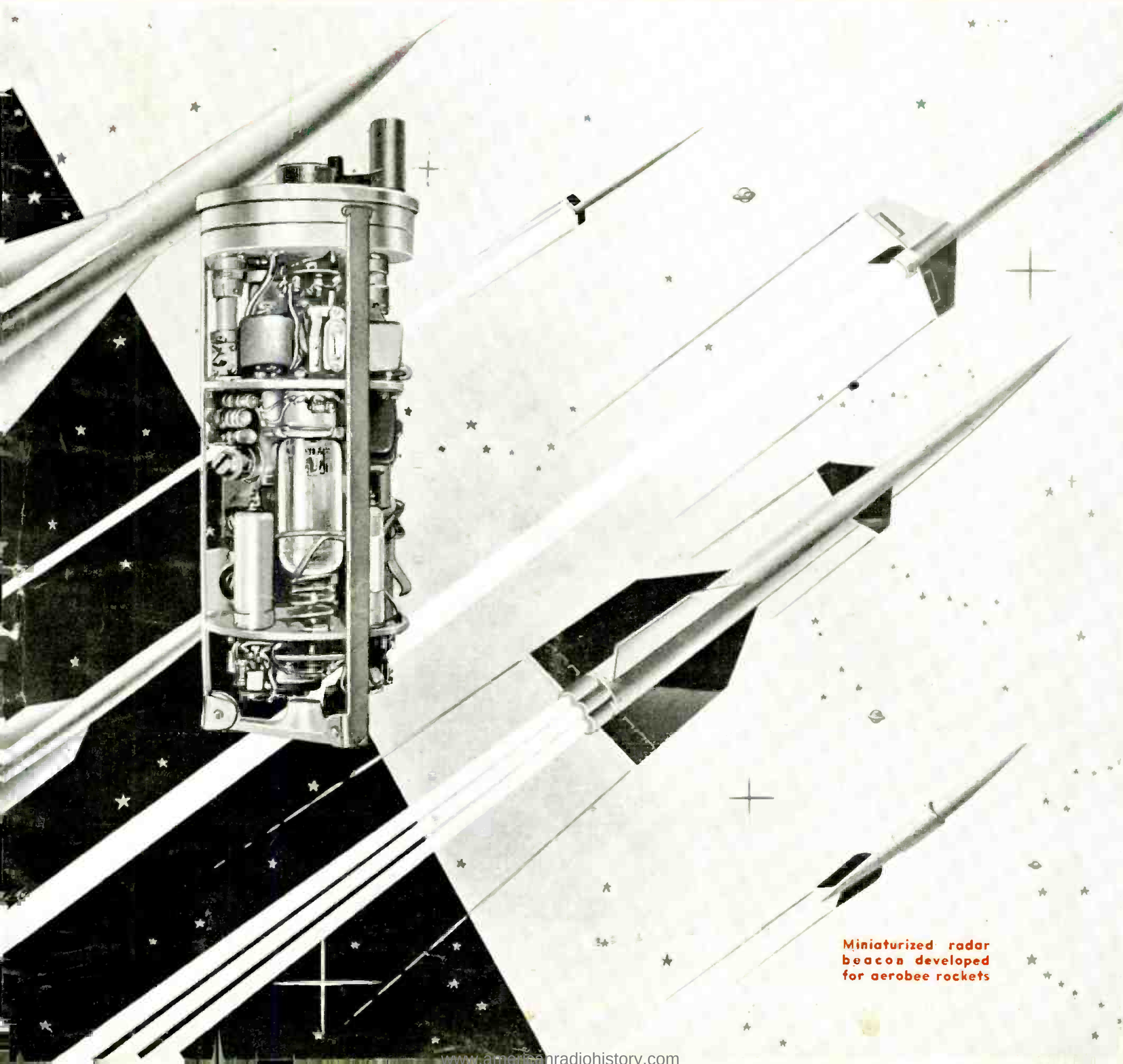
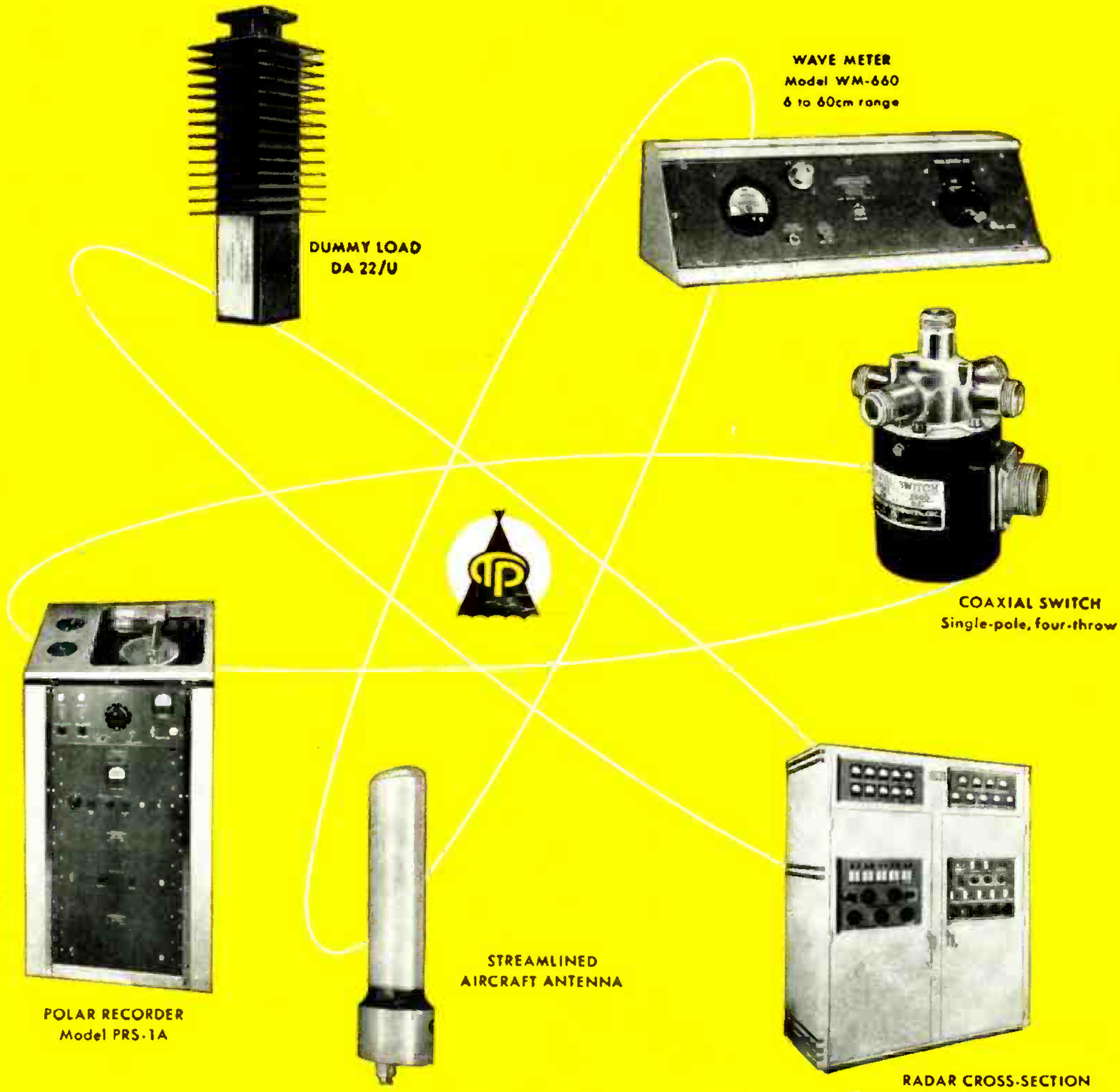
TELE-VISION ENGINEERING

FEBRUARY, 1952

The News-Engineering Journal of VHF-UHF TV, Radar and Allied Industries



Miniaturized radar beacon developed for aerobee rockets



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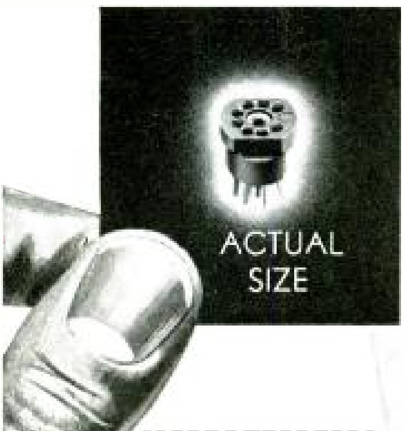
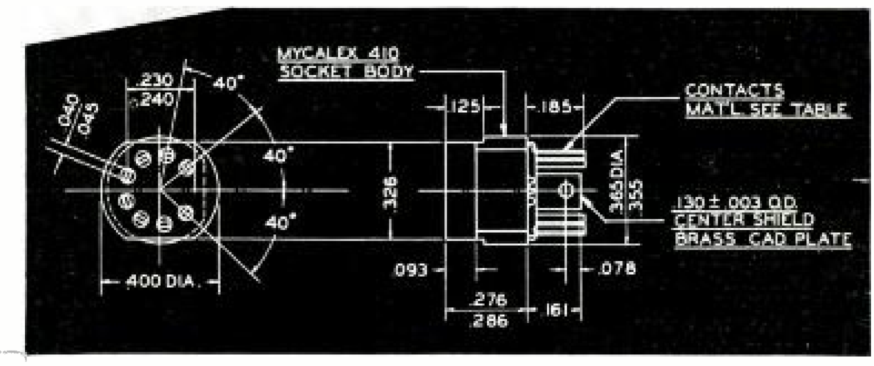


TOP VIEW

BOTTOM VIEW



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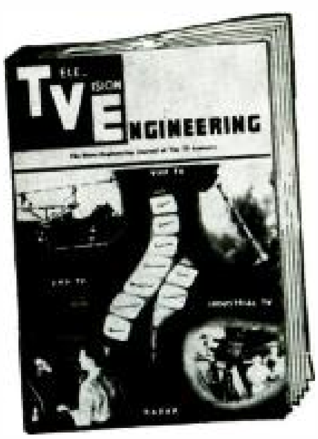
Miniaturized radar beacon, employing subminiature tubes and components, developed for guided missiles. *(Courtesy U. S. Signal Corps)*

Editor: LEWIS WINNER



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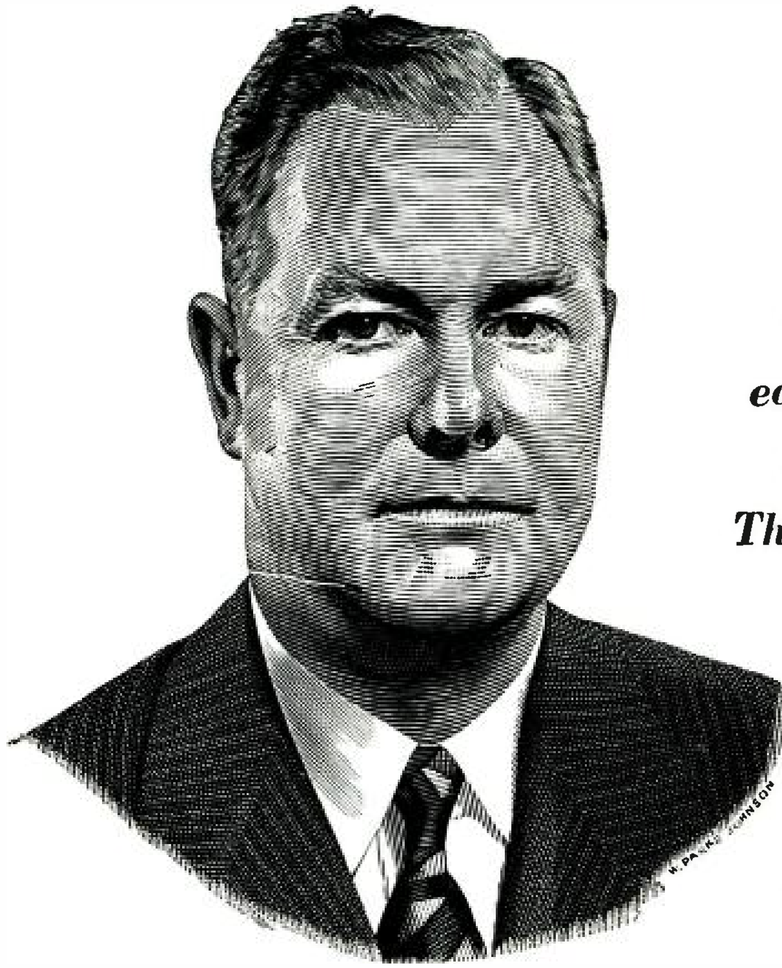


TELE-VISION ENGINEERING

LEWIS WINNER, Editor

February, 1952

UHF Interest Begins To Dominate Industry-Scene—Though ultrahigh-land will not be an official community until about the fifteenth of March, when the trumpets will blow hailing the end of that long, long freeze, there are rousing plans afoot for the new sprawling home of the nation's sightcasters.

The first cue to the top priority that it seems will be given by practically everyone to the ultrahighs, appeared during a TV seminar in Washington when the tenor of the meeting was set by page advertisements published in all of the Washington dailies. Headlined *UHF Means More TV For More People*, the advertisements declared that: "To manufacturers it will mean the creation of vast new markets . . . for home TV receivers." And to broadcasters . . . "The opening of *uhf* will mean added opportunities to extend local and national TV coverage."

Further evidence of the accent on *uhf* appeared in a seminar report revealing that consultants will be supplied with portable *uhf* transmitters, antennas and receiving equipment, to conduct field surveys for prospective broadcasters. It was also disclosed that ultrahigh activities in New York will become even a more dominant factor within the new few months, when a series of a special tests are conducted via an 850-mc antenna mounted on the *vhf* tower on the Palisades. These tests are expected to provide important tropospheric data. To supplement this probe, there will be inaugurated a comprehensive coverage project which will feature the use of a series of antennas, mounted at 200, 400, 600 and 800-foot heights, all motor driven, and radiating over smooth and rough terrain. It is expected that the results of these tests will provide conclusive coverage-production formulas.

While the results in Bridgeport, New York and elsewhere have proved that ultrahighs can deliver an extremely satisfactory signal, several coverage problems have appeared on the horizon, particularly in hilly terrain where operation has been found to be spotty. This, it is expected, may be overcome by beam tilting, which tests have showed can provide substantial gains in outputs. In one instance, it was found that a tilt of 1.3° downward* provided an increase of signal strength out to about 5 miles. Beam tilting and beam shaping can also be used to reduce coverage, and thus provide a means of minimizing interference and permit closer station spacing. With the probability that ultrahigh stations may be allowed to operate with a megawatt of power, sometime in the future, the radiation-control possibilities of beam tilting and shaping are certainly significant.

Last month, it was indicated that *uhf* will play a prominent role during the forthcoming IRE convention, when nearly a score of papers will be presented on the subject. It has now been learned that the ultrahighs will be a featured attraction at the NARTB engineering session in Chicago, not only during a paper session, but also at a special symposium involving members of consulting engineering and manufacturing organizations.

UHF is certainly roaring along!

Functional Classification Sought As Pattern — The many variations of services encountered in TV have prompted many to consider the widespread adoption of functional classifications, similar to those used in technical institutes, which would pinpoint the services to be rendered in various departments.

To illustrate,** a *research engineer* or *scientist* has been classified as one engaged in pure research into physical or natural laws to increase basic scientific knowledge, with *applied research* being directed to a solution of specific problems. Other suggested classifications have been: *development engineer*—applies results of research to produce new methods, products, structures, machines or equipment; *design engineer*—makes detailed plans and specifications for use in construction of structures, machines or equipment; *planning engineer*—deals with selection of equipment or layout of structures and facilities and its integration into a system to accomplish some definite purpose; *production engineer*—handles problems associated with actual manufacture of products; *test or quality control engineer/analytical scientist*—tests or analyzes finished products, machines, structures, or equipment to determine whether or not it is satisfactory; *operating engineer*—is responsible for the satisfactory operation of a complete system of some type or of some part of a system; *plant engineer*—is responsible for the satisfactory operation and maintenance of general structures and facilities; *executive/management engineer*—directs and supervises a manufacturing, production or construction industry.

TV at the IRE—TV, which has become the mighty monarch of the airlanes, will truly reign in a regal fashion at the annual IRE meeting from March 3rd to 6th, when every facet of the art will be covered: color, the ultrahighs, power tubes, transmitters, antennas, tuners—all analyzed by the country's leading specialists. As cited earlier, there'll be full-day sessions on receiver design, and another full-day meeting on TV broadcasting. Specifically, some of the topics to be covered will be fixed and mobile TV lighting, transient response, use of heliocopters for field-intensity measurements, *uhf* klystrons, transmitter design for the ultrahighs, station construction and theatre conversion.

Practically during every day at the IRE, TV will sparkle as a leading attraction—a stirring tribute to an infant art which during the past few years has thundered along and truly set the pace in industry.

During this 4-day session, we'll be at our familiar stand at Grand Central Palace at Booth *288*. Hope we'll be seeing you!—L. W.

*See *uhf* report in October, 1951, TeleVision Engineering.
**With apologies to Rensselaer Polytechnic Institute.

TVE-grams . . .

TVcasting Expansion Forecast Despite Restrictions: Notwithstanding defense production restrictions, new TV broadcasting facilities will become available for over a score of cities throughout the country not too long after the freeze is lifted, according to a three-month study by a task force of industry experts, which included William H. Chaffee, Philco; Keston Arnett, DuMont; Admiral Edwin D. Foster, RCA; and C. W. Michaels, G.E. . . . In their opinion, it will be possible to meet material requirements for transmitters, studio equipment and antennas up to July '53 from present inventories and current allocation materials, without any requests for increased allocations. Their report revealed that there are now 28 transmitters already in the hands of prospective broadcasters, 20 in stock, and 154 being processed; sufficient material for these transmitters are assured. . . . Commenting on the anticipated permits for construction that the FCC is expected to approve, the specialists declared that about 140 authorizations would be issued by the end of the year, and 190 by the end of '53, with *vhf* and *uhf* sharing about equally in the assignments. It was believed that around two dozen *vhf* stations might go on the air before the end of the year, and that the ultrahigh-transmitter installations would not become a reality until '53, when about 60 would begin to operate in this range. Over 70 more *vhf* stations should also begin telecasting in '53, it was reported. . . . While steel for the antenna towers was noted as a critical item, it was pointed out that in many instances the use of existing towers now accommodating AM or FM antennas, and tall buildings and hilltops, should play an effective role in reducing tower heights, and steel requirements. Many owners of existing stations have already been consulted on the use of their radiating structures for TV antennas. . . . According to the investigating committee . . . "Television potentially is the most powerful system of communication yet devised" . . . and as such is certainly a vital factor in our national policy which recognizes the . . . "essentiality of a complete national communication system."

Dress Rehearsals for NTSC Color: The compatible color-system techniques evolved by industry representatives on the National Television Systems Committee are now undergoing crucial tests in Philadelphia at Philco; Syracuse at G.E.; and in New York at RCA, Hazeltine and DuMont. Among those scheduled to look in for the first time, in an official way, are members of the FCC. (Many of the members of the FCC's engineering departments have been present unofficially during preliminary system studies). The tests are expected to disclose the degree of flicker, if any, observable on receivers; brightness and contrast range available; continuity of motion possible; registration virtues; color breakup and color fringing, if any; color fidelity; brightness resolution possible; picture texture; susceptibility to interference; adequacy of deflection sync information; fringe-area possibilities; sound quality reproduction; possible uses of ultrahighs, etc.

A New VHF Propagation Theory: At the Bureau of Standards in Washington, Dr. J. Feinstein has developed a new theory for the propagation of *vhf* waves beyond the horizon, which suggests a new role for the gradual change in the refractive index of the atmosphere with height. This change, or gradient, is said to lead to reflection as well as refraction of the waves as they travel out into space from the transmitter; the amount of reflection is noted as being small, but enough to lead to appreciable propagation of signals beyond the horizon. According to Feinstein, the new theory might mean that higher-powered TV stations located farther apart than line-of-sight might interfere with each other. Attempts to prove the validity of the theory will be made at a NBS transmitting site on Cheyenne Mountain, in Colorado, 9000 feet above sea level. It is believed that the distances prescribed in the new allocation schedule are sufficient to avoid the possible interference problem cited by Feinstein, and that power balancing can be used as a means of controlling any possible interference problem in the future.

Military Gunsight Now Serving as TV Camera Finder: A gunsight, developed for use on anti-aircraft gunnery, has been found to be an ideal rapid-action shot pin-pointer for TV cameras. Known as an *optical ring sight*, the finder consists of a single glass-faced disc so constructed that a set of concentric rings appear at target distance in the field of view. . . . Field cameras, now being made by one manufacturer, are featuring this unique rapid sight.

CONSERVATION MEASURE: Inserting tungsten rod into small hole at tip of an ultrasonic vibrator, which literally shakes glass beads off the rods, salvaged from tubes which have been found faulty during manufacture. (Courtesy Raytheon)

UHF TRIODE: Medium-mu pencil-type triode (RCA 5893) which is said to be capable of providing peak output of over a 1000 watts in grounded grid service as a plate-pulsed oscillator at frequencies up to 3300 mc. Design employs a coax-electrode structure of double-ended metal-glass type in which plate and cathode cylinders, each ¼-inch in diameter, extend outward on opposite sides of a grid flange.

RADAR GAS-SWITCHING TUBE: Broadband gas-switching tube (G.E. 6038) which is claimed to cut recovery time to about 8 microseconds at a power of 50 kw, with a pulse repetition rate of 1000 pulses per second, and a pulse width of .5 microsecond, at 9300 mc. Tube can be used in equipment having a maximum transmitting power of 100 kw.

TVE-grams . . . Personals

New Posts: *J. A. Milling*, formerly chief of the NPA end equipment branch (on leave from the RCA Service Co., where he served as vice president), has been appointed director of the electronic division of NPA. Milling, who succeeds *Edmund T. Morris, Jr.*, who is returning to Westinghouse, will also serve as chairman of the Electronics Production Board. Defense Production Administration. . . . Vice Admiral *Edwin Dorsey Foster* (U. S. N. Ret.) has been appointed vice president and director of planning for RCA Victor division, RCA. . . . *Philip Barnes* has been named director of the sales division of the Weston Electrical Instrument Corp. *Hubert M. Ricks* has been named general sales manager, succeeding Barnes. . . . *George Adams* has been named factory superintendent of the Permoflux Corp. *Howard Roth* has been named industrial sales rep. . . . *Dr. Courtnay Pitt* has been appointed vice president-finance to the top-level management policy committee of Philco Corp. . . . *R. N. Kellogg, Jr.*, formerly advertising director of Machlett Labs. has joined Burlingame Associates in the same capacity.

Bernard Tullius has been appointed sales engineer for the transmitter division. DuMont Labs. . . . *George W. Jernstedt* has been appointed manager of engineering for the special products development division of Westinghouse. . . . *Ferdinand W. Schor*, formerly chief engineer in charge of government equipment engineering at Hallicrafters, has been named chief engineer in charge of military engineering for Motorola. . . . *Charles H. Crutchfield*, formerly vice president, has been named senior vice president and general manager of the Jefferson Standard Broadcasting Co. *Larry Walker* has been named a vice president and assistant general manager. . . . *Harold E. Tyler* has been appointed general manager of Setchell-Carlson, Inc. . . . *J. J. Samuels* has been appointed general sales manager of Fidelity Tube Corp. . . . *Nicholas DeFalco* has been named manager of the receiver quality control department of DuMont, headquartering at the East Paterson, N. J., plant. . . . *Irving G. Rosenberg* has been appointed director of operations, responsible for Allen B. Du Mont Laboratories, Inc., television receiver and cathode-ray divisions.


J. A. Milling


Philip Barnes


Hubert M. Ricks


Bernard Tullius


Ralph Bown

Dr. Ralph Bown, formerly director of research, has been appointed vice president in charge of research for Bell Telephone Labs. Other appointments at Bell Labs: *Dr. J. B. Fisk*, director of research-physical sciences; *Dr. H. T. Friis*, director of research in high frequency and electronics; *Dr. W. H. Doherty*, director of research in electrical communications; and *Dr. R. M. Burns*, chemical coordinator. . . . *Steven E. Lasewicz* has been named production manager of The LaPointe Plascomold Corp. He was formerly chief engineer of Horton-Bristol Co. . . . *Irwin Weinstein*, formerly assistant chief engineer of Sarkes Tarzian rectifier division, has joined Electronic Devices, Inc., as assistant sales manager. . . . *Kenneth A. Hoagland* has been appointed assistant engineering manager of the picture-tube division of DuMont.

Albert Coumont, formerly with International G. E., has been appointed service manager of RTMA. . . . *Armin P. Buetow*, general manager of Magnecord, Inc., has been named executive vice president of the company. . . . *Henry C. Roemer*, formerly executive vice president, has been elected president of Federal Telephone and Radio Corp. . . . *Homer R. Oldfield, Jr.*, has been appointed resident manager of the G. E. advanced electronics center at Cornell University. . . . *Robert Moore* is now production engineer at E. I. Guthman Co.

Marvin Hobbs, electronics adviser to the chairman of the Munitions Board, has been appointed a member of the Electronics Production Board succeeding C. W. Middleton, who is now engaged in field activities for the Department of Defense. . . . Other *EPB* members are *Harry A. Ehle*, consultant to the Undersecretary of the Army; *Don G. Mitchell*, consultant to the Undersecretary of the Air Forces; Capt. F. R. Furth, USN, Director, NRL; and F. H. Warren of the Atomic Energy Commission. . . . *Albert Lederman* is now technical representative of the Sylvania government relations department in Washington. . . . *A. Kalinsky* has been appointed general manager in charge of production for Heldor Manufacturing Company, division of Heldor Bushing and Terminal Corp., Bloomfield, N. J. . . . *Everett E. Gramer*, vice president of the Gramer Transformer Corp., 2734 N. Pulaski Road, Chicago, has assumed the duties of western sales manager for the company, with headquarters at 2738 E. Third Street, Tucson, Ariz. . . . *Karl Kramer*, technical service manager for the Jensen Manufacturing Co., appeared at a recent meeting of the Indianapolis IRE to deliver a paper on *High Fidelity Problems and Loudspeaker Design Considerations*. . . . *Frank D. Langstroth* has been appointed vice president in charge of operations of Video Products Corp. and its affiliate company, Sheraton Television Corp. at Red Bank, N. J. Langstroth was formerly president of Starrett Television Corp. in New York.

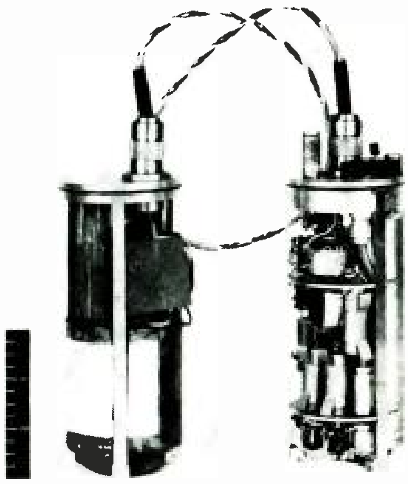

W. H. Doherty


J. B. Fisk


K. A. Hoagland


Robert Moore


Frank D. Langstroth



MINIATURE

Recently Developed Radar Beacon, Used With Antenna Flush-Mounted in Rocket Skin, Provides Continuous Flow of Signals to Tracking Radar Set on Ground, Regardless of the Amount of Tumbling in the Air

Left and above

PROTOTYPE BEACON and power supply, with and without housings; one of twelve units constructed with Signal Corps model shop facilities, which were subjected to extensive field and bench tests, to determine shortcomings and design deficiencies.

Transponder beacons‡, in conjunction with specially modified ground radar sets, are used extensively by Signal Corps engineers in the instrumentation of guided missile flights. The chief advantage of this approach over other instrumentation techniques is that the reduction of range and positional data is almost instantaneous.

In the design of electronic gear for rocket or guided missile applications, where not only the weight and volume of the equipment are of prime importance, but also the ability to withstand the severe environmental conditions to which it is subjected, the trend towards miniaturization is a natural one. The smaller mass and moments of tiny components permit them to withstand greater shock, acceleration, and vibration than do their larger counterparts.

Fortunately, the research departments of the various government services, as well as many organizations in private industry have expended much effort in developing and making available a multitude of subminiature components. As a result, numerous miniaturization programs have been undertaken, among which the transponder beacon has played a role.

The design engineer, in achieving compactness with these new components, is confronted with many new problems. The concentration of numerous heat dissipating components in a small volume results in extremely high operating temperatures. Since high temperature adversely affects both the life and operational characteristics of most components, all possible techniques of transferring heat away from the equipment, including radiation, must be used. Temperature sensitive components must be favorably located and thermally insulated. Effective electrical shielding and proper component placement is mandatory to avoid regeneration or interaction in closely spaced high-gain circuits.

These and many other problems

VIEWS OF THE PRODUCTION MODELS of the beacon and power supply.

TRANSPONDER BEACON For Guided Missiles

by B. H. SINCLAIR

Electronics Engineer

SCEL, Evans Signal Laboratories

arose in the design of the miniature beacon in the labs. Twelve prototypes were constructed with Signal Corps model shop facilities and after extensive field and bench tests, the shortcomings were recognized and corrected before placing the beacons into production. As will be noted in the illustrations, many refinements were included in the production models.

The Transponder Beacon

The miniature beacon unit, comprising receiver, decoding, trigger, modulator, transmitter, and duplexing circuits, is housed in a pressurized container 2½" in diameter by 6⅜" long and weighs less than two pounds. All controls are readily accessible at the side and top of the container. The power supply and remotely controlled switching mechanism are housed in the second pressurized container, dimensionally similar, also weighing less than two pounds.

All tubes and pluck-out items in the beacon can be easily removed, and all other components can be serviced by trained technicians. Components are well secured and mounted in positions favoring proper operation under the conditions of high acceleration to which they are subjected in actual use. Tube mounts serve a trifold purpose: as a method of securing and shielding the tubes, and as a means of transferring heat away from tubes by contacting the outer container. The container is blackened both inside and out to transfer heat away from the equipment by radiation. A long cylindrical tube, the microwave transmitter cavity, is also blackened to radiate heat. What appears to be a head casting in the unit, is actually a coax *rat-race* duplexer. There are 120° spaced stringers, under tension when secured in the container, which provide the backbone of the beacon.

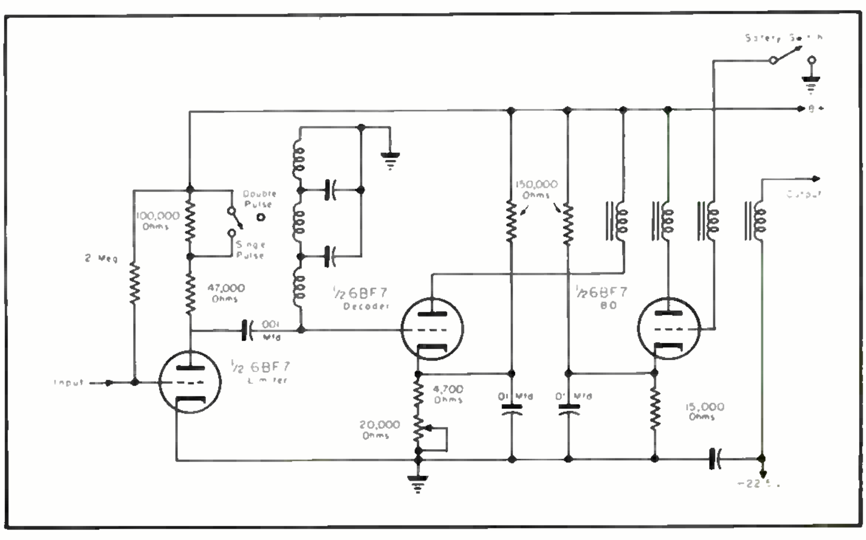
The bottom section of the power supply is a hermetically sealed vibrator voltage supply, completely rectified and filtered. Located above are a remotely controlled switching mechanism, *C* battery, and special *A* battery. All are readily accessible.

A circularly-polarized turnstile antenna is supplied with the beacon. Many installations, however, require special antennas peculiar to the particular missile.

Mention of the environmental conditions under which the beacon must operate will probably clarify the unusual geometry and layout of the equipment. Since the beacon must operate in the low pressure regions of the upper atmosphere, high-voltage circuits such as the transmitter must be pressurized to prevent corona and arcing. Cylindrical structures lend themselves to pressurization techniques more readily than do rectangular structures. In addition, the equipment must operate under conditions of high transient and constant acceleration, which requires components to be mounted in that position which favors most reliable operation. Using this particular arrangement, the beacon will operate satisfactorily beyond 100g constant acceleration along its longitudinal axis, and substantial acceleration in other planes. The beacon is also required to operate under severe conditions of shock and vibration without the use of shock mounts. This requires well secured leads and components, which has dictated the use of etched-plate circuitry and the adhesion of all small compon-

(*Continued on page 30*)

‡ *Transponder beacons are slave electronic devices which can be likened to telephone repeaters. Upon receipt of a low level signal, a signal of higher level, similar in character to the received signal, is emitted. Used in conjunction with pulse-type radar sets, this type of beacon increases the effective range of the interrogating radar set, and by using different transmit and receive frequencies, eliminates unwanted signals and reduces ground clutter at the radar. In actual use, the beacon is mounted in experimental rockets or guided missiles and tracked by the radar from take-off to impact. Range and positional information are automatically displayed on elaborate pen recorders at the radar, and running photographs are made of pertinent indicators for further correlation with other instrumentation techniques.*



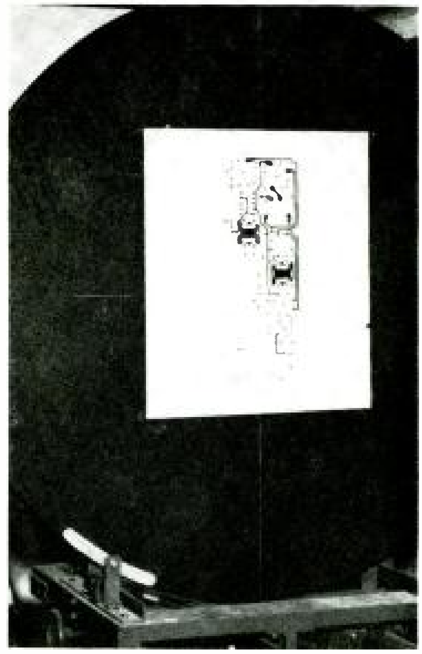
Above
CIRCULARLY POLARIZED TURNSTILE antenna supplied with the beacon.

Right
SCHEMATIC OF THE LIMITER decoder and trigger circuits.

ETCHING printed patterns in a ferric-chloride etcher.

Right.
MASTER DRAWING mounted in preparation for photography.

Below.
PRINTING CIRCUIT pattern on a foil-clad laminate utilizing a vacuum-frame and carbon-arc lamp.



PRINTED CIRCUIT

WITH COMPETITION in the TV and allied fields reaching an all-time peak while production costs continue to increase, industry has been searching for less expensive design methods and assembly techniques. As one solution, there has appeared the application of printed circuits on foil-clad laminates, which offers improved reliability and greater economy.

The printed circuit is a metal-conductor pattern on an insulating material which serves as a connecting medium for electrical components, replacing to a large extent the internal maze of wires normally found in conventionally-assembled chassis. Among the various methods used to produce the conductor pattern, that of etching foil-clad laminates appears to have the widest range of applications. This circuit is achieved by printing a pattern on a metal clad surface with acid resistant inks, paints or enamels utilizing numerous means of transfer of which photography, silk screening and offset printing are a few. One system which lends itself to circuit reproduceability and from which precise pattern configurations can be obtained, is the photoetch process. This procedure combines the technique of applying an acid resist photographically and the art of metal etching. A photographic image is transferred to a sensitized metal foil clad surface which, upon exposure to light, forms an insoluble acid-resistant enamel top, and the undesired foil areas are then etched away in an iron-chloride solution prior to the fabricating operation.

For most circuit applications, copper foil in a variety of thicknesses is bonded to one or both sides of laminated plastics of the desired grade and thickness. Laminated plastics other than phenolics, such as teflon, melamine and silicone fiberglass are available depending upon temperature requirements, and metal foils other than copper, such as silver, aluminum and brass are used. In certain applications where flexibility is of prime importance, metal foil clad supports including fiberglass cloth, nylon and paper, to name a few, can be supplied. Circuits utilizing the proper combination of the foregoing materials may, in addition, be plated with a wide assortment of metals for a superior electrical contact, an extremely hard wiping contact surface, or as a protection against corrosion. The etched and fabricated circuits are supplied ready for assembly or completely assembled as desired.

One type of printed-circuit chassis, which is becoming increasingly important in guided missle and rocket applications, features circuitry on one or two sides of a suitable rigid-formed plastic. This is necessary, since the assembled chassis must be mounted after assembly so that its shape conforms with the inside or outside contours of its cylindrical mounting shell or container, with no mechanical hold.

PC Advantages

Exponents of printed circuits have cited many advantages for the technique. Specifically, it has been found that *pc* offers:

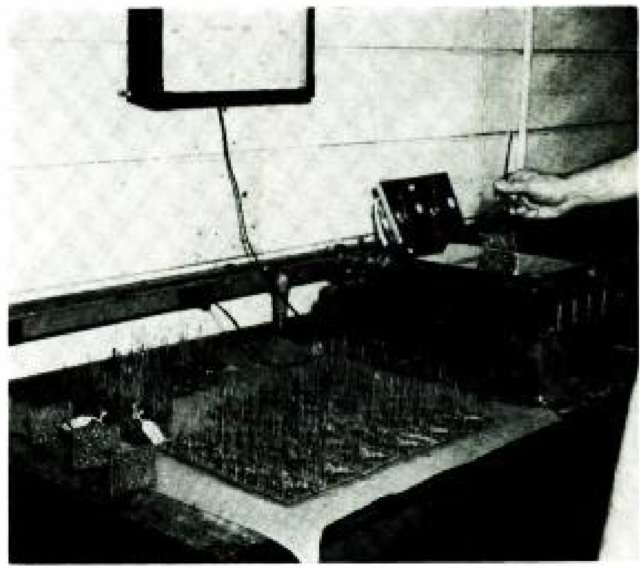
(1) Reduction in costs through the elimination of a large percentage of manual wiring. Specialized labor is unnecessary as operations are controlled through mass processing methods. Assembly and inspection times are reduced and rejects can be minimized, since the geometric positioning of components and conductor patterns is exact. Component leads are merely inserted in holes and can all be simultaneously fixed in position by a one-shot dip soldering operation.

(2) Extreme miniaturization can be accomplished, limited only by the size of the components. Smallness, heretofore unknown, can be realized by stack-

Report on PC Foil-Clad Laminate Assemblies and Practices Which Have Been Found to Offer Not Only Appreciable Reductions in Wiring and Assembly Costs, But Flexible Circuit Reproduceability and Miniaturization Possibilities, Plus Standardization of Production on an Accelerated Mass Production Basis

EYELETTING CIRCUIT pattern terminations for component lead insertions.

DIP-SOLDERING of printed circuit chassis after mounting all components.



Design Methods and Assembly Techniques

ing assembled plates or rolling circuits on flexible supports into cylindrical forms. This is possible, since no space need remain to provide for the accessibility of instruments necessary for assembly under conventional wiring systems.

(3) Improved reliability is assured since electrical defects between conductors and component leads is practically eliminated, and the soldering of all joints is insured since they can be made simultaneously through dip soldering. There is no discrepancy between circuit layouts since all are derived from a master design.

(4) Design changes during production runs can easily and inexpensively be made by revising the engineering drawings and preparing a new master photographic plate.

Some PC Shortcomings

Certain shortcomings have appeared in printed circuit assemblies in the past, but most have been resolved. In early assemblies, it was found that it was possible to solder and unsolder components from the conductor pattern no more than four or five times during the life of the unit, without the foil lifting from the surface, as a result of too many exposures to a hot iron.

by WILLIAM A. TEWELL

Photocircuits Corporation

Currently when numerous soldering operations are anticipated at foil terminations, eyelets, which serve as a mechanical anchor, are inserted at these points. These eyelets also serve as a connecting link between circuits on both sides of the insulating base. Three-dimensional circuitry also represented an earlier limitation. However, this problem has been solved by stacking plates, using rigid pin connections between each layer, or using a conductive pattern on a flexible support as an electrical wiring harness.

The most obvious difficulty encountered to date has been in the hardware mountings. Generally, it is not easy to adapt available hardware, such as tube sockets and other similar devices, since the problem of insuring a good electrical and mechanical connection between the external component tabs and the circuit pattern is ever present. One solution evolved features bending of the tabs over to meet the foil pattern, then eyeleting and soldering. Another approach employs a right angle lug anchored to the foil pattern, resistance welding the lugs to the tabs of the socket. Both of these methods have been found cumbersome adding to assembly costs. In the case of tube sockets, the desirable *floating effect* of the pin tabs is lost in securing the tabs to the chassis. However, cooperation between hardware and printed-circuit manufacturers is resulting in the formulation of new designs which should result in the satisfactory solution of these problems soon.

Line Width (Inches)	*Approximate Overload Current For Foil Lines (Amperes)* (.00135" copper)	(.0027" copper)
1/4	23	35
1/8	15	20
1/16	10	15
1/32	5	8
1/64	3	5

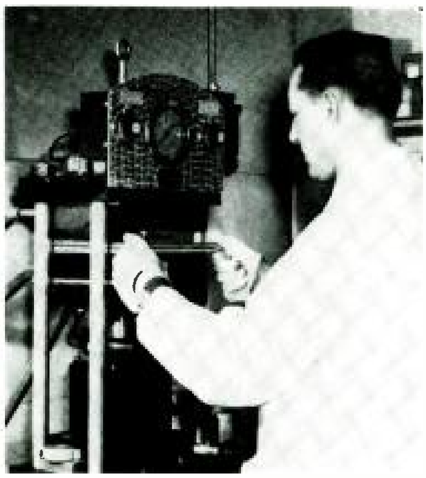
OVERLOAD CURRENTS for printed circuits on copper

Applications

Printed circuits lend themselves in many ways to television applications. Television tuners have been produced, and several types of radical designs are in the pilot-run stage and will soon be in production. The new tuners incorporate printed high-frequency coils, with the wiping surfaces silver plated for good electrical contact. Coils with inductances under 20 uuh can be made, but the size becomes excessive when higher values are required. This low-value type of coil is quite practical for TV frequencies. Incidentally, it has been found that printed spiral coils have about the same inductance as air core coils of the same number of turns.

The possibilities of flush circuits in television contact and switching assemblies have also been considered. In the flush process a circuit pattern of any configuration is embedded in an insulating base material in such a way that their surfaces are monoplanar. The flush contact surface offers the advantages of a superior metal-to-base bond, since the foil is embedded in the plastic material. There is also freedom from lifting or tearing, due to the rubbing action of the contact, as the contact slides over both surfaces which lie in the same plane. Rotary-channel switches properly plated are extremely adaptable. When the metal surfaces are properly plated, a hard and extremely long wearing contact, which will also be free from corrosive effects, can be realized. Experience has shown that with spherical contacts exerting approximately 1-ounce pressure, a .00025" silver plate on a .00135" copper surface will provide over 100,000 satisfactory operations. If there is a danger of the silver contacts sulfiding, a .000005" layer of rhodium may be plated on the silver. This application will increase greatly wear resistance and prevent tarnishing.

The extremely hard surface afforded by nickel can be further improved by coating with a thin rhodium plate. A commutator of this combination should last in excess of three-million revolutions, either under intermittent or continuous operation. A switch or wiping contact of this nature is satisfactory for *dc* and low-frequency operation; nickel, because of its ferromagnetic properties, is not good at high frequencies, where the noise level may become quite pronounced.



PRESSING experimental laminates developed in the laboratory.

By proper design of contact brushes and a choice of base materials, in conjunction with a silver-plus rhodium plate, it has been found possible to produce *hf* switches with a life expectancy upwards of a million operations before failure, providing minimum contact pressures are maintained. The flush-circuit principle has been found to make it possible to produce switching arrangements, which heretofore could not have been made without the design of a bulky and complex piece of equipment.

There will be available, soon, etched-foil antennas, which offer reliability at reduced cost, to replace the standard pressed wire-wound type. Good tolerances can be expected and line widths of 10 to 15 mills with equal spacings can be maintained without difficulty.

[1]The Teleregister Corp.

Coil *Q*'s in the neighborhood of 150 can be anticipated.

Assemblies and Techniques

Electronic assemblies can be manufactured utilizing printed conductor patterns and standard, miniature and subminiature components. In a typical assembly, for a computer application in an automatic inventory system, there are some 500 plug-in units which are composed of three tubes and one printed circuit plate.[1] The circuit plate consists of, on the average, sixteen components and twenty-two external lead wires, assembly being achieved by dip soldering.

The obvious advantages, as realized by this manufacturer, includes in addition to shorter wiring times and cost reductions: (*1*) Simplification of circuit testing; (*2*) ease of component replacement; (*3*) virtual elimination of cold solder joints; and (*4*) relative freedom from short-circuiting possibilities.

This printed-circuit chassis is approximately 2½" by 2¾", a size dictated, in part, by the condition that a larger unit would suffer from warpage of the insulating base when immersed in the solder bath. If the warpage problem obtained, it would be necessary to clamp the chassis in a metal frame to keep it flat during this operation. Should this not prove satisfactory it may be more convenient to revert to conventional soldering techniques.

The foregoing method of assembly can be easily expanded to include television chassis. In certain applications, the *if* strip has been constructed as a separate unit, and connections to the main chassis made by the use of pin connectors, conventional wiring methods or possibly the use of flexible foil wiring harness, produced by etching foil on a flexible support. In an adaptation of a present assembly technique, as applied to dip soldering large printed-circuit chassis where warpage is to be prevented, tinned eyelets have been inserted as receptacles for component leads. The leads are formed and cut so, that upon insertion, their length will protrude through the eyelet barrel. The preforming and cutting of leads and their insertion is a semi-automatic process to speed assembly and reduce inspection time.

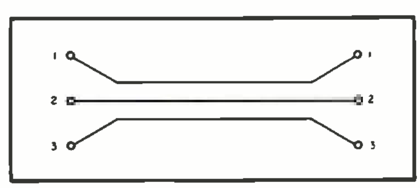
[*To Be Concluded in March*]

Base Material	Thickness of Copper Conductor	Conductor Characteristics								
		1/16" leads, 1/16" space			1/32" leads, 1/16" space			1/32" leads, 1/32" space		
		Capacitance Measurements between Conductors								
		1 to 2 mmfd	1 and 3 to 2 mmfd	1 to 2 mmfd/in	1 to 2 mmfd	1 and 3 to 2 mmfd	1 to 2 mmfd/in	1 to 2 mmfd	1 and 3 to 2 mmfd	1 to 2 mmfd/in
Phenolic[1] ..	.00135	4.5	10.0	.9	4.0	9.0	.8	4.75	10.0	.95
Phenolic[2] ..	.00135 (flush)	4.7	10.2	.94	4.5	9.5	.9	5.2	10.5	1.04
Melamine‡ .	.00135	5.5	12.5	1.1	5.0	11.5	1.0	6.2	13.2	1.24
Phenolic[3] ..	.0027	4.5	10.5	.9	4.1	9.9	.82	5.0	10.1	1.0

[1 2 3]XXXP. ‡ Fiberglass.

In preparing table, frequency of 1500 kc was used. Lead length was 5". A Boonton type Q-meter was employed.

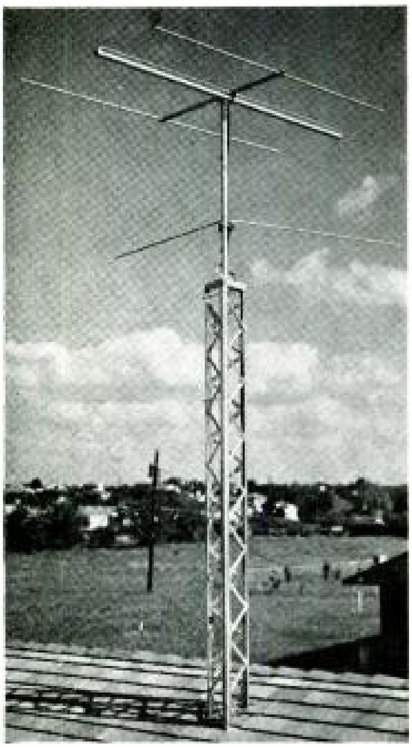
DISTRIBUTED CAPACITANCE values of copper conductors of various widths on various base materials.



SAMPLE set of conductors.

ANTENNA SETUP which was found to be ideal for reception of channel 5 (30 miles from transmitter) and channels 4 and 8 (local stations): Upper element is yagi resonant at channel 5. Lower element is V beam, resonant at channel 4 and multiple of channel 8. Antennas, erected during construction of house, are supported by house wall beams.

Interesting Solution Evolved for Two Cities in the Southwest, Which Provides Two-Way Pickup of Low and High-Band Stations in Fringe Area of One Metropolis and Low-Band Station in Fringe Area of Companion City, Affording Three-Station Viewing for Residents of Both Cities



Two-Way Fringe-Reception System

by MORT ZIMMERMAN

Supervisor of Engineering
Television Engineering Services Company

WITH THE ADVENT of the freeze, three years ago, and the subsequent halt on installation, many areas in fringe locales were faced with odd problems. In the Ft. Worth-Dallas section of the southwest, the situation was quite a vexing one. For those in Dallas, with channels 4 and 8, found that they were in the fringe area of a channel 5 station in Ft. Worth, and naturally those in the latter city were in the fringe area of the pair of stations in Dallas.

Thus, with reception from three stations possible, maintenance organizations and technicians were confronted with quite a problem. Receivers in Dallas had to be modified so that they could pick up signals from two local stations, and with a flip of a switch, a fringe area station, too.

Set owners were not satisfied unless all three channels could be received. It was found necessary, therefore, to provide an antenna system, with high gain and directivity for low-band station on channel 5, plus a low-gain antenna for channel 4, a low-band station and channel 8, a high-band station.

Channel Interference Problem

To complicate further the situation, receivers utilizing the 22.1 mc *if* band were found to suffer from interference; the second harmonic of the oscillator of the receiver tuned to channel 5 beating with channel 8, thus producing an image of channel 8 on the channel 5 frequency. Therefore, the high gain antenna used in Dallas to receive Ft. Worth's channel 5, not only had to be of sufficient gain and directivity but, most important of all, had to reject channel 8, the local powerful Dallas station only when the receiver was tuned to channel 5.

When the 45-mc *if* system was introduced, it appeared as if reception problems in this area would be decreased. However, it was found that the interference problems now prevailed between channels 4 and 8.

External traps and stub lines then came into popular use. Receiver manufacturers also began to include internal resonant traps, which helped to alleviate this problem.

The foregoing factors lead to the development of standard antenna installations in the Dallas area, consisting of a three-element yagi, resonant at channel 5, plus a broadly tuned single *V*-type antenna, two leadins and a switch for antenna choice.

The *V-type* antenna selected, a variation of a single dipole with increased directivity due to angular displacement of resonant rods, provided sufficient signal for reception of the Dallas channel 4 and 8 stations.

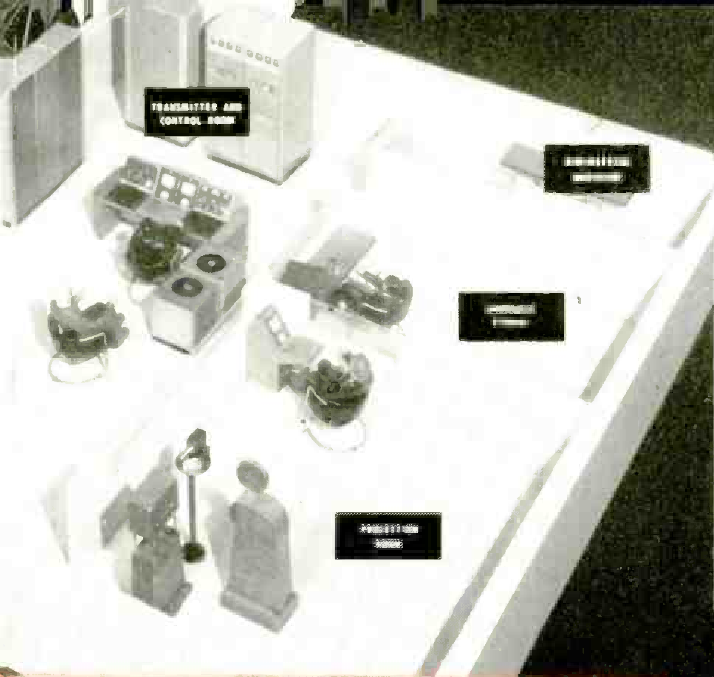
During the study of the foregoing problem, efforts were made to set up a standardized format of installation, which might be followed in other communities faced with similar receiving oddities. It was found that it would be impossible to adopt such a method, providing for a basic type of antenna *system* that would work in a particular location, because of local or surrounding geographical or man-made problems. However, it did appear possible to follow a plan, which could forecast the receiving problem and thus permit the design of systems to fit the condition.

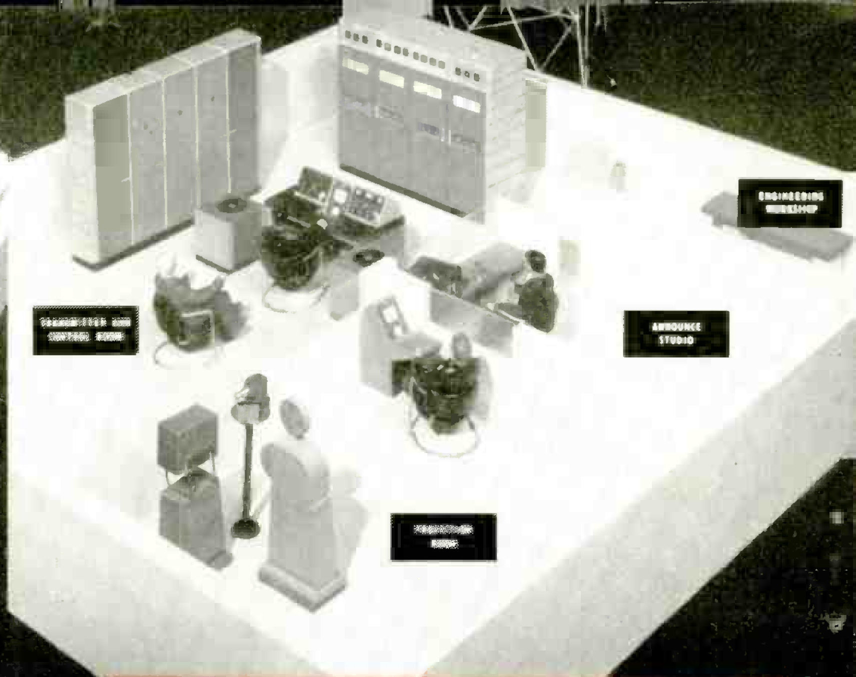
The system revolved about the use of exploded maps, which would reveal variations in the terrain of the area with such detail that reference could be made to the hundred block of a particular street where the antenna installation was to be made. Unfortunately such a map could not be purchased.

It was found geographical terrain maps which are available, would be suitable, revealing the terrain of the city. After investigation, it was learned that such maps could be secured from Washington.[1] Accordingly, it was decided to purchase a terrain map of Dallas County which showed the City of Dallas not larger than three inches square. The problem then was to transfer to scale, the information on this map to a large four-foot square map of the City of Dallas, scaled off to street numbers, street names, main highways, etc. Once this was accomplished, it became necessary to verify the terrain detail by locating various check points throughout the city, which proved to be in accordance with the map; hills, valleys, plateaus, etc. The two local stations were then spotted along with all tall structures, high interference sources, bodies of water, and all physical elements which might cause interference and reflection of signals. Thus, reference to this map would reveal the type of problem in

(Continued on page 24)

[1]Department of Interior.





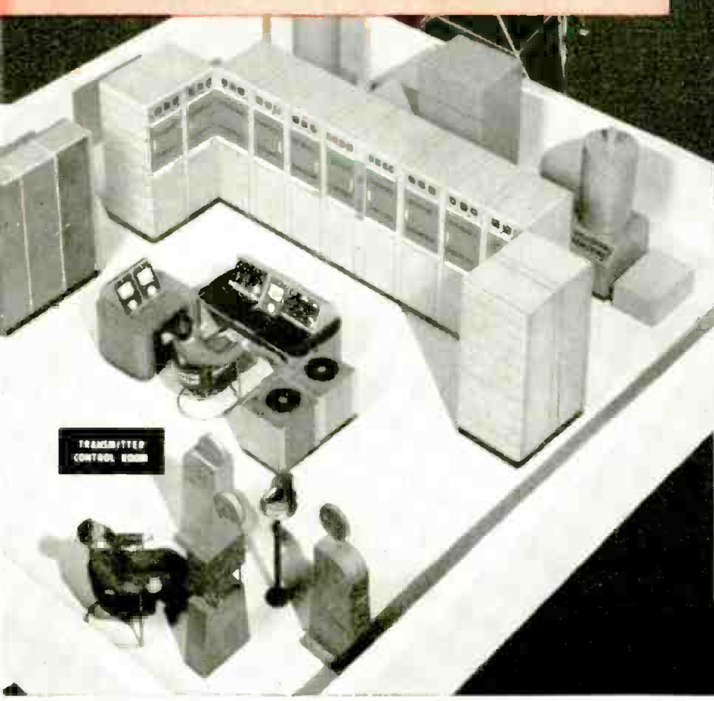
500 watts VHF (ERP range, ½ to 2 kw) This is a control-room set-up—complete with an RCA 500-watt transmitter, announce booth, and film facilities. The arrangement, and an RCA 5-bay Super Turnstile Antenna, provides up to 2 kw ERP*—gets you on the air for minimum outlay.

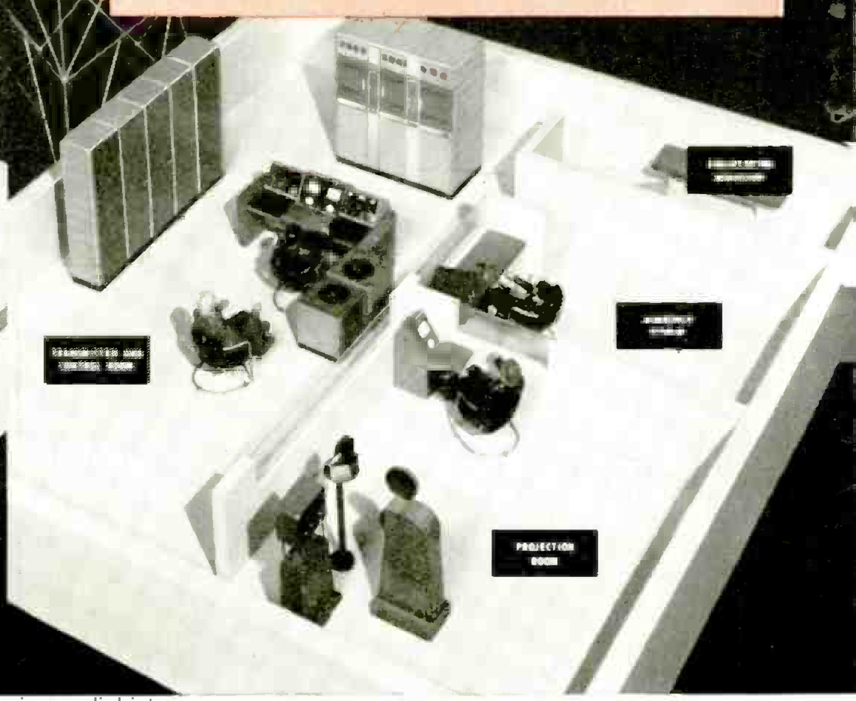
2 kw VHF (ERP range, 2 to 20 kw) Similar to 500-watt plant, but uses an RCA 2-kw transmitter. The ideal set-up for getting up to 20 kw (ERP) for a small investment. "In line" racks at left of control console are: monitoring, audio, and video equipments, sync generator, and power supplies.

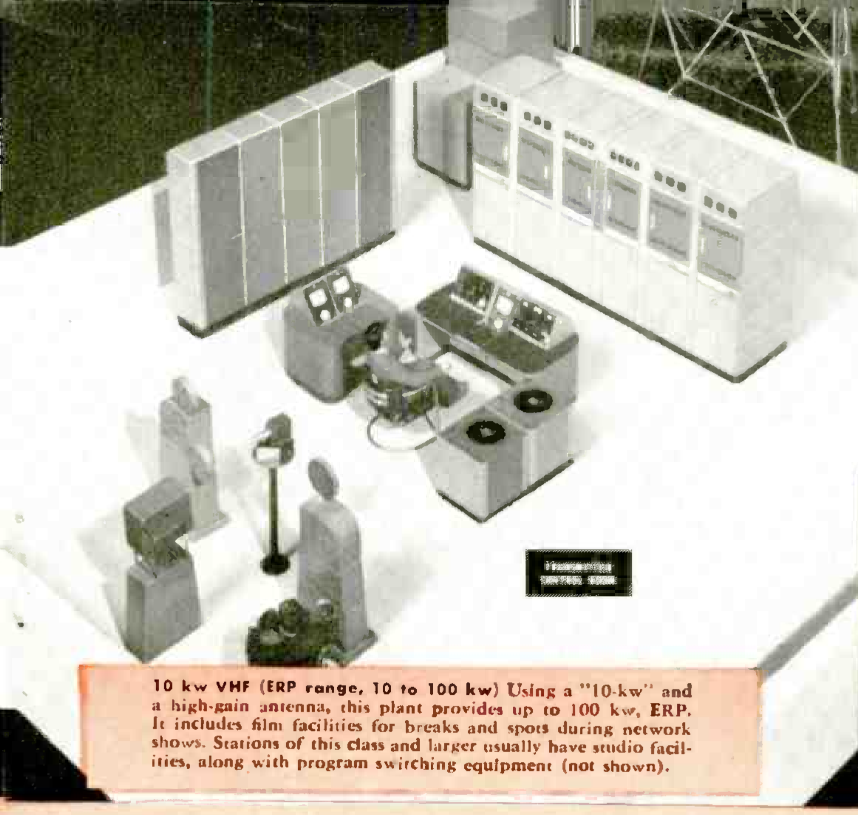
"Tailored" transmitter plants

50 kw VHF (ERP range, 50 to 200 kw) Block "U" set-up for RCA's "50-kw." This arrangement is well suited for local building situations—or where physical limitations call for an antenna of medium gain and high ERP. Note film camera control and preview monitor next to operator for his convenience.

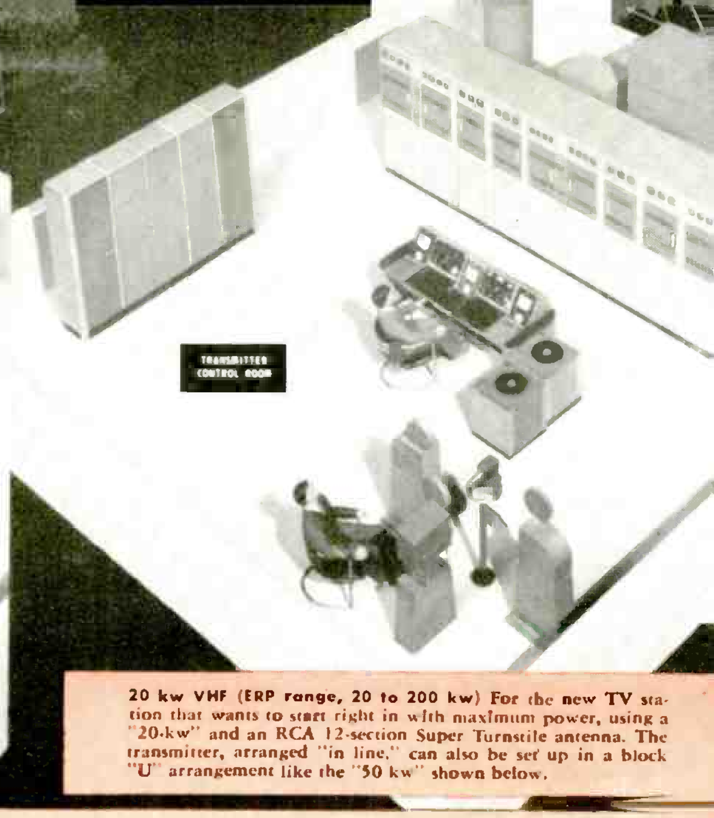
1 kw UHF (ERP range, 1 to 20 kw) For areas where UHF channels will be assigned, the "1 kw" and UHF antenna make it practical to start with a minimum investment. It offers interesting possibilities for areas up to 150,000 people—could prove popular in communities up to 1 million. Note network, film projection spots, station break facilities.







10 kw VHF (ERP range, 10 to 100 kw) Using a "10-kw" and a high-gain antenna, this plant provides up to 100 kw, ERP. It includes film facilities for breaks and spots during network shows. Stations of this class and larger usually have studio facilities, along with program switching equipment (not shown).



20 kw VHF (ERP range, 20 to 200 kw) For the new TV station that wants to start right in with maximum power, using a "20-kw" and an RCA 12-section Super Turnstile antenna. The transmitter, arranged "in line," can also be set up in a block "U" arrangement like the "50 kw" shown below.

... for any TV power up to 200 Kw!*

10-kw UHF (ERP range, 10 to 200 kw) Using an RCA "10-kw UHF" type TTU-10A and a TFU-24B high-gain antenna, this set-up offers the next logical step above the "1-kw" range. Or, you can start with 1 kw now—and increase power later simply by adding RCA matching amplifiers and associated equipment.

These models represent seven typical TV transmitter room arrangements for various power classes—from 500 watts to 200 kw, ERP*. They include the film equipment required for spot, station breaks, and network operation. They show the basic or minimum facilities you need to go "on the air" for a given power. The set-ups are worked out in accordance with tried-and-proved operating procedure and provide a handy means for estimating your space requirements. There is ample leeway to meet the particular needs of every station.

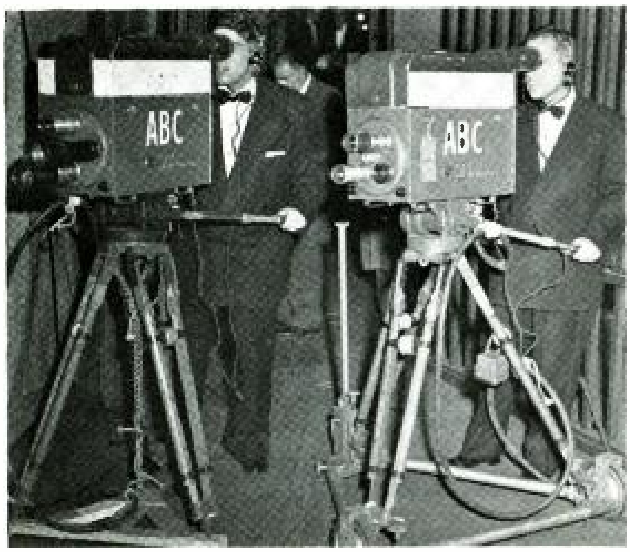
Your RCA Broadcast Sales Representative is ready to give you planning help like this—throughout your station! By all means, call him.

*Effective radiated power

RCA

RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT **CAMDEN, N.J.**

TV Technical Operations



TWO CAMERAS at stage right-wing position at Metropolitan Opera House.

CAMERA position in pit (stage left; adjacent to percussion section).

by G. E. HAMILTON

Eastern Division TV Engineer
American Broadcasting Company, Inc.

THE PRODUCTION OF A TV program involves the judicious use of not only technical and artistic talents, but the equipment at hand. For best results, it is necessary to consider each and every element in the facility chain and those who are responsible for its operations. In many instances, this can be quite a project.

Often, shows require more sets and gear than several complete stage presentations. In one thirty-minute program, developed for network feed, it has been found necessary to use fifteen scenes and an elaborate setup of equipment and personnel. The show, *The Ruggles*, produced in Hollywood, requires three cameras and pedestals, each camera having four different lenses for picking up of a variety of picture areas.

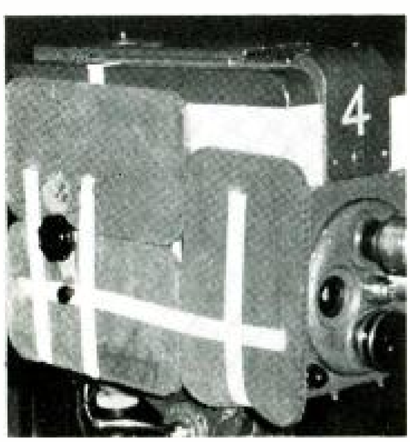
Each camera and pedestal is handled by a camera man whose responsibilities cover the adjustment of camera height, setting up of proper lens, composing and focusing the picture, traveling of the pedestal, and keeping the camera electronically adjusted.

Also, generally used, are three-wheeled microphone booms. Each boom requires one operator to keep the mike in its proper position for each scene. Stationary spot microphones are also employed in this production to cover areas which are not accessible to the boom; included are hanging, announce, sound-effects and filter mikes. Book ends, telephones, light fixtures, flower vases, etc., used as set props, frequently house these stationary microphones. Often, specially recorded sound effects played through a speaker, are picked up by a microphone, a practice which allows the cast to hear the effects and respond to cues.

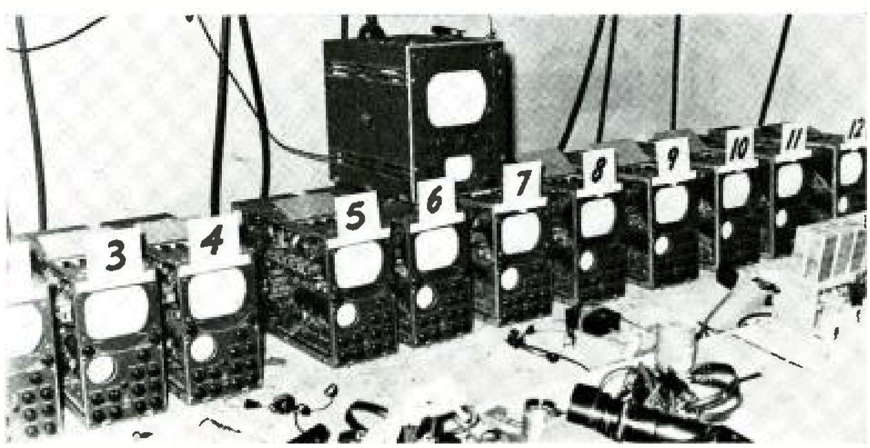
Also used for cueing are numerous picture monitors, set up to guide sound effects operators, orchestra director, and the stage manager.

Not only do we find bustling activity on the sets, but in the control rooms, too, where the *program* and *technical*

CAMERA position in pit showing sound absorbing rubber pads (stage left—opposite view of camera shown above, at right).



CAMERA control desk before program time.



Facilities and Procedures Employed During Typical Studio-Format Production and Event Telecast Such as Metropolitan Opera in New York City

directors, *video control* and *audio engineers* assume the responsibility of the production. Here, the skills of technical and program personnel combine to present an efficient, smoothly coordinated team, all working toward a common goal-perfection. Here, emergencies are handled; emergencies, such as actors skipping lines, equipment failures, accidents, fainting, ad-libbing, poor timing, etc.

The time required to prepare a show for its on-the-air presentation is infinitesimal in comparison to a motion picture production of similar length. The complete *Ruggles* show is prepared in less than 8 hours, including rehearsal and air time. This does not, of course, include the time spent by the cast in learning their lines. During rehearsal the actors must develop positions, attitudes, moods, characters, and polish.

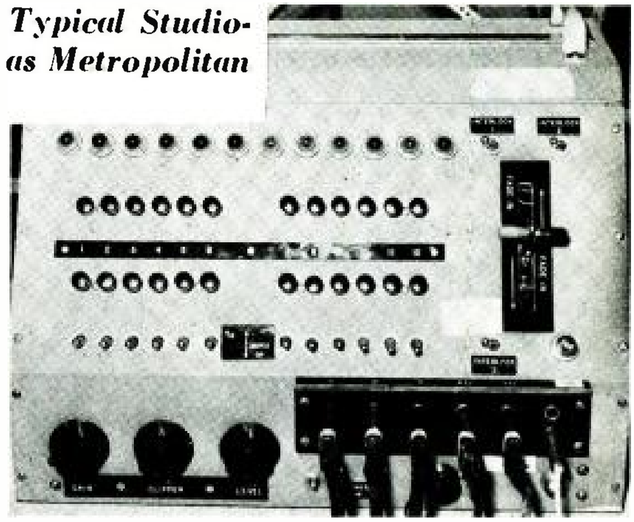
In preparing for a show of the *Ruggles* type, the engineering personnel arrive about one hour ahead of the cast, to set up the necessary technical facilities. Thirty to forty-five minutes are allotted to the alignment of cameras and associated equipment.

The show is then rehearsed on a start-stop basis, during which time all facets of the production are polished. The actors are directed as to positions, pace, voice timbre, mood, etc. A series of *take* pictures are analyzed for technical quality. Lighting is adjusted to give the proper scenic mood effect and at the same time maintain satisfactory contrast ratios. Boom shadows are reduced to an absolute minimum by placement of the microphone boom and by lighting techniques. Run-through time is dependent upon the complexity of the show.

At the conclusion of preliminary rehearsals, a final dress rehearsal is scheduled. Dress rehearsals are seldom stopped since in essence they represent the finished product. Timing is carefully checked during these final runs, and steps taken to change the pace of monologue, or alter length of music bridges, or the script, if necessary, to conserve or add minutes or seconds to the production.

Following the dress rehearsal, final electrical adjustments are made on cameras and equipment so that the ultimate in quality, particularly on the TV recordings, may be realized.

The foregoing illustrates how the system must be integrated. There are, however, several limitations which make the realization of perfection an extremely difficult task. Camera tubes often represent a problem. The particular type of camera tube determines the lighting requirements. During the show it is impossible to stop and reset cameras and lighting; therefore, these factors must be made controllable by pre-planning. For instance, a lighting level of from 50 to 100 foot candles illumination must prevail as base lighting. Key and accent light must be used with caution; back light should be about 1 to 2 times the base light and from a low top-rear vertical angle. Experience has revealed that top light must be avoided, due to the difficulty in keeping facial contours properly lighted. Only a contrast range of only about 30:1 can be handled for small area contrasts and must be limited to about 5:1 for large areas. This condition obtains because of the inability of the camera tube to accept other than these parameters. With the newest types of camera tubes, the brightness color response has been found to be similar to that of the eye.



TWELVE-CHANNEL TV mixer showing intercommunication switching, stabilizing amplifier remote controls, TV fader and mixer system, and intercom outputs to the production and engineering directors.

The Event Telecast

While the foregoing type of telecast is a complex project, it is a fixed routine type of presentation, for which a pattern of planning can be adopted. In contrast to this controlled-condition show is the *event telecast*, where there are innumerable variables to consider. One of the most extreme and hazardous types of such remotes is the peagant pickup. Televising of the Metropolitan Opera represents a perfect example of an involved event-telecast, which was truly hazardous due to the magnitude of the undertaking from the viewpoint of finance, production, and engineering requirements. Events of this nature must *bring* to the television audience the glamour of the *first night* celebrities, lively behind-the-scene activities and a vivid telecast of the offering with all its traditional pathos, tragedy, romance and elegance.

Many problems can enter into such varied requirements. Since the opera has been basically produced for a live audience, the production does not consider such items as TV camera positions, TV lighting requirements, power demands, microphone positions or even costume and makeup. It was found necessary to ask the TV production and program personnel to integrate TV *into*

PERSONNEL directing the event: Left to right . . . network engineering operations director, field supervisor, spot program director, technical director, assistant program director, program director, musical director, and camera man.

(Continued from page 17)

the philosophy of this world-famous opera house. This was accomplished by using an 11-point format of the following nature:

(*1*) Introduction of program with an announcement card describing the sponsor and opera; aural word of welcome to the TV audience follows.

(*2*) Spot interviews with audience celebrities.

(*3*) Word of welcome and greeting from Metropolitan sponsor and network officials.

(*4*) Word description of opera theme.

(*5*) Overture with cameras integrated into the various orchestral sections and phrases of the music score.

(*6*) Televising of opera (Act I).

(*7*) Behind the curtain scenes with opera personnel; artists, managers, directors, electricians, stage hands, etc.

(*8*) Word description of following act.

(*9*) Televising of Act II.

(*10*) Intermission; interviews with personalities in lounge, and interviews with Metropolitan personnel.

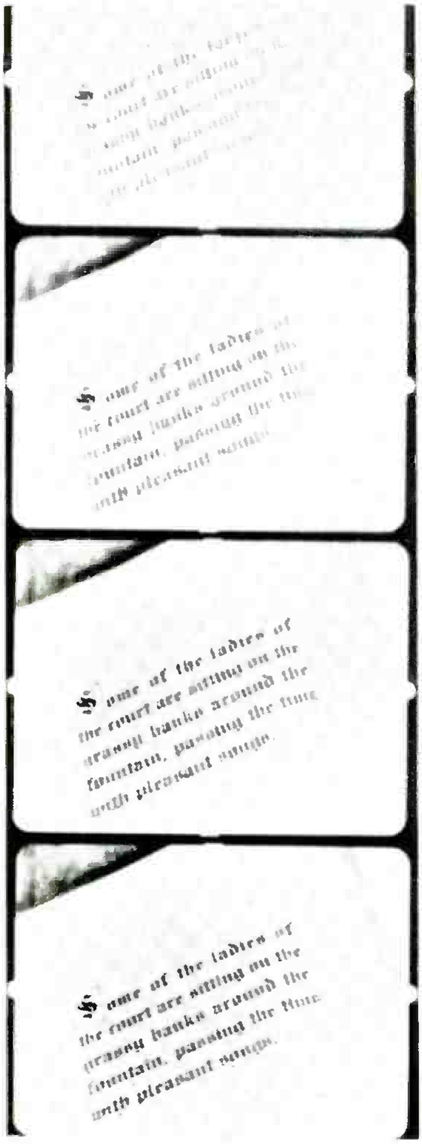
(*11*) Televising of Act III.

While much of the foregoing format is of a planned schedule type, camera rehearsal is not possible. Execution of such a production requires that every person be a part of a smooth functioning organization. The program and technical directors must *feel* the timing of the moment and each must be versed in the elements of the opera art.

Recently, it was decided to telecast the opera *Don Carlos*. This classic, a beautiful example of opera finesse with striking staging, presented many pickup problems. During most of the scenes, the stage must be lighted poorly with many deep shadows. To overcome this lighting defect, electricians of the *Met* augmented the scene lighting with violet and deep blue lights to complement the image orth's sensitivity to the blue spectrum. Thus pickup was vastly improved. Incidentally, the change was not noticeable to those in the live audience. Twelve cameras were employed for pickup, each having its control in a control center. To permit the use of any of these pickups, a twelve-channel mixer unit was employed; it was possible to provide smooth lap dissolve or switching with this technique.

Protection against equipment failure was afforded by having two sync generators operating with switch provision. Two paths were available between the Metropolitan Opera house and ABC master control; microwave link and telephone company coax cable. Spare cameras, controls and power supplies were available in case of difficulty. The telecast required the use of 4,250 feet

PROGRAM NOTES of the opera, as they appeared on the monitor, showing the resolution capability of the system used.



of camera cable and 2,200 feet of coax cable for monitor facilities.

One of the cameras had to be positioned in the orchestra pit adjacent to the percussion section. Severe microphonics were caused by the close proximity to the tympani, direct sound vibration striking the camera. This problem was solved by installing rubber pads on the exterior of the camera.

To sum up: successful telecasting is possible and practical, but only by virtue of a high degree of cooperation and a high order of organization between departments and personalities.

Credits

The author is indebted to Philip Caldwell, Cam Pierce and Truck Krone of the ABC western division; Edward Horstman and James Valentine of the central division, and William Trevarthen, Merle Worster and Jack Stoody of the eastern division for their assistance in supplying details for this discussion.

Part II . . . Echo Behavior As Disclosed in Theory and Under Actual Conditions in Sonar and Radar Applications . . . Spectrum of Echoes . . . Design Application Problems

Optimum Signal

In the initial installment, a theoretical analysis of echo ranging was offered.

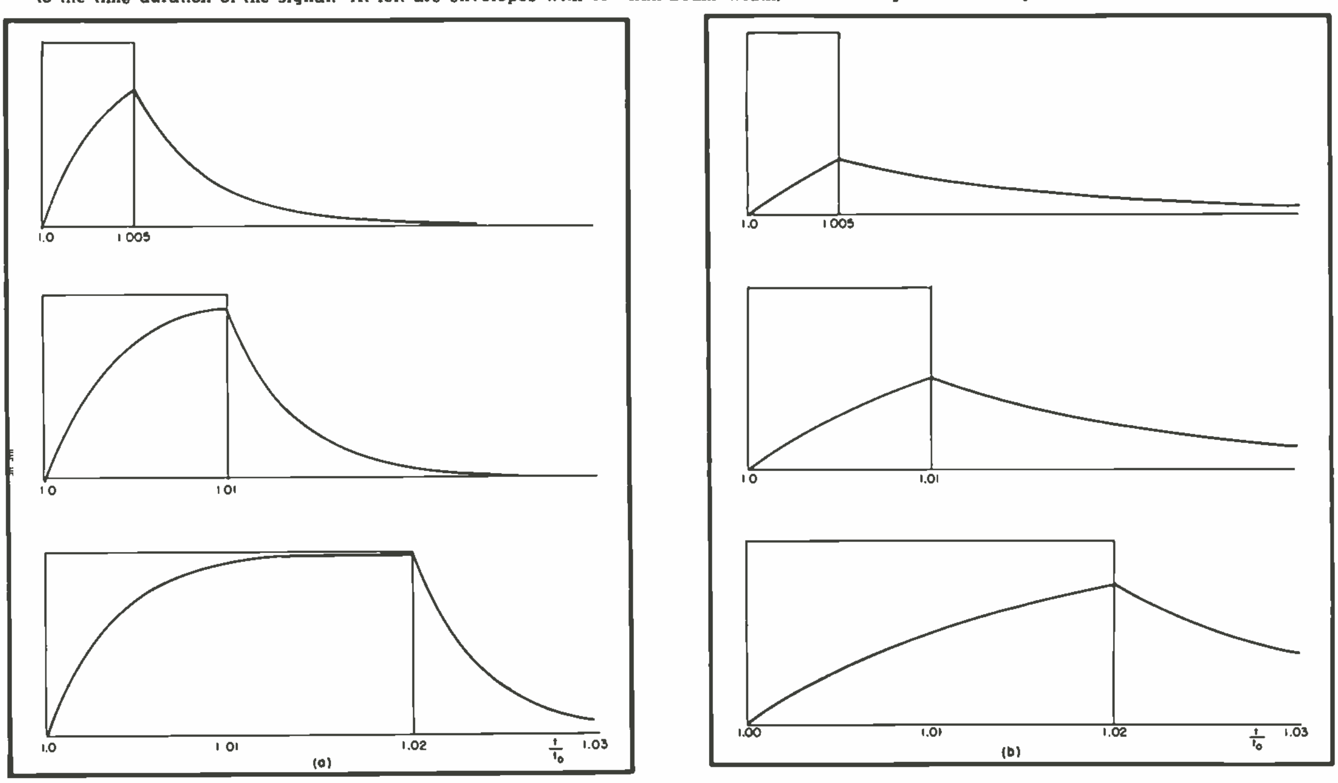
Having completed the analysis we may well ask how true it is. How well do the echoes really follow the theoretical behavior? Oscillograms of actual echoes are never as simple as those described. If they have any characteristic at all, it is that no two echoes are alike. There are always bumps and hollows which can quite obscure the general trend. The theory is at fault, of course, in assuming a plane uniformly rough sea bottom with a uniform reflection factor. The bottom is not flat. As the annular zone ΔS spreads out, it passes over hills and valleys, so the reflection is not instantaneously diffuse. Some increments of the echo are moved forward or back in time. When the zone climbs a hill the echo power increases at faster than the normal rate. As the zone passes down the far side of the hill, there is a compensating deficiency in the echo. Furthermore, the bottom may be strewn with rocks which have a greater reflection factor than the surrounding sand or mud. It is easy to see how these effects cause chaotic fluctuations in the echo. The theory only provides the average law on which the fluctuations are superposed. Actually, this law should be taken with a grain of salt and a considerable margin of safety must be provided. However, the law does introduce a basis for design. Without the theoretical analysis it would be difficult to deduce the law empirically from actual observations.

Design for Accuracy

The problem of accuracy in distance measurement requires precise timing of the arrival of the echo. For this purpose a rectangular echo is required, but such an echo is not available. Even if a rectangular signal is transmitted, the geometry forces us to tolerate an echo with a gradual rise and a gradual decay. The shape may be further modified by random fluctuations so severe that the basic envelope is not discernible. Only the beginning of the echo is dependable for timing, but no apparatus can be sensitive enough to indicate the arrival exactly at t_o. The indication must wait until the received power, w, has grown to some threshold value, and obviously the threshold must have a margin over noise. The delay required to reach the threshold introduces error, because it is not predictable.

Variations in the reflection factor, fluctuations caused by gross irregularities of the bottom contour, and varying degrees of aeration of the water beneath the ship, all contribute variations in the echo strength. The echo is not the only thing received. Noise from one cause or another is always added to it. In general, noise can be decreased by narrowing the acceptance band of the receiving system. However, narrowing the band does not reduce the fluctuation of noise, and it does slow down the response of the indicating system. Finally, there are unavoidable variations in whatever gain establishes the absolute sensitivity or threshold of the system. All these effects can cause the time of indication to wander.

Figure 5
Representative echo response envelopes for different beam widths and signal lengths ½, 1 and 2% of the echo time. The ordinates have been normalized so that the asymptotic limits would be always at the same height. This height is indicated by a rectangle whose base is drawn equal to the time duration of the signal. At left are envelopes with 10° half-beam width, while at right are envelopes with 20° half-beam width.



Characteristics for Distance Measurement By Echoes

by LAURENCE BATCHELDER

Submarine Signal Division
Raytheon Manufacturing Company

The only way to minimize the wander is to make the echo rise as fast as possible. The steepness may be measured in normalized time, because it is reasonable to demand relative rather than absolute accuracy. The initial slope of all the curves in Figure 3* is $10^{-2\alpha d}$, regardless of the beam width. Referring to *(5)* it will be noted that we should maximise.

$$t_o\left[\frac{dw}{dt}\right]_{t=t_o} = 2\pi\rho W_o \frac{A_c^2}{\lambda^2 d^2} 10^{-2\alpha d} \quad (6)$$

The reflection factor ρ is a property of the sea bottom, over which there is no control. It is possible to increase the transmitted power W_o, but that costs size and money, and the law of diminishing returns soon shows up. Also, a definite limit is reached at the cavitation point of water. If the alternating pressure amplitude of the sound exceeds the hydrostatic pressure, the total instantaneous pressure is negative for part of the cycle. Water is very weak in tension, and cannot support much negative pressure for long. Therefore, it just breaks apart, forming bubbles of vapor. These bubbles are fatal to sound propagation. In any case, the increase in transmitted power is a trivial solution. It is better engineering to increase the echo by choosing the parameters wisely.

Among the remaining parameters, d is the depth we wish to sound. That is the problem. We can't adjust it. It will be noted, however, that the expression *(6)* increases as d decreases. That is good in a way, for it allows greater accuracy in shallow water where it is needed most. The quantities that can be controlled are the capture area A_c, the wavelength λ, and the attenuation factor α. This factor, α, is a property of the sea-water, and is a characteristic of nature. However, it can be controlled, because α is a strong function of the carrier frequency, and we are free to choose that frequency. For sea-water, α is given empirically by

$$\alpha = 0.16 f_k + 0.0016 f_k^2 \text{ db per kilometer} \quad (7)$$

where f_k is the frequency in kc. Obviously, it is necessary to keep the frequency low, particularly when d is large. However, lower frequencies have longer wavelengths. Since λ^2 appears in the denominator of *(6)*, a compromise is clearly indicated.

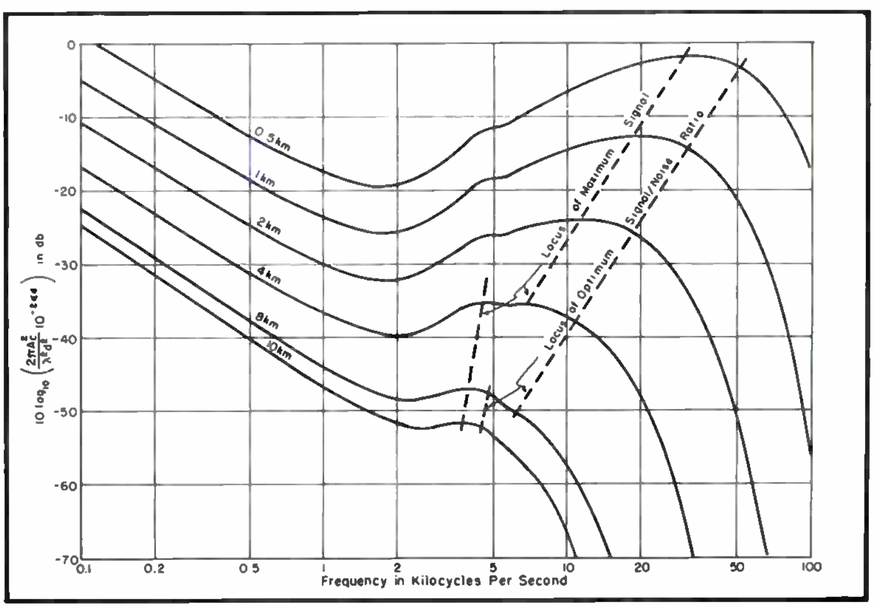
Before the compromise can be made, something should be known about the capture area A_c. When directivity is large, and the beam is narrow, A_c is closely equal to the actual active area of the transducer face. We can surely increase that area, just by building a larger unit. To be practical, however, we must think of weight and cost. If the area is doubled, we can gain 6 db in A_c^2. That is fine, but the weight and cost have been multiplied by $2^{3/2} = 2.8$. Perhaps the 6 db are worth it, and maybe more. But, there is a limit to the cost customers can pay, and a limit to the weight ships can float. In the other direction, when the actual area of the transducer face is reduced, the capture area does not follow in proportion. A hydrophone can act as an energy sink. When its directivity is reduced the hydrophone can reach out and abstract energy from a larger area. Thus, the capture area depends on the actual area and the wavelength according to the relation

$$A_c = \frac{\lambda^2 \Delta}{4\pi} \quad (8)$$

where Δ is the directivity factor. When expressed in decibels, $10 \log_{10} \Delta$ is the directivity index. This is wholly analogous to the directional gain of a radio antenna. The factor, Δ, depends on the shape of the active face and par-

Figure 6

Plot of equation (6) with $\rho W_o = 1$. The transducer is assumed to be a circular piston 48" in diameter.



*TeleVision Engineering, January, 1952.

From a paper presented at the annual '51 National Electronics Conference in Chicago.

(Continued from page 21)

ticularly on its size in wavelengths. For a circular piston of radius *a*,

$$A = \frac{(2\pi a/\lambda)^2}{1 - \dfrac{2J_1(4\pi a/\lambda)}{4\pi a/\lambda}} \qquad (9)$$

where $J_1(\ )$ is the first order Bessel function of the first kind.

Altogether, we find that the ratio A_e^2/λ^2 is quite involved. It increases indefinitely with A_e, but has a minimum with respect to λ. Since λ is inversely related to the frequency, it also controls attenuation, and must be chosen in view of the overall objective of maximizing *(6)*. To make the problem concrete, the variation in *(6)* is shown by Figure 6. All terms in *(6)* except ρ and W_n have been included in these curves. The calculations are based on an active face 48 cm in diameter, which represents about the largest practical size.

In the low-frequency region the wavelength is large compared with the diameter, and the beam is broad. A_e is then proportional to λ^2. The ratio A_e^2/λ^2 is also proportional to λ^2, or inversely proportional to the square of the frequency. In this region the curves are falling with a slope of —6 db per octave. As the frequency is raised and the wavelength shortened, directionality takes effect. The transition from the omnidirectional condition occurs when the wavelength and diameter are comparable. In the case of Figure 6, λ is about 1.5 diameters at 2 kc, where the curves are at the minimum. Above this point, the capture area is asymptotic to the actual area, and no longer diminishes with increasing frequency. Then, the function *(6)* grows inversely as λ^2 or directly with the square of frequency. This region is characterized by a rise of +6 db per octave. The small kinks near 5 kc are due to oscillations of the Bessel function. As the frequency continues to rise, the logarithmic attenuation becomes predominant and the curves fall sharply. The greater the depth of water, the lower the frequency at which this phase begins.

Spectrum of the Echo

The ideal transmitted signal is a sinusoidal carrier wave modulated by a rectangular pulse. It may be expressed as a function of time, whose Fourier transform gives the frequency spectrum of the signal. The spectrum contains all frequencies, but the majority of the power is concentrated around the carrier frequency. The longer the rectangular pulse t_1, the narrower is the peak in which the power is concentrated. The effective bandwidth of the signal is inversely proportional to t_1. Suppose our ideal signal were to be passed through a selective circuit tuned to the carrier frequency. The envelope of the output would rise and fall exponentially with time. The frequency spectrum would show the effect of tuning. Components far from the center frequency would be reduced, and the spectrum would be more closely concentrated around the carrier. The new bandwidth would be inversely proportional to the effective *Q* of the selective circuit.

The envelope of Figure 4*d*,* shaped by the geometry of the echo process, closely resembles the exponential rise and fall. We might dispense with mathematical exactness, and say the shape is truly exponential. Then, it would be possible to find the frequency spectrum of the echo in the same way as if the shaping in the time domain had been controlled by a tuned circuit. It would be necessary only to find the time constant or equivalent *Q* of the geometrical process. Unfortunately, the curves of Figures 3* and 5 represent power as a function of time. The exponential functions which they resemble appear in circuit theory as envelopes of voltage or current. The voltage envelope of the echo does not resemble the exponential quite as closely as might be desired. The approximate treatment by analogy to the exponential function is not accurate, and the correct calculation of the frequency spectrum is not simple. However, it may be reasoned qualitatively that the geometrical shaping of the echo has the effect of narrowing the spectrum of the receiving signal. The more slowly the echo approaches its asymptotic limit the narrower is the bandwidth.

If we increase the order of magnitude of our grain of salt, and carry out the calculation by analogy to the exponential function, we find

$$\Delta f = \frac{2.5}{t_0 \sin^2 \Theta_{10}} \qquad (10)$$

for the bandwidth introduced by geometrical shaping. This calculation is based on an empirical relation between the half-beam width Θ_{10} and the time required for voltage of the echo to rise to $(1 - 1/\varepsilon)$ times its asymptotic value. Of course the fluctuations from the average law may preclude a band quite as narrow as this, but fluctuations are less prominent on deep echoes. The important point is that the geometrically shaped echo has a much narrower spectrum than the original signal. The rectangular pulse has a bandwidth in the order of $1/t_1$. Since t_1 is perhaps 1% of t_0, the geometrical shaping reduces the bandwidth by a factor in the

(Continued on page 24)

Echoes

(*Continued from page 22*)

order of *10*. It is fortunate, too, that the bandwidth is narrowed progressively as the depth increases, because a narrow spectrum allows a highly selective receiver for discrimination against ambient water noise. We buy this advantage at the expense of accuracy in timing. It is a forced sale in the sense that we have no choice, but it is a favorable circumstance that gives accuracy in shallow water and selectivity in the deep.

Correction

In the discussion of the incident sound loss, on page 34 of the January issue, it was stated that this loss can be accounted for by a suitable numerical value of the reflection factor of the sea bottom. The Greek character used to identify the factor should have been ρ.

Acknowledgment

The author is grateful to his associates, B. B. Gauld, R. E. Kirkland, and R. A. Dixon for their clarifying discussions of the material in this paper.

Fringe Reception

(*Continued from page 13*)

existence at a particular street address of the city. Within three months after the system was introduced, enough installations had been placed to cover practically all general areas of the greater Dallas area. In each case, reasons for *ghosts* and *snow*, if existent, were clearly revealed on this map. Soon a particular type of antenne system was chosen for each area and it was found that even in streets adjacent to one another, different types of antenna systems were required.

When the present freeze is lifted, the problems of reception will certainly increase in magnitude, as stations are added. The use of terrain maps will play an important part in helping to solve them.

Next Month

THE REPORT on foreign sources of resistors, capacitors and selenium rectifiers, scheduled for this issue, will be published in March.

The concluding installment of the Dean paper on *TV Audio Facilities* will also appear in the March issue.

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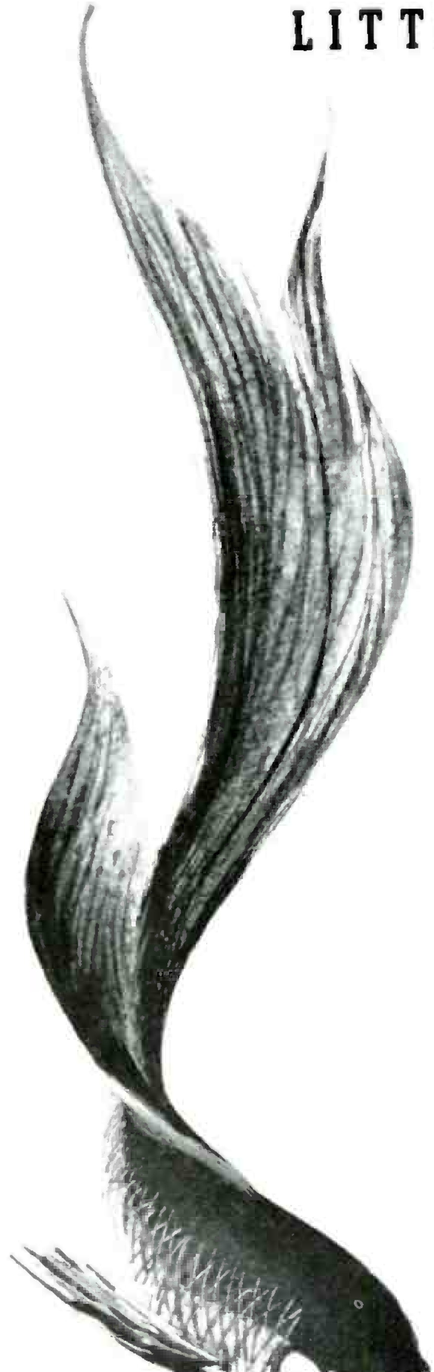

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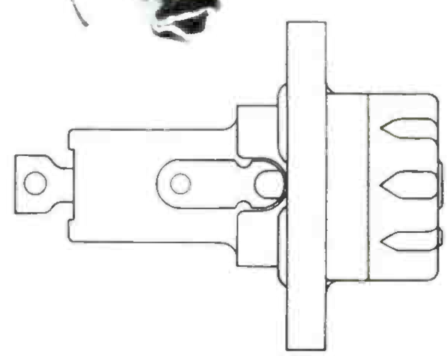

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Broadcast News

Magnetic Tape Splicer

A DEVICE which cuts and splices ¼" magnetic recording tape has been announced.

The operating principle is based on the use of a combination of electrically produced heat and precise pressure, applied within an accurately controlled time cycle, which is said to produce strong, perfect, diagonal splices. Instead of being held together by conventionally used adhesives, a plastic weld is obtained, without, however, adding to the thickness of the tape or using any of the tape material for the weld. The properties of the magnetic recording tape are said to be unaffected and the splice is inaudible even with playback amplifier at maximum gain. Also, the tape is said to retain its original flexibility.

The equipment, self-timing, operates with automatic line-voltage compensation. Each automaticaly controlled splice takes from 1 to 5 seconds, with 5 seconds required after splice to permit tape to cool off.

Splicer can be used for addition of sound as well as deletion, and tape salvaged from editing can be spliced again, erased and reused.—*MT-1; for all additional information contact Leonard A. Herzig, sales division, Prestoseal Manufacturing Corp., 38-01 Queens Blvd., Long Island City, N. Y.*

Presto-Splicer

Parabolic Antenna Feed

A PRESSURIZED FEED for 2000-mc parabolic antennas has been designed. A pressure of eight to ten pounds per square inch is provided. Solving the problem of increased radome density, *vswr* has been held under 1.25 to 1 for the dipole style feed.

The new feed is designed to mate with ⅞" Teflon flexible copper air line, having .015" wall and 11/32" conductor. Can be adapted to brass line where desirable.—*The Workshop Associates, Division of The Gabriel Co., 135 Crescent Road, Needham Heights, Mass.*

TV Lenses

A LINE OF LENSES for TV cameras, made by Carl Zeiss, Jena, is now available for the American market.

At present the line includes focal lengths ranging from 1" to 14".—*Ercona Camera Corporation, 527 Fifth Ave., New York 17, N. Y.*

Production Aids

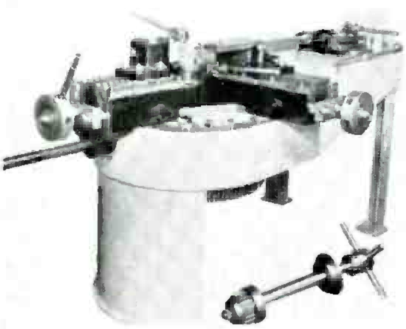
Wave-Guide Bender

A HAND-OPERATED TUBE BENDER and specially designed dies for bending wave guides have been announced.

Capacity of the hand bender, using compound gear, is 2" standard pipe 8" radius.

The machine is arranged to travel 210° for bending parts requiring 203°, allowing for spring back on large radius.

The dies shown in the illustration are for bending ½ x 1" .065 wall copper tubing.—*Further details available from Henry Williams, chief engineer, Special Machinery Division, General Riveters, Inc., 785 Hertel Ave., Buffalo 7, N. Y.*



General Riveters Bending Machine

Hermetically-Sealed Terminals

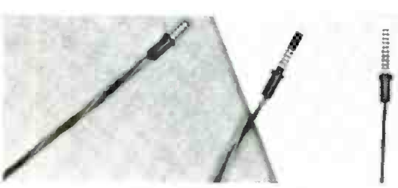
SMALL COMPRESSION-TYPE hermetically-sealed terminals for transformers and other hermetically-sealed components have been developed.

Available in three styles: turret head, milled and drilled or eyelet. Terminal is approximately 21/32" overall length; maximum diameter is 3/16". Recommended voltage rating is 2000 volts rms. Recommended maximum current rating of 6 amps and insulation resistance greater than 500,000 megohms. *Terminal 187; Heldor Bushing & Terminal Co., Inc., 225 Belleville Avenue, Bloomfield, N. J.*

Subminiature Sliprings

SUBMINIATURE SLIPRINGS, that are said to be heat resistant beyond the critical temperature for molded materials, have been developed.

Sliprings are molded with a compound that is claimed to have a tensile strength of psi 4000-4500, flexural strength of psi 6000-6500, rockwell hardness (M scale) 27.0, heat distortion temperature of 225-235° F. Special molding forms serve to eliminate shrinking, swelling and temperature effects. Factory tested to 1000 volts.—*Naer Corp., 631 South Sepulveda Blvd., West Los Angeles 49, Calif.*



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Instruments

Decade Signal Generators

Signal generators have been developed for the range from 10 kc to 100 mc. Consist of a series of decade-switched oscillators with the following features: Direct readings for 9000 separate steps of frequency; high-frequency accuracy without the use of charts or dials (all frequency settings are obtained with decade-switching); short term stability, ±2 cycles, at all frequencies; ±.05%, at maximum frequency.—*Decalator model 10-100; Decade Instrument Co., Caldwell, N. J.*

Decade Instrument Decalator

Audio Oscillator

An audio oscillator, with a frequency range from 18 cycles to 1.2 mc in five overlapping ranges, has been developed.

Instrument features an output of ±.5 db from 18 cycles to 100 kc, distortion that is said to be less than .2 per cent, accuracy and stability ±2 per cent ±1 cycle for line-voltage variations (10 volts) to 210 kc. Matching transformer is available for operation with balanced output.—*Model 510-B; Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.*

Waveforms Audio Oscillator

Frequency Marker

A frequency marker that produces calibration signals at 1-mc intervals within the frequency range of 950 to 2,040 mc, has been introduced.

Frequencies are said to be determined to an accuracy of one part in one-hundred million. An interpolation oscillator produces a comparison signal by which the frequency of an unknown signal is determined to within 10 kc. Markers are available at 10 mc or 1-mc intervals throughout the entire frequency. *Model FM-L; Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

TV Parts

Miniature Power Resistors

MINIATURE POWER RESISTORS, in 2, 5 and 10-watt sizes, have been announced.

Resistors feature welded construction from terminal to terminal, and silicone material that seals the resistance element, making it impervious to moisture. Standard tolerance is one per cent, but tolerance as high as 0.05 per cent can be furnished. Resistance shift is claimed to be less than 0.00002 per cent °C.—*Dalohms; Dale Products Co., Columbus, Nebraska.*

Dalohm Resistors

Subminiature Tube Sockets

SUBMINIATURE TUBE SOCKETS, featuring the use of injection-molded glass-bonded mica* for the socket body, have been announced. Can be mounted without screws or rivets in shaped chassis holes.

Electrical characteristics are: Loss factor of .015 at 1 mc; insulation resistance (minimum) of 50,000 megohms.

Sockets are available with cadmium-plated brass contact terminals or silver-plated beryllium copper terminals. Center shields optional.—*Mycalex Tube Socket Corp., 30 Rockefeller Plaza, New York 20, N. Y.*

*Mycalex 410.

Mycalex Subminiature Tube Socket

Feed-Thru Capacitor

SMALL FEED-THRU CERAMIC CAPACITORS, for filtering leads passing through a chassis, have been announced.

Capacitor is resin-sealed in a recessed cup at the top of a metal ferrule. Thru-lead passes through a hole in the center of this dielectric disc, providing, it is said, equal radial distribution to the grounded outer shell of all high frequencies being bypassed. Rated at 500 volts *dc*, capacitance values of units range up to 100 mmfd.—*Type 503C; Sprague Electric Co., North Adams, Mass.*

Industry Literature

Sprague Electric Co., North Adams, Mass., has released a 24-page catalog, *21*, describing military-grade paper dielectric capacitors made according to JAN-C-25 specifications.

Hickok Electrical Instrument Co., 10528 Dupont Ave., Cleveland 8, Ohio, has issued a folder, *TT5*, describing 10 models of their dynamic mutual-conductance type of tube testers.

United Catalog Publishers, Inc., 110 Lafayette St., New York 13, N. Y., have published a loose-leaf book, *UCP Pricing Service*, listing the net prices of over 100,000 standard electronic parts and equipment of over 400 manufacturers. Listings are arranged in alphabetical order by manufacturer's name: catalog numbers in numerical and alphabetical sequence with list and net prices.

Grant Pulley and Hardware Co., 31-85 Whitestone Pkway., Flushing, N. Y., has released a 4-page folder describing the uses, application and installation of radio-recorder slides. Two models are detailed, one for underneath mounting, and the second for side mounting.

Leeds and Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa., has issued an 8-page brochure describing a power-level recorder that records power level by attenuating the input signal to match a constant internal reference voltage. Recorder, with square-law detector, may be used up to 60 db, and is said to have a limit of error of ± .5 per cent of full scale within the frequency range of 40 to 150,000 cycles.

Freed Transformer Co., 1718-36 Weirfield St., Brooklyn 27, N. Y., has released a booklet, *Freed Facts*, which contains a summary of the types of transformers and test instruments manufactured and also details on technical literature available.

Radar Beacon

(Continued from page 9)

ents to the chassis with a suitable quick-setting plastic compound. As a result the beacon will perform satisfactorily under vibration up to 55 cps at .08" total excursion, up to 500 cps at lesser amplitudes, and withstand 100 g impact for 1 millisecond duration in all planes. Lastly, satisfactory operation is required at ambient temperatures from 0° to 70° C. This, plus normal temperature rise, demands satisfactory operation up to 110° C. With the components distributed as described, plus the blackened surfaces, and tube shields which contact the outer container, the only impairment in operation of the equipment at the upper temperature is approximately one db loss in receiver sensitivity. No deficiency in operation is suffered when the beacon is packed in dry-ice.

[To Be Concluded in March]

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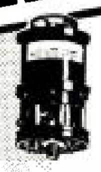
Briefly Speaking . . .

TV in Latin America, which a short while ago had been described as an extremely limited possibility item, has become instead quite an unusually lively operation. A few weeks ago there appeared an announcement that two more stations, with powers of 5- and 1-kw, would begin operating in the cities of Monterrey and Guadalajara, Mexico, on channels 6 and 10. The 5-kw station will have an erp of 18½ kw, while the 1-kw installation using an 8-bay triangular loop antenna, will have an output of about 8 kw. It is believed that the stations will begin full-schedule operations in the late winter of the year. . . . Engineeretts will be in the spotlight at the Centennial of Engineering, which will be held in Chicago during the summer. Participating as part of a recently organized Women's Society of Engineers, the ladies, numbering some 200, are planning to be very active during the convention, and present a number of interesting papers on various phases of engineering. . . . Sales of TV picture tubes to receiver manufacturers totaled 4,062,375 units valued at $97,937,583 in the first eleven months of '51, RMTA reported recently. Member-companies reported that they had received orders for $53,477,376 for radio navigation aids, both search and fire-control radar, and $9,849,916 sonar orders in the third quarter of '51. . . . A half-million-dollar expansion program which will provide new facilities for the capacitor, and metals and ceramics divisions of P. R. Mallory and Co., Inc., of Indianapolis, has been announced. An additional 35,000 square feet of manufacturing space will be added to the capacitor division for the manufacture of electrolytic capacitors, and 27,000 square feet provided for the metals and ceramics division. . . . Sylvania Electric has purchased the assets of the A. W. Franklin Manufacturing Corp., and the Franklin Airloop Corp., 43-20 34th St., Long Island City, New York. Sylvania will continue to operate Franklin in its present location as a unit of their parts division. A. W. Franklin, founder and president of both companies, has been retained by Sylvania as general manager of the Long Island City plant. . . . The Department of State is looking for radio engineers for its Voice of America program. Interested American citizens, of at least five years' standing, may obtain further information by writing a resume of their qualifications to the Division of Foreign Service Personnel, 1734 New York Ave., N. W., Washington, D. C.

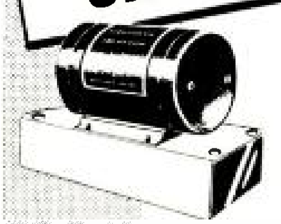
SPECIAL MOTORS

SELSYNS



DYNAMOTORS

POWER UNITS



BLOWERS

THIS EQUIPMENT IS THE FINEST AVAILABLE, BUILT BY LEADING MANUFACTURERS AND UNCONDITIONALLY GUARANTEED BY WELLS. MANY TYPES NOT LISTED ARE IN STOCK. SEND US YOUR REQUIREMENTS FOR IMMEDIATE QUOTATION.

MOTORS AND SELSYNS

MANUFACTURER	TYPE OR NO.	VOLTAGE	RPM	DIMENSIONS	SPECIAL INFORMATION
Stewart Warner	....	6VDC	...	2¼"x2¼"	¼"x½" Lg. shaft
John Oster	B-9-2	12VDC 1.4A	5600	2¼"x3¼"	¼"x7/16" Lg. shaft. Shunt Wd.
General Ind.	62800	13VDC 9A	6800	2⅛"x4"	¼"x¾" Lg. shaft. 1/12 HP
Emerson	D-26-BT	24VDC 24A	100	2¼"x5½"	160 Ft.-Oz. torque
Redmond	7-N	24VDC .96A	6000	2¾"x3¼"	Complete blower assembly
F. A. Smith	40H	115VAC 60 Cy		6"x5½"x5"	100 CFM blower ($12.95)
Western Elect.	FL	115VAC 400 Cy	6700	3¼"x4"x4½"	25 CFM blower
Signal Elect.	D-4272	24VDC .66A	2100	2¼"x2⅞"	¼"x1" shaft. 1/190 HP
Stromberg	D-4496	24VDC .45A	....	2½"x3⅛"	¼"x¾" shaft. .003 HP
Amglo	......	24VDC	...	1½"x2⅛"	Telephone ringing circuit motor
John Oster	A-16B-26R	26VDC		1½"x2⅛"	3/16"x5/16" shaft. Series Rev.
John Oster	DEST-8-1R	27VDC 1.4A	3800	2¼"x4⅝"	⅜"x¾" shaft. 1/40 HP
Delco	5069267	27.5VDC .25A	6000	1⅝"x2½"	¼"x1⅛" shaft. 1½ Oz-In Tq.
Western Elect.	KS5996-LO4	28VDC	..	2"x2⅞"	3/16"x7/16" shaft. Series Rev.
Bendix	MO5B	28VDC 1.75A	3200	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Bendix	E-11500-1	28VDC 1A	9000	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Fractional Mtrs.	SH-280	28VDC 3.1A	3900	3¼"x5½"	¼"x⅝" shaft. Used in ART 13
Electrolux	20100	28VDC .1A		2"x2 15/16"	5/32"x⅝" shaft. 20 Deg. rotation
John Oster	A-21-E-12R	28VDC .4A	..	1½"x2⅜"	3/16"x⅜" shaft. Series Rev.
Emerson	D-26-BV	28VDC 3.1A	3900	2½"x3½"	¼"x⅝" shaft. 1/20 HP
Electrolux	16876	28.5VDC 1.8A	2200	3¾"x5"	¼"x1¾" shaft. 1/35 HP
General Elect.	2J1GI	57.5VAC 400 Cy		2¼"x3½"	Selsyn transmitter
General Elect.	5BN38HA10	80VDC .25A	3000	2⅞"x5⅛"	¼"x¾" lg. shaft
General Elect.	2J1FI	115VAC 400 Cy		2¼"x3"	Selsyn generator
Diehl	11-1	110VAC 60 Cy	..	4"x5¾"	Synchro repeater selsyn
Bendix	..	110VAC 60 Cy		3¼"x5½"	Synchro differential selsyn
Bendix		110VAC 60 Cy		3¼"x5½"	Synchro transmitter selsyn

DYNAMOTORS AND POWER UNITS

MANUFACTURER	TYPE OR NO.	INPUT	OUTPUT	DIA.	LGTH.	SPECIAL INFORMATION
Eicor	ML3415-254	27.5VDC 1.5A	250VDC .060A	4"	8⅜"	With bracket mounting
Eicor	ML3412-42	13.8VDC 2.45A	220VDC .070A	3⅜"	5¼"	No mounting
Western Elect.	DM53AZ	14VDC 2.8A	220VDC .080A	2¾"	4½"	With base plate
Westinghouse	1171187A	27VDC 1.4A	285VDC .060A	2⅛"	4½"	No mounting
General Elect.	5DY82AB52	27VDC 1.5A	285VDC .060A	2¾"	4½"	No mounting
Western Elect.	1171091B	27VDC 1.6A	285VDC .075A	2¾"	4½"	No mounting
Redmond	5047	27VDC 1.75A	285VDC .075A	2¾"	4½"	No mounting
Eicor	ML3415-254	27.5VDC 1.5A	100VDC .150A	3½"	5½"	With base plate
Eicor	ML3420-194	27.5VDC 4.0A	325VDC .200A	3⅜"	6½"	With base plate
C.Q.R.	355D2BA	27.9VDC 1.25A	220VDC .070A	3⅜"	5⅜"	No mounting
Continental	DM310A	28VDC .5A	100VDC .01A	2¾"	4½"	No mounting
C.A.Y.	DM32A	28VDC 1.1A	250VDC .060A	2¾"	4½"	With base plate
Pioneer	PE86M	28VDC 1.25A	250VDC .060A	2¾"	4½"	With base and filter
Bendix	DA-1A	28VDC 1.6A	230VDC .100A	3⅜"	5½"	No mounting
Redmond	DM5 3A	28VDC 1.4A	220VDC .080A	2¾"	4½"	With base plate
Redmond	5056	28VDC 1.4A	250VDC .060A	2¾"	4½"	With base plate
Eicor	ML-3420-90	28VDC 3.3A	400VDC .125 A	3½"	6½"	With base plate
Continental	DM33A	28VDC 5A	575VDC .160A	3½"	7½"	Cont. duty. No mounting
Winco	41S6	13VDC 13A 13VDC	250VDC .060A 300VDC .225A	4"x	8⅜"	With base plate Intermittent
Continental	DMX310A	12VDC 2.8A	150VDC .100A	2¾"	4½"	Cont. Duty. No mounting

MANUFACTURER	TYPE OR NO.	INPUT	OUTPUT	DIMENSIONS	SPECIAL INFORMATION
Pioneer	PE 55	12VDC .16A	500VDC 0.2A Cont.	7¼"x12¼"x13½"	Pwr. Unit W/DM 19G DYN. Filter and Mounting
Westinghouse	PE 94C	28VDC 10.5A	300VDC .260A 150VDC .010A 14.5VDC 10A	8¼"x6½"x12½"	Pwr. Unit W/DA3A DYN. Filter and Mounting

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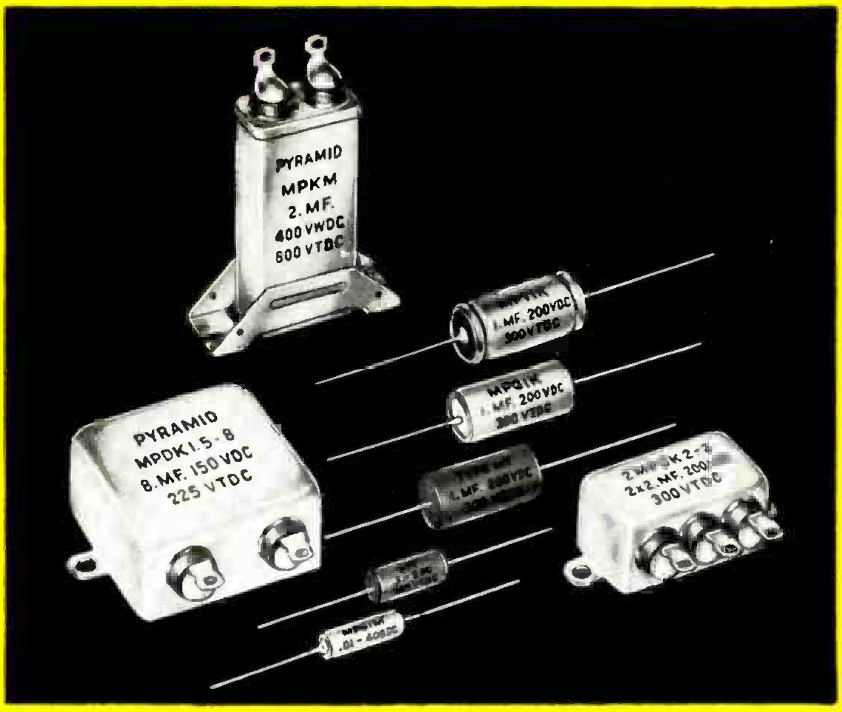

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NEW!

BUTTON CERAMIC CAPACITORS

...FOR TV AND U-H-F DESIGN

Design of electronic equipment and TV receivers for the higher frequencies is simplified by a new series of button ceramic capacitors developed by Sprague. A completely new construction using a disc capacitor element instead of the conventional dielectric tube results in higher self-resonant frequencies and improved circuit efficiency.

For bypass applications, Types 505C, 506C, 507C, and 508C are unique. The dielectric button is housed in a recess in the top of a hex-head machine screw and is sealed against moisture by a plastic resin. This shielded construction minimizes ground inductance and keeps it at a fixed value while providing a short bypass path to ground, which is radially uniform over the capacitor element. The lug terminals are essentially at tube socket terminal height to help maintain short, uniform lead lengths.

Type 501C is a ferrule shank bypass capacitor for push-clip mounting in TV receivers while type 503C is its feed-thru counterpart. The disc capacitor element is resin-sealed in a recess in the top of the metal shell.

Type 502C "shirt-stud" capacitors are ¼" diameter buttons intended for coupling in u-h-f TV set front ends.

All units are rated at 500 volts d-c and are available in both characteristic SL and GA general application bodies.

Engineering Bulletin 605 gives complete details on these new and different capacitors. Request it today on your company letterhead from Sprague Electric Company, North Adams, Mass.

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NEW HIGH-VOLTAGE CERAMIC DISCS

Sprague Cera-mite Capacitors are now available in 1000 and 1500 volt ratings as well as in the usual 500 volt ratings. Write on letterhead for Bulletin 601C.