions

(*Continued from page 78*)

start of the rheostat winding by the end of the winding.

The theory of networks consisting of three kinds of elements is sadly incomplete. However, by means of a simple device, replacing every fixed resistance in the network by the sum of an L and an S type of element, a series connection of the two, the network can be reduced to one containing only two kinds of elements. The theory of such networks is quite complete.

By analyzing the network on this basis, we come to the following properties of the transfer function:

a. The transfer function is a rational fraction in X.
b. The order of the numerator polynomial is equal to or less than the order of the denominator plus one.
c. The roots of the numerator may lie anywhere in a complex X plane.

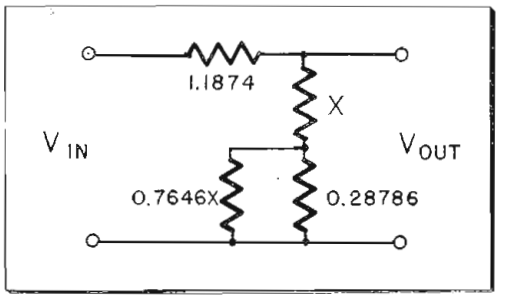


Fig. 7: Physically realizable network

d. The roots of the denominator are simple and may lie anywhere on the real X axis except in the range zero to one.

We may note, in passing, that it proves to be expedient to define a new parameter p, such that

$$p = (1-X)/X \qquad (4)$$

This transformation maps the physical working range of X, zero to one, onto the positive portion of the real p axis, and the poles are all shifted to the negative real axis. The zeros may still be generally distributed. When this is done, a direct analogy is found between these networks and networks consisting of resistances and inductances. The techniques of synthesizing such networks can draw from the rapidly expanding collection of RL transfer function synthesis techniques for the determination of network component values.

Rational Approximation

Since we know the properties of the networks, our next problem is finding methods of approximating the desired function or numerical data by functions which can be

NONLINEAR FUNCTIONS (Cont.)

realized by the networks. The techniques we have employed for developing the rational functions necessary to the above task are not quite as satisfactory as the techniques for polynomial approximation.

We have used two methods. The first, borrowed from W. E. Milne's book on *Numerical Calculus,* always provides a rational function which exactly fits the data at selected points. However, there are two drawbacks to this method. One, and the most serious, is that the denominator often turns out to have complex roots. This function cannot be synthesized. The other is that the more points of fit selected, the higher the order of the function.

Second Method

The second method, which always results in a realizable function, consists of finding a polynomial approximation to the data, and dividing this by a polynomial which approximates a constant over the useful range of X. A very convenient and suitable

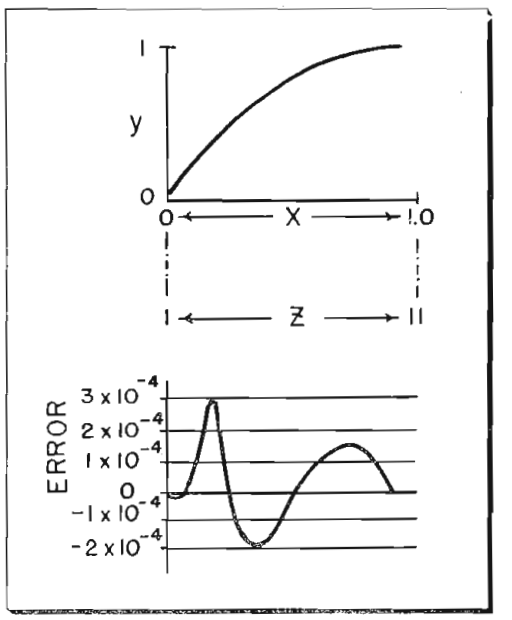


Fig. 8: Scale of rotation on shaft and error

polynomial is one consisting of the products of pairs of factors of the form shown below:

$$P = \prod_{i}^{n}(X + a_i)\ (X - a_i - 1) \quad (5)$$

The order of this polynomial, 2n, is selected to make the function synthesizable. The roots are selected reasonably far from the approximation range so that there is little corruption of the approximating polynomial.

A refinement in this method consists of finding the approximating polynomial, selecting a suitable P, multiplying this by the original data to establish new data, and finding a new polynomial to fit the new data.

Sometimes the effects of P can be almost completely removed.

It is generally desirable to factor the numerator, since factors remote from the range of approximation can then be removed by selecting identical factors for P. This conveniently reduces the order of the function.

Once a suitable rational fraction has been determined, the third phase of the filter problem, how to synthesize the network, becomes paramount. Instead of describing possible procedures we shall refer you to the large body of literature on the techniques of synthesizing RC networks to produce a required transfer function. It should be noted that if the poles and zeros of the approximat-

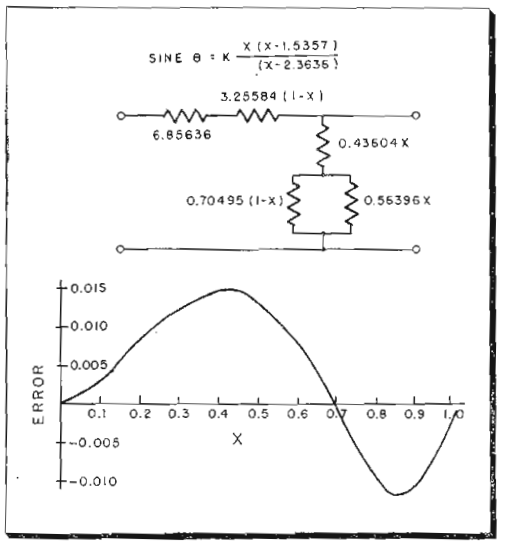


Fig. 9: Variable resistance network for sin θ

ing fraction lie in the left half plane of complex X the network can be synthesized by means of fixed resistances and linearly increasing rheostats. If they lie in this plane to the right of unity, then the networks will consist of fixed resistances and linearly decreasing resistances. An example, the synthesis of a network which generates the natural logarithm, is presented below.

Synthesis of Log Function Network

1. Approximating Function

$Y = X(X+0.64436) / (X+1.5618)(X+0.28629)$

This approximates $\log (10X + 1)$ from X equals zero to X equals nine.

2. Transfer function of L Network (Fig. 6)

$$T = \frac{J_{12}}{J_{11}}$$

3 Set $J_{11} = K(X+1.5618)(X+0.28629)/F(p)$

$J_{12} = (X+0.64436) / F(p)$

These impedances will be realizable if F(p) is (X+a) and a is selected to lie between 0.28629 and 0.64436. If we permit a to remain literal and expand J_{11} and J_{12} as general partial fractions we find

4. $$J_{11} = K\ X + \frac{(1.5618)(0.28624)}{a} + X\left[\frac{(1.84809-a)a - (1.5618)(0.28629)}{a(X+a)}\right]$$

$$J_{12} = X + X\,\frac{0.66436 - a}{(X+a)}$$

5. To avoid duplication of types of networks

NONLINEAR FUNCTIONS (Cont.)

in J_{11} — J_{12} and J_{12} we can set $K = 1$ and find an a such that

$$\frac{(1.84809 - a)\,a - (1.5618)\,(0.28629)}{a} = (0.66436 - a)$$

$$a = 0.3765$$

This will permit physically realizable networks.

6. $J_{11} = X + 1.1874 + \dfrac{0.28786\ X}{X + 0.3765}$

$$J_{12} = X + X\,\frac{0.28786\ X}{X + 0.3765}$$

7. The network is shown in Fig. 7.

8. The scale of rotation on the shaft is shown in the accompanying Fig. 8. The network generates log z over the range 1 to 11. The errors are shown in Fig. 8 as well.

Figs. 9 and 10 show networks for generating nonlinear functions to a zero to 90° and the sinh function

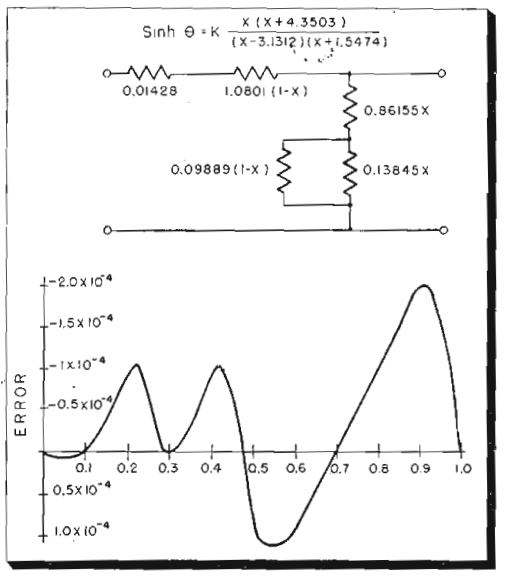


Fig. 10: Network for generating sinh function

from zero to one. The theoretical errors are shown in each figure.

Electrical networks capable of generating nonlinear functions to a high degree of precision can be constructed from linear potentiometers. Their flexibility, simplicity, and relative cheapness provide a real challenge to cams and other mechanisms for storing empirical or functional data. They are not represented as guaranteed solutions to all such problems; on the other hand, they can provide the computer designer with a very effective tool when properly used.

This paper was presented at the National Conference on Airborne Electronics, May 1953, in Dayton, Ohio.

A.T.&T. Seeks More TV Channels

The Long Lines Department of the American Telephone and Telegraph Co. is seeking FCC authority to install additional microwave transmitters on the Chicago-Milwaukee-Minneapolis radio relay system. The proposed transmitters would provide two television channels from Chicago to Milwaukee via Palmyra, Wisc. A third channel covered in the application would provide a video link from the junction station at Palmyra to Minneapolis.

New West Coast Microwave System

A microwave radio system has been sold to the Southern California Edison Co. by the Westinghouse Electric Corp. The utility will use microwave to improve its power distribution facilities, augmenting its present private wire voice communication system.

Initially, microwave will provide a voice channel linking the dispatcher's office in Alhambra with utility's office in Visalia 185 miles away. Five repeater stations will be used to carry signals over the rugged Tehachapi range. Later the system will be extended to Big Creek, Southern California Edison's hydroelectric power project 250 miles north, and join with extensive communication facilities of the Pacific Gas & Electric Company.

Beam Guidance Control

A major advancement in aircraft automatic pilots for safer bad weather landings is announced by USAF's Air Research and Development Command.

The new device is identified as a Beam Guidance Control but will be known as the Radio Beam Coupler in the simplified commercial version soon to follow priority production of the military type. The system becomes a part of the modern high-performance automatic pilot, and introduces more effective usage of new VOR-omnirange beacons and other radio "tracks" on principal airlanes of the world.

It accurately holds a straighter course and automatically compensates for wind drift while riding omnirange or other beams.

NARTB Issues "Facts About TV"

Television's benefits in home education and its influence on reading habits are the subject of the first edition of "Facts About TV" issued recently by the Television Information Committee of the National Association of Radio and Television Broadcasters.

Reported for the first time in this TIC publication is a survey by NARTB's Research Department of a single week's educational programming by television stations which are members of the organization. The 60 percent of member stations participating in the survey reported 226 hours and 5 minutes of educational programs during the one week at a cost to the stations of more than $128,000.

PERSONAL

James Stone has joined Battelle Institute, Columbus, Ohio, where he will conduct engineering research leading to the development of digital computing systems and components for handling technological information and mathematical problems. Before this assignment, Mr. Stone was a senior electronics engineer on the NEPA project conducted by Fairchild Engine and Airplane Corp. at Oak Ridge.

Thorton W. Chew, formerly chief engineer of KFMB-TV, San Diego, Calif., and previously engineering supervisor for Don Lee Television, Hollywood, has been appointed director of

Thornton W. Chew

TV operations and engineering for the John Poole Broadcasting Co., operators of UHF stations in Los Angeles, Sacramento, and Fresno.

Oscar F. Haug, formerly associated with Bendix Aviation Research Laboratories, Detroit, has become project engineer for the Ultra-Viscoson, a new ultrasonic instrument for measuring fluid viscosity. Formerly concerned with the design and development of guided missile electronic components at Bendix, Mr. Haug moves to the company's Cincinnati division to handle engineering production of the new instrument.

Conrad H. Hoeppner has been appointed manager of the electronics department of the W. L. Maxson Corp., New York, N.Y., where he will direct research and development and electronic phases of guided missiles, radars, computers, servo-mechanisms, etc. Previously, Mr. Hoeppner was engineering products manager for Raytheon Mfg. Co.; director of the electronics laboratory of Glenn L. Martin Aircraft Co.; and senior radio engineer with the Naval Research Laboratory, Anacostia, D.C.

G. Milton Ehlers has been appointed chief engineer of Aerovox Corp., New Bedford, Mass. From 1946 until his recent appointment with Aerovox, Mr. Ehlers was president of Herlec Corp., Milwaukee, Wisc. a subsidiary of Sprague Electric Co.

Carl E. Smith, having resigned his position as vice-president in charge of engineering for United Broadcasting Co., has expanded his staff and will concentrate on consulting practice. His

Carl E. Smith

organization will continue under the name of Carl E. Smith Consulting Radio Engineers with offices and laboratory facilities at 4900 Euclid Ave., Cleveland 3, Ohio., the studio plant of radio station WHK, where, also, he will continue to serve as president of the Cleveland Institute of Radio Electronics. **James S. Hill,** formerly chief engineer of radio station WHKK, Akron, Ohio, and **William F. Kail,** formerly with General Electric Co. are members of the firm's staff. Currently, the firm is handling the completion of the antenna system of one of the super-powered radio stations that the State Department intends to locate on the periphery of the Soviet-dominated land mass.

Barnett F. Golderg has been named TV technical supervisor, and **Stephen H. Wesley** has become chief transmitter operator at WIS-TV, Columbia, S.C.

Dr. Walter A. Donohue has joined the Edison Laboratory staff for research in chemical engineering problems related to the Edison medical gas division. Formerly, Dr. Donohue was a development engineer in the polychemicals division of the duPont experimental station, and a research engineer on solvent recovery for Merck & Co.

R. E. Langworthy is the new chief engineer for the Kalbfell Laboratories. Previously, he was an assistant project engineer in the San Diego division of Convair.

Edward S. White has been named Engineer in Charge of the Advanced Development Laboratory of CBS-Columbia. He will continue advanced circuit development and act as consultant on special projects.

Abraham Hyman recently resigned from JFD Mfg. Co. to establish a private consulting practice at 126 West 22nd St., New York 11, N.Y. For several years Mr. Hyman was a supervisory engineer for the Civil Aeronautics Administration in New York.

Theodore H. Cook, Jr., has been appointed a senior electronic engineer for CBS-Columbia. Previously, he worked on the development of color TV and studio equipment at RCA Laboratories. **Frank J. Powers** has been named head of the industrial en-

Frank J. Powers

gineering department. **Robert E. Savold** has become manager of field engineering for the same corporate unit and **Albert Beckman** has become a mechanical project engineer on government assignments. Earlier, **Jerome Goldman** was made a senior electronic engineer on government equipment and **Eugene Lieberman** was made liaison engineer for the product engineering staff.

Harold M. Greenhouse, formerly with the Ohio State University Research Foundation, has joined the research department of the Ferroxcube Corp. of America where he will undertake research on the development of new types of ferrite magnetic materials.

Dr. George T. Croft has joined the Edison Laboratory's physics research group. His principal interest will be research in fundamental solid state physics as concerned with semi-conducting materials. The Edison laboratory recently announced the development of a heat-sensitive cable, constructed of semi-conductor materials, for use in a fire detection system. Part of Dr. Croft's work will be in the furtherance of this development. **Dr. Joseph Varimbi** recently became a member of the company's chemical research group. His major project will be research in the battery field.

Arthur V. Peterson has joined the staff of the vice president in charge of engineering of the American Machine & Foundry Co., and will concentrate on the expansion of the company's activities in the atomic energy field. Mr. Peterson, who has spent more than ten years with the U.S. atomic energy program, served as consultant with the Weapons Evaluation Group of the Dept. of Defense for six months prior to his present assignment.

Bruce Arnold, Robert Asimow, Bertrand F. Farber, Harold M. French, William R. Gockel, and Douglas J. Hamilton have been awarded Hughes Cooperative Program fellowships for study toward the Master's degree in electrical engineering at the University of California. Concurrently, they will serve on the technical staff of the Hughes Research and Development Labs., Culver City, California.

Brig. Gen. Edwin R. Petzing, head of Signal Corps Engineering Lab., Ft. Monmouth, N.J., succeeds **Brig. Gen. Rex Van Den Corput, Jr.,** as chief signal officer of the U.S. Army in Europe. Gen. Van Den Corput has been transferred to the Office of Chief Signal Officer, Washington. **Brig. Gen. James S. Willis,** personnel and training chief, OCSO, named commander of Signal Corps Supply Agency, Philadelphia, will be succeeded by **Col. Samuel Collins,** 3rd Army signal officer.

Robert Redfield has been appointed chief engineer of the government division of the Webster-Chicago Corp.

Berkeley Williams, Jr., has been appointed to the engineering staff of Rotron Manufacturing Co., Woodstock, N.Y. Mr. Berkeley was previously with Sperry Gyroscope, engaged in development engineering.

Robert C. Cheek, recently appointed to the new post of assistant manager of engineering for Westinghouse Electric Corporation's Electronics Div., will supervise administrative and organizational activities under **F. S. Mabry,** divicion engineering manager. Before his promotion, Mr. Cheek was assistant division sales manager.

Israel Melman, formerly engineer in charge of the advanced development laboratory, has been promoted to chief engineer of the special products division of CBS-Columbia Inc., subsidiary of Columbia Broadcasting System. He will be concerned with the development of color TV receivers and other special items. **Eugen W. Rose,** formerly with Western Electric Co., has been appointed electronic engineer on military equipment for the subsidiary.

Pacific Mercury Warehouse Burns

A radar research laboratory, facilities for guided missile production, and thousands of television receivers, worth nearly a million dollars were destroyed recently when fire swept a warehouse of the Pacific Mercury Television Manufacturing Co. in Van Nuys, Calif.

Intercom

(*Continued from page* 81)

circuit feed. The microphone for return talking may be disconnected by means of a switch located on this same chest plate. Volume controls are provided for each earphone. The order and program circuits are at a relatively high level, that is, loud enough, with the earphone controls at maximum volume, to overcome high ambient sound such as might exist near an orchestra.

The key switching arrangement consists of a standard panel which may be mounted in any location and can accommodate up to 15 keys. The director's panel may have as many as 15 load selector keys, whereas the audio and video operators may have only 4 or 5 keys. In the special case of the technical director, certain of these intercom keys are built into the video switching panel. For example, the order circuit keys for the film room are placed close to the appropriate video switching and projector control buttons. All keys are two way, and are so wired that one position continuously ties the source microphone to the selected load busses. The other position transfers the selector relay control to a foot pedal. In this latter case, only when the foot pedal is depressed will the source circuit be connected to the load. This arrangement is used, for example, to permit the technical director to route orders to the projection room only when pertinent and exclude from the projection room the continuous chatter normally on the order circuit. In similar fashion, the audio operator can momentarily break into the boom operator's program circuit to issue special or emergency instructions.

Review of Functions

Referring again to Fig. 5, let us review the functions of this intercom system during rehearsal and program. During rehearsal the director uses the studio address or "E" circuit for instructions to all floor personnel. This will be supplemented by the technical director's use of the "A" circuit to cameramen, floor manager, video booth, audio booth, etc. Talk-back to the director's booth is frequently through the program microphones that are open, although those personnel having chest sets complete with microphones will automatically come up on a loudspeaker in the director's booth. In addition, during rehearsal the "C" circuit may be used by individual video control opera-

tors and cameramen to discuss camera adjustments and other similar matters without interfering with the progress of the rehearsal. At the same time an assistant director may be discussing cues with a remote unit by means of the "D" circuit. In this way it is believed that lost time during rehearsals can be minimized.

On the Air

When on the air the situation changes. Needless to say, the studio address system is disabled and any sound re-enforcing is done with the separate public address system. The majority of instructions channel through the technical director. The technical director sets keys in the up position to feed the studio order circuit and any other locations that require continuous cueing. These locations will usually use headsets. Keys in the down position permit cues to film control, transmission, etc., only when the foot pedal is depressed. These locations are usually set up on loudspeakers. The program director, the technical director, and the audio operator can also feed the "B" or interrupted program circuit. This circuit might be used by the program director to instruct the orchestra conductor to make a last minute music cut, or by the audio operator to pass emergency instructions to a boom man.

The audio operator has a single headset receiving the technical director's order circuit, and two loudspeakers for program monitoring and cue. He can talk to the director's booth, video booth, or those other locations provided on the available keys. These keys will normally be left in the unlocked position, and the press-to-talk foot pedal will be used.

Video Operators

The video operators will talk to cameramen on the carbon circuit and, as outlined before, can isolate a single camera in the event of trouble. In addition, they have a limited number of keys which function in the same manner as those in the audio control booth.

The generalized system shown in Fig. 5 can be assembled in a single rack. It can be either decreased or increased in size and scope, as required by the traffic load or by the size of the studio plant, without departing from the basic design philosophy, and without requiring modification of any existing installed equipment.

This paper was presented at the 1953 IRE National Convention, March 23-26, in New York City.

BOOKS

Fields and Waves in Modern Radio

By Simon Ramo and John R. Whinnery. 2nd Ed. Published 1953 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 576 pages. Price $8.75.

Practicing engineers and graduate students should find a wealth of highly useful information in this volume covering electromagnetic theory. This new edition has been expanded by about 10%, allowing the inclusion of much current material on horns, slot antennas, paraboloids, and slow wave-guide structures. A complete new chapter on microwave networks has been added, and the rational mks system of units is used throughout. Other chapters cover Maxwell's equations, skin effect, propagation, waveguides, transmission lines, resonant cavities and radiation. Particular attention is paid to the electromagnetic concepts of oscillations and waves.

In textbook style, the end of each section, where appropriate, poses several typical problems relating to the subject matter. A listing of solutions to these problems is not included, unfortunately. However, the clear-cut text and large number of illustrations describe fields and waves most satisfactorily. The mathematical analyses are fully adequate without being exhaustive. All in all, this book is quite comprehensive, and as a useful reference should prove a worthwhile addition to an engineer's library. AJF

BOOKS RECEIVED

RTCM Symposium Papers,

Spring 1953 Meeting. A 119 page, soft covered, 8½ x 11 in., book containing reprints of the seventeen papers delivered at the Spring 1953 meeting of the Radio Technical Commission for Marine Services, Wardman Park Hotel, Washington, D. C. April 20-22.

Television Interference

Edited by Philip S. Rand. 3rd edition. Contains 30 articles and recommended reading list on various sources of TVI and methods of eliminating interference. 107 pages. Price $0.25. Published by Remington Rand, Inc., 315 Fourth Ave., New York 10, N.Y.

Organizational Position of the Industrial Safety Engineer

In this new 32-page 5½x7½-in. booklet the Society For Advancement of Management, 74 Fifth Ave., New York 11, N.Y. with the cooperation of the American Society of Safety Engineers, show 17 basic charts that give management and safety people the progress of safety work since the A.S.S.E. was formed in 1911.

NBS Announces New Publication

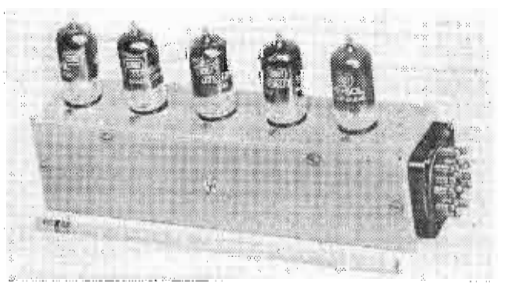
Reference Data for Orienting Quartz Plates by X-Ray Diffraction, by Catherine Barclay and Leland T. Sogn, National Bureau of Standards Circular 543, 7 pages, 6 figures, 2 tables, 15 cents. (Order from Government Printing Office, Washington 25, D. C.)

VOLTMETER

Model No. 655 VTVM is designed to serve a variety of industrial applications employing vibrator power supplies, ac generators, and other equipment that

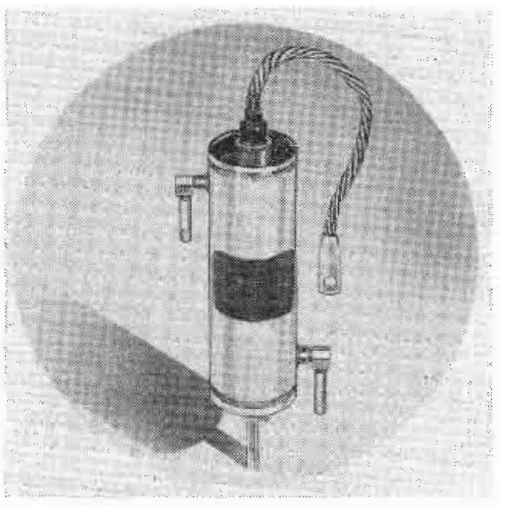
utilizes waveform types or dc. The unit enables peak-to-peak ac measurements from 0.20 v. to 4,200 v. on 7 ranges; ac RMS measurements from 0.10 v. to 1,500 on 7 ranges; dc measurements from 0.02 v. to 1,500 v. on 7 ranges; and resistance measurements from 0.2 ohms to 1,000 megohms on 7 ranges. The electronic measuring circuit uses a balanced bridge type dc amplifier and sensitive meter with a high impedance voltage divider. A 1.0 megohm isolation resistor provides an input impedance of 11 megohms on dc. An additional peak-to-peak rectifier and a compensated attenuator are used for the ac measurements. **Radio City Products Co., Inc., 152 West 25th St., New York 1, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

BINARY COUNTER



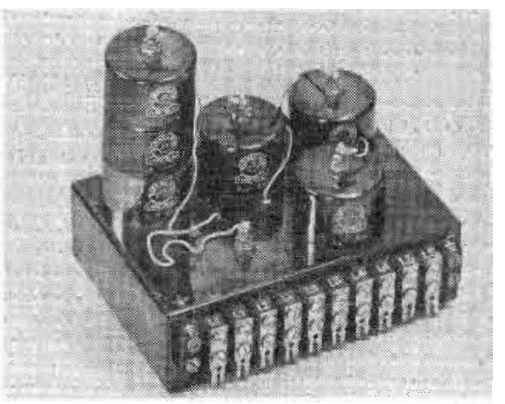
The Model 1001 is a new magnetic 9-stage binary counter plug-in package that counts at rates up to 50 kc. The unit can perform such functions as intergration, addition, multiplication, and division when used with other plug-in packages. Total current required; input stage reset, 5 ma; 9-stage counter at 50 kc, 10 ma; 9-stage counter at 10 kc, 2 ma; heater at 6.3 v., 1.5. The unit is supplied with 12AU7 tubes operating with a nominal plate voltage of +150 v. and a bias of —12 v. Input signal requirements: sine wave or pulse, at least 4 μsecs wide at 15 v. and less than 30 v. peak. Output pulses: 20 to 22 v. positive peak, 5 μsecs wide at one-half height. Pulses counted

down from input rate by factors of ½, ¼, ⅛, 1/16, 1/32, 1/64, 1/128, 1/256, and 1/512. Input stage porvides an output pulse at the input rate shaped to match the pulse outputs from the counting stages. Size: 8 x 2x2 in.—**Laboratory of Electronics, Inc., 75 Pitts St., Boston 14, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.



IGNITRON

The NL-5551 is a metal, water-cooled, mercury pool, tube designed for welder and similar ac control applications. Its rating is approx. equivalent to a 300 amp. magnetic contactor. The mercury pool enables the tube to handle extremely high currents on an intermittent basis. AC control application ratings are based on full cycle conduction (no phase delay) regardless of whether phase control is used or not on frequencies from 25 to 60 cps and any voltage between 250 and 600 v. rms. Construction is seam-welded, stainless steel. Weight approx. 4 lbs. **National Electronics, Inc., Geneva, Ill.**—TELE-TECH & ELECTRONICS INDUSTRIES.

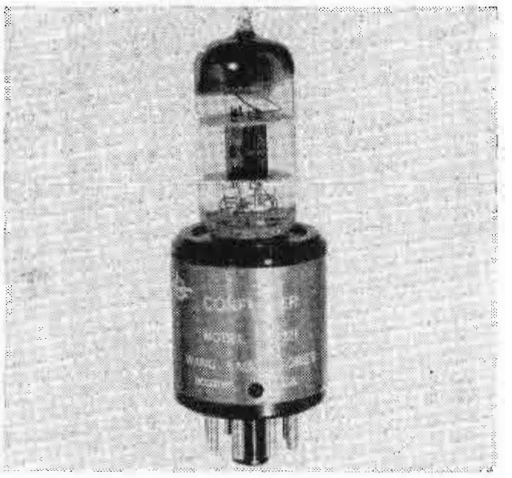


DECADES

A new development in inductance decades eliminates the disadvantages of switch boxes. Inductance units plugged together in various combinations provide decade steps of inductance with a minimum number of units required. **Burnell & Co., 45 Warburton Ave., Yonkers, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

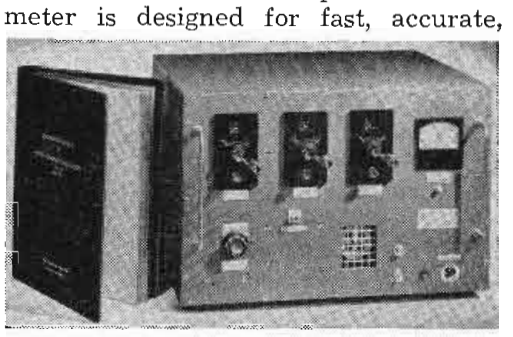
PULSE GENERATOR

The "Confluxer" pulse generator produces each pulse when the instantaneous voltage of the input initially exceeds a fixed value. The device is then reset by the return of the voltage below the critical value. Voltage-time product for each pulse is constant for any operating load. The output for a given load resistance produces a constant charge-per-pulse. This pulse output can be integrated to obtain a voltage proportional to the frequency of the input. Output has a linearity of 0.2%. Input waveform with a rise-time as slow as 0.1 sec. still insures proper operation. Resolution time permits full charge per pulse when generated pulses are more than 15 μsecs. apart. Output pulse-rating is 200 v. —μsecs. Normal operation gives pulse voltage of approx. 70 v. peak and a pulse duration of 3 μsecs. Minimum output load is 2,500 ohms. Required minimum input 10 v. **Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.**—TELE-TECH ELECTRONIC INDUSTRIES



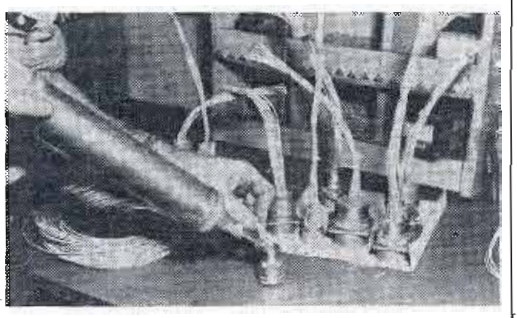
IMPEDANCE WATTMETER

Model 141 variable impedance wattmeter is designed for fast, accurate, measurements between 2 and 30 MC. Designating its input impedance as Z= R + jx, R can be adjusted over the 5 to 500 ohm range, and jx can be adjusted between —250 and +250 ohms. Up to 250 watts of power can be dissipated. Overall accuracy of the directly indicated power measurement is within 10%. Accuracy of impedance magnitude is within 5%. Correct impedance is established for each frequency by setting three counter-type dials in accordance with a calibration book. Power is read directly on a front-panel meter. The equipment is powered by a 110/115 v. 60 cps ac source; weighs 79 lbs.; and measures approx. 26 x 17 x 18 in. **Sierra Electronic Corp., 1050 Brittan, San Carlos, Calif.**—TELE-TECH & ELECTRONICS INDUSTRIES.



DIELECTRIC SEALER

Designed as a flexible potting compound, the EC-1120 dielectric sealer retains its physical properties through the range —65° to 200° F. and is water resistant. Also, the sealer resists fuels and oils and is unaffected by salt air. The high solids content of the material (approx. 92% by weight), insures against excessive shrinkage; and, no special equipment is needed for its application. Stored at temperatures below 75° F., unaccelerated EC-1120 has a shelf-life of



over one year. A heavy liquid, the sealer can be applied to electrical connections by knift, spatula, or flow gun. **Minnesota Mining & Mfg. Co., Adhesives and Coatings Div., 423 Piquette Ave., Detroit 2, Mich.**—TELE-TECH & ELECTRONIC INDUSTRIES

RESISTOR

Style 155 pyrolytic resistor has a one-piece molded case and is considerably smaller than the non-insulated size RN20 with insulating sleeving. Actual size of the unit is $1^{9}/_{32}$ in. long with a $^{3}/_{16}$ in. diam. Leads are axial #20 thinned copper wire. Insulating sleeving is not required. Standard tolerances are 1%, 2%, and 5%. Current production of these ½ w. deposited-carbon precision resistors is on values from 100 ohms to ½ megohms. The units meet MIL-R-10509A test requirements and are sold under the name, "Hi-Stab." **Erie Resistor Corp., 644 W. 12, Erie, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

CARRIER SYSTEM

A new line of power-line carrier equipment, Type FD, for power system relaying, telemetering, supervisory control, and voice communication enables closer channel spacing, made possible by highly selective receiver filters and frequency crystal control. Frequency ranges are 40 to 90 and 90 to 200 KC. Assemblies operate from either station battery or alternating current. **Westinghouse Electric Corp., Dept. TP-285, 2519 Wilkens Ave., Baltimore 3, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES

See NEW PRODUCTS
for the
Electronic Industries
Starting on Page 109

Minn. Mining Buys Irvington Varnish

Minnesota Mining & Manufacturing Co., St. Paul, Minn., recently announced the purchase of Irvington Varnish & Insulator Co., Irvington, N.J. Directors of Minn. Mining approved a $7,000,000 purchase agreement whereby Irvington became a 3M division and Irvington stockholders will receive 3M common stock and cash for the Irvington holdings.

The Irvington Varnish & Insulator Co. chemical division produces an extensive line of resins, produced mostly from the liquid derived from cashew nut shells, which are used in the electronics field because of their high dielectric strength.

Rust-Proofing Ferrous Metals

New developments in rust-proofing ferrous metals by low-cost chemical immersion methods are said to give promise of achieving standard salt-spray test ratings for effectiveness hitherto attained only in the field of electro-plating.

After several years of use in commercial production and comparative tests by ordnance and private laboratories, Rust-Proofing and Metal Finishing Corp., Commercial Ave. and Binney St., Cambridge, Massachusetts, has announced a new chemical treatment for iron and steel articles. Products treated by this process are reported to withstand standard salt-spray tests from 12-times to 24-times as many hours as those treated by standard phosphate-coating methods in worldwide use during more than a quarter of a century. It can be applied in integral colors ranging from gray and black through blue, green and olive drab.

The "Endurion" treatment's major contributions against rust and corrosion are:

(1) a substantial and significant increase in rust-proofing durability on both oiled and unoiled surfaces.
(2) uniform, all-over protection on every surface the chemical treatment fluid can reach.
(3) greater protection without "building up" for threaded parts and close-fitted assemblies which cannot be given equivalent rust-proofing by any other known means.
(4) a superior base for bonding paint, which permits one coat to provide the protection of several coats.

BULLETINS

Transistor Manual

Bulletin E-212, published by CBS-Hytron, 100 Endicott, Danvers, Mass., division of Columbia Broadcasting System, is an 8-page, comprehensive transistor manual. In three parts, the manual presents theory, data, and nine basic transistor applications, and explains point-contact and junction transistor operation by vacuum-tube analogy. Conduction by "holes", and P-N-P and N-P-N transistors are also explained.

Tube Insulators

Bulletin 537, prepared by American Lava Corp., Chattanooga 5 Tenn., subsidiary of Minn. Mining & Mfg. Co., gives the mechanical and electrical properties required in vacuum tubes. Lava and synthetic ceramics are described in relation to the requirements.

Capacitors

Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., South Plainfield, N.J. have released Bulletin No. NB-154 which presents technical data covering "Budroc" Steatite-cased paper tubular capacitors.

Coils and Filters

Burnell & Co., 45 Warburton Ave., Yonkers, N.Y. have announced a 12-page catalogue which presents complete information on toroids, high-quality coils, and various audio filter networks. Also, engineering data in the form of "Q" and attenuation curves.

Amplifiers

H. S. Martin & Co., Electronics Div., 1916-20 Greenleaf St., Evanston, Ill., have released a four-page brochure that describes Model 352A basic amplifier and Model 352CA control amplifier and presents specifications of the units.

Terminals

Ten groups of hermetically-sealed, sealed glass-to-steel, feed through terminals are presented in a new 20-page catalogue prepared by The Fusite Corp., 6000 Fernview Ave., Cincinnati 13, Ohio. Besides terminal lists, the catalogue includes specifications, electrode designs, and short case histories on usage.

Tubes

The descriptions and electronic engineering data covering electronic tubes used for communication, industrial, rectification, radiation detection, electro-medical, amateur, and special purposes are contained in the revised and condensed catalogue recently released by Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N.Y.

Sockets

A new 12-page catalogue released by Vector Electronic Co., Dept. EL, 3352 San Fernando Rd., Los Angeles 65, Calif., presents new types of socket-turrets, socket-strips, plug-in hardware, improved tube socket test adapters, and pluggable and permanent type components designed for unit construction.

Numerical Computers

"The Gerber GraphAnologue and Variable Scale" is the title of a 10-page booklet by The Gerber Scientific Instrument Co., 89 Spruce St., Hartford 1, Conn. It explains two new engineering instruments which multiply, divide, and proportion distances.

Facilities Report

The W. L. Maxon Corp., 460 West 34th St., New York 1, N.Y. have released "Maxon facilities report", number three, a profusely illustrated, 31-page presentation of the company's engineering organization, and its facilities employed in the development and manufacture of electronic, electrical, pneumatic, hydraulic, and electro-mechanical systems and equipment.

PA System

J. M. Loge Sound Engineers, 2171 W. Washington Blvd., Los Angeles 18, Calif. have released a brochure that describes the battery operated, Loge portable public address system (Porta-Kall) and presents its specifications and optional equipment.

Receiving Tube Guide

A complete guide on receiving tubes for design engineers is now available. The 47-page booklet contains characteristics and ratings of 300 tube types. Designed for ease of use, the tube symbols are easily interpreted and are closely associated with their tabular information. The only cross references employed associate the tube type with its dimension drawing. Send 35 cents for booklet, RU-020, to Westinghouse Electronic Tube Div., Dept. T-329, Box 284, Elmira, N.Y.

Capacitors

The Gudeman Co., 340 W. Huron St., Chicago 10, Ill., July, 1953 catalogue, M-100, presents general information and engineering data covering Type QT molded paper capacitors.

Circuit Breakers

Keller Sales Co., 915 W. Oakdale Ave., Chicago 14, Ill., have released Cat. No. 1/52 E-T-A 1.4.52 which describes and presents performance data covering single-pole, thermally-operated, miniature, over-current circuit breakers produced by Ellenberger & Poensgen G.m.b.H., Altdorf near Nurnberg, Western Germany.

Industrial Process Control Firm

Stromberg-Carlson, nationally prominent in the communications field since 1894, has announced participation in a new industrial process control firm, Electronic Control Systems, Inc., 2138 Westwood Blvd., Los Angeles, Calif.

The new firm, headed by Leonard Mautner, president, and Alexander F. Brewer, executive vice-president and secretary, will concentrate on seeking out and solving automatic process control and data handling problems.

R. C. Tait, president of Stromberg-Carlson is a director in the new concern. Mr. Mautner, since graduation from MIT, has managed the TV transmitter division of Allen B. DuMont Labs., was president of Television Equipment Corp., and headed electronic research and development of guided missiles laboratories for Hughes Aircraft Co. He is the holder of many electronic patents. Mr. Brewer, California Institute of Technology graduate with a Leland Stanford University master's degree, has specialized in similar fields for 13 years and holds patents in electronic circuits and microwave work.

I. Melville Stein, formerly executive vice-president of Leeds & Northrup Co., has succeeded Charles S. Redding who had been president of the company for 14 years and is now chairman of the board. The chairmanship had been vacant since the death of Morris E. Leeds in 1952. D. H. Schultz, secretary and treasurer since 1940, has succeeded Mr. Stein as executive vice-president; Mr. George W. Tall, Jr., vice-president, has assumed the additional post of secretary.

Newland F. Smith has been appointed general manager of Gray Research and Development Co., Inc., 658 Hilliard, Manchester, Conn., subsidiary of the Gray Mfg. Co., producers of dictating equipment and central dictation systems. Mr. Smith formerly was director of general engineering for Mutual Broadcasting System and WOR.

Newland Smith

R. H. Mulford, a vice-president of Owens-Illinois Glass Co., has been elected vice-president and general manager of Kimble Glass Co., a subsidiary. Mr. Mulford will report to C. R. Megowan, president of Owens-Illinois Co., and chairman and president of Kimble Glass Co.

W. H. Jeffery has been made vice-president and general manager of Philco Corp. of Canada, Ltd., Toronto, a position previously held by **Sydney L. Capell,** who became president of Philco International Corp., Philadelphia, last January.

Rear Admiral Thomas F. Halloran, USN (Ret.), has been made general manager of the Baird Assoc. Transistor Development Laboratory. Since his retirement in 1948, Admiral Halloran has participated in the advanced management program of the Harvard Graduate School of Business Administration, and engaged in the design, development, and production of electronic and electromechanical equipment.

INDUSTRY NEWS

(*Continued from page* 199)

Allen K. Shenk and **Jerome D. Heibel** have been named vice-presidents of Erie Resistor Corp., Erie, Pa., manufacturers of electronic components and molded plastics. Mr. Shenk, now vice-president in charge of sales, joined Erie Resistor in 1942 after a twelve-year period of service with W. S. Hill Co., Pittsburgh. Mr. Heibel is now in charge of research engineering. He joined Erie Resistor in 1936; and, since 1949, has served the company as director of research and engineering. He is chairman of the RTMA committee on ceramic dielectric capacitors.

Robert C. Sprague, chairman of the board of the Sprague Electric Co., North Adams, Mass., has been elected a director of the Massachusetts Business Development Corp., a recently-created agency of the Massachusetts State Legislature for the purpose of promoting jobs and attracting industry with the many unique advantages of the state.

Robert C. Sprague

Katherine Crowley has become executive vice-president of Henry L. Crowley & Co., Inc., West Orange, N.J. Miss Crowley is a Wellesley College alumna and is experienced in the production of high-frequency powdered-iron cores, sever-service steatites, and magnetic ceramics.

Les Wildberg, president of Leader-Electronics, Inc., Cleveland, Ohio, recently announced the decision of his company to enter the manufacture and sale of TV equipment. Items primarily for consumer use will be sold nationally through regional representatives to manufacturers and TV set distributors.

Dale A. Lichty, has been promoted to vice-president in charge of sales and engineering of Hydro-Aire, Inc., Burbank, Calif. Mr. Lichty, who has been with the company since it was organized in 1943, will be in charge of aircraft accessories sales and an expanded research and development program.

TELE-TECH ADVERTISERS — OCTOBER, 1953

INDUSTRY NEWS

(*Continued from page 200*)

Robert L. Westbee was recently elected a vice-president of Minnesota Mining & Manufacturing Co. He will head a new organization which will include the electrical insulation and sound recording tape division, the Irvington Varnish and Insulator division, and the American Lava Corp., a wholly-owned subsidiary. Mr. Westbee had been general manager of the electrical insulation and sound recording tape division since 1948.

Roscoe A. Ammon, for 12 years general manager and chief engineer of Marion Electrical Instrument Co., Manchester, N.H., has become president and

Roscoe A. Ammon

treasurer of the company. William F. McElroy, the former president, has retired from active management, but will continue to serve as a director of the company and in an advisory capacity. Herbert Schachat has become vice-president in charge of operations.

George B. Fraser was elected president of The Astatic Corp., Conneaut, Ohio. Formerly vice-president and general manager, Mr. Fraser also had been treasurer since he joined the corporation in 1936. Floyd W. Woodworth, one of the company founders, was president until his retirement in 1950.

Harold Blumenthal has been made sales manager of the manufacturers division of Shure Bros., Inc., Chicago, Ill., manufacturers of microphones and acoustic devices. Mr. Blumenthal had been with the company for six years in the capacity of sales engineer before his recent appointment.

A. S. Chivers has been appointed assistant sales manager of Barry Corp., Watertown, Mass. He will handle the advertising and sales of shock mounts and vibration and noise isolators. Before his appointment, Mr. Chivers was sales coordinator of Barry's Pacific division.