TELE-VISION ENGINEERING

JANUARY, 1951

Checking samples of incoming components in quality control.

SEGMENTED DEFLECTION YOKE CORES

This popular 4-segment design is highly efficient. It is easy to handle in TV production work and assures a minimum of breakage. 2-segment types are also available.

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VOLUME 2 **JANUARY, 1951** **NUMBER 1**

MONTHLY FEATURES

Cover Illustration

Incoming quality-control inspection station, where operators check samples of components and accessories to determine whether or not supply is meeting manufacturing standards.
(Photo by Edward Padykula; Allen B. DuMont Laboratories, Inc.)

Editor: LEWIS WINNER

ABC

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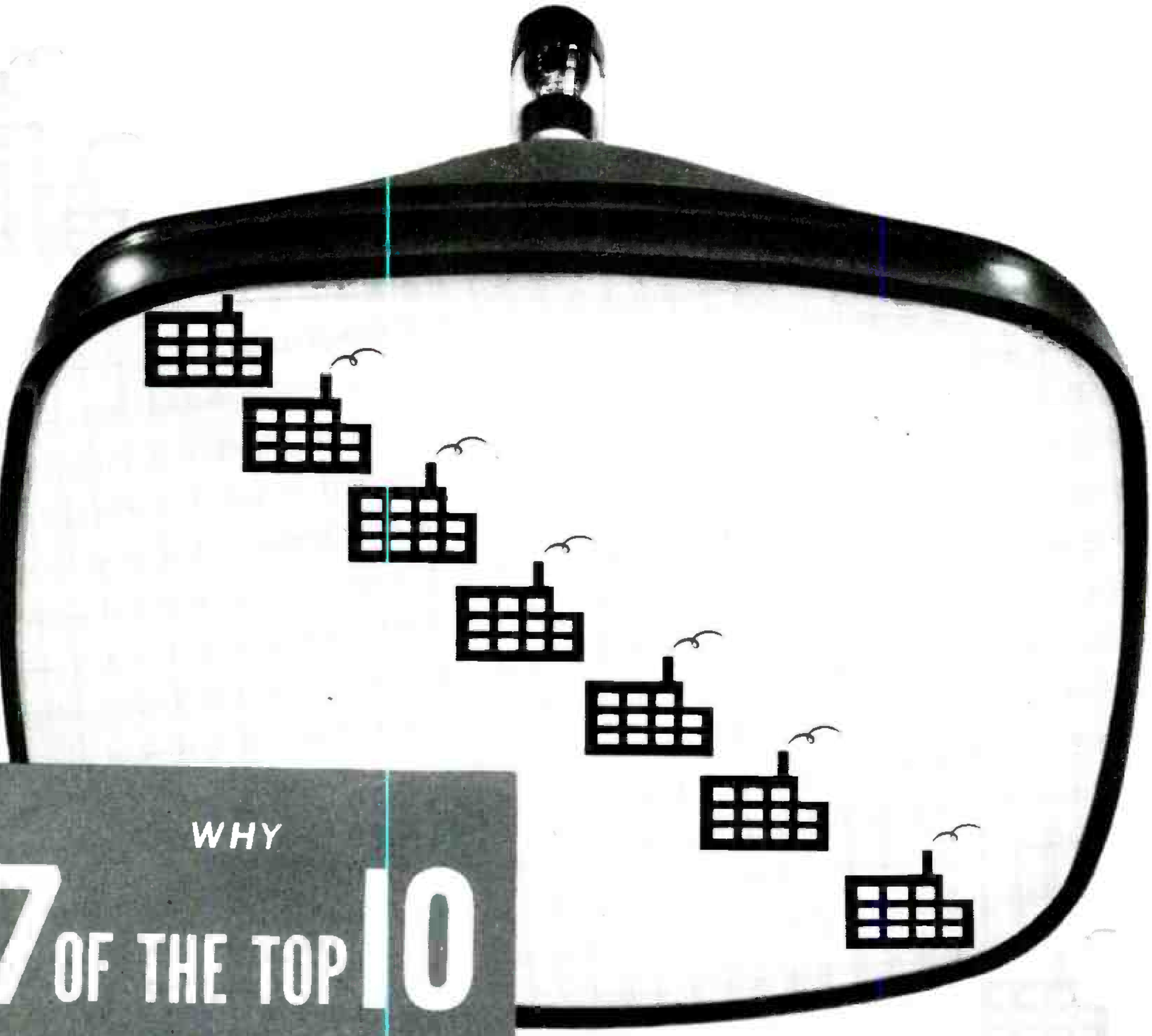

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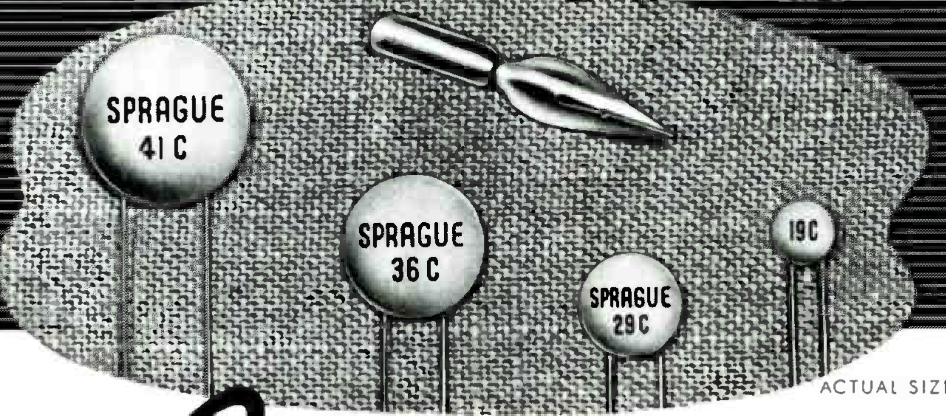

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TELE-VISION ENGINEERING
LEWIS WINNER, Editor

January, 1951

An If Freeze-Lift Promise

THOSE VHF DE-ICING predictions, which have been particularly rampant during the past sixty days, received the first '51 interpretation recently from none other the FCC headman Wayne Coy during an address in Buffalo. Admitting that even he had made so many wrong predictions when the freeze would be over, that he should have been cured of making any statements on the problem a long time ago, he pointed out though that this time he felt that he could offer something conclusive. It was his opinion that . . . "we will be out of the freeze and granting applications before the third anniversary of the freeze is upon us." And then he added the famous *if* line, stating that . . . "like all good prognosticators, I want to make a reservation." The freeze will be lifted, he said, unless . . . "the mobilization program is so large by late summer, that it will not be possible to utilize raw materials in the building equipment and the construction necessary to get television stations on the air."

Looks as if the August-September period may be an historic one in the TV parade of events.

Manpower Allocations

WITH SCIENTIFIC AND ENGINEERING PERSONNEL availability looming as a critical problem, many probes have been instituted to determine the most practical approach to this complex issue. In one plan outlined by the Engineering Manpower Commission of the Engineers Joint Council there appears the suggestion that a reserve of men be created through the registration by selective service of every man up to the age of 70 who has a bachelor's degree with a major in one of the critical fields of engineering, or who is enrolled in a program of training leading to a bachelor's or a higher degree in one of these fields, or who is employed in one of these fields of activity. Also recommended by the group was the organization of a national engineering personnel board, who in addition to interviewing the registrants and establishing criteria for inclusion in a reserve, would make selections with critical skills for military, civil defense and industrial allocation.

The council felt that inequality of manpower numerically could be overcome by quality of manpower technically. To meet the growing needs for trained engineers, the specialists said that it is imperative that we have an increase of enrollment in colleges and not the reduction called for in present plans. The commission felt that qualified students should be permitted and strongly urged to complete their education. It was their firm belief that the numbers of men now trained in science and technology, and the numbers of youths competent to receive and utilize such training, are seriously limited. In their opinion . . . "Promiscuous and unplanned deployment of such personnel would be ruinous to our defense program."

Supporting these bold views were representatives of five engineering societies: ASME, ASCE, AIMME, AICE and AIEE, plus members of the American Society for Engineering Education.

Films and TV

TELEVISION RECORDING, a year ago an experimental program with many, has become a sound, practical and extremely popular medium with thousands of hours of programming to its credit.

In a recent TBA progress report on the role of film in TV, George T. Schupert, of Paramount TV Productions, said that approximately 6500 hours of programming have been film-recorded by the four major networks, mostly off the tube. NBC led the users of film with nearly 2000 hours on the books, ABC and CBS following along with approximately 1900 and 1700 hours logged, while DuMont indicated a film output of about 1000 hours.

Very few would have predicted a year ago that film might be playing so outstanding a role in TV operations. Not only have transcribed programs been growing in stature, but specially filmed programs also have been keeping pace. Schupert stated that some of the sponsors have been spending very substantial sums for made-to-order TV films, with General Mills, for instance, paying over $40,000 for the films for three of their shows, as a weekly item.

The film trend has introduced many factors, involving new techniques for lighting, camera angles, film processing, video and sound pickup, perspective, etc.

Citing that inadequate linking facilities may be with us for some time under the present emergency, Schupert declared that film provides a workable solution. In his opinion, films can supply nine-tenths of the answers to TV programming troubles. That's quite a supply!—L.W.

TVE-grams....

The Management Front

A Rousing Record: The tremendous output possibilities of industry really bloomed in '50, routing all production estimates. At the peak of the fall boom, according to RTMA prexy Bob Sprague, industry was producing TV chassis at an annual rate of better than ten-million units, a fact that is particularly striking not only in view of the emergency problems which had introduced many shortages and bottlenecks, but the new excise taxes and tighter credit restrictions, which affected distribution in many areas.

The billion-dollar market promised for TV roared in during '50, too, exceeding '49 income by more than 100 per cent. To meet this market, manufacturers stepped up their production schedules to such an extent, reported RCA prexy Frank Folsom in his annual report, that in a single month more sets were made available to the public than during the entire year of '48.

The enlarged TV audience spurred broadcasters to extend their networks and strike out in multi-million dollar expansion programs. Folsom disclosed that when the present construction plans of NBC are completed, their investment in television will be between $35,000,000 and $40,000,000.

The '51 Picture: With NPA's curb program flicking away at many of the materials deemed essential by industry, there'll be production problems on some lines, although many feel that the situation should not be too acute for the first or possible second quarters. Reviewing the scene in his annual forecast, Don Mitchell, president of Sylvania, said that set sales demand should continue strong as long as it is possible to secure the necessary materials to make them. However, he said, to alleviate any problem of material shortages, engineers and laboratories are seeking substitute materials and methods that could be used without reducing product quality.

Commenting on business in the house, Mitchell declared that Sylvania is carrying over into the new year close to $70,000,000 of unfilled orders.

"Looking ahead to '51," said Mitchell, "our major problems will be three-fold: production space and facilities, materials, and manpower."

That industry can adequately fulfill presently predicted military requirements, if allowed to convert on the basis of sound planning, appeared as the opinion of G.E.'s vice prexy Dr. W. R. G. Baker, in another year-end statement.

Doc pointed out that present trained television and radio production employees, technicians and Service Men constitute a reservoir of skilled labor that would be one of the nation's greatest assets in a time of all-out military production.

"In addition," he said, "a part of the physical facilities necessary for production of huge quantities of electronic equipment for military purposes could be provided by present expansion plans within the industry."

The NPA Orders: As '50 drew to a close, the official production agency issued a notice declaring that not only were aluminum, cobalt, copper, nickel, tin and zinc critical materials, but quite a few others including cadmium, chromium, magnesium, mica, molybdenum, talc in block form (steatite), tantalum, tungsten, zircon and vanadium. In addition, NPA reported that it was considering an order restricting distribution of barium carbonate, used in production of glass TV tubes as well as radar tube envelopes. Chemists disclosed that it might be possible to modify the formulas involving the white powder which might affect a saving and provide a greater spread for industry and government.

Aware that severe rollback orders would seriously affect the economy of the industry, every effort is being made to cushion the impact. As the first step, NPA has issued a policy booklet outlining its methods of operation, organization and the facilities available through its bureaus and committees, including the industry advisory section, offices of civilian and labor requirements, analysis and reports, and field services. The latter, incidentally, are listed and reported as now appearing in local telephone directories. Presented too, in the booklet, are the names of the heads of the prin-

Howard E. King, RCA antenna engineer, reviewing a progress report on the 7-station FM/TV Empire State Building antenna, which is expected to be in full operation by early March, before a group of consultants who participated in a symposium dealing with practical considerations in the use of TV super-turnstile and super-gain antennas. The design and installation of the antenna will be analyzed in a nine-paper panel on Broadcast Day (March 20) at the IRE national convention at Grand Central Palace.

cipal divisions. Of particular interest to those in TV are the names of directors of the electronics and communications equipment products divisions: John G. Daley and Calvert H. Arnold, both of whom are cited as acting heads. Incidentally, Glen Ireland is special assistant to General Harrison, while Edward H. Lane is special assistant on small business. Joseph Bates heads the chemical unit, and tin, lead and zinc activities are under the jurisdiction of Whitman W. Hopton.

Government Clearing House for Technical Data: A technical information clearance service, to be operated through the Department of Commerce Office of Technical Services (OTS), has been set up to provide a central place to which one may write for guidance as to whether specific technological information which is not subject to formal security regulations should be released, withheld, or given only limited distribution. It is not mandatory to follow the recommendations.

Inquiries may be addressed to the office in Washington (25).

Research

Pulse Counter: A pulse counter which counts discrete video pulses has been designed by the Naval Research Lab as part of an overall investigation of the operation of a number of pulse sources on the same channel. It has a maximum counting rate of two megacycles and a minimum of 25 cps.

In connection with the overall problem, a multiple video pulse generator, having 300 separate pulse sources of adjustable pulse length and recurrence rate, had previously been designed and constructed by the lab. This generator, however, required auxiliary equipment before it could be used to analyze existing systems that make use of a number of sources; the pulse counter is one of these auxiliary equipments. The specifications on the output pulses of the multiple pulse generator are: Pulse length, .5 to 8 microseconds; pulse rise time, .05 microsecond; number of sources, 0 to 300 and recurrence rate, 20 to 400 cycles *per source.*

The counter, therefore, had to count approximately a total of 20 to 120,000 pulses per second, neglecting overlapping of pulses. To count all pulses, it had to have a maximum counting rate greater than two megacycles, the reciprocal of the minimum pulse length, since nonoverlapped pulses will have random spacing down to zero time, measured from the back of one pulse to the front of the next.

This problem might have been met by having each pulse draw a fixed charge through a meter calibrated in average recurrence rate, but with such an arrangement it is difficult to maintain a high degree of accuracy under the established recurrence rate and resolution time requirements. For this reason, it was decided to use a pulse counter which could count in discrete numbers.

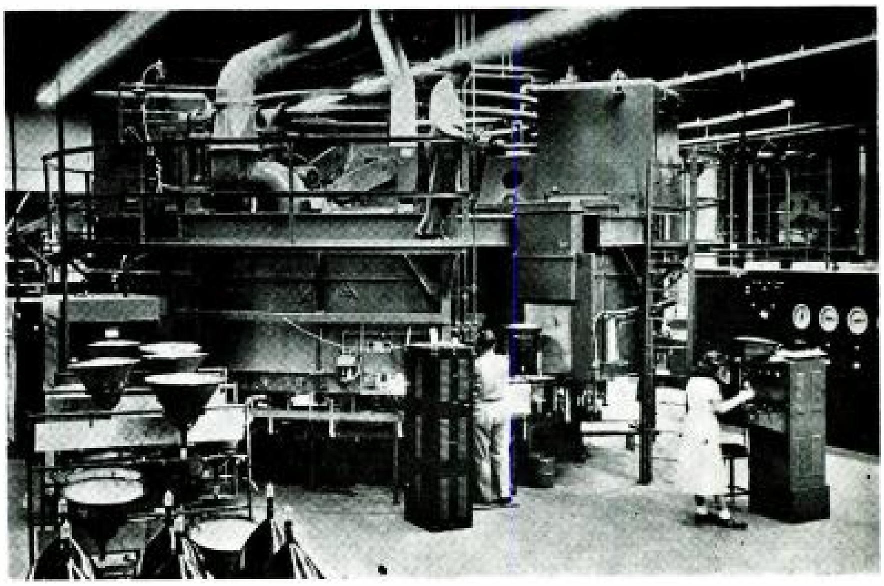
Two types of such counters were considered: (*1*) The type which uses Eccles-Jordan circuits connected to form either a binary or decade counting system, and (*2*) the capacitor storage type, in which each pulse count is stored as a capacitor charge.

The first-named type has reasonably high maximum counting rate, absolute accuracy within the limitations set by the resolution time, and, what is essential in so many cases, the ability to store a count indefinitely. However, it apparently is difficult to produce this type with a resolution time less than about two microseconds. Moreover, since the counter to be used with the multiple pulse generator concerned has only to sample pulses over short periods (in the order of a second or less) the indefinite storage time capabilities of the Eccles-Jordan type counter were unnecessary. And thus, a capacitor storage type counter was designed, built, and found to meet the requirements.

The interval during which the circuit of this device will count pulses is determined normally by a crystal-controlled.

Above

Harry R. Ashley (right) president of Eico, inspecting the use of the company's 'scope and *vtvm* at an alignment position on the production line of the New York plant of Emerson Radio.



Right

Automatic machines, designed and built by Sylvania Electric, now in use at the Seneca (N. Y.) plant, which can exhaust as many as twenty-four 24-inch tubes in a step by step process. Each machine is said to cost upwards to $200,000.

one-second interval timer, although provision is made for external pulse control of the counting interval, if this is ever desirable. The output of the counting-interval timer is used to open a gate tube, allowing the input pulses that are to be counted to pass to the first of a cascaded series of six decade counters.

Each of the input pulses to the first (or units) decade counter draws an approximately equal charge into a storage capacitor, building its potential up in jumps until the tenth pulse; the latter then discharges its capacitor to its initial zero-count condition. Each successive ten-pulse group repeats the process. Each time the first decade counter goes through a ten-pulse cycle it delivers a single pulse to the second (or tens) decade counter, this process being repeated in turn for each decade counter. At the end of the counting interval, a pulse from the interval timer causes each meter circuit to measure the storage capacitor potential in the corresponding decade stage. At the end of a counting period the meters, which are calibrated from *0* to *9*, rise from zero to the count obtained and retain this reading for several minutes, even though the storage capacitors lose their charge.

To make another count, the main panel switch is first thrown from *count* to *reset* to return the meters and storage capacitors to zero. Throwing the switch to *count* then starts another counting period.

Televised Microscopy: Significant extension of the range, power and versatility of the light microscope has been achieved by the use of the eyes of the TV camera, according to Dr. A. K. Parpart, chairman of the Princeton Department of Biology.

Though the televised-microscopy equipment has been used primarily for research at Princeton, Dr. Parpart said that it had proved convenient for showing specimens to several persons simultaneously in a conference group. It has also been used successfully in large classroom demonstrations by Dr. Harry Fulbright, former Princeton physics professor.

Adaptation of the television system, an industrial type using the vidicon pickup tube, for miscroscope work, was done by L. E. Flory and J. M. Morgan of the RCA lab research staff.

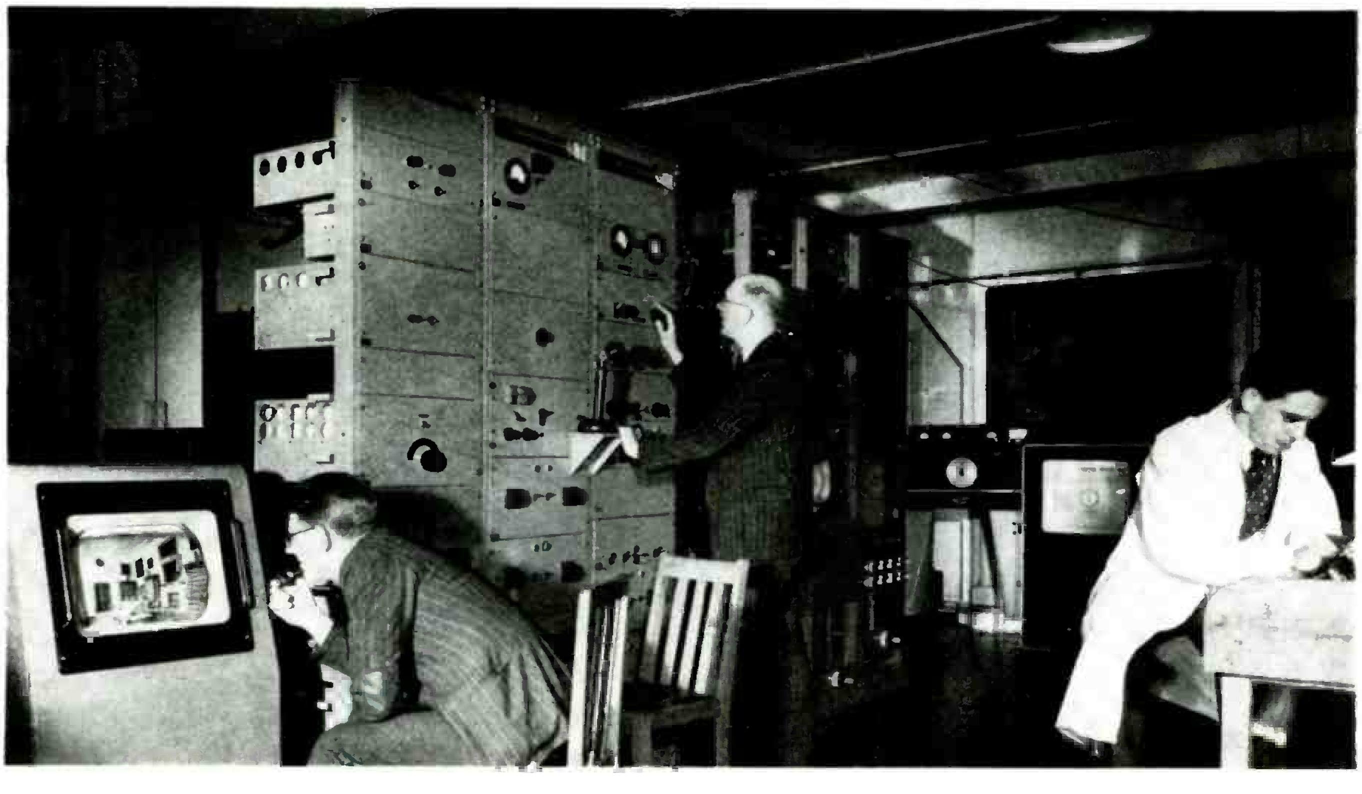
The experimental installation consists of a lab microscope mounted beneath an industrial TV camera, which is no larger than a personal 16-mm motion picture camera. The televised microscopic scene is transmitted by cable to a standard receiver-monitor placed nearby.

For microscopy, the Vidicon has been sensitized with materials which make it receptive to a particular narrow band of wavelengths. For the model used by Dr. Parpart, a red-sensitive tube and a violet-sensitive tube were provided.

With the red or violet tube, Dr. Parpart explained, it is possible to select a narrow wavelength band for study of a particular cellular material whose light absorption characteristics lie in that band.

Many biological specimens, such as granules of certain red blood cells, can at present be studied only after they have been stained, he said. With televised microscopy, the appropriate tube will make the specimen stand out clearly without staining, he said.

New research laboratory of the BBC at Kingswood Warren, Surrey England, where all facets of TV transmission and reception are being studied, including the use of 405-, 525-, 625- and 819-line pictures. The lab is staffed by 200, of whom approximately half are engineers.



TVE-grams . . .

The Production Line

Improved Electrical Insulating Materials: The Naval Research Lab has developed a mica type paper and an asbestos paper. The mica paper, made from low-grade ore and scrap at a saving of high-grade stock, is claimed to stand intense heat, and be stronger, and have greater capacitance than kraft paper. The improved asbestos is said to form readily into paper with excellent uniformity and high value as a dielectric: the manufacturing process involves a wetting procednre in which centrifugal action removes magnetite or iron oxide particles.

Injection Molded Silicone Rubber: A method for injection molding silicone rubber, wherein silicone* rubber is forced into the cavities of a mold under high temperature and pressure, has been announced. This process, developed by Minnesota Rubber and Gasket, is said to be applicable for relatively small molded parts where the manufacturer requires either extreme temperature characteristics or high dielectric for insulating purposes; grommets, bushings, seals.

Injection molded silicone rubber is said to provide for retention of physical properties and close dimensional tolerances where used in applications subject to 300° to 400° *F* or as low as —130° *F*.

* Silicone resins, introduced in 1943, are described as a cross between glass and ordinary plastics, and are especially notable for their resistance to extreme temperatures. Based on a framework of silicon and oxygen, modified by carbon-containing organic groups, the silicones are available as liquids, semi-solids, grease-like compounds, rubbery solids, and resins that solidify permanently under heat to form flexible heat-resistant films. The largest market is as a mold-release lubricant. (*Courtesy A. D. Little, Inc.*)

Solventless Varnish: A material which remains liquid as long as a stream of air bubbles through it, but which hardens in a few minutes when away from air, has been developed in the chemistry divisions of the General Electric research lab. Its properties are thus opposite to those of paint, which hardens when exposed to air.

The lab scientists responsible for the new development, Dr. Robert E. Burnett and Birger W. Nordlander, have tagged the substance *anaerobic permafil*, borrowing a word from the biologists: the term *anaerobic*, which means *non-airliving*, was coined by Louis Pasteur.

Anaerobic permafil is said to remain liquid as long as it is aerated. When away from air it solidifies quickly, without heating, or adding catalysts and accelerators. According to the lab, when two metal strips are coated lightly with the material and clamped together, the joint will support ten pounds after ten minutes; after 20 hours, it will hold 100 pounds. If still faster hardening is desired, the permafil may be heated, up to 212 degrees *F*, and solidification is said to take place in a minute or less.

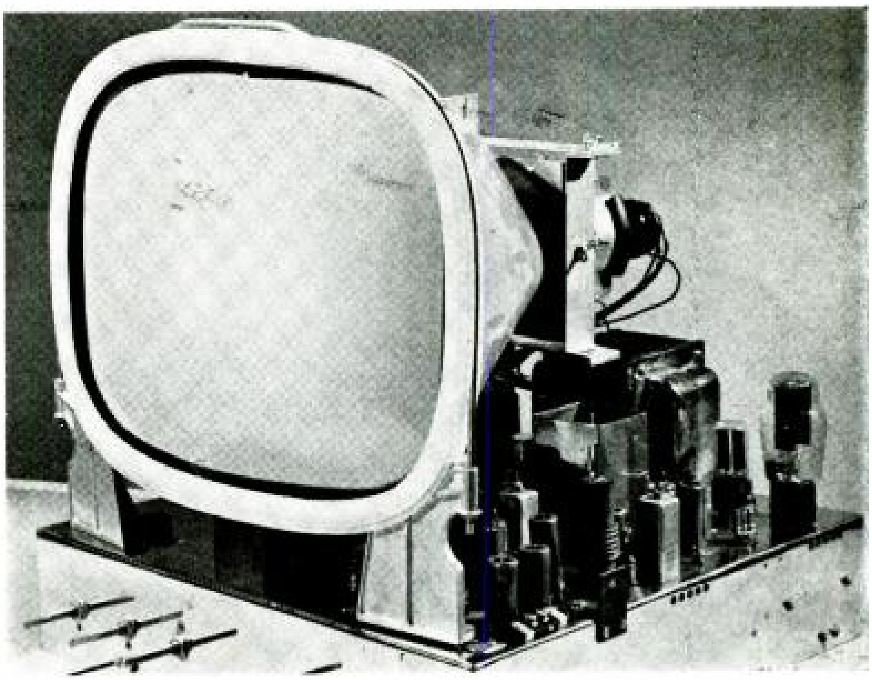
The varnish is still the subject of experimental investigation, and thus far only limited laboratory quantities have been produced. It is not yet available commercially, though plans are being made to put it on the market soon.

Trends

The Key Man At the Station: In one effort to determine the essential status of those at the helm of the small stations, manpower officials were confronted with a rather interesting report. In an emergency, they were told, it appeared as if the fellow who runs the transmitter would actually be the only one who couldn't be spared, and as in the early days in most stations, he could serve as announcer, sales manager and general manager, too, if necessary: indispensability, plus! —L. W.

Right

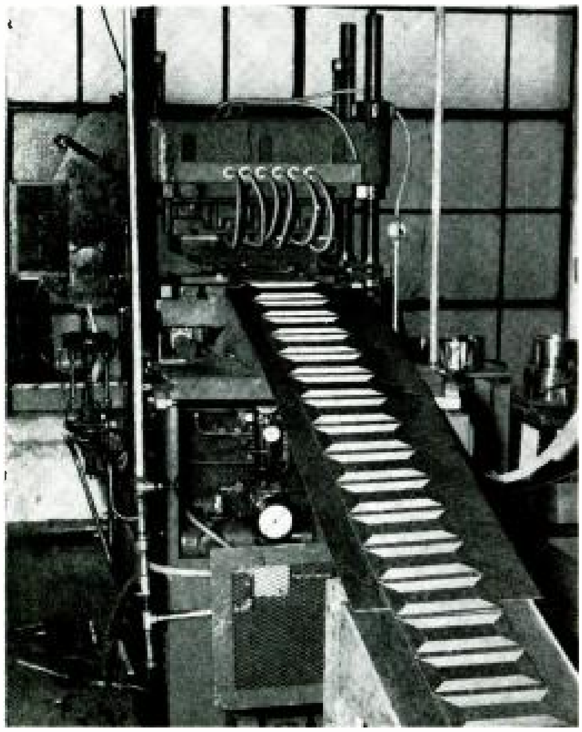
Mounting and insulating ring* and sleeve* recently developed for the 17" rectangular metal tube. (U.S. Pat.* 2503813; *Anchor Industrial Co., 533 Canal Street, N. Y. C.*)**



Below

Lucille Barnhill, of the Eitel-McCullough final inspection department, presenting the 100,000 Eimac 19-inch metal-cone picture tube to Wade Langley, manager of the Salt Lake plant.

Figure 1a
Loop antenna being die stamped on automatic press.



Mass Production COMPONENT and CIRCUIT DIE STAMPING

by RALPH G. PETERS

Accelerated Production Techniques have received particularly close study in chassis operations, especially in TV, in view of the receiver's complexity and the resultant increase in wiring. Many ingenious methods have been evolved to step up the assembly of the chassis, one of which has involved the use of die stamping of wiring.

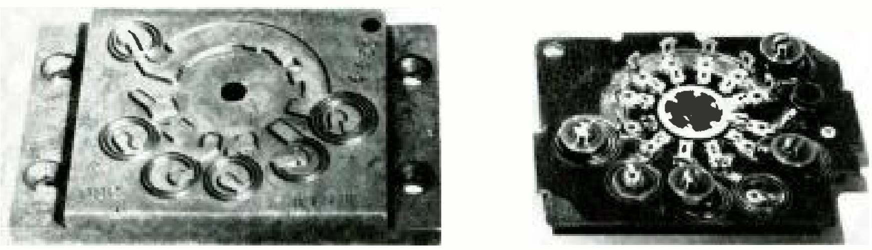
In this procedure[1], actually a method of mechanized production, a sheet of conducting metal, coated on one side with an adhesive, is simultaneously formed into an electronic circuit and staked and bonded to an insulating base by a heated male shearing and forming die bearing the circuit layout. Basically, stamped wiring features the use of a thin sheet of insulation with a series of parallel conductors running in a horizontal direction on one side and a series of vertical conductors on the other side. Interconnection between conductors on the two levels is accomplished by punching through the insulation intervening between the conductors and then joining them by means of an eyelet, pin or other method. Other circuit components, such as shields, inductors, capacitors and switch contacts, may be stamped out and connected simultaneously with the stamping of the circuit wiring.

Conducting mediums such as tinned, silvered and plain copper, tinned and plain brass, aluminum and silver have been employed in various thicknesses. A variety of phenolic, plastic and paper sheets have been found suitable as insulating bases.

The stamping process has been applied to such complete assemblies as a switch-type tuner[2] using two tubes.

In fabricating this, the drawing layout is made to a scale five times the size of the desired stamped circuit. Since this is a switch-type unit, stations being tuned in by rotation of a switch which connects the proper circuits, the circuit is divided into four sections: input, *rf*, oscillator and converter. A plastic template is then made from which the dies are engraved on a pantograph engraving machine. In use, the dies for the four wafers are locked together on a plate, having built-in electric heating units, in a 150-ton standard automatic toggle press; a knuckle type having high working pressure and smooth dwell pressure. Bakelite insulating plates (1/16" thick) which previously in one operation had their mounting and other holes (when desired) and their shapes punched out, are stacked on the press for automatic feeding. The next step involves the feeding of a conducting medium .005" thick pure electrolytic oxygen-hydrogen-free copper, procured from the mill in long rolls of proper width, through a machine which cleans it in a bath, roller coats it with an adhesive and dries the coating with infra-red ray lamps at a rate exceeding 25 feet per minute. A thermoplastic cement[3], used as supplied without additional processing, serves as the adhesive. After drying, the copper rolls are placed on the stamping press and production can proceed at a rate of 20 stampings per minute.

When the press is operated the dies cut the copper, forming conductors,



[1]*Originated and patented by A. W. Franklin, president of the Franklin Airloop Corp.; patents* 2,401,472; 2,431,393.

[2]*Franklin* 500-*A*-6.

Figure 1
Die and assembled oscillator wafer incorporating four brass plates.

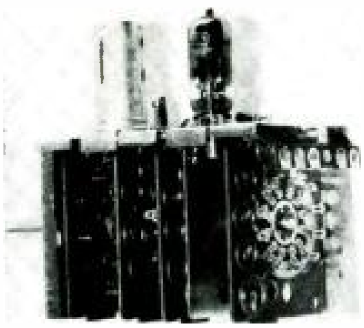


Figure 2
A two-tube die-stamped tuner.

Die Stamping of Circuit Wiring and Variety of Components Out of Sheet of Conducting Material, Which Is Simultaneously Attached to Sheet of Insulating Material, Cited as Overcoming Limitations of Use of Hand Procedures in Assembly, Wiring, Soldering and Testing. System Found to Minimize Maintenance of Completed Units and Provide Assurance of Peak Performance Through Application of Die-Controlled Setups.

and presses all cut edges three-one-thousandths of an inch into the insulation. The dies are heated electrically to 230° F and soften the insulation sufficiently to facilitate locking the copper securely in place. The heat simultaneously sets the thermoplastic cement so that the copper is both mechanically locked and cemented to the insulation. The copper is smoothly and completely sheared and is firmly bonded to the insulator.

Following the stamping operation, the plates next go to a punch press, where the holes for eyelets and pins are punched out in a single operation. In still another press, eyelets and pins flow from hoppers through feeder tubes to plate holes and are clinched in place. Resistance soldering with standard-type solders is employed to obtain good connections between the stamped circuit and the eyelets and pins.

Automatic Feeding

Depending on the volume of production, connection of resistors, sockets, switch rotors and other components can be made automatically or manually. Workable arrangements can be made for automatic feeding of components having pre-formed leads. The number of hand operations required to finish the unit, such as mounting the wafers to the chassis, can thus be reduced to a minimum. Jigs for automatic testing of completed units become far more feasible as one result of this production process.

Figure 1 illustrates the front of a completely assembled oscillator wafer incorporating four brass plates mounted above spiral inductors and adjustable by a screwdriver for varying the inductance. The brass ring mounted on a cylindrical tube at the right center of the wafer is one stator of the fine tuning control capacitor. The other stator ring is mounted on the rear of the wafer, while a brass slug controllable from the front of the assembled unit is employed to move in and out of the tube for fine tuning control. Figure 2 shows the completely assembled tuner ready for insertion in a receiver.

Design Simplification

The stamping process has also been found to simplify design. The fixed nature of the wiring and inductors and the necessarily careful planning of both wiring and placement of parts makes it possible to operate tubes nearer the *spill-over* or *hot point* in production models for improved performance. Advantage may also be taken of the fact that feedback, pickup, parasitic oscillations and other interactions affected by the relationship of leads, if avoided by proper original design, will not appear normally in production models. In addition, the greatly reduced possibility of changes in values of inductance and of stray capacitances in the circuit, permits more critical design and use of higher gain tubes. The uniformity and constancy of the distributed circuit capacitances in production models becomes a function of the uniformity of the insulating plate and constancy of its characteristics, so that this problem can be localized to an item amenable to control. Electrostatic shielding of leads can also be introduced, a ground lead stamped between two other leads acting as an electrostatic shield in a manner similar to the screen in a screen grid tube. This effect may be used, for example, to provide

(*Continued on page 23*)

[3]U. S. Rubber Kotol.

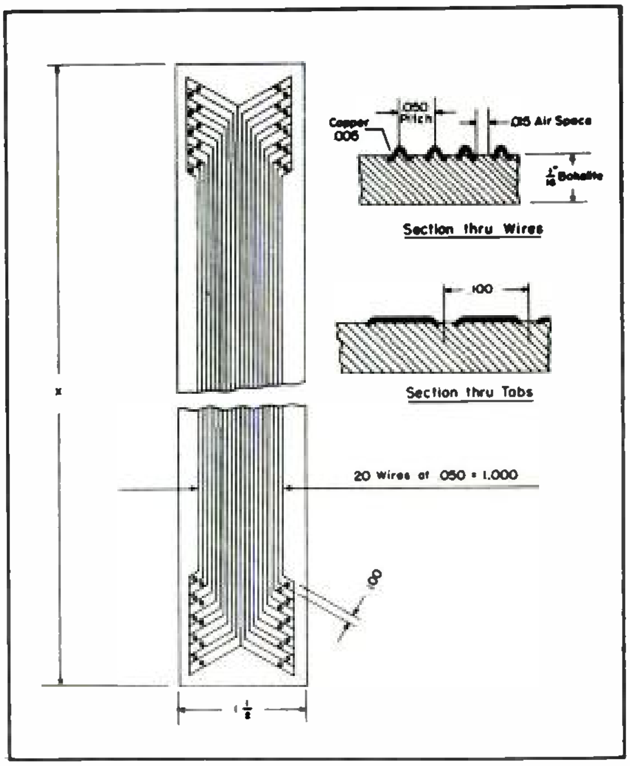


Figure 4
Die-stamped wiring panel for replacing conventional cable assemblies.

Perspective Distortion

Quantitative Evaluation of Perspective Distortion Revealed as a Means of Minimizing Problem and Providing an Indication of the Adequacy of Any Proposed New Standards for Picture Definition.

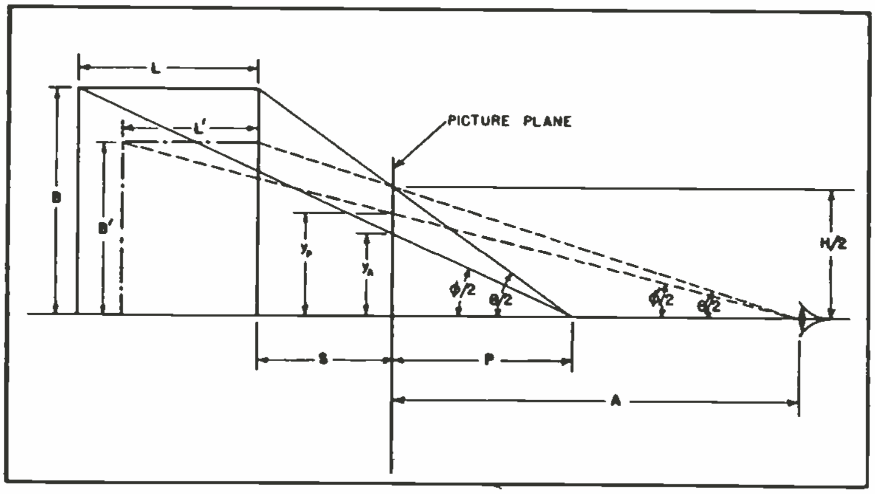


Figure 1

Diagram illustrating image dimensions of a three-dimensional object for which the proper viewing distance is P. Broken lines indicate the original object, of reduced size, but having dimensions that would make it appear in correct perspective when the viewing distance is increased from P to A. The perspective distortion is numerically $(y_P - y_A)/y_P$.

Perspective Distortion may occur in any type of picture, and has long been recognized in a qualitative way by photographers. In still and motion picture photography qualitative rules are used to control perspective distortion, and such rules may usually be applied without limitation due to picture definition. In television pictures, however, the picture definition may frequently be the determining factor for perspective distortion.

A familiar example of perspective distortion occurs in viewing photographs in which the distance from the camera to the object photographed was small compared to the visible length of the object along the camera axis. Thus, in a picture of a person in a sitting position with the feet extending toward the camera the feet often appear disproportionately large; in a photograph of the guns of a battleship taken from a point just beyond the gun muzzles the diameter of the gun barrels may appear to taper in the wrong direction. More extreme perspective distortion is present in viewing the image of one's face reflected by a curved surface such as a silvered ball. Viewing a scene through a telescope may introduce severe perspective distortion and, as may be seen later, viewing present television pictures of many types of scenes at a distance of six screen heights is equivalent to viewing the actual scene through the *wrong end* of a low power telescope.

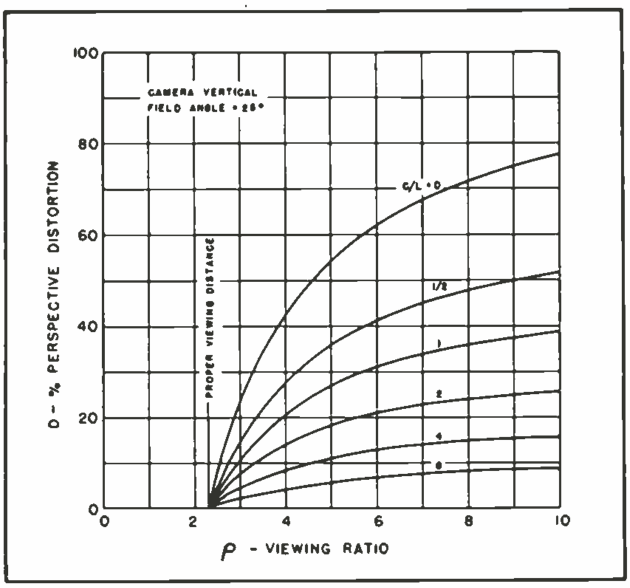


Figure 2

Curves of perspective distortion versus viewing distance in screen heights for scenes requiring various C/L values. A viewing ratio of six is typical with present television pictures.

Quantitative Definition and Evaluation of Perspective Distortion

Perspective distortion in a photograph or television picture can be eliminated and the picture will appear in correct perspective if the image is viewed at one particular distance, called the *proper viewing distance.* Hardy and Perrin[1] have defined the proper viewing distance as the focal length of the camera lens multiplied by the magnification used in producing the picture from the negative. It is more convenient for the purposes of this discussion to use the following equivalent definition: The proper viewing distance is the distance at which every pair of points in the picture subtend the same angle at the eye, as the corresponding points in the actual scene subtend at the lens of the camera. This definition also requires that the line of sight to the center of the picture be normal to

*This paper is not related to the author's work for the Navy Department.

in TV PICTURES

by EDWARD C. LLOYD, Principal Marine Engineer, Bureau of Ships, Navy Department*

the picture plane, and this condition is assumed in this analysis.

If a picture is viewed at any distance other than the proper viewing distance, perspective distortion will result. Let us consider the television screen image of a three-dimensional object or object space of depth L and half-height B, for which the proper viewing distance is P and the actual viewing distance is A, as shown in Figure 1. The height of the image of the object plane farthest from the picture plane is less than the height of the image of the object plane nearest to the picture plane. From the foregoing definition of proper viewing distance, no perspective distortion will be present if the ratio of the angles subtended by these heights at the eye is equal to the ratio of the angles subtended by these heights in the object space at the camera position. If the ratios are not equal perspective distortion is present, and is defined as the fraction by which the height of the image of the far plane differs from the height it would have if no perspective distortion were present. Thus, in Figure 1 the perspective distortion is

$$D = 1 - y_A / y_P \qquad (1)$$

where y_A and y_P refer to the actual image height and proper image height, respectively, of the far object space plane. The proper image height is the height that reduces the apparent dimensions B and L, as seen at distance P, to B' and D' as seen at distance A such that $B/B' = L/L'$. It may be noted that positive distortion occurs when the actual viewing distance is greater than the proper viewing distance, and that negative distortion occurs when the actual viewing distance is less than the proper viewing distance.

The expression (1) may be written in terms of the proper and actual viewing distances, the distance from the camera to the near plane of the object or object space, called the camera distance, and the visible length L of the object along the camera axis. Referring to Figure 1, $y_A = P \tan \frac{\phi}{2}$ and $y_P = A \tan \frac{\phi'}{2}$. Also,

$$\tan \frac{\phi}{2} = \frac{B}{L + S + P}$$

and

$$\tan \frac{\phi'}{2} = \frac{B'}{L' + S + A} = \frac{P}{A} \, \frac{B}{LP/A + S + P}$$

Eliminating ϕ and ϕ' from these four expressions and substituting the resulting values of y_A and y_P in equation (1) gives

$$D = \frac{L}{L + S + P} (1 - P/A)$$

From the definition of proper viewing distance it is seen that the camera distance is $S + P$. Denoting this distance by C, and rearranging the last expression,

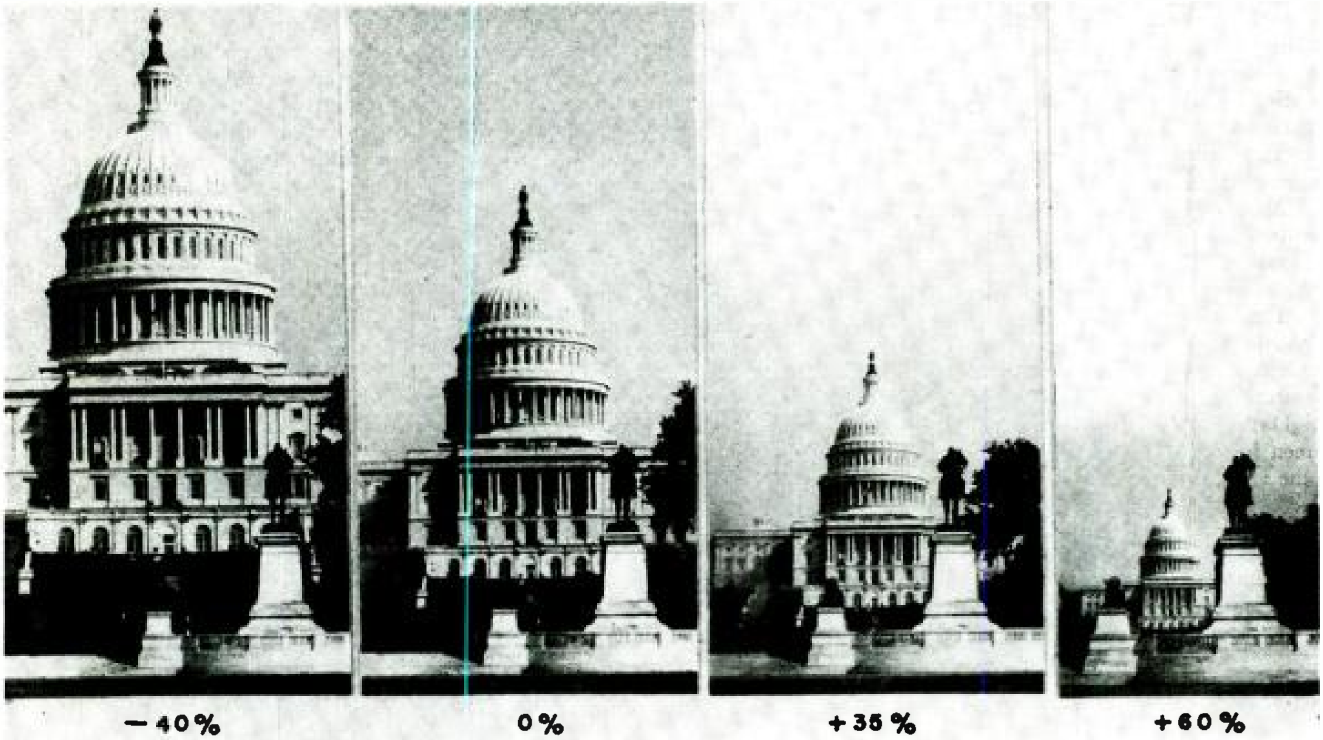
$$D = \frac{1 - P/A}{1 + C/L} \qquad (2)$$

Equation (2) is the basic expression for perspective distortion. It will be

*Hardy and Perrin, *The Principles of Optics*, pp 465-469, McGraw Hill Book Co.; 1932.

Figure 3

Perspective distortion in a scene of large depth. The near object space plane is at the statue in the foreground, and the far plane is at the Capital building dome. Values of perspective distortion are indicated for a viewing distance of 10".



+20%

+40%

0%

+60%

Figure 4

Perspective distortion for an object of moderate depth. Distortion disappears when each picture is viewed at its proper viewing distance, as follows: lower left, 10"; upper left, 5.3"; upper right, 3"; lower right, 1.6". Values of distortion are given for a viewing distance of 10".

noted from this expression that the distortion is zero when the actual viewing distance is equal to the proper viewing distance, and that for minimum distortion the screen should be viewed at a distance as nearly equal to the proper viewing distance as possible. It is further evident that the distortion is smaller for larger values of the camera distance to the object-length ratio, C/L. For views of a flat surface normal to the camera axis this ratio appproaches infinity and the distortion is zero regardless of the screen viewing distance.

Equation (2) may be made somewhat more convenient for application to television pictures by introducing the viewing ratio ρ and the camera vertical field angle θ. The viewing ratio is the actual viewing distance expressed in screen heights: $\rho = A/H$, where H is the screen height. The vertical field angle is the vertical angle of view of the camera, and in Figure 1 $\tan\frac{\theta}{2} = H/2P$ or, approximately, $\theta = H/P$. Combining these expressions for ρ and θ with equation (2) gives*

$$D = \frac{1 - 1/\rho\theta}{1 + C/L} \qquad (3)$$

where θ is expressed in radians.

The curves of Figure 2 were plotted from equation (3), and illustrate the manner in which perspective distortion varies with the viewing ratio. For viewing ratios between six and ten, commonly used with present commercial television receivers, it can be seen that for a camera vertical field angle of 25 the perspective distortion varies from zero to more than 60 per cent, depending on the depth of the scene and the position of the camera. It may also be noted from Figure 2 that the location of the viewer is more critical near the proper viewing distance than at distances appreciably greater.

Negative values of distortion may occur but are of less interest than positive values, for several reasons. Negative distortion may always be avoided since limitations of picture definition, camera distance, etc., do not generally operate to prevent correction of nega-

---

*An alternative form of equation (3) that is slightly more accurate, but less convenient for use, is obtained by replacing ρ by $1/\theta'$ giving $D = \frac{1 - \theta'/\theta}{1 + C/L}$.

Figure 5

Perspective distortion may produce the unpleasant effects in facial features as illustrated in these pictures. The severe distortion of the right hand picture would not often occur in practice. In computing the values of distortion the depth L was taken as 8".

0%

+10%

+20%

+40%

Figure 6

Perspective distortion for an object of moderate depth. At a viewing distance of 10″ the viewing ratio is approximately six for these pictures, a value that is typical for present television pictures. The values of distortion of —10 per cent to +50 per cent correspond to camera vertical field angles of about 5° to 50°.

tive distortion. Secondly, unlike positive distortion, the magnitude of negative distortion is limited by the dimensions of the object. The greatest negative distortion occurs when θ is made as small as possible; for this case $\theta = h/C$ where h is the height of the near portion of the object. Substituting this value in equation (3) and solving for the minimum value of D gives $D = -L/\rho\ h$. Thus, for an object of equal height and depth the magnitude of negative distortion cannot exceed 25 per cent at an assumed minimum viewing ratio of four. Finally, it follows from the definition of perspective distortion that a given magnitude of negative distortion is not equivalent in effect to the same magnitude of positive distortion; for example, 20 per cent positive distortion produces the same amount of distortion as 25 per cent negative distortion, and 100 per cent positive distortion corresponds to infinite negative distortion.

To evaluate various numerical values of perspective distortion, a series of photographs was taken of each of several objects. The photographs of each series were taken at successively shorter distances, and enlarged or reduced as necessary to provide the same image height of the near portion of the object in each picture. Thus, the values of both P/A and C/L were reduced as the camera distance was reduced, providing successively greater distortion when all pictures of a series are viewed at the same distance. Care was taken to maintain the same angular orientation of the object with respect to the camera axis for all pictures of a series. Several series of such photographs are shown in Figures 3 to 7. All of these photographs should be viewed at a distance of ten inches to obtain the values of distortion given.

Criteria for Studio and Camera Techniques

For a television system for which the picture definition and the corresponding minimum viewing ratio has been determined, the expression (3) for perspective distortion may be usefully applied to keep the distortion to a minimum. In particular, the camera distance C and vertical field angle θ may be adjusted toward optimum values, and scenes arranged to reduce the depth L, insofar as other considerations permit.

For determining the maximum camera field angle and the corresponding lens focal length required for a given limit of distortion, equation (3) may be written

$$\theta = \frac{1}{\rho}\,\frac{1}{1 - D\,(1 + C/L)} \qquad (4)$$

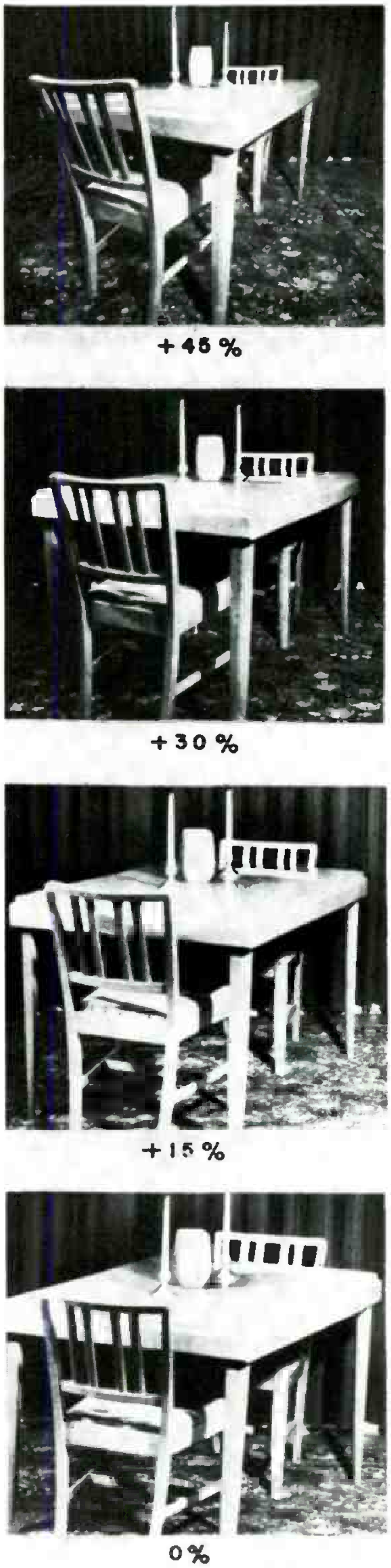
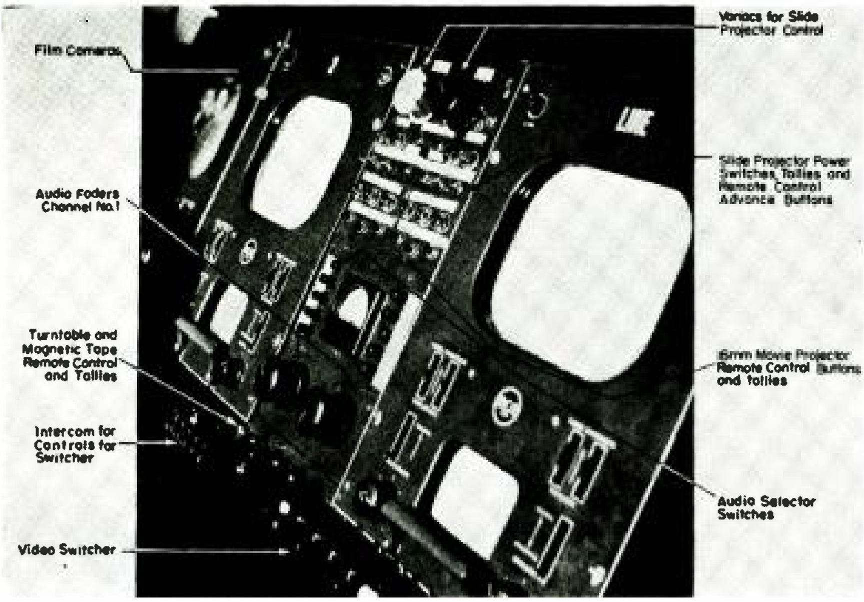


Figure 7

Pictures illustrating perspective distortion in scene having dimensions that would frequently be encountered in a studio scene.

[*To Be Concluded in February*]



Left:
View of control panel showing audio faders' channel, audio selector switches, etc.

TV

Right: Figure 2
View of the push button in the finger rest which connects the pickup to a high-gain amplifier for cueing without requiring operation of console equipment.

Two-Channel Audio System Evolved Affords One-Man Control of Audio and Video Facilities as Well as Transmitter: Video Man Operates Console Featuring All Slide Projector and Film Projector Controls, as well as Two Audio Mixers Each with Five Position Input Selectors. Program Channels Can be Combined to Permit Vocalist to Sing to Accompaniment of a Record Without Danger of Acoustic Feedback.

The KRON-TV operating console may be compared with the cockpit of a large airplane. Two men, seated side by side, control this huge and expensive craft and under normal conditions they are quite relaxed. During take-off and landings they are somewhat tense and must closely coordinate their operating functions.

In our plant there are the two operators who normally are responsible for an equivalent investment in equipment and their operating functions require coordination and planning prior to and during switching sequences. A broad knowledge of the television system is required of the operators, but this knowledge can be obtained during a few months of activity. The airplane pilot's responsibilities include not only the investment in the airplane, but also the lives of his passengers, while the TV operator's responsibility is chiefly program continuity. An error may cost the rebate of commercial time, embarassment to the station, and inconvenience to the viewers. The operator's responsibility is a complete one, in that the entire business structure of the station depends upon the condition of the equipment and the skill of the operating staff.

Realizing that certain limitations may be imposed upon the program structure in the design of the operating console, it was decided to study the system carefully using a block diagram and a scale model and then build up the plan as a full-scale mockup, utilizing experienced program and technical personnel in the *dry runs*. The equipment locations chosen by this time and motion study have been very satisfactory in practice and only a few minor revisions of rack mounted equipment have been made.

In practice, only one man operates the station during the test pattern and afternoon-microwaved studio programs. His responsibilities include two film camera chains, two 16-mm film projectors, two automatic slide projectors, one fixed slide projector, one opaque projector with news ticker, complete video facilities including two microwave receivers, audio equipment and the television sound and picture transmitters. During the peak-operating periods at night two men are assigned, one for video control and film, and the other is responsible for the transmitter and audio. A third man is utilized when the two cameras in the transmitter studio are required.

The audio requirements of this installation vary from a one-fader and program key requirement to a possible six-channel mixer problem. Since the six-channel mixer could not be conveniently accommodated adjacent to the video operator and he would not have time or enough hands to operate it, a compromise was made and the audio system was divided into two independent channels; one with a two-position mixer with selector switch adjacent to the video control position, and the other a six-channel mixer within arms reach, but located for convenient operation by a second man. The block diagram of this system is shown in Figure. 1.

Since two independent audio channels were required and a choice of the same inputs for each channel was desired without switching, a unique mixer utilizing isolation coils was designed. Both mixer channels operate at the same level −20 dbm and were designed for 150-ohm impedance.

Two cabinets were built, one containing all of the rack mounted amplifiers and the six-mixer channel and monitoring circuits, and the other containing two mixers, each with a five-position selector switch, a volume indicator and the remote controls for the projection equipment. Only 8″ wide, the latter unit matches the television film camera control and switcher cabinets.[1]

Provision has been made at each console for starting and stopping two turntables and two magnetic tape recorders by remote relay control. Previously cued recordings can thereby be more easily utilized.

The output of the two film projectors can be automatically switched by the factory supplied *douser* unit and hence appears on the mixer as only one program source. An equalizer is utilized to permit some compensation for audio quality variations on film. Provision for two 15-kc studio lines and one network or remote line, and two magnetic

Audio Systems Engineering

by R. A. ISBERG, Chief Engineer KRON-TV and President, Isberg Engineering Co.

recorder playback units were included in the design, although only one line and one magnetic tape unit is presently utilized. Six preamplifiers amplify[2] the output of two turntables[3] and four microphones to mixer level.

The outputs of the two mixers each feed amplifiers[4] which have individual channel master gain controls and program keys on the panel.

The outputs of the program keys can be linked to combine both channels to feed the transmitter or to use either channel for audition while the other channel is on the air. Amplifiers[5] are utilized for the audition program amplifiers and a third unit has been provided to feed the network or as a spare.

The monitoring circuits provide two amplifiers[6], one for the on-the-air monitoring controlled by selector switches on the transmitter console, and the other for auditioning and cueing program sources. The speakers for these monitors have been widely separated to avoid confusion as to the program source. A nine-position push button selector switch mounted on the large audio console panel facilitates cueing and auditioning of all program sources. In addition an independent cueing system has been incorporated in the turntables, which eliminates the possibility for operating errors while cueing records. A *dpdt* push button switch has been installed in the finger rest of the turntable; Figure 2. Depressing the switch connects the pickup to an independent amplifier and speaker. The same amplifier is used for both turntables.

The flexibility built into this audio system permits transfer of control from one mixer to the other with no inter-

(*Continued on page 23*)

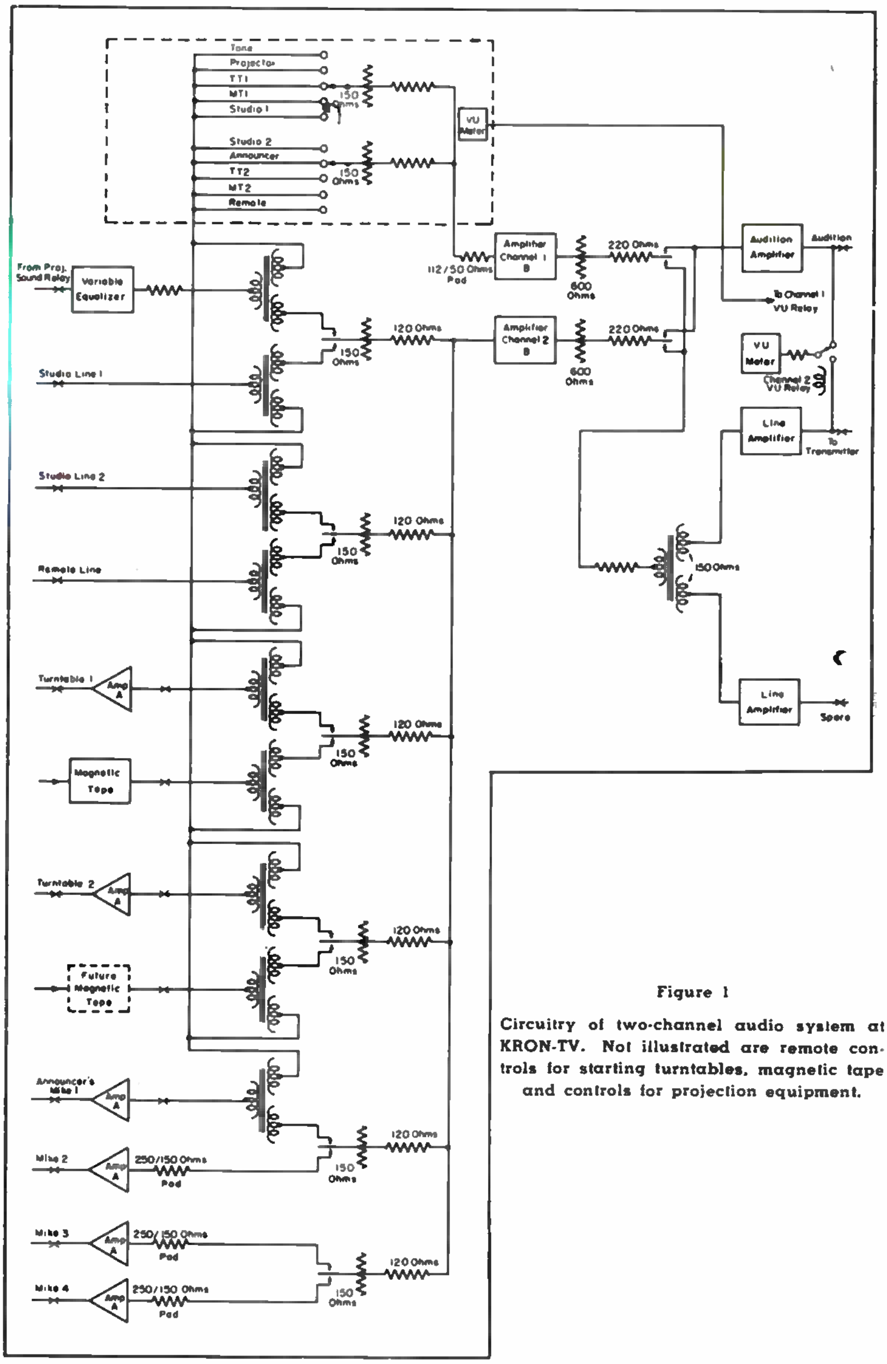


Figure 1

Circuitry of two-channel audio system at KRON-TV. Not illustrated are remote controls for starting turntables, magnetic tape and controls for projection equipment.

[1]RCA. [2]RCA BA-1A. [3]RCA 70D.
[4]RCA BA-2C. [5]RCA BA-13. [6]RCA BA-4C.

VIDEO RELAY SWITCHING

by C. R. MONRO, Television Terminal Equipment Engineering

Engineering Products Department, RCA Victor Division, RCA

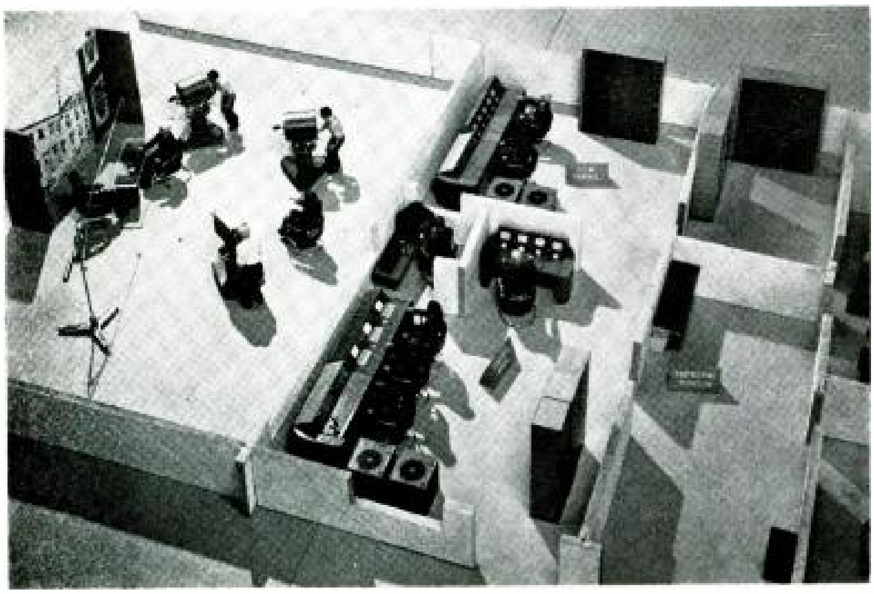
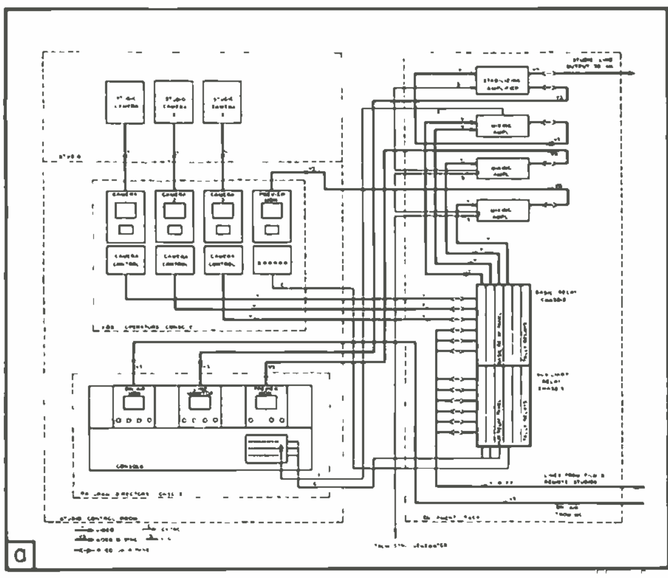


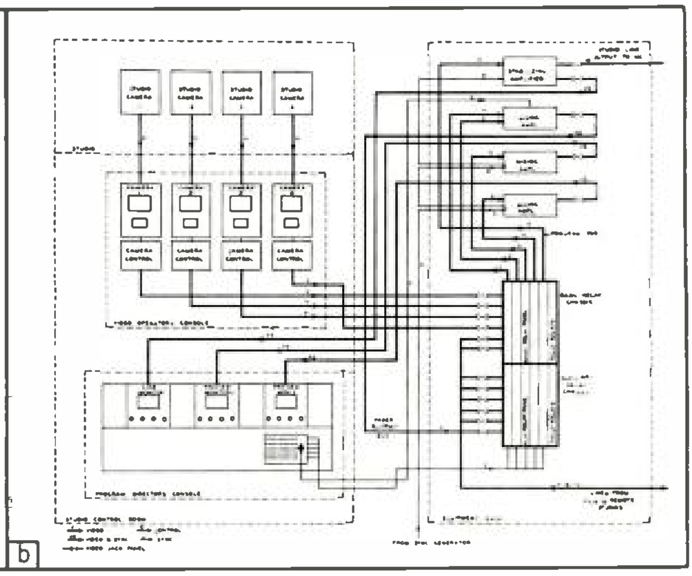
Figure 1
Basic elements of a larger studio layout with three monitors in the director's console.

Figure 2
Audio and video console position, on a raised platform behind the camera controls which may be adopted to permit program and technical directors to see their own monitors the camera monitors and also into the studio. Control room in front seats audio operator, program director and technical director. Announce booth is at left.

For a larger studio, built to handle full-scale dramatic plays or musical revues, more cameras must be used in the studio itself and the inserted portions from film, slides, or other studios might easily require more than six inputs. Also, more studio monitors are required in the control room to keep track of the additional activity. For this purpose there is available a program director's console[1] into which a twelve-input switching control panel has been built, and which may contain as many as five program monitors.[2] Figure 1 illustrates the basic elements of this larger layout with three monitors in the director's console, to cover *on-the-air, line*, and *preview*. The console itself may be located against the studio window as shown, or on a raised platform behind the camera controls as in Figure 2, so as to permit the program and technical directors to see their own monitors, the camera monitors, and also into the studio. The video block diagram for these layouts appears in Figure 3. It will be noted that by the addition of an auxiliary relay chassis, the number of inputs in the video switching rack can be extended to twelve. In addition, the video operator has been provided with a preview monitor by the addition of another panel or relays and a sync mixing amplifier. A further extension of these control facilities has been the addition of a *program bus* row of push buttons to the control panel, which per-

Figures 3 (a) and 4 (b)‡
In (a) appears a block program for video facilities using a program console. In (b) is a block diagram of a video-facility layout with a program console and program bus output.





Part II. . . . Switching Systems for More Than Six Inputs. . . . Examples of Switching Variations. . . . Audio-Video Switching Setups. . . . Present Switching. . . . Studio Control of Master Switching.

mits previewing of the output of the fader channel, since any input may be put directly on the air through the program bus or sent through the fader channel for special picture effects. To extend application possibilities further two preview monitors have been included in the program consoles and four studio cameras are connected to the video operator's console.

Although the preceding discussion was based on a live talent studio, the same facilities are equally useful for a film studio which contains several cameras and projectors. Similarly, a large network center fed from several remote points such as theatres and sports arenas may also use a set of these control facilities, handling the complete station programming of shows and commercials without tying up master control facilities.

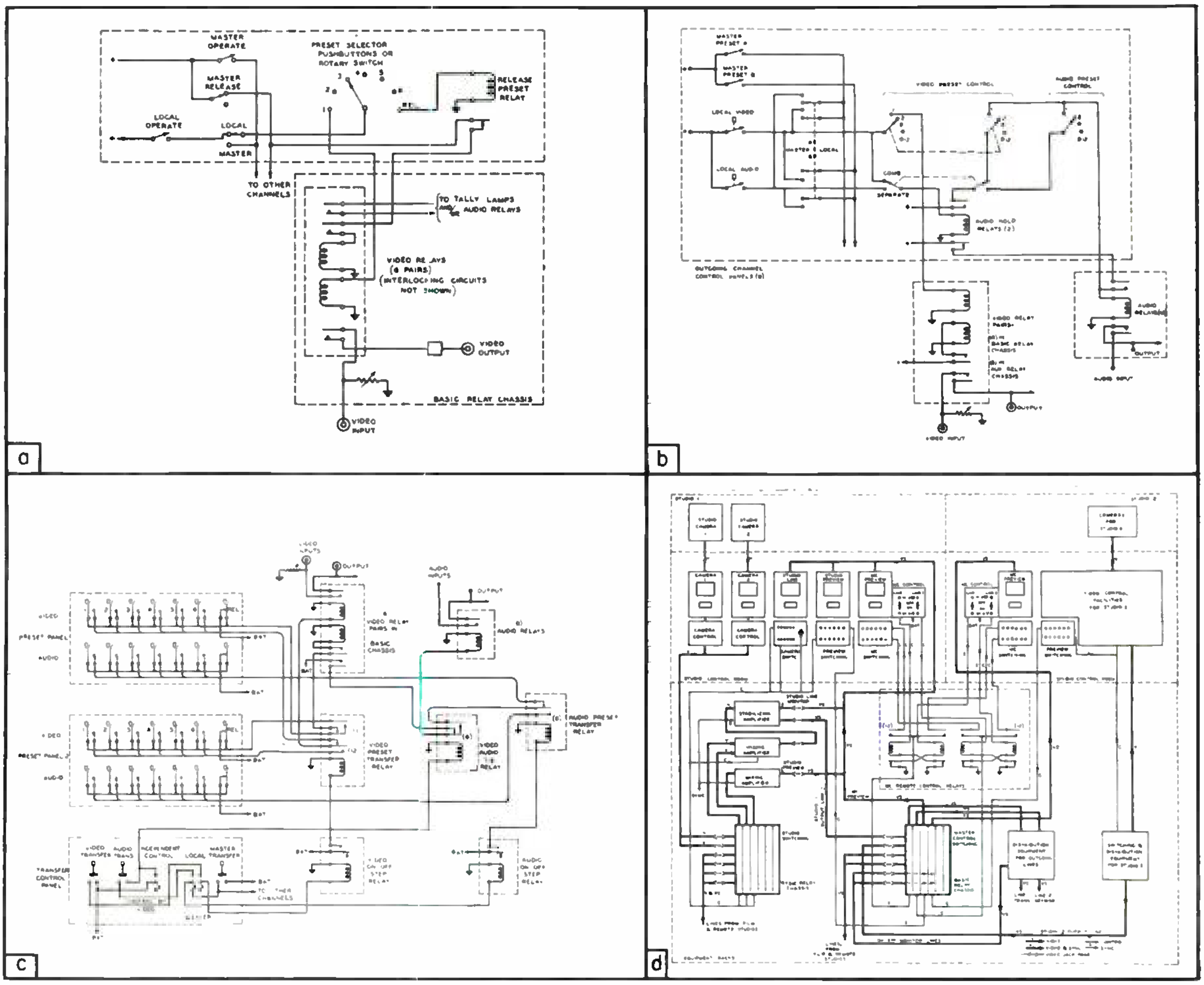
Variations Possible

Obviously there are endless variations possible, the illustrations given here serving only as examples. In Figure 1 (Part I[3]) the video console shown in the film control room was arranged to handle the two film cameras and also the master control facilities, which will be described later. In Figure 7, the film studio has been located on a different floor of the building, with its control room adjacent to it. Or, the film control could be combined with studio facilities in a single control room arrangement. With sufficient monitoring facilities, it is even possible to locate the studio control room separately so as to eliminate the usual connecting window area and so make more floor area available in the studio. The basic

[1]RCA TC-5A. [2]RCA TM-1A.
[3]TeleVision Engineering; December, 1949.

Figures 5 (a), 6 (b), 7 (c) and 8 (d) ‡

A simplified diagram of a preset mc video switching setup appears in (a). In (b) is a simplified diagram of the preset audio-video mc switching used at KECA, Los Angeles, Calif. The setup in (c) represents the preset audio-video mc switching used at WOR-TV, New York. In (d) appears a simplified diagram of two-studio control of mc video switching.



Relay Switching

(*Continued from page 19*)

reason for all of this should be kept in mind, since it is actually the key to the much desired *new and different* operation. Production people are constantly searching for new ideas of presentation and they must, wherever practical, be provided with the necessary facilities. The need becomes obvious for smooth-running operation during all the cutting and trimming that occurs in the building of a show. All of this must go on while the show unfolds; there is no time for retakes or changes because the audience is literally looking over your shoulder.

The live talent and film studio control facilities do not comprise the only application of video relay switching in a television plant. In *master control*, program material from all the available sources, whether studios or remotes, must be chosen at the proper time and sent out to the transmitter or network. Operating schedules call for split-second timing with no errors and a minimum of delay in meeting emergency or unusual requirements as for rehearsals and special client showings.

Here again, video relay switching finds its place in providing a flexible system. The actual switching panels used differ widely, however, in following each different station's operating philosophy. In Figure 1 (Part I[3]) the master control monitoring and switching facilities are shown combined with film control consoles. In Figure 7, the master control room is in a different part of the building. The block diagram shown in Figure 6 illustrates the typical connections for these facilities using standard console sections and master monitors. Appropriate push-button panels are mounted in the consoles.

Audio-Video Switching

Many are now using *tied-in* audio switching in which audio channel relays are operated from the video system or just the opposite in which an audio console and its associated relays have provisions for operating the video relay bays. A further variation, is provision for either separate or tied-in operation. Control circuits for one such arrangement are shown in Figure 5. In this circuit the audio relays in a standard master control audio console[1] are switched from their own push buttons to the tally contacts on the video relays in the relay switching system.[2]

Although the timing requirements for transfer time are quite different in the two systems, the video switching relay strips fit in without change. It is the

[1]RCA BCS-1A. [2]RCA TS-20A.

‡ Circuits extremely simplified; one relay in drawing may actually be two, or more in a special interlocking circuit or in identical circuits for other channels.

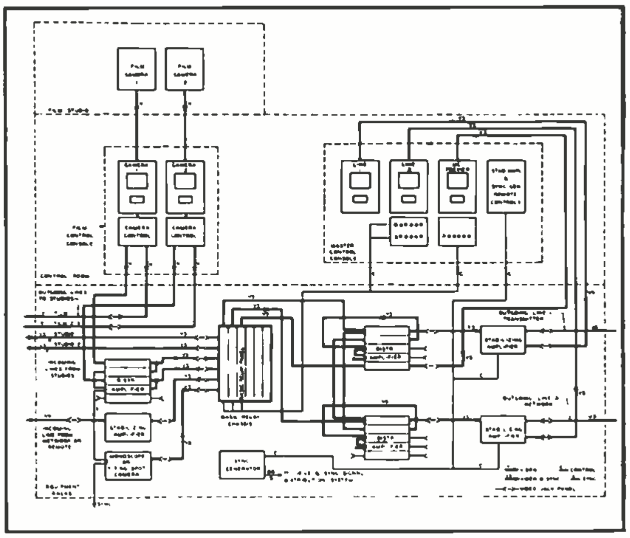


Figure 6‡
Block diagram of master control facilities.

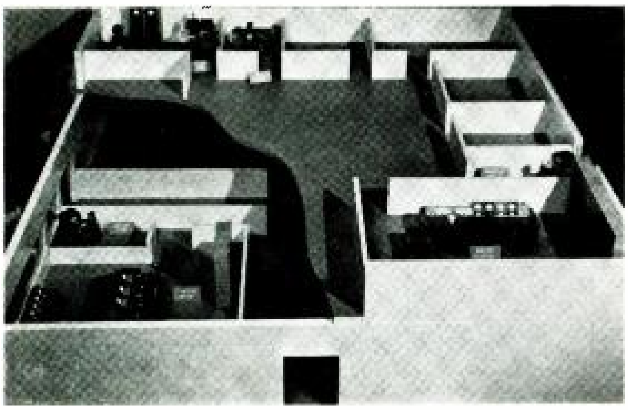


Figure 7
TV station with facilities located on two floors.

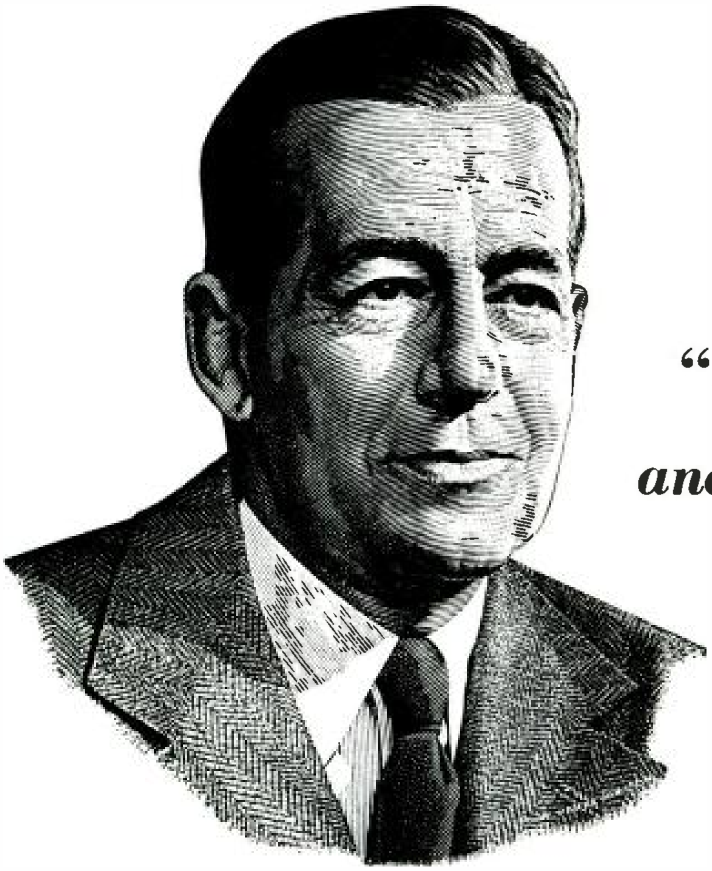
usual practice to provide a gap switching sequence in the audio channels, as a part of the relay interlocking circuits, which is very long compared to the value tolerable for video. When operated from such a system, however, the video relays transfer at their own rapid rate independently of the audio timing. In the opposite arrangement, audio relays operated from the video channels should be provided with *operate* delay coils to restore the usual audio gap.

Preset Switching

A considerable improvement in operating ease and accuracy may be brought about by the use of a *preset* switching system. With this arrangement, the rotary or push-button switch usually used for channel selection is normally dead and may then be set up for the next channel arrangement to be put on the air. Then, at the proper instant, one trip button will cause one or several channels to transfer to the new *preset* schedule. One type of preset control circuit is shown in Figure 6. Only one outgoing channel is shown here; several are normally used side-by-side. For operation of individual channels the preset switch is set to the desired incoming channel, then the local operate button is pushed at the proper instant. For master operation of several channels simultaneously, the channels to be used are set up and then switched to master position. Then, the master operate button will transfer all the channels at the same time.

A similar circuit, extended to include control of an audio switching system is shown in Figure 7. Normally, the audio and video relays are both operated from the selector decks of the video preset switch. However, complete interlocking circuits for the audio relays are included so they may be operated separately or in conjunction with the video relays either on the same or different incoming channels. An additional feature is a form of *double* preset in which the outgoing channel trip circuits may be connected to either of two master busses. In this way, two program arrangements can be preset and then put on the air in sequence. For instance, during a program change, a local commercial introducing a certain show might be picked up on the transmitter line using the *master preset A* circuit, then, without disturbing the transmitter feed, the network line would be switched to the same program at the conclusion of the announcement by operating the *master B* circuit.

[*To Be Concluded in February*]



"*Freedom of thought and independence of action . . .*"

DONALD W. DOUGLAS

President, Douglas Aircraft Company, Inc.

"Freedom of thought and independence of action are among the keynotes of America's economy. They are fundamental to our way of life. Systematic savings through the Payroll Savings Plan help the individual maintain his own independence and freedom of action and make us strong as a nation."

In more than 21,000 large companies (employing 100 or more) and in many smaller companies, more than 8,000,000 men and women are helping to keep America strong. By systematic saving in U. S. Savings Bonds they are doing their part to offset inflationary tendencies . . . they are building a reservoir of future purchasing power to support industry...they are providing financial independence for themselves and their families.

The widespread success of the Payroll Savings Plan is an excellent example of our freedom of thought and independence of action. Far-sighted employers *offered* these 8,000,000 Americans an *opportunity* to enroll in the Payroll Savings Plan. There was no pressure, no emotional stimulation. A Payroll Savings Plan application was placed before them. They "signed up"—to the benefit of themselves, their companies and their country.

Has *every* man and woman in your company been *offered* an opportunity to share in the benefits of the Payroll Savings Plan? How about the newer employees? How about those who did not sign before but may wish to do so now? Delegate one of your top executives to conduct a person-to-person canvass of your employees to make sure that *every* man and woman gets an application blank. You don't have to urge them to enroll, or to increase their present allotment—they are anxious to build for their own independence.

Get in touch with your State Director, U. S. Treasury Department, Savings Bonds Division. He is ready to help you—with a package plan that reduces your work to the minimum.

The U. S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the G. M. Basford Company and

TELEVISION ENGINEERING

TV Audio

(*Continued from page* 17)

ruption or variation of level. Both mixers can also be used to feed programs is to the transmitter at the same time. This procedure is necessary when it is desired to have an artist in the live studio sing to the accompaniment of a recording which is being played on the air at the same time.

The singer's voice can be amplified by one channel and the recording by the other and the two channels combined to feed the transmitter. The studio monitoring speaker can be fed the output of the recording channel alone, without danger of acoustic feedback.

Credits

Credit is especially due to William Nielsen for the layout and construction of the audio consoles, and to William Sadler, Donald Anderson, Fred Street, and Roger Woodruff for their many helpful suggestions and assistance in construction. While it is true that the audio system cost several times the price of a conventional commercial audio consolette, the saving in manpower has already paid for this differential and the station will continue to benefit for many years.

Die Stamping

(*Continued from page* 11)

hum reduction by shielding grid leads from the filament leads.

In addition to the fabrication of adjustable inductors, adjustable air capacitors can be made by stamping out one plate of the capacitor and suitably mounting the adjustable plate above it.

The stamping process has also been found suitable for use in production of *hf* equipments (of the order of 20 to 500 mc), since stability of circuit values can be affected. Tests have shown that it is actually impossible to measure any difference in the inductance of, for instance, loop antennas stamped from the same die, and these loops have run in the order of 200 microhenrys or more. Once an inductor has been stamped, it is permanently embedded in the insulating plate and its value can not change. Previous to stamping, the insulating plate can be treated with a coating to keep it non-hygroscopic so that inductor values can be held at ± 0 tolerance. Values of Q up to 200 have been achieved for 210 microhenry loop antennas stamped on lucite with the loops tuned to 1 mc. The Q of inductors may be increased by employing silver-

(*Continued on page* 24)

(*Continued from page 23*)

plated copper (or by electroplating silver on the inductors after stamping). Increased inductance may be achieved by painting or stenciling high Q magnetic paint on the rear of the insulating plate behind the inductor, or if the paint is non-conducting, it may be stenciled between the inductor turns. Similarly magnetic slugs may be locked into place in depressions at the rear of inductors to increase the inductance. Radio-frequency transformers and coils having two or three windings in parallel also can be produced. Inductors may be stamped in rectangular spirals instead of circular so as to obtain greater inductance for a given area. Mutual coupling between two plane spiral inductors on either side of the insulating plate can be increased by mounting a cylindrical compressed powder metal slug at the center of the inductors and perpendicular to their plane. The slug could be mounted to permit adjustments of coupling. Another method of accomplishing tuning of an inductor, besides the use of an adjustable brass slug above the inductor, is to employ a spring arm, adjustable for mechanically contacting various portions of the last turn of the inductor. A variable tuning unit can also be produced by stamping coils on two pieces of insulating material, one of which can be moved relative to the other.

It should be noted that since pure rolled metals, such as copper, are employed, the current carrying capacity of stamped circuits is the same as that for conventional wiring using equivalent cross-section conducting areas. In addition, because of the greater surface presented by the flat stamped wiring compared to ordinary round wires, skin effect is less and heat dissipation is improved. The conductance of stamped wiring is not affected by the nature of the base material. Similarly as in conventional wiring, given sufficient cross-section area of conductors, the current carrying capacity of stamped circuits will be found to be more than sufficient for all currents used in low-power electronic circuits.

It is not necessary to prepare dies or use the stamping press in constructing experimental or preproduction models. Determination of inductor size may be made by using a previously stamped coil of a value larger than required and then cutting the end off with a knife until the desired value is achieved. Conductors may be laid down using scissors for cutting the metal to size and obtaining adherence with any electrical grade of glue, while connections are made with a soldering iron. Thus, it is possible, with relatively little construction cost, to build a production prototype.

Tooling and Dies

Tooling up for the production of stampings does occupy a greater percentage of total production costs, than in conventional assembling and production methods. This, however, can be considered as a desirable feature, in that with the reduction in labor requirements, a continuous improvement in methods and an accumulation of presses and other tools can result, in a relatively short time, in substantial savings in production costs.

The die is comparatively inexpensive, since the tooling cuts are shallow. In addition, the die does not require critical materials or special cutting abilities. Only a male die is required. (The female nest, where used, does not require any of the characteristics of a die except for non-critical layout.) The total cost of a typical die is approximately $400 at present. The dies usually last for a complete stamping run, since they tend to hone themselves and are not subjected to destructive forces in the process. The life of the average die should be adequate to produce a minimum of 250,000 stampings.

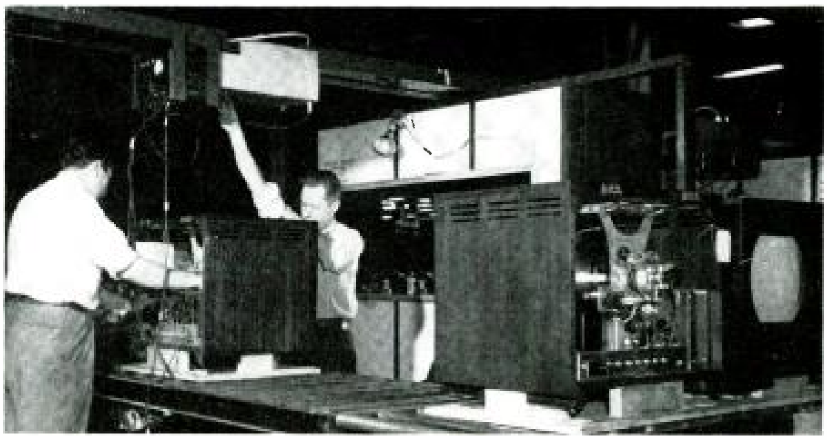
Reductions in size and weight of units employing stamped circuitry may may be considerable, since such intensively used items as wire insulation, sleeving, cable clamps and cording, terminal boards and strips, solder and ground lugs, and hardware can be eliminated. Many items such as multi-section rotary switch supports and wafers and coil forms can also be eliminated.

The inherent monoplane structure of stamped circuitry presents many possibilities. Both for production and maintenance purposes, all components are open to view, and components may be tested and replaced.

The insulator base provides area for stenciling or stamping of reference symbols, names or instructions in proximity to associated items. Since terminals are all in one plane, connection of attached components in one operation can be made by dip soldering. The elimination of hand soldering minimizes cold solder joints. Such operations as moisture and fungus proofing, and testing of such proofing involve less time, effort and materials. Roller coating for insulation of the stamped circuitry or for surface coating of the insulating plate can be accomplished simply and automatically. Spray or dip methods of coating or impregnating can also be employed. Since conductors are considerably shorter than in conventional wiring, the savings in copper for large volumes of production become substantial.

Human Aspects of Engineering Quality into a Product*

by CARL L. GARTNER, Receiver Quality Control, Allen B. DuMont Laboratories, Inc.



Final test of receivers in quality control.

Part II. . . . Securing Maximum Effectiveness From Sampling and Control Charts.

A FREQUENT MANAGEMENT mistake is to plan a schedule so that there is no opportunity to make major changes before, during, or after the pilot run, in the event of unexpected findings. The unexpected should always be expected in as important and complex an operation as modern mass production.

Another essential phase of quality-control planning to eliminate the human aspects, gets under way with the beginning of production. The first problem is to obtain the best quality consistent with the design and process capabilities. This calls for a tight quality rein on production each step of the way, from incoming materials until the finished article is shipped.

We are all familiar with the control chart as a production tool. The technical aspects of sampling are also well known. However, as it has been often indicated, sampling and control charts are only tools to be used as an index of quality. By themselves they are worthless. The finest tool cannot work without the hands to guide it. We are told that 90% of quality control of production is in obtaining proper corrective action, but too seldom is there any organized plan of obtaining such action. This is where careful planning and resultant routine action is important.

It has been found that the best way to get a process in control and keep it in control is to "lay down the law" to manufacturing groups. Specifically, a procedure is set up where automatically after a process shows out of control, the parties responsible are notified. If continued lack of control exists, the process is automatically and immediately stopped until corrective action satisfactory to the quality control group has been taken. In cases, where lot by lot sampling is done, the same effect can be achieved by bouncing all rejected lots back to the manufacturing group and demanding 100% inspection by manufacturing. It is important to emphasize that these procedures should be standard routines and should *not* have to entail a decision every time poor quality is observed. In this manner, there can be no outraged cries, no unpredictability for the manufacturing groups.

They know exactly what quality is expected, and also what will happen when and if they fail to comply; the human aspect is again being eliminated.

This may seem to be a rather drastic way of controlling process quality, and it is! The immediate result of installing such a system will invariably be slowed production and irate tempers. However, the long run effect will not only be improved quality of the product, but less salvage, scrap, repair, and best of all, more production than before.

**An IRE Professional Group on Quality Control paper presented at the Syracuse IRE-RTMA meeting.*

At West Coast IRE Meeting

Left to right: Conrad Strassner and Sylvan A. Wolin of Pyramid Electric Co., Mrs. Strassner, and Mert Levenberg of Condenser Products Co., reviewing capacitor situation during recent IRE California meeting.

Resonant Coax Lines

THE CONCLUDING INSTALLMENT of the J. Gregg Stephenson paper on *Discontinuity Tuning Charts for Resonant Coax Lines* scheduled for January will appear in February.

Production

Self-Adhesive Metal Nameplates

SELF-ADHESIVE METAL NAMEPLATES which are said to require no pre-drilling of holes, screws, rivets or other fastening devices have been announced.

Consisting of a .003" thickness of aluminum foil anodized and dyed to government specifications, the nameplates were developed to meet the needs of Boeing during the last war.

Backed with a high tensile bonding material, plates can be applied to any smooth, cohesive surface on metals, porcelain, bakelite, polystyrene, glass, wood, paints or enamels.

Available in any one of five colors: brown, red, black, blue, green and aluminum.—*C and H Supply Co., Metal-Cal Division, Boeing Field, Seattle, Wash.*

Potential Tap Without Cutting Wires

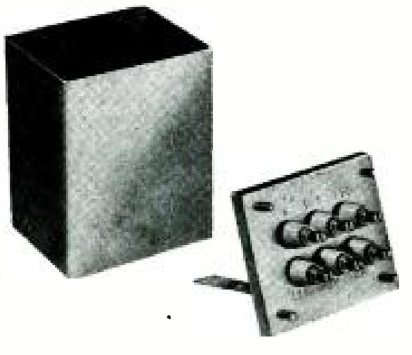
A POTENTIAL-TAP DEVICE that allows a voltage measurement to be made across a load without the usual *breaking in* on the line has been produced.

Consists of a wafer-thin plate which slips over the prongs of standard Edison plugs and provides two tip jacks that receive standard phone tips. The appliance to be checked is plugged through the potential tap into the power receptacle. Voltmeter with phone tip leads may be used to check the voltage with the appliance on or off.—*Model 400 PT; Industrial Devices, Inc., Edgewater, N. J.*

Industrial Devices potential tap.

Transformer Cans

STANDARD SIZES of transformer cans are now available, with or without brackets, weld studs, blind inserts, compression-type hermetic seal bushings and stamped ratings.—*Heldor Metal Products Corp., 85 Academy St., Belleville, N. J.*



Instruments

High-Frequency Signal Generator

A SIGNAL GENERATOR FOR MICROWAVE or super high frequencies, which offers continuous coverage from 3800 to 7600 mc, has been produced.

Provides a 1 milliwatt signal into a 50-ohm coaxial load at zero dbm. Equipped with an output attenuator reducing output level to less than —100 dbm. Repeller voltage tracks automatically, and no adjustment is required to select the correct frequency. Accuracy is said to be ½ of 1%.

Instrument may be externally frequency modulated with maximum deviation of +10 mc. It may be externally pulse modulated, with a positive or negative peak voltage of approximately 15 volts. Internal square wave modulation is also provided within the frequency range of 400 to 1000 cycles per second.—*Model 618A; Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.*

H-P shf signal generator.

Utility Monitor

A SELF-CONTAINED UTILITY monitor, available either as a portable instrument or as one designed for rack or console mounting, has been announced.

Monitor is supplied in either of two models; 12½-inch housed in a gray carrying case with dark umber gray trim, and a 10-inch for mounting in the studio. Adapters for either rack or console mounting of the unit are also available.

The monitor has a high-impedance video input with provision for looping or terminating the signal. Vertical scanning can be easily reversed by a switch to permit use of the mirror system of viewing. The frequency response extends to 6 mc, utilizing the signal available from a closed circuit in the TV control room. Five controls mounted on the front panel. The controls and the panel may be removed and mounted for remote control use in the program console.—*Models TM-2B and TM-2A; Broadcast Equipment Section, RCA Engineering Products Department, Camden 2, N. J.*

Regulated Power Supply

A POWER SUPPLY, adjustable from 250 to 300 v, designed to provide in excess of 800 ma, with a regulation of better than .02%, is now available. Ripple is said to be held to low levels required in television applications. Output impedance is less than 1½ ohms.—*Model PT-112; Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

TV Parts

Knobs and Dials

A SERIES OF KNOBS AND NICKEL-SILVER DIALS in a variety of sizes and calibration markings is now available, supplied with or without black phenolic skirts or satin chrome dials. Knobs are designed with extra thick walls. All types have heavy brass inserts and twelve flutes instead of eight.—*E. F. Johnson Co., Waseca, Minn.*

E. F. Johnson knobs and dials.

Remote Control

A REMOTE CONTROL UNIT which permits tilting, panning, focusing, and lens changing of television cameras by distant operators has been announced.—*General Precision Lab., Inc., Pleasantville, N. Y.*

RF Coax Switch

A COAX SWITCH capable of transmitting *rf* current up to 10,000 mc with *swr* said to be attributable to the switch itself, substantially less than 1.5:1 at most frequencies, has been developed. May be manually or electrically actuated and can be made to switch from two to six coax channels.—*Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, Ohio.*

Personals

Arthur L. Chapman, general manager of the radio and television and parts divisions; *Curtis A. Haines*, general manager of operations of the radio tube and television picture tube divisions; *John B. Merrill*, general manager of the tungsten and chemical division; and *Howard L. Richardson*, director of industrial relations, have been appointed vice presidents of Sylvania Electric.

A. L. Chapman

C. A. Haines

J. B. Merrill

H. L. Richardson

Kendrick Lippitt, chief engineer of Technical Appliance Corp., is now serving with the RTMA 31C committee on receiving antennas.

Ray F. Sparrow has become senior vice president of P. R. Mallory & Co., Inc., Indianapolis, Ind.

Robert K. Roulston has been appointed assistant to the president of Air King Products.

Captain David R. Hull, USN (Ret.), has been elected a vice president of Raytheon. Hull, formerly assistant manager of the equipment divisions, succeeds Wallace L. Gifford, who has become a director and vice president in an advisory capacity.

Jack Kaufman, president of Lewis & Kaufman, Inc., and a group have purchased the entire capital stock of Taylor Tubes, Inc., Chicago. Kaufman will direct the operations of both Taylor Tubes, Inc., and Lewis & Kaufman, Inc., of Los Gatos, Calif.

Robert H. Paschall has been appointed vice president in charge of sales of Universal Electronics Sales Corp., Philadelphia, Pa.

Marvin Hobbs has been appointed chief of the electronics division of the Munitions Board and government chairman of the Electronics Equipment Industry advisory committee.

Matthew A. Camber has been appointed national rep for the manufacturers' division of Fidelity Tube Corp., East Newark, N. J. *Leon L. Adelman* has been appointed Metropolitan N. Y. rep for the jobber division and becomes advisory sales manager.

L. L. Adelman

M. A. Camber

M. J. Alexander has joined Thomas Electronics, Inc., Passaic, N. J., to direct the television picture tube sales and advertising programs.

J. B. Lindsay, formerly with RCA, has joined the engineering department of Thomas Electronics, Inc.

M. J. Alexander

J. B. Lindsay

VWOA News

Personals

HARRY L. CORNELL, who recently suffered a severe case of pneumonia, is reported to be on the road to recovery, and resting in Florida. . . . A. Barbalate has been under a doctor's care since October. The best for a rapid recovery. . . . Six new members have been welcomed into our ranks: Eric A. Roberts, Commander Charles E. Biele (USN), Elton Earl Wood, Gedney M. Rigor, Joseph H. McKenney and Edward E. Freeman. Roberts, who resides in Larchmont, N. Y., reports for work at the Texas Co. offices in New York City, where he holds the position of electrical engineer of the marine department. In the key business since July, '30, he has served on the SS Lewis Luckenbach, Paul Luckenbach and many others. A very active ham, his station has been the key point through which election returns have been channelled to New York City for rebroadcast by voice. . . . Wood's wireless days go way back to '17. He sailed aboard the SS Yuma. . . . Rigor, who now resides in Clinton, Md., began his space work in '18 in the U. S. Navy. His first wireless activity was as an assistant involving the placing into service of the old wireless direction finder stations *DF* at Cape Henlopen, which was one of the first, Cape May and the Bethany Beach group. He also sailed aboard a subchaser and a destroyer and put in some time at NSD *DF* station. Assignments to merchant ships included SS Allentown, SS Ed. Luckenbach, SS President Polk, SS Hahira, SS Bohemian Club, etc. His first license was signed by *RY* Cadmus at Baltimore, November 20, 1919. During the '30's he held down a trick at WNW and in '38 returned to active duty with the Navy where he is still active. His tour of duty has included the Cheltenham Naval radio station, U. S. Naval air station at Trinidad, and as Radar Officer in the 8th Naval District, moving to BuShips in '46. His present rank is Lieutenant. . . . McKenney, who hails from Houston, Texas, is regional manager for the FCC. He also began his wireless career in '18 aboard the USS Oklahoma of the U. S. Navy and subsequently saw service aboard the USS Imperator until late '19 when he became a commercial operator working for such oldtimers as Ship Owners Radio Service (SORS) and RMCA. In '22 he went with the Federal Barge Line out of Memphis, Tenn., until March, '23, when he joined the U. S. Engineers. From March, '28, to date he has been continuously with either the Department of Commerce, Federal Radio Commission or the FCC.

Industry Literature

Lefax, Philadelphia 7, Pa., has issued a catalog listing 2,000 of their pocket-size technical books. Books consist of approximately 140 pages of tables and data in pocket size, loose leaf form. Subjects listed include: hydraulics, machine design, surveying tables, metallurgy, metals, transformers, relays, meters, electricity *ac-dc*, *ac* motors and generators, electrician's data, general math, physics, radio, television and FM.

The Richardson Co., 2762 Lake St., Melrose Park, Ill., has published a four-page brochure, entitled *Insurok Molded and Laminated Plastics*, which describes a line of laminated and molded plastics products. Includes a description of available forms, fabricated parts, gear stock, bearings, and post formed laminates.

Allied Electric Products, Inc., 76 Coit St., Irvington 11, N. J., has released a 24-page catalog, No. 161, describing attachment plug caps, cube taps, cords, lamps and TV picture tubes. Introduced are two *Tapmaster* extension cord sets. Cataloged in detail is a complete line of *spring-action* blades and contacts. *Sheldon* aluminized reflector lamps are also described.

Marcus Transformer Co., Inc., 32-34 Montgomery Street, Hillside, N. J., has published a 4-page bulletin, No. 50-FC, describing air-cooled distribution transformers.

Synthane Corp., Oaks, Pa., has released a six-page folder entitled *Practical Methods of Machining Synthane Laminated Plastics*, which includes data on tool speeds and recommended machine setups for circular sawing, band sawing, turning and boring, threading, drilling, milling, automatic screw machining, gear cutting, punching, and machining of glass base material. Chart on sheet standards lists 18 performance ratings for each of 17 grades of laminated plastics.

The RCA Tube Department has prepared an enlarged edition of their booklet, *Phototubes, Cathode-Ray, and Special Tubes*, CRPS-102-A. Booklet contains data on more than 150 tubes, including single-unit, twin-unit, and multiplier phototubes; cathode-ray tubes; TV camera tubes; TV monoscopes; low-microphonic tubes; uhf tubes, etc.

The Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif., has released another issue of their *H-P Journal* covering a 700-mc voltmeter and its applications.

Andrew Corp., 363 E. 75 St., Chicago 19, Ill., has published a 32-page general price-list catalog, covering semi-flexible and rigid coax transmission lines, gas equipment, open wire lines and fittings, antennas, etc.

Astron Corp., 255 Grant Ave., E. Newark, N. J., has published a 12-page catalog, AC-2, detailing characteristics of dry electrolytics, molded paper tubulars, oil paper capacitors and *Metalite* self-healing, subminiature, metallized paper capacitors.

Briefly Speaking . . .

Plant expansion activity, now really spinning around, has produced quite a few striking facility innovations. In Boonton, N. J., for instance, Measurements Corp. now has a new completely air-conditioned building located on an 8½-acre tract, one story in height, 250 feet long by 100 feet wide, with double walls of vitreous bricks. It is reported that all interior walls have been moisture-proofed, and in addition, radiant heating has been installed as one type of a heating system, while blower-type space heaters can be used as an alternate system. . . . Synthane Corp., Oaks, Pa., have moved their district office to 125 Parkway Road, Bronxville, N. Y. . . . Electronics Measurements Corp. will soon be located at 280 Lafayette St., New York 12, N. Y., where they will occupy floor area twice that of their present facilities. . . . Major Ray A. Morris is now assistant sales manager of IDEA, manufacturers of the Regency booster. . . . Benjamin Ozaroff has become president of the Fidelity Tube Corp., 900 Passaic Ave., East Newark, N. J. . . . William H. Hazlett has been named field rep for the eastern seaboard of the Audio and Video Products Corp., 1650 Broadway, New York 19, N. Y. . . . Arthur L. Morrison has become purchasing agent of Weston Electrical Instrument Corp., succeeding George T. Deaney, who has been made war activities coordinator. . . . A folder describing six instruments for FM and TV servicing has been released by the Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill. Described are a plate conductance tube tester, field strength meter, mirroscope, *rf* volt-ohmmeter, *ac-dc* volt-ohm-milliammeter and the genescope. . . . The Ira Kamen-Richard H. Dorf text on *TV Master Antenna Systems*, published by John F. Rider, is now available. Book is priced at $5.00 and contains 368 pages and 234 illustrations. . . . A line of television cabinets is described in a 14-page catalog released by Standard Wood Products Corp., 43-02 38th St., Long Island City, N. Y. . . . A three-shift operation, involving between 1,500 and 1,800 people, is now underway at the plant of the Clarostat Mfg. Co., Inc., Dover, N. H. . . . Recent issues of the *Aerovox Research Worker* contain discussions of audio-frequency distortion measurements and TV-antenna installation for the fringe areas.

Measurements plant at Intervale Road, Boonton, N. J.

ADVERTISERS IN THIS ISSUE

TeleVision Engineering

JANUARY, 1951

OPPONENT:

TIME

A top bobsled team—athletes trained to work as one in handling their balanced, ruggedly built sled—can consistently defeat the clock in negotiating the treacherous, one-mile Mt. Van Hoevenberg run.

Likewise, T. E. I. engineers and production personnel work as a unit with a similar goal — the conquering of TIME's deteriorating effects through the building of an ever-stronger picture tube. For Thomas' highly trained personnel, specially designed equipment, and efficient production techniques are consistently increasing the life of Thomas tubes in the contest with TIME.

For the greatest value in today's television picture tubes—for top operating efficiency and truly LONGER life—specify T. E. I. In all popular rectangular sizes, black-face.

THOMAS ELECTRONICS, Inc.

118 Ninth Street — Passaic, New Jersey

. . . the RCA-17CP4 metal shell rectangular kinescope

As pioneers in the development of the kinescope, RCA leads again with a new and advanced type of metal-shell *rectangular* kinescope . . . destined to become the industry's leading large-picture tube. The new RCA-17CP4 has a picture area of 14⅝" x 11", and offers designers the following notable advantages . . .

Use of the metal shell not only makes practical a construction which weighs less than a similar all-glass tube, but also makes practical the use of a higher-quality face plate than is commonly used on all-glass tubes.

The rectangular shape, which allows reproduction of the transmitted picture without waste of screen area, permits use of a cabinet having about 20 per cent less height than is required for a round-face tube having the same picture width. In addition, the chassis need not be depressed or cut out under the face of the tube and controls can be located as desired beneath the tube.

The 17CP4 with its design-center maximum anode-voltage rating of 16 kilovolts, provides pictures having high brightness and good uniformity of focus over the whole picture area. It has a high-efficiency, white fluorescent screen on a relatively flat, high-quality faceplate made of frosted Filterglass to prevent reflection of bright objects in the room and to provide increased picture contrast.

Employing magnetic focus and magnetic deflection, the 17CP4 features an improved design of funnel-to-neck section which facilitates centering of the yoke on the neck and, in combination with better centering of the beam inside the neck, contributes to the good uniformity of focus over the entire picture area. The diagonal deflection angle is 70° and the horizontal deflection angle is 66°.

Other features incorporated in the 17CP4 are short overall length and an ion-trap gun which requires only a single-field, external magnet.

RCA Application Engineers are ready to co-operate with you in applying the 17CP4 and associated components to your specific designs. For further information write RCA, Commercial Engineering, Section 58AR, Harrison, N. J.

Another **RCA-developed tube**

Designed for Radiosonde Service, the RCA-5794 employs two resonators integral with the tube. The output resonator is tuned to 1680 Mc by means of an adjusting screw. Useful power output is 500 milliwatts.

The Fountainhead of Modern Tube Development is RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES HARRISON, N. J.