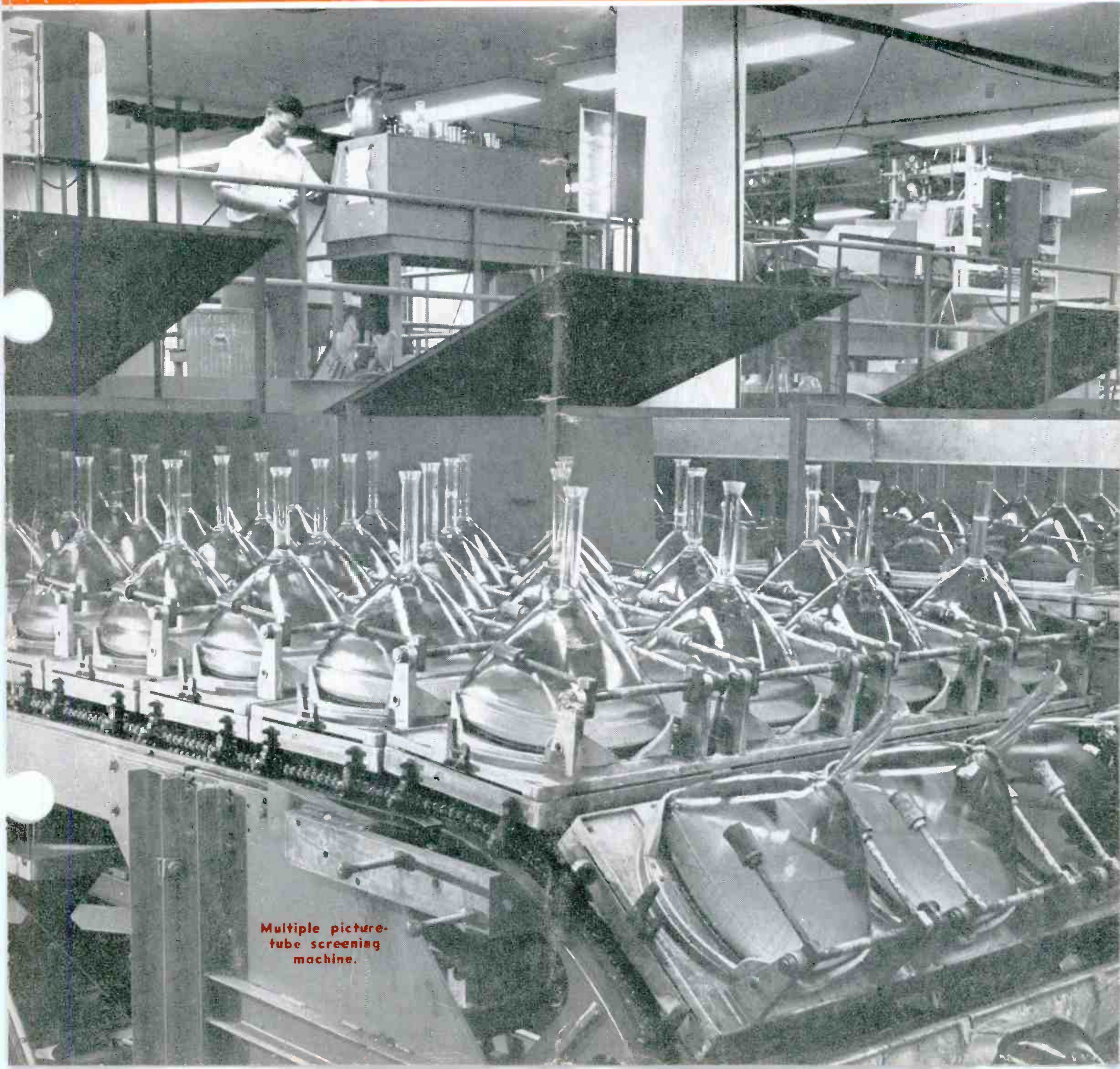
TELE-VISION ENGINEERING

DECEMBER, 1950

F. Gehres



Multiple picture-tube screening machine.

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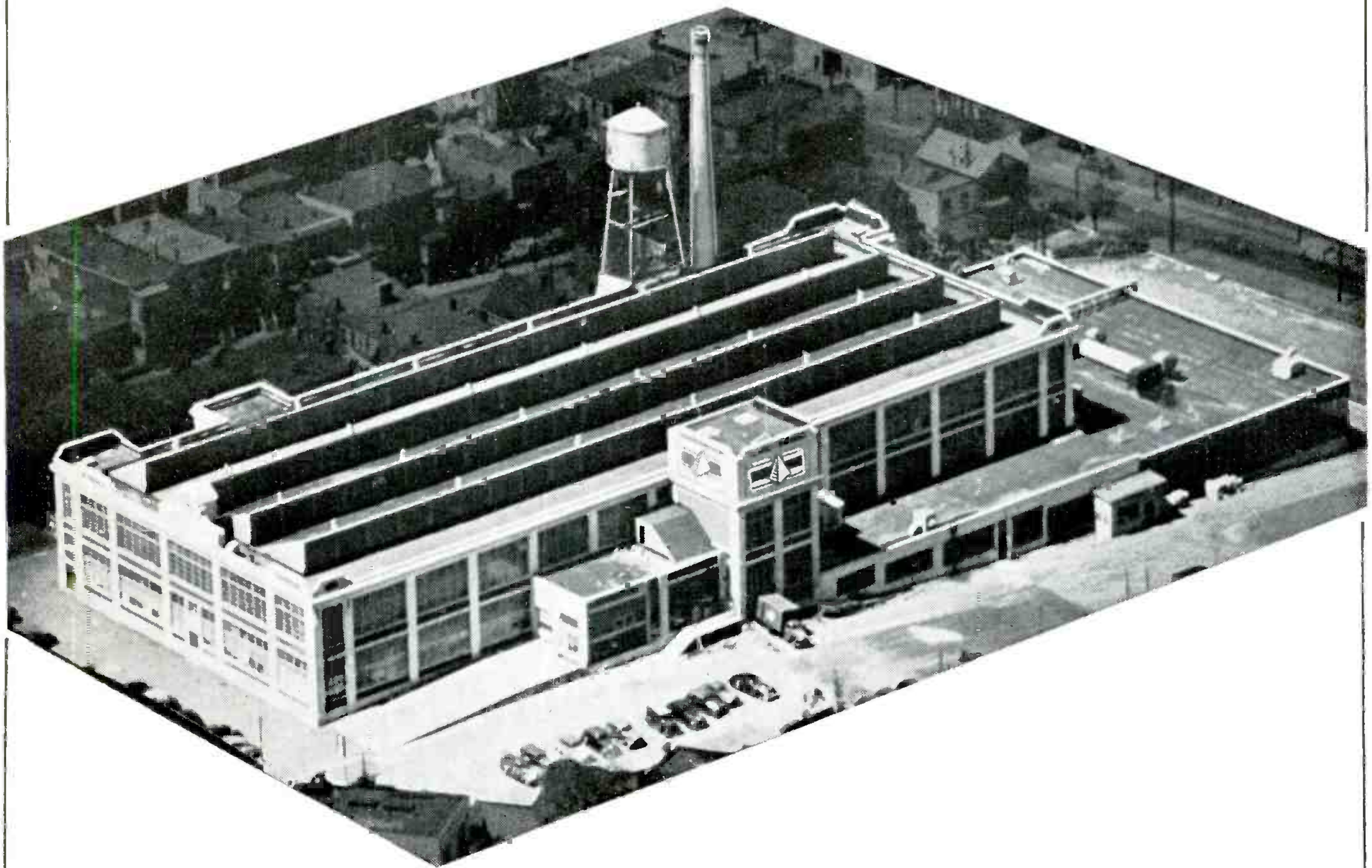

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VOLUME 1 **DECEMBER, 1950** **NUMBER 12**

MONTHLY FEATURES

Cover Illustration

Mass 12 to 19-inch picture-tube screening conveyor at Electronics Park which provides for liquid settling in the phospor screen-coating operation. (*Courtesy G.E.*)

Editor: LEWIS WINNER

ABC

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Mid-West Representative: Stuart J. Osten, 333 N. Michigan Ave., Chicago 1, Illinois. Telephone: Dearborn 2-3507
Eastern Representative: J. J. Brookman, 52 Vanderbilt Avenue, New York 17, N. Y.
East-Central Representative: James C. Munn, 2253 Delaware Drive, Cleveland 6, Ohio. Telephone: ERieview 1-1726.
Pacific Coast Representative: Brand & Brand, 1052 West 6th Street, Los Angeles 14, Cal. Telephone: Michigan 1732. Suite 1204, Russ Building, San Francisco 4, Cal. Telephone: SUtter 1-2251.

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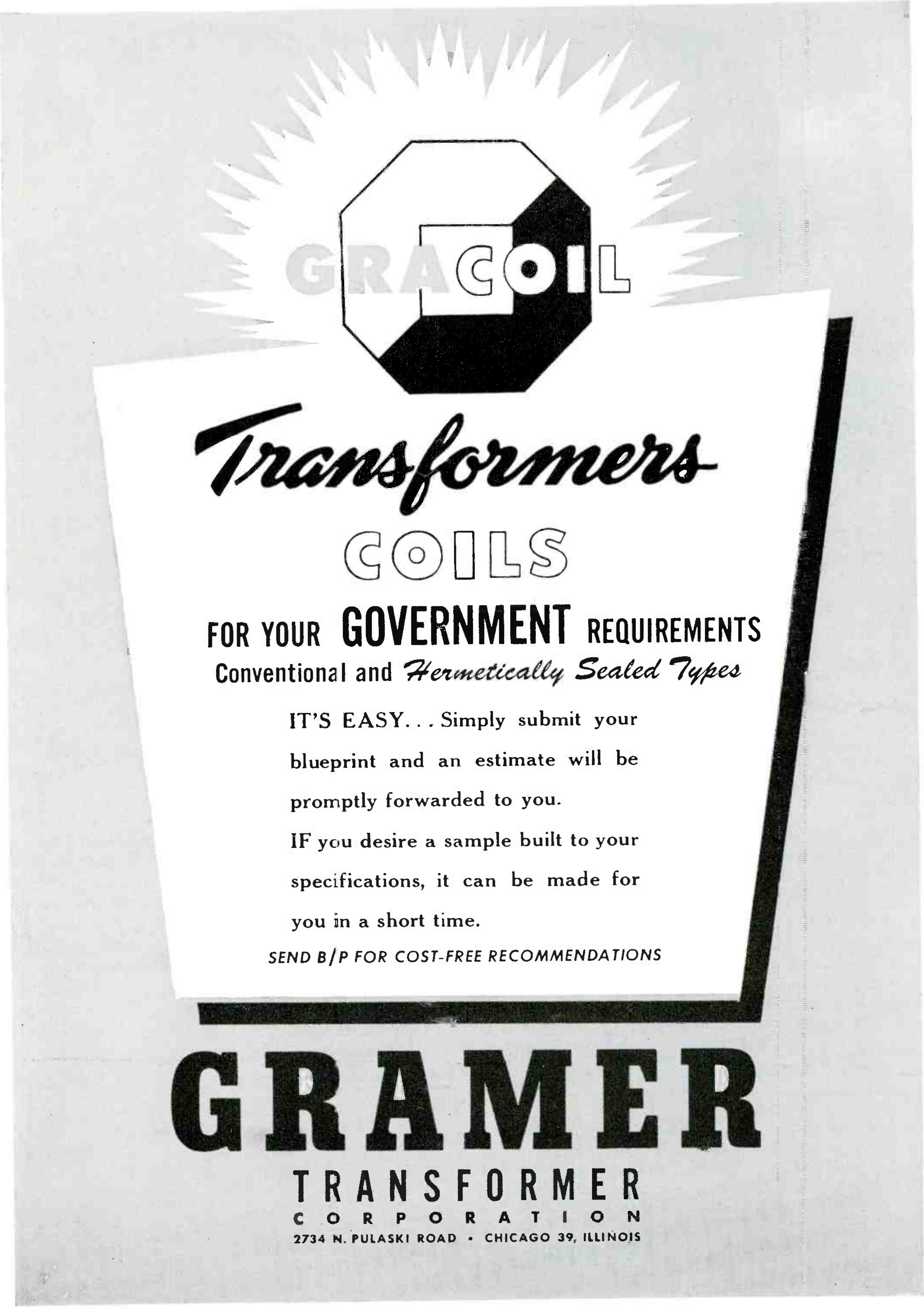
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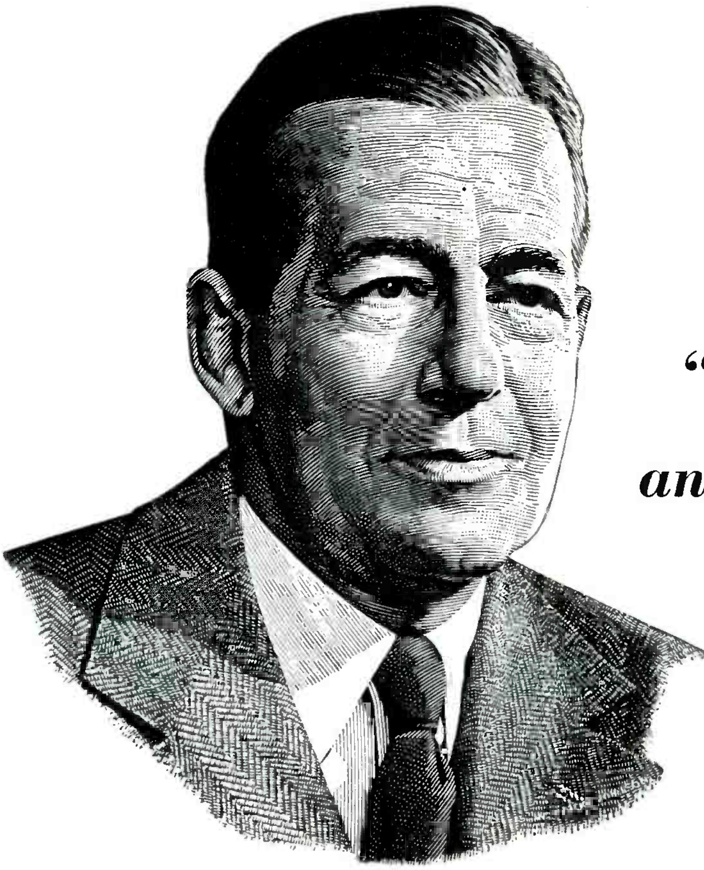


TELE-VISION ENGINEERING
LEWIS WINNER, Editor

December, 1950

Six Years of Progress

When, Shortly After V-J Day, there appeared ecstatic prophecies about the future of television, there were hosts of scoffers who shrugged and pointed to the oft-repeated *round-the-corner* predictions of prior years. It didn't take long, however, before there was a wholesale conversion of the skeptics and all-out enthusiasm blossomed. Today, TV is the glowing idol of everyone. And there are some startling figures around to show why looking and listening has become so popular.

Around '45, there were about 8500 receivers in operation and you could count the number of TV stations on the fingers of both hands. What's the picture today? There are close to 10-million receivers installed, for which the public has invested 3-billion dollars. We have 107 stations operating in sixty-three of the nation's top markets, representing an investment of nearly 57-million dollars. And in addition, network cables and relays have spread westward for over 2000 miles.

Commenting on this startling expansion, during the recent TBA annual meeting, prexy Jack Poppele said that the real cause for wonderment is the total fascination which has wrapped itself around virtually every family owning a TV set.

Probably the most unusual feature of this stirring growth, he continued, is the fact that television has grown and prospered in spite of various pitfalls, road blocks, and other impediments that have stood in the way of its full maturity.

Lauding our system of free enterprise as the reason for the prosperity TV enjoys today, Poppele declared that . . . "We can be thankful for such a system, since television would never had made the tremendous gains it has achieved were it not for private enterprise. And we can be doubly thankful that TV is a national service, since this great means of communication can do much to assist the government in its mobilization of manpower to meet any crisis that might arise."

That Freeze

Those Prospects for the Early Removal of the channel clamp, which has collared industry for almost 26 months, were once again shuttled back to a questionable timetable, when the cutback program was announced. Some predicted that regardless of what the FCC might do, and incidentally there are indications now that freeze relief might appear during the spring of '51, lack of materials would prevent any actual removal of road blocks. However, some manufacturers have revealed that they have a stockpile of components and accessories which would enable them to build up substantial transmitting gear.

Whether or not NPA will permit construction of towers and new studios next spring, has also been a puzzling topic, of concern to many. General Harrison has stated that at present there is no ban on such construction, but he has not provided any assurance that industry would be able to continue to operate on a business-as-usual program. It is believed that because of the significant coverage afforded by TV, government would permit construction, including the erection of towers. Permission may not be granted on a broad scale, but on a plane which should provide equitable distribution.

Creative Engineering

In TV, with its broad variables, it has been necessary to evaluate unusual spans of engineering activity, in which resourcefulness is a key factor. Operating under such a program, involving the use of the creative type of engineer, the results can be extremely stimulating.

According to many, creative engineering is the only answer to successful production today. Professor H. G. Thuesen, head of the School of Industrial Engineering of Oklahoma A. & M. College, in his recent book on *Engineering Economy*, pointed out that the creative engineer . . . "not only seeks to overcome physical limitations, but also initiates, proposes and accepts responsibility for the success of projects involving economic and human factors."[1]

In his view, the general acceptance of creative engineering would extend the usefulness of engineering, and might be expected to avoid any misapplications. He felt, too, that engineers should be permitted to voice their opinion on costs and selling. It was his belief that at least a partial remedy for the situation is for engineers to assume the responsibility for creating products with built-in sales appeal.

Declaring that engineering is an emerging profession, the professor said: "People have great confidence in the integrity and ability of engineers. Perhaps nothing will enhance the prestige of the individual engineer and the profession of engineering more, than the acceptance of the creative role."

A challenging theme, demanding the pointed consideration of not only the engineering fraternity, but management as well.—L. W.

[1] From *Engineering Economy* by H. G. Thuesen, published by Prentice-Hall; copyright 1950, Prentice-Hall, Inc.

TVE-grams . . .

The Management Front

Subcontracting: With production activity speeding along to new highs almost daily in almost every phase of sight and sound, taxing normal facilities, it has become necessary to arrange for expansion on quite an accelerated scale. Many, large and small, have found that the problem can be minimized through the use of subcontracting.

The approach affords several unique advantages. For instance, large prime contractors have found that they can use the specialized techniques of the subcontractor to augment his own production program. And the smaller firm has learned that he can participate as a member of a team in key programs, which he could not handle alone because of incomplete facilities. Commenting on these points recently, during an AMA talk, Harry Erlich of G. E. said that the subcontractor can avail himself of the engineering, manufacturing, and procurement *know-how* of the prime contractor and can eventually develop himself into the position of a potential prime contractor.

Small Plant Operation: Rapid expansion requirements have also emphasized the usefulness of small plants providing special-product output. According to Don G. Mitchell, Sylvania Electric prexy, the small plant has the advantage of flexibility, mobility, and good employee morale. Talking before the annual meeting of the ASME, Mitchell said that his remarks were based on the operation of Sylvania which he described as a large small company operating "under a policy of decentralization of manufacturing wherein the line authority is out in the field and the functional authority stays at headquarters."

He pointed out that with the exception of one small test equipment plant, their smallest plant has 230 employees, and the largest has 2,900 employees, and except for five plants, all have less than 1,000 employees each.

"Most large companies were once small but in the process of becoming large, the management became absorbed, more and more, in major corporate matters to the point where intimate contact with the day-to-day operations and with the personnel was lost," Mitchell said.

Management's feeling is, he continued, that operating in small plants with a high degree of local authority and responsibility helps to maintain that intimacy without losing any of the benefits of a strong central organization.

Mitchell revealed that the experience of his company has proved that . . . "small plant management can accomplish relatively as much, and sometimes more, than big plant management."

"In fact," he said, "we see many advantages to small plant management that very large plants do not as a rule enjoy, such as executive training through independence and responsibility."

Management personnel were described as . . . "the most important part of small plant operation," since managers of such plants . . . "have to be good all-around men for the simple reason that the small plant cannot afford an army of specialists."

Discussing the importance of good local relations, Mitchell stated that communities generally like small plants: "We encourage our people to take part in civic affairs as citizens, to be active in charitable drives, in service clubs and in young people's activities. And that means not only the management and supervisory people, but all the employees . . . We like to feel that the payroll we create in a small community helps materially to improve the local economy, but we know that unless we live as a neighbor and good citizen, all the money we bring into that place will not bring the good-will we want."

Declaring that one of the major problems of manufacturing management is that of good labor relations, Mitchell said: "If everything else were equal between centralized and decentralized operation, we think labor relations alone would tip the scales in favor of the latter. We have found that managers of small plants are much closer to the employees under them than the managers of a large plant could be. By sort of working and living together a mutuality of interests is built up."

Left: Sound recording tape, recorder and playback lab equipment recently installed by Minnesota Mining to permit measuring of output and uniformity of output at any frequency, signal-to-noise ratios, dynamic range, wow, flutter, harmonic distortion, intermodulation, and modulation noise. Included in equipment are an AM-FM tuner, 'scope, wow meter, Ballantine voltmeters, dual-channel oscillograph with associated dc amplifiers, two hi-fi audio amplifiers, two professional quality recorders that operate at any speed from 3¾ to 15 inches per second, and a sonic analyzer for measuring distortion and frequency response and for showing noise spectra. Bias circuit, built into recorders, is said to permit introducing wide variations in bias.

Reports and Reviews of Current TV News

The Critical Six: Those six precious metals . . . aluminum, cobalt, copper, nickel, steel and zinc . . . so essential to industry, appear to have received quite an assignment from the NPA. With the first of the year set as the official opening of a conservation drive, the metals will find themselves falling into a stockpile at a cutback rate of 20% to 35% and possibly higher for such metals as cobalt.

As in the instance of aluminum, which it was felt would never be declared a short item, a shortage of base production and in some instances, power facilities have so affected processing that outputs have fallen way beyond requirements.

The Copper Problem

Supply in copper, for example, has not kept pace with demand. George F. Hessler of Graybar reported recently that the present monthly rate of shortage is approximately fifty thousand tons, or close to one-third of our estimated requirements of a hundred and eighty thousand tons. Strikes have been an unfortunate factor in production curtailment. There have been difficulties in the copper fields of the Andes, and in the Bayway, New Jersey, plant of Phelps Dodge and the Marion, Indiana, plant of Anaconda. Only recently the latter plant was reopened after being closed for several weeks.

Zinc Difficulties

Production problems have been current, too, in the zinc plants. Annual consumption of zinc in '49 was seven hundred and forty-one thousand tons. Current requirements have been found to be substantially above the available production, leaving a large deficit. But what makes this situation even more critical, according to Hessler, is the fact that the government today is requisitioning fifty percent of the production to catch up on stockpile requirements, which fell off during a recent eighteen-week strike in the industry.

The Future

While the picture looks dismal, the problem is not hopeless. Production expansion is on the way and in addition there are the nation's power resources, which can supply enormous drive. Hessler revealed that power output today far exceeds that of 1940. In '40 82.6-billion kilowatt hours of electrical energy were used in manufacturing. Today, an all-time high annual rate of 155-billion kw hours is being used. Figured at the rate of one kw hour of electrical energy performing the equivalent of 1.7 days work by human standards, Hessler said that we have added to our total effective working force, one billion men.

He felt that if the need arises, our power output could be stepped up considerably, adding to our total working force millions more workers.

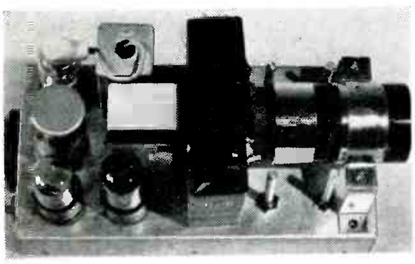
Research

Compatible Color: Striking improvements in the development of the RCA compatible, all-electronic color television system were revealed in a progress demonstration in Washington recently.

With the number of color dots on face of tri-color tube increased from 351,000 to approximately 600,000, it was possible to show a higher definition color picture. New red and blue phosphors in the tri-color tube also served to add to picture brightness and eliminate optical filter.

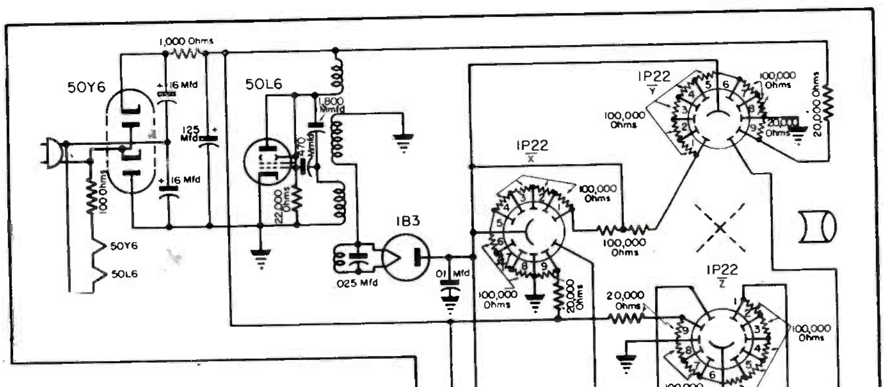
Color Measurement: Several efforts have been made to use photocells for direct color measurements. Fast spectro photometers were designed and one instrument displayed the spectral response for all practical purposes instantaneously. These instruments facilitated the accumulation of the basic data considerably. However, they left considerable computational work to be done in order to establish the visual effect of the measured color.

To avoid the tedious job of product integration to obtain the *ICI* coordinates, it was proposed to construct an instrument with certain photocell-fiber combination approximating the *ICI* standard distribution factors. However, the extent of approximation was limited particularly for the x curve with its



Above: Tristimulus photometer which features use of a 5-inch lens to focus light on three multiplier phototubes through a beam splitter consisting of two crossed semi-transparent mirrors.

Left: Robinson metering pump for hot waxes and cements, currently used for filling electrolytic capacitor cases with bonding compound; transformers with potting compound; electrical switch parts with sealing wax; for enclosing miniature rectifiers in molded wax cases; and for end filling selenium rectifiers with sealing compound. Pump is a variable-discharge spur gear type equipped with a single revolution clutch.



Circuit of photometer. An *rf* supply is used for *hv* required by multipliers. Rectifier and resistance divider are employed to supply voltages, rather than use taps on the coil, since the capacitance of the three multiplier phototubes is excessive. The *rf* oscillator is operated from a well-filtered power supply to provide a constant sensitivity on short time basis.

double components. To solve the problem George C. Sziklai of RCA Labs has developed an instrument which provides a good approximation of the *ICI* coordinates by means of a unidirectional crossfeed arrangement, which injects a portion of the *z* response into the *x* response circuit. Three integrated signals can be read on three meters simultaneously and the *ICI* coordinates can be computed by one addition and two dividing operations.

Called a *tristimulus photometer*, the instrument consists essentially of an *eye* and a *brain*. The *eye* is made up of a lens which focuses the light under study onto a mirror assembly designed to split the beam into three parts of equal intensity. The three beams then pass through three filters, each sensitive to a range of wavelengths corresponding to the basic color components.

The *brain* of the instrument starts with three photocells, one for each filter. The photocells convert the light energy to electrical energy which passes through circuits, each of a different design, to compensate for the mathematical dissimilarities between the three color components. Finally, a corrected value for each component is read on microammeters.

The readings are in terms of the three theoretical basic components, as defined by the International Commission of Illumination, by which any color in nature can be described in standard terms. The filters select the closest real approximations to the theoretical primaries, which are referred to in colorimetry as *x*, *y* and *z*. Then the electronic circuits mathematically *shape* the actual values, transforming them to the oretical values of *ICI* color specifications.

The theoretical color values have no counterparts in the realm of actual colors. The use of the theoretical primaries is necessary in colorimetry to do away with the use of negative quantities of light in the mathematics of color definition. However, by employment of the theoretical primaries, a practical system of color measurement is said to be attained.

The Production Line

300 - Ounce Injection Molding: The possibilities of molding extremely large items such as combination consoles were indicated recently with the development of a 300-ounce injection molding machine by Watson-Stillman of Roselle, N. J.

The progress made in thermoplastics molding is exemplified in the new molding machine, when it is recalled that 12 years ago the capacity of injection molding was 6 ounces, and in '45 the capacity was only 24 ounces. In '47, eight ounces were gained and in '49, 60 ounces was the top capacity. A 200-ounce unit then became available.

Hourly Capacity, 300 Pounds

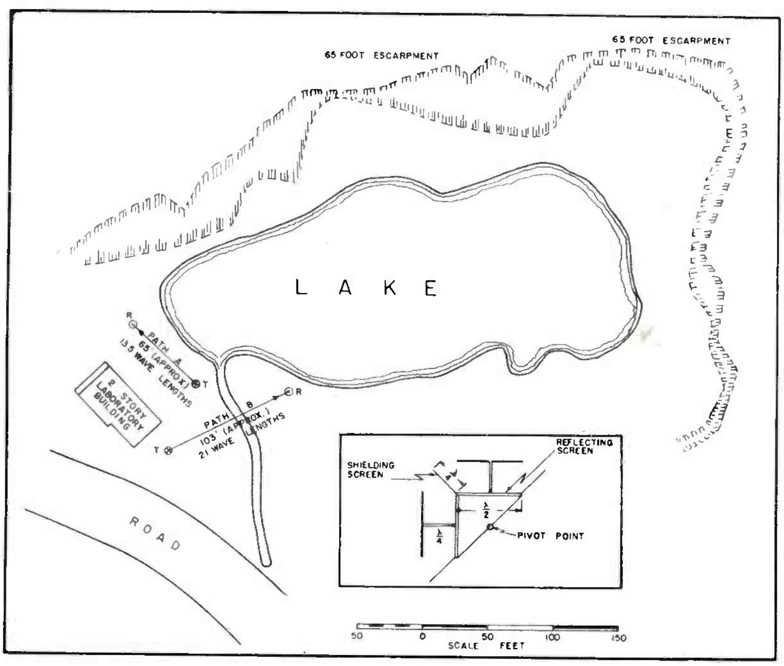
The machine, with a pre-plasticizing unit, weighs 152,000 pounds. The machine is said to have a capacity of 300 pounds hourly. Clamping capacity is 1500 tons. A model, operated by a 90 hp motor, has been installed in the plant of Amos Molded Plastics, Edinburg, Ind.

Check List for Production: To attain greater efficiency in the plant, manufacturers must take the time to evaluate management techniques, and to put into effect such steps as may be needed to improve his operations. A periodic analysis of this type, if done in thorough and objective fashion, will prove helpful to any business. To facilitate these analysis, Frank K. Shallenberger, associate professor of industrial management at Stanford University, has proposed a unique check list.

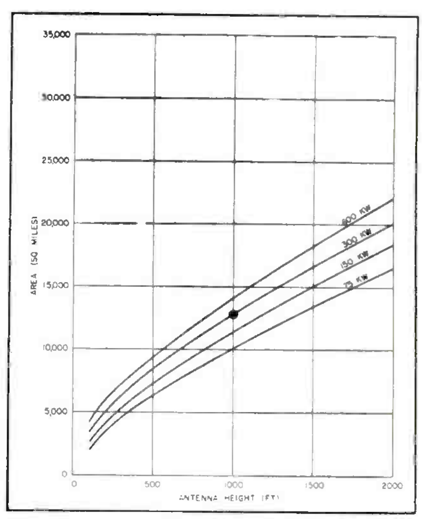
The list, which appears in a Department of Commerce book called *Production Management in Small Plants*, covers managerial functions, production control, stock control, cost and quality control.

Methods improvement are also reviewed, management being asked to

Below: Geographical arrangement of vhf test antennas, showing transmission paths used in checking null zone fields of directional antennas. Study, prepared as part of a series of exhibits illustrating the practicability of directional antenna systems for enlarging the usefulness of the vhf channels, was offered by Paul F. Godley to FCC on behalf of Lehigh Valley Television, Inc. Transmitting source was a 207-mc signal fed to dipole on rotable structure.



Below: Effect of transmitting antenna height on coverage in grade C service areas at 195 mc; one of a group of plots submitted by A. Earl Cullum, Jr., during FCC hearings.



TVE-grams . . .

note if they have an organized program for methods improvement and if some individual has been assigned definite responsibility for carrying on the program.

Whether or not the foremen and shop workers have been brought into the methods-improvement program is also queried.

Once a new method is developed, management is then asked if it makes certain that the operator is using the new method, and if work on methods already improved is continued in the search for an even better way.

Tooling possibilities receive attention in the check study, too. Questions asked are:

Have you investigated the economies offered by specialists in short-run production — metal stampings, for example?

When you get into large quantities, do you still try to get by on cheap tooling? Or do you make your tooling as good as the job warrants?

Do you apply the techniques of methods study to the design of jigs and fixtures that will never be used again?

Do you provide proper care and protection for your tooling?

Do you waste space storing patterns, templates, jigs, dies, and fixtures that will never be used again?

Probing plant layout, the listing asks:

Have you appraised your plant layout recently? Are you making the best use of the space you have or are you using it as an excuse for doing nothing? Is there congestion, waste movement, back-tracking, needless handling up and down stairs or through narrow doorways? How about general working conditions—noise, heat, light, ventilation? What about supervision, housekeeping, safety, access to tool cribs and stores? . . . Is your layout flexible? Expandable? Is it geared to your plans for future operations?

Other pertinent phases management is asked to check include materials handling, safety, maintenance and shop housekeeping.

Trends

Resolution: With the move to larger and larger viewing areas in home chassis growing and the interest in theatre TV actually speeding along, the problem of resolution has been receiving more and more attention.

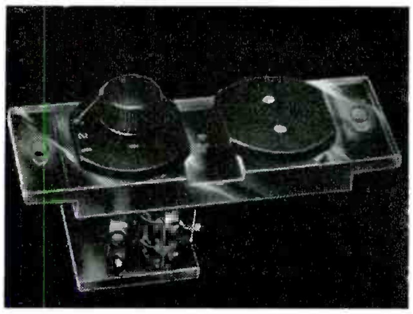
With the present scanning line rate of 525 it is possible to secure a resolution of 340 lines horizontally and 400 lines vertically. At a 4:1 viewing distance, which is the minimum for home viewing, the scanning lines cannot be resolved by the eye so that the standards are considered adequate.

However, to accommodate theatre patrons who might be closer to the screen than the minimum 4:1 distance, more picture detail and a greater number of scanning lines are desirable. Discussing this knotty problem during the recent SMPTE meeting, Ralph Little, Jr., of RCA, said that the selection of the number of scanning lines is a function of the economical bandwidth and a compromise on the balance between the resolution of the picture elements in the horizontal and vertical dimensions.

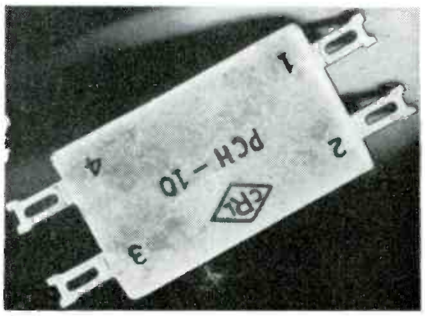
Citing the resolution possibilities at 4.25 and 8 mc on 525, 625, 735 and 819 lines, Little disclosed that vertical resolution at 525 is 488: at 625, 582; at 735, 683; and at 819, 762. However, the horizontal resolution results are quite different. At a bandwidth of 4.25 mc, on 525, we have 340: 283 at 625; 240 at 735; and 216 at 819; at 8 mc, on 525, it is 640; 533 at 625; 453 at 735 and 407 at 819.

It will be noted that the present 4.25-mc standard permits a balanced horizontal and vertical resolution of approximately 400 television lines. An increase in the number of scanning lines, while retaining the bandwidth, reduces the horizontal detail. However, an 8 mc system provides a balanced resolution when using 625 lines, a resolution which appears to be ideal for large screen TV, so ideal that it has been decided to provide for the use of the wider band in equipment now being made.

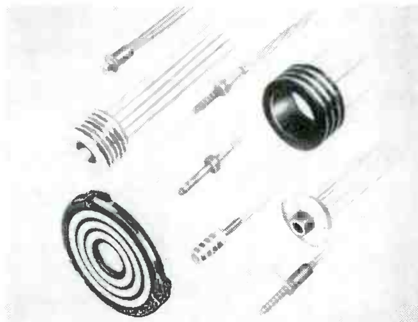
Perhaps 8mc will become a goal for a hi-fi type of TV service not only in the theatre, but at home, too, for those 24- and 30-inchers and even larger models now being investigated.—L.W.



Flush mounted sockets, including a three position switch and socket combination which fit standard electrical outlet boxes and receptacle plates. Socket switch provides changeover to any one of three antennas. Available is a single flush socket for 300-ohm line designed for terminating leadin concealed in wall for antenna installed without rotator. (terminal spacing, ½"); dual flush socket for 300-ohm line; and a flush socket for four-wire rotator control. (*Courtesy Mosley Electronics, 2125 Lackland, Overland, Mo.*)



Printed circuit H-Pads with four terminals for connection between the 300-ohm transmission line and receiver input terminals. Four types have been designed, which provide insertion losses of 10, 20, 30, and 40 db, respectively. Several H-Pads can be mounted on a rotary selector switch which is then inserted between the receiver input terminals and the transmission line. Impedance 300 ohms. Physical dimensions are 1¼" long x 13/16" wide by 3/16" thick. (*Courtesy Centralab, 900 E. Keefe Ave., Milwaukee 1, Wis.*)



Miniature slip ring assemblies built up of prefabricated rings and produced by an application of electroplating. In this method a plastic (*Selectron 5003*, Pittsburgh Plate Glass Co., or an equivalent) is molded around the wire leads. Machining reduces this core to the proper shape with groves; this procedure is said to make conducting rings an integral part of the unit. Hard silver is then electrodeposited into the grooves to form the rings. Subsequent machining is said to insure perfect concentricity and great dimensional accuracy. Range of sizes possible with this method includes diameters from .050" to several inches. (*Courtesy Electro Tec Corp., South Hackensack, N. J.*)

Human Aspects of Engineering

Evaluation of Problem Discloses That Management Can Minimize Human Aspects in the Design and Production of a Quality Product by Exerting the Necessary Controls on All Phases of the Manufacturing Plan.

REGARDLESS OF HOW extensively we formalize procedures and exert controls, boiled down to its essentials, all industry is dependent on the functions of human beings in operations ranging from the most simple to the most highly complicated.

A formal organization, that is well constructed, will permit the fundamental team work that is so necessary to the smooth functioning of intricate manufacturing processes and would minimize reliance upon individual peculiarities by providing adequate checks and balances. Elimination of the human aspects would make it easier for management to produce a quality product.

The numerous details of running an organization cannot be left to chance, but must be meticulously planned every step of the way. Good planning results in routinizing the handling of problems as far as possible. It makes life more predictable and therefore easier for the many members of the factory team. Obviously, the human element plays a more important part as the degree of the management function becomes greater. The operator on the line is readily controlled. The administrator, however, is not subject in his actions to the interpretation of control charts and would probably be highly incensed if anyone tried to run a chart on his effectiveness. The engineer designing the product is a highly complex machine and his output is unpredictable.

These factors probably account for a phenomena that has been observed all too often. The *quality control engineer* steps into an organization full of enthusiasm for the tools which have been given to him and by which he proposes to improve or maintain the quality of a given product. He does everything according to the book. *He wins friends and influences people,* using the best psychological approach and in spite of this, the product may fail to get the final approval of either top management or the consuming public. If this man is experienced in industry, the chances are he will recognize the cause for the seeming failure on his part. Either management has failed to indicate the required quality level and insist that it be attained, or a bad guess has been made by management as to what is required and the consuming public is not satisfied.

In any case, either the planning or the execution of management's plans have failed. In a desire to analyze this type of failure, all too often those whose function it is to criticize, accept the conclusion that the design and engineering was inadequate. This is all the more likely if an aggressive and strong quality control organization is already functioning in the plant.

An apparent inadequacy of design does not necessarily indicate any inadequacy of engineering talent and many factors can contribute to what in a post mortem might be considered an inadequate design. In the broadest sense, management indicates to engineering the general nature of the product desired, but top management cannot quantitavely specify beyond the price bracket into which the product shall fall, the time for which it is scheduled to be produced and some rough outline describing the product. The engineer is then faced with the responsibility of creating a product which, as is generally desired by management, is the best that can be obtained in its price field.

Another factor enters into the situation at this point. Generally, the broad perimeters of the specification are considered as much as a year or even two years before the scheduled production date, and the best opinion of management as to the requirements for consumer acceptance at the time of the inception of the project might be completely reversed before the production date arrives. An example of this is the anticipation that the market a year from a given date will be ready for a low-priced product selling for x dollars and that competition will force even the most conservative manufacturers into this category. A year later there appears a sellers' market with shortages of vital materials and unquestionably a situation requiring an entirely different product and quality level.

Adequate planning can forestall or minimize design errors of this nature; the single most important step in planning for quality is devising the master schedule of design, development and test of the product. It is this stage of manufacturing that determines the ultimate success of the product both in the factory and in the field. This is when most of the basic difficulties are either begun or ironed out. The philosophy of quality conrol has always been *prevention, not inspection.* The place where quality can be built into the product is in the pre-production stages of the manufacturing plan. During the entire design cycle, the adequacy of the task specification must be reviewed continuously by a committee of manufacturing, quality control, engineering, sales and top management. If the design project continues behind locked doors without this review, it will descend on manufacturing at the scheduled date with too great a likelihood of being completely unsatisfactory. Again, the human aspect has turned out to be too great.

The determination of a satisfactory product at this point is not its ability to meet the engineering design specification based solely on quantitative data. These data are merely the engineer's interpretation of the performance characteristics of the product which is required by management and essentially this specification must be confirmed under the existing market conditions, current competition and previous production experience. The errors and traps that the engineer may so readily fall into at this point can be controlled and minimized by that committee consisting of manufacturing, quality control, engineering, sales and top management. Quality control must be a sort of recording secretary, keeping close record of the suitability of the design and attempting to interpret the group findings of this committee.

The desirable characteristics to be specified into the design should not be the result of one man or one department's opinion or bad guess. If the

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

Quality into a Product*

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

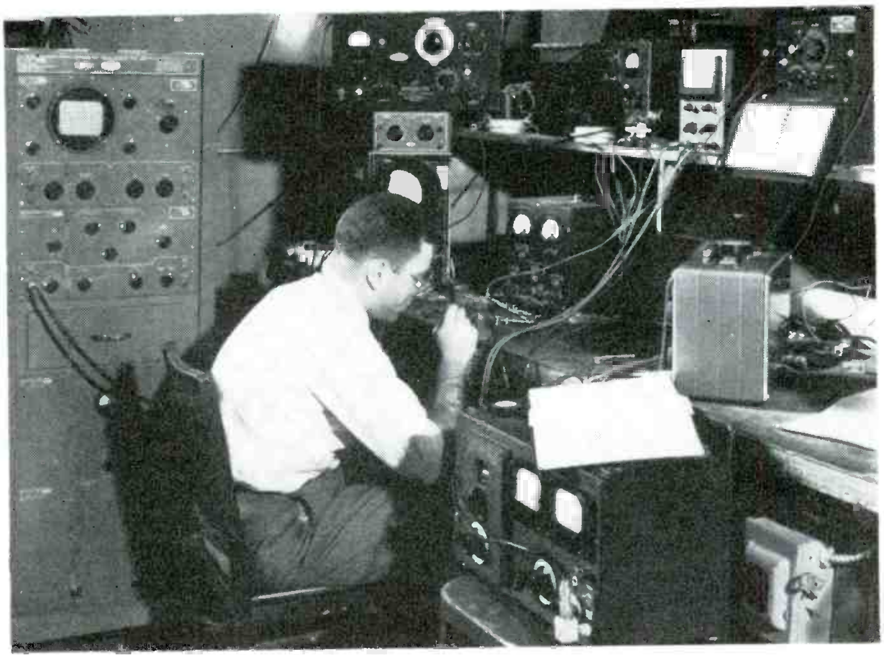
human aspect is to be reduced to a minimum, these specifications should be the outcome of intensive and extensive investigation and at all times completely up to date. By this means and only by this means, can the engineering department and the engineer be considered anything resembling a precision tool that it is possible to adjust properly to put out a product of the requisite quality, and within the range actually required by management.

This introduces another major aspect of the control of quality in production that requires discussion; the specification. Adequate specifications involve two problems. The first is determining what the customer requires and how this correlates with the specification. The second is to have an adequate in-the-factory method of determining meaningful specifications. If proper specifications are to be arrived at, there must be a plan to avoid too great a dependence on the human.

There are two somewhat related methods of determining what will satisfy the customer. It is generally agreed that the customer's satisfaction is at least desirable. Both of those methods are necessary. The first method of gauging consumer reaction involves the conducting of factory and field tests and observations by *experts* to determine what is satisfactory to the consumer and how this correlates with actual laboratory measurements. There are many requirements which can clearly be determined in this manner.

There will be numerous requirements, however, which are more or less arbitrary, if only *expert* observations are considered. To complement this method of arriving at consumer requirements, it is vitally necessary to systematically collect field information directly from the customer. There are numerous ways of accomplishing this objective. Perhaps the most scientific method is to obtain a representative sample of customer opinion by actually sending skilled representatives into the field. Wherever possible the customer's opinions should be correlated with measurable quantities.

After customer requirements have been determined and the correlation



Measuring equipment used in quality control work.

with measurable quantities established, the next step is to establish factory specifications. The relationship of engineering and quality control to specifications is not only an interesting subject, but one of vital importance to a smooth running factory.

A proper organization chart will *not*, except in the most general manner, indicate how specifications should be handled. If, as usually happens, the engineering department determines a specification before production begins and uses that specification for production acceptance purposes, it is likely that more than one specification which cannot possibly be met by the design and production process will be in effect.

If this state of affairs continues for any quantity of production, there is bound to develop a lack of confidence in the specification, resultant confusion and non-routine decisions which eventually lead to diminished faith in the ability of the organization to make a satisfactory product. This is a case where poor planning has resulted in production difficulties and lack of confidence in the product. To avoid this dilemma two specifications must be provided:

(*1*) The *engineering design specification* which is essentially a task specification.

(*2*) The *quality control acceptance* specification which is a realistic production specification based on a pilot run and early production run analysis of the design and process capabilities.

Under those circumstances the design specification becomes a guide to engineering and management as to what is practically desirable in the product. This specification should never be used for production.

The *acceptance specification*, which is based on design and process capability studies, is the specification to be used for production. If, after the *acceptance specification* is established, it is found that its requirements are lower than that of the *design specification*, there are a number of alternative courses of action available.

(*1*) If the drop in requirements is tolerable, production can proceed according to the *acceptance specification*.

(*2a*) If the drop in requirements is not tolerable and all units cannot meet the *acceptance specification* limit which has been made to agree with the design specifications—

(*2b*) Or, if the drop in requirements is not tolerable, the production (*Continued on page* 18)

Metal-Backed TV Picture Tubes

by C. T. WAUGH, Design Engineering Section, C-R Tube Division, General Electric Company

IN AN EFFORT to provide increased light output and improvement in contrast in picture tubes, many avenues of research have been probed. In one instance the possibilities of metallizing have received considerable study. Intensive analyses of the project have revealed substantial gains in light output can be achieved through the use of metal films with light-reflecting properties. In determining how the light output from the fluorescent screen can be improved, it has been necessary to review the conditions which exist when a beam of electrons strike the screen; Figure 1 (*a*) and (*b*). In a non-metallized screen only about 50 per cent of the light generated in the phosphor screen, when the screen is under cathode-ray excitation, is transmitted forward toward the tube face. Approximately 20 per cent of this light is lost because of internal reflections in the tube face. This leaves only about 30 per cent or less of the total light as useful on the front of the tube. If a smooth film of metallic aluminum is deposited on the bombarded side of the phosphor, the light which would otherwise be emitted toward the inside of the tube will now be reflected forward. The electron velocity is in excess of that required for penetration of the thin metallic film. The result is that the usable light output can almost be doubled, at present rated anode potentials.

Tubes with metallized screens have been found to provide an increase in brightness which varies with the thickness of the metallic film. Generally, direct-view ubes, which rely on the aluminum film to prevent penetration of negative ions, are made with a film whose thickness gives a crossover voltage around 4,500 to 5,500; Figure 2. The term, crossover voltage, is applied to that value of anode voltage where the light output of the tube with the metallized screen is equal to that of the tube without a metallized screen; point *x* in Figure 2.

In Figure 3 we have an enlarged view of the surface of the phosphor screen which shows the peaks and valleys which are formed by the contour of the phosphor crystals. Were a film of aluminum deposited on a surface of this

Figure 1

Conditions which exist when a beam of electrons strike the screen. View in (a) represents a screen without metal backing showing light emitted in all directions. In (b) the effects of a metal backed screen are shown, light being reflected forward.

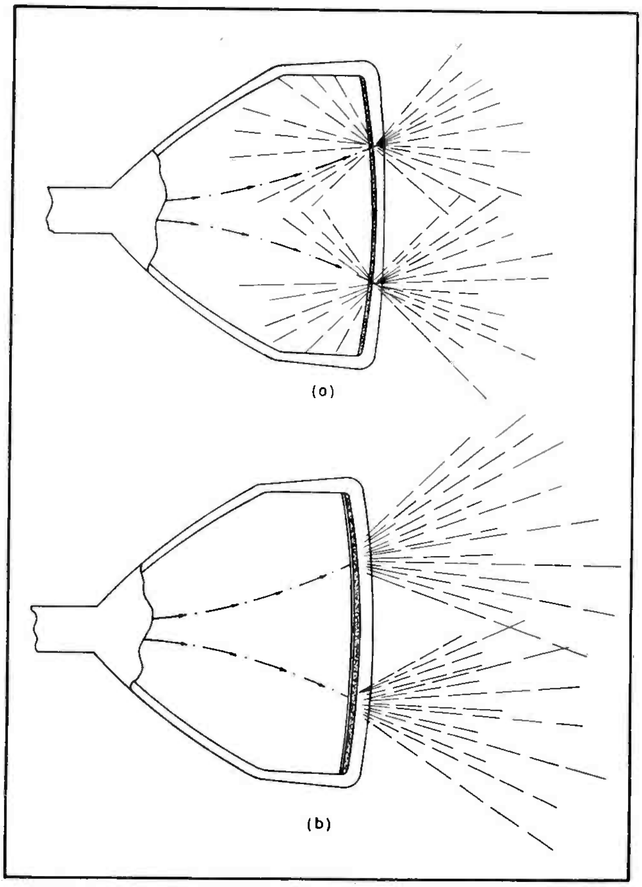
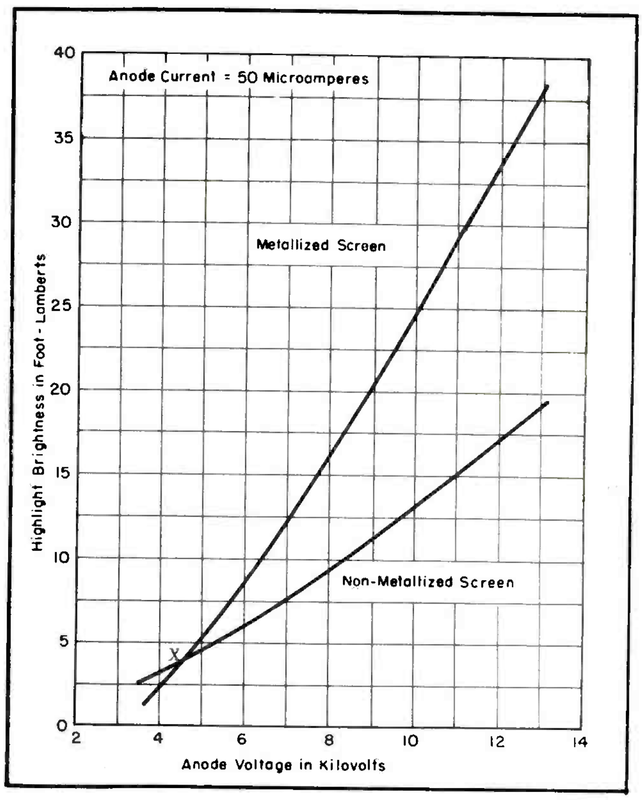


Figure 2

Plot illustrating the crossover voltage; that value of anode voltage where the light output of the tube with the metallized screen is equal to that of the tube without a metallized screen, or point X in the plot.



nature, the resultant layer of metal would be so rough that it would diffuse the light from the luminescent screen instead of reflect it. To produce a smooth film of metal it is therefore necessary to provide an intermediate layer of some substance which will fill in these valleys and produce a smooth surface upon which the aluminum may be deposited. This substance may be something which can be removed after the metal film has been deposited. To accomplish this a plastic material which has the required characteristics is used. The plastic is applied to the surface of the phosphor in liquid form and is then solidified and thoroughly dried. After this has been accomplished, the bulb is evacuated and pure aluminum metal is evaporated onto the smooth surface of the plastic film. The tube envelope is then baked at a temperature which takes out all the plastic material and leaves a film of aluminum with a mirror finish adjacent to the phosphor.

Sticking potential, an undesirable characteristic of the phosphor (fluorescent screen material), is a term commonly applied to a voltage saturation of the screen material in television picture tubes. The phosphor material is made up of two components; usually zinc-sulphide or zinc-silicate compounds. The saturation occurs at approximately 12,000 volts anode potential and is brought about by the secondary emission properties of the phosphor.

When the anode potential on the picture tube is below the 12,000-volt range, there are as many secondary electrons given off the screen as there are primary electrons striking the screen from the cathode-ray beam. As the potential of the screen is raised above the critical voltage, the ratio of secondary electrons to primary electrons becomes less than unity, thus allowing the screen to build up a charge which tends to repel oncoming primary electrons. Thus, the velocity of the electrons is reduced until a stable condition exists where the secondary ratio is again unity. An increase in anode potential beyond 12,000 thus brings about a very slight increase in screen brightness; the brightness curve flattens out as shown in Figure 5.

A major advantage was realized in the application of the metallizing process to projection types as well as large direct-view picture tubes which operate at relatively high anode potentials. Projection picture tubes have been designed to use 25 to 30 kv on the anode. By applying a thin film of aluminum on the bombarded side of the phosphor, it was found possible to utilize this range of voltage effectively and at the same time to increase greatly the useful light output for the same amount of energy put into the screen. The conductivity of this metallic film provided a path by which the secondary electrons could escape from the screen. The result was that the brightness of the screen increased as a linear function of the applied anode potential.

Ion-Spot Prevention

Prevention of ion spot blemishes on modern picture tubes is essential to good quality. The ion spot is an annoying dark spot which is formed in the center of the picture tube face after it has been operated for a number of hours. It occurs in tubes using electromagnetic deflection, unless these tubes have an ion-trap gun or have a metal-

Figure 3

A magnified view (encircled) showing irregularities on surface of phosphor screen appears in (a). Illustration in (b) shows result when light from inner walls of tube is reflected back onto screen when metal film is used.

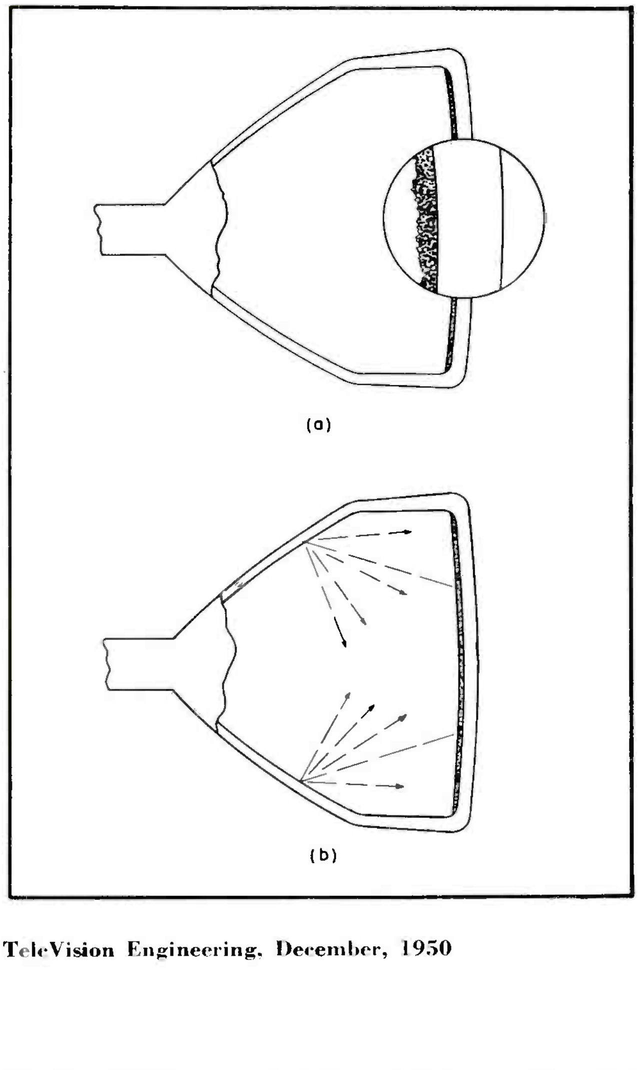
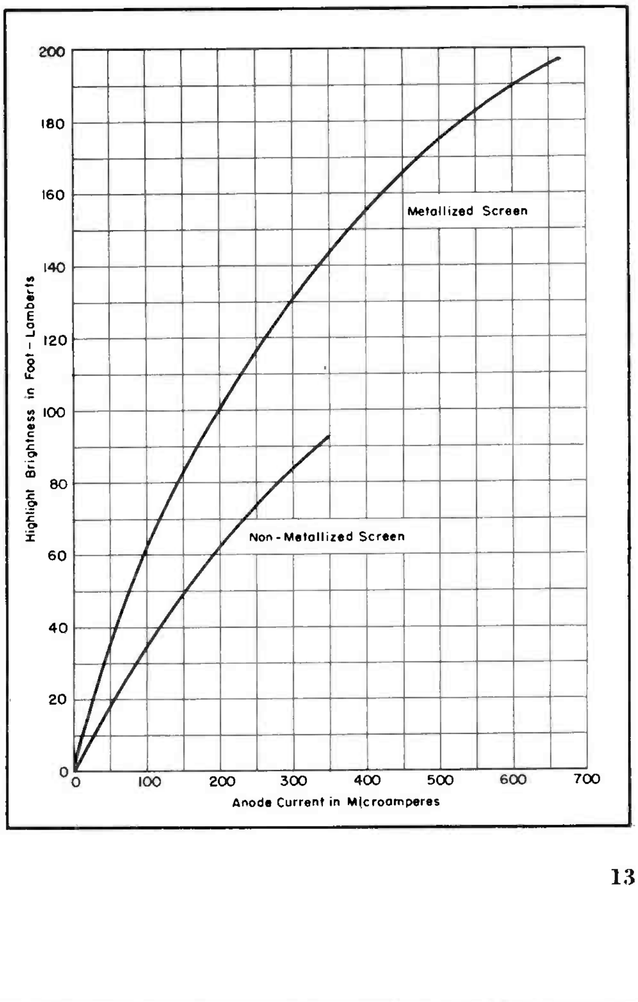


Figure 4

Plot which discloses that at an average screen brightness level, for example 35 foot lamberts, the anode current of an aluminized tube is only one half that of the non-aluminized tube.



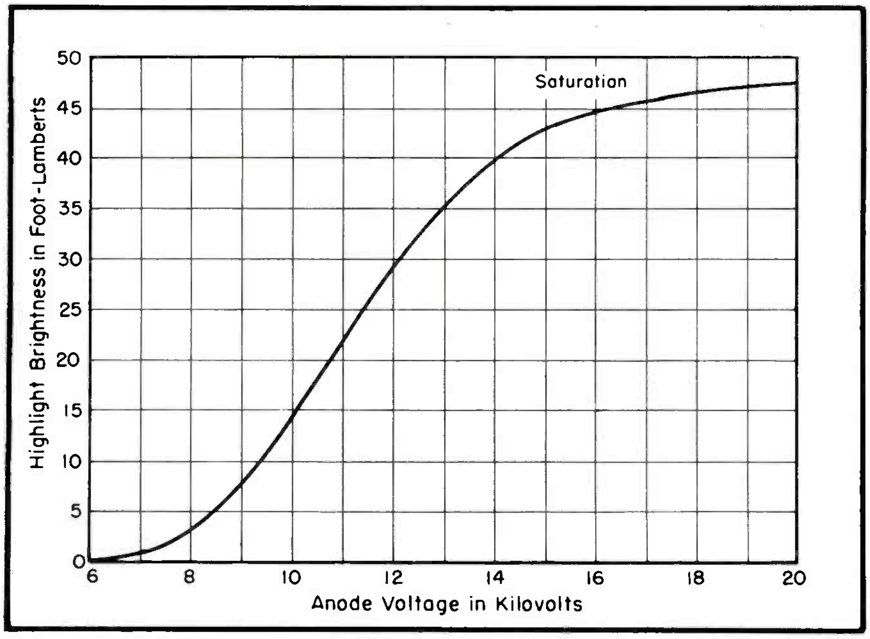


Figure 5
Curve which illustrates how the brightness results flattens out, even though the anode voltage is increased.

lized screen, and is the result of negative ions impinging on the phosphor material which makes up the fluorescent screen. The ion spot usually measures from approximately 1/4" to 1" in diameter, depending on the type of focus used (magnetic or electrostatic and has quite a well-defined boundary.

Some preventive means must be employed to protect the screen material from the damaging effect of these negative ions. When the ion-trap electron gun is used, the gun being designed to produce an electrostatic field to which both the negative ions and the electrons respond, the electron beam and ions are diverted off the axis of the tube and the ions do not impinge on the screen. Therefore, they do not discolor the screen with the resultant familiar ion-spot. An external magnet which fits over the neck of the picture tube is then required to straighten out the electron beam only and direct it along the tube axis to the screen.

With the metal-backed tube the ion spot is eliminated without the use of an ion-trap gun, because the aluminum film which covers the surface of the screen material is very thin and is pervious to the electrons, but not to the negative ions which have considerably greater mass. Electrons penetrate the aluminum film at low velocity so that any sacrifice in anode potential is negligible. Tubes with metallized screens, which have been given many hours of life test under extreme operating conditions, have been found to indicate a freedom from the ion blemish.

It has also been found that contrast is improved, as a result of the aluminum film on the back of the screen. In the non-aluminized tube much of the light is emitted toward the inside of the tube. This light which is lost reduces the possible contrast, in that some of it is reflected from the inside walls of the tube back onto the screen, even though these walls are coated with a black paint to help prevent reflections as well as to conduct electrons. With a film of aluminum on the back of the phosphor all this light is reflected forward, where it is useful and cannot get back to the inside walls. Likewise, any light from any other source in the rear of the screen or inside the tube cannot penetrate the metal film to reduce contrast.

In Figure 4 we have a curve which shows that at an average screen brightness level, for example 35 foot lamberts, the anode current of the aluminized tube is only one-half that of the non-aluminized tube. The lower the anode current the lower the diameter of the electron beam and the better the resolution.

The resolution will be better in all cases where the average anode current is below the value which would be used on a non-aluminized tube. The condition in which all available brightness is used would be where an extremely high ambient light level exists. In this case, it may be assumed that the anode currents would be equal, but advantage taken of the much greater brightness factor in the aluminized tube.

Although only few cases may be encountered in present television applications where electrostatic charges are found to cause appreciable trouble, the metal conducting layer will prevent any charges from distorting the picture on the phosphor screen or from tearing out the entire picture.

Other metals than aluminum have been used in development work for producing the thin films used in picture tubes. None, however, have proved as successful. Aluminum has been found more desirable than other metals for several reasons:

It is easily evaporated. and does not react chemically with the screen material as do many other metals.

It forms a strong thin film, but is still pervious to electrons at normal operating potentials.

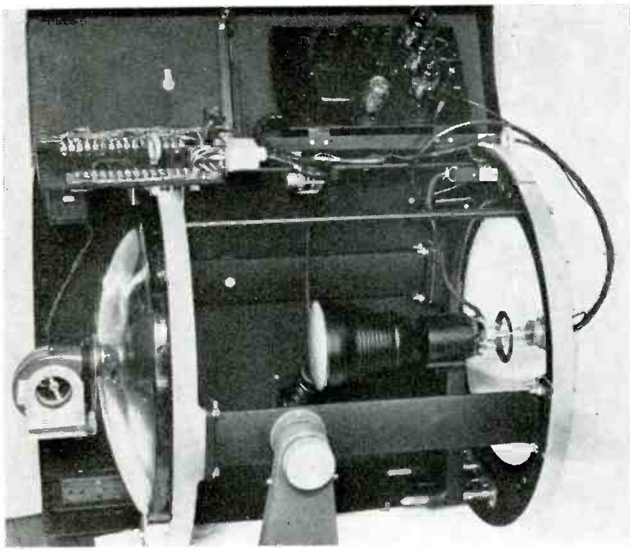
It is conductive, thus reducing sticking potential.

It can be deposited so as to give a film, which, though opaque, has a smooth mirror-like surface which has high light-reflecting properties.

Several factors contribute to the reason for not making all tubes aluminized. In one instance we find the problem of the additional cost of tube processing. Another factor is that additional manufacturing facilities are required. The cost of development work is still another factor.

The introduction of larger sizes, such as the 19-inch and greater, in recent months has accented the need for metallizing the screen, since metallizing precludes the necessity for going to higher anode voltages. Normally, the increase in picture area results in a lower light output unless the anode voltage is increased proportionally to keep the power input to the screen constant. To provide this voltage may mean the addition of another doubling stage in the rectifier and higher voltage filter capacitors. In addition, more deflection power is required. This may mean larger sweep amplifier tubes or additional tubes. Another *hv* factor that must be considered is the cost of additional insulation in the receiver for high voltages.

As mentioned earlier, sticking potential (voltage saturation) is encountered at certain levels of anode voltages. This means that increasing the potential above 15 or 16 kv provides very little increase in light output. Therefore, on the larger sizes of tubes it becomes extremely difficult to obtain values of light output comparable to that now available in smaller types. By metallizing the screen, however, it has been found possible not only to eliminate the *sticking potential*, but it is not necessary to increase the anode voltage beyond 15 or 16 kv because of the increased light output. Incidentally at these voltages, there is no problem of *x-ray* radiation. a situation which can exist at the higher voltages, required in some installations with larger picture tubes.



Theater TV Systems

by E. M. JEFFERY

View of projector.

Highlights of SMPTE Paper by Ralph V. Little, Jr., Covering 80-Kw Equipment Now in Use, Featuring 7-Inch Projection Tube and 26-Inch Mirror Which Results in a Throw of 62′.

THEATER TELEVISION as an entertainment medium has now reached the practical commercial stage. To date nine installations of a system[1] featuring a 7-inch projection tube, operated at 80,000 volts, have been installed in motion picture houses throughout the country.

Describing the operation of the system in a typical installation, during the recent SMPTE meeting at Lake Placid, N. Y., Ralph Little, Jr., of RCA said that an effective focal length finally of 15.515″ is now being used, providing a nominal projection throw of 62′ from the face of the picture tube to the screen for a 20′ wide picture.

Little pointed out that an off-the-air receiver is provided as a signal source during the initial period of use or as a source of test signal if the normal signal is to come via microwaves or coaxial cable. As auxiliaries to the signal selector a 7″ picture monitor and a 3″ 'scope are used to check the projector functions without projecting a picture on the screen. A switching system provides for the switching of the video and audio lines to the projector and to the theatre sound system, respectively, as well as to a 'scope and a monitor which are provided for level setting and quality control.

A projector video amplifier has a cathode follower video return which supplies a signal, attenuated by a ratio of 100:1 from the picture-tube drive.

The 'scope, a 3RP1, is provided with a 60-cycle sine wave sweep, *dc* setting for the vertical deflection, and a calibration circuit set to provide 1 volt, peak-to-peak, marker lines when its switch is set on calibrate position.

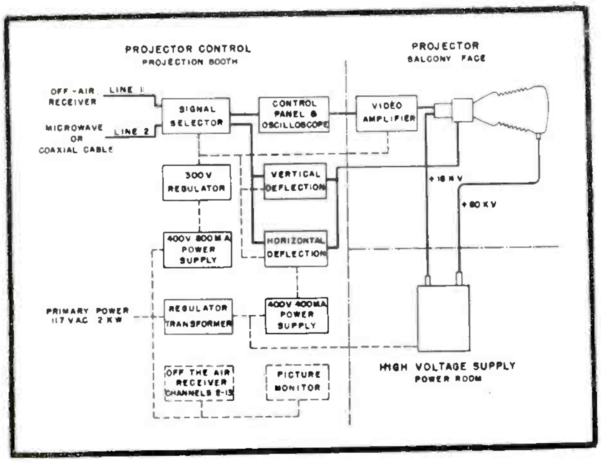
[1]RCA PT-100.

The 7″ monitor can likewise be switched to view the pictures on the incoming lines or from the picture tube in the projector; when on the projector a complete system operation check is obtained without requiring the picture on the theatre screen.

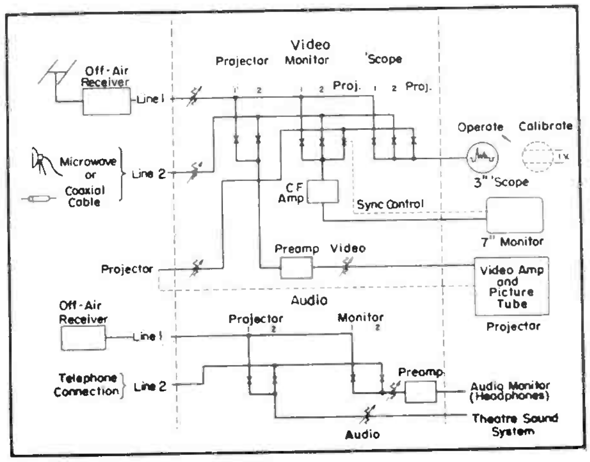
Discussing the monitor, Little said that this instrument is provided with driving pulses from the projector scanning circuits; it then shows the operation of the scanning lock-in as well as the picture quality, otherwise the monitor is synchronized from the incoming signal.

The audio signal can be obtained from either one line (off-the-air receiver), or another line which may be a telephone-line connection. Projector audio would normally be connected to the theater motion picture sound system and is provided with an attenuator for level setting.

Block diagram of theater TV system, showing video and audio setup, plus air and line pickup provision.



Simplified switching schematic of the signal selector.



MASS PRODUCTION Test and Alignment*

by RALPH G. PETERS

Custom-Built System Provides for the Alignment of Picture and Sound IF Amplifiers, IF Traps, IF, Detector and Oscillator Circuits, and Video, Chassis and Final Test, Through Use of Picture and Sound Generators, IF Generators, etc.

In TV chassis manufacture, factory tests on a lab level have been found to be a must procedure not only to provide uniformity in production, but speed-up on the lines and as a result a reduction in manufacturing costs.

In one effort to provide such a test system a custom-built plan has been evolved providing three major test operations: *if* and trap alignment, *rf* alignment, and video, chassis, and final tests.

The system can be adapted to a wide range of production requirements varying from 100 to over 1,000 units per day.

The *if* and trap alignment operation covers alignment of traps, stagger-tuned *if* amplifiers, and sound-channel discriminators. Equipment utilized includes an *if* generator[1], with nine panels supplying nine separate frequencies, all of which are fed through coax cables and line couplers[2] into an attenuator[3]. A 'scope and a *VoltOhmyst* are used as output indicators at each test station.

The *rf*-alignment operation in the test system provides accurate alignment of *rf*, first detector, and oscillator circuits on all channels. The equipment includes a sweep generator[4] for alignment of the *rf* and first-detector circuits.

Any one of 12 channels can be selected by rotating a twelve-position switch, mounted on the front panel. The width of the sweep for each channel is adjustable from zero to ±6 mc. Two markers are provided, one tuned to the sound carrier frequency, the other to the picture carrier frequency.

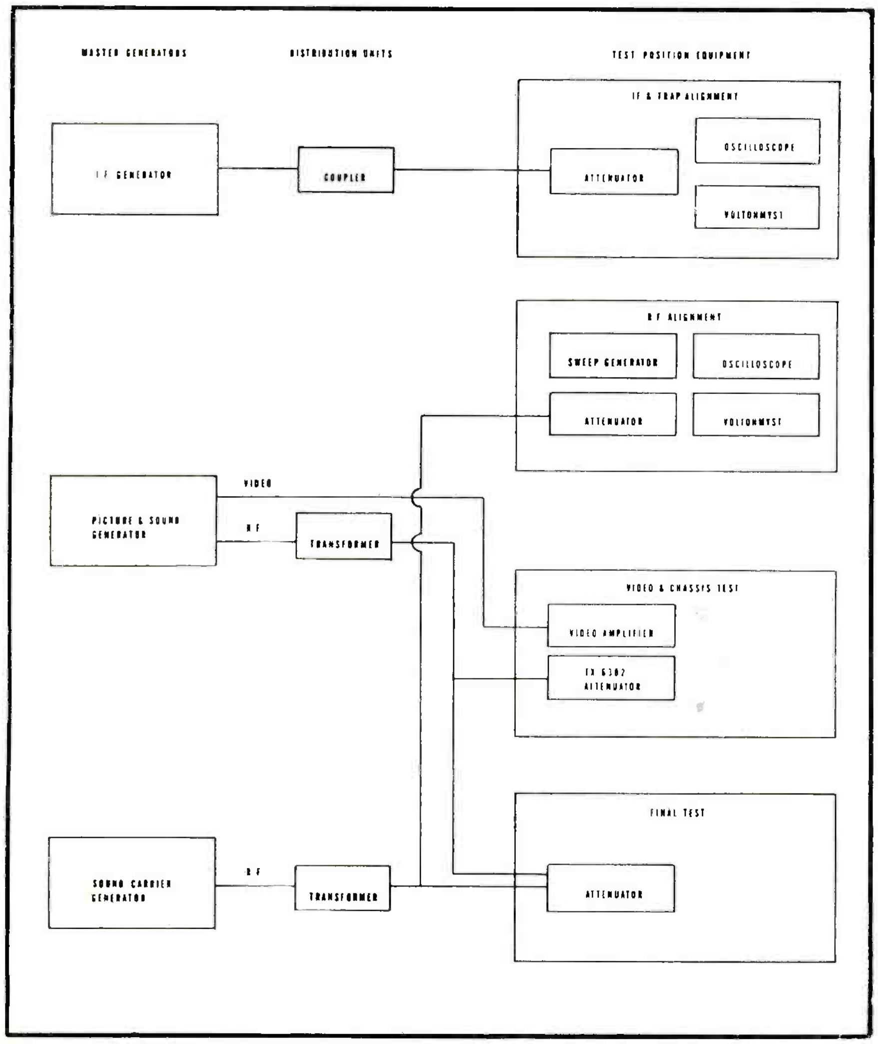
Alignment of the local oscillator within the receiver requires a high degree of frequency accuracy and stability. Consequently, this alignment adjustment is made using accurate crystal-controlled signals, provided by a sound carrier generator[5]. This generator has twelve separate outputs, each f which is the sound carrier frequency signal of one of the presently assigned channels. These signals are fed through distribution transformers[6] and coax cables into attenuators.[7] At this point the particular frequency desired for test can be selected and its amplitude adjusted to the desired level. Each of four output lines carries three different frequencies, allowing for full twelve-channel coverage. To prevent incorrect identification of an *rf* frequency, each of the three

(*Continued on page* 19)

From a special TV manufacture factory-test brochure prepared by the test equipment section of RCA.

[1]RCA TX-6451. [2]RCA TX-6414. [3]RCA 6303. [4]RCA WR-94B. [5]RCA TX-6448. [6]RCA TX-6429. [7]RCA TX-6382.

Overall layout of factory test and alignment equipment, indicating manner in which signal generators supply signals to all different types of test positions.



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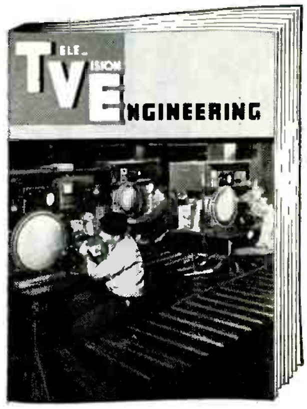

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Human Aspects

(*Continued from page 11*)

lines can be halted until a change in design or process is made which will enable the *acceptance specification* to be raised to agree with the design specification; that is, the product can now meet a higher standard.

All changes in the *acceptance specification* should be made by quality control in writing and should include temporary waivers. Under no circumstances should there be *acceptance specifications* which are not being followed in practice.

If this procedure is followed, it is unlikely that manufacturing will be asked to do the impossible, in making the product to a specification that cannot be met. The *acceptance specification* will indicate what is leaving the plant since manufacturing can meet it. If the specification is not met. meaningful action can be taken to correct the process. There are no cases of asking the impossible, confusion is lessened and the confidence of the production team is maintained.

In this instance, the execution of the specification plan is reduced to a routine. Everything is in black and white. Decisions are based on this concrete specification and are not pulled out of the air. In addition. management by comparing the *design* and *acceptance specification* can obtain a good idea of what the product can do in relation to what was initially desired. The *quality control* group. by providing well-planned operations which avoid confusion, helps maintain morale.

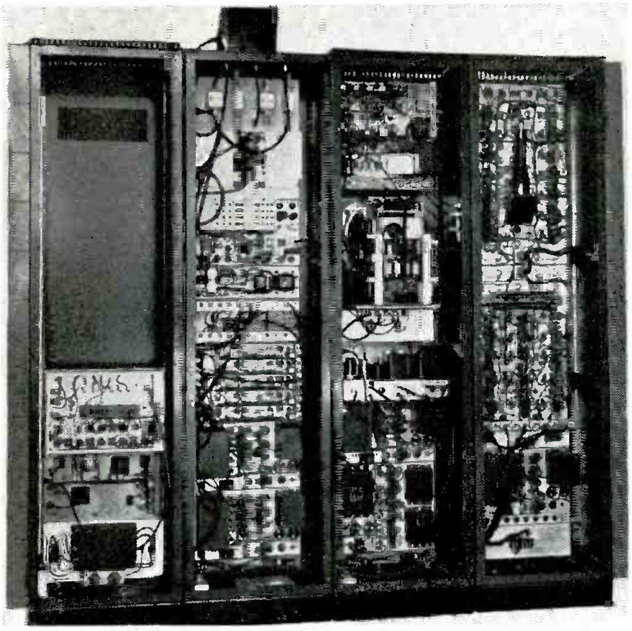
The *quality-control* group is a key group in making certain that only a satisfactory product will reach production.

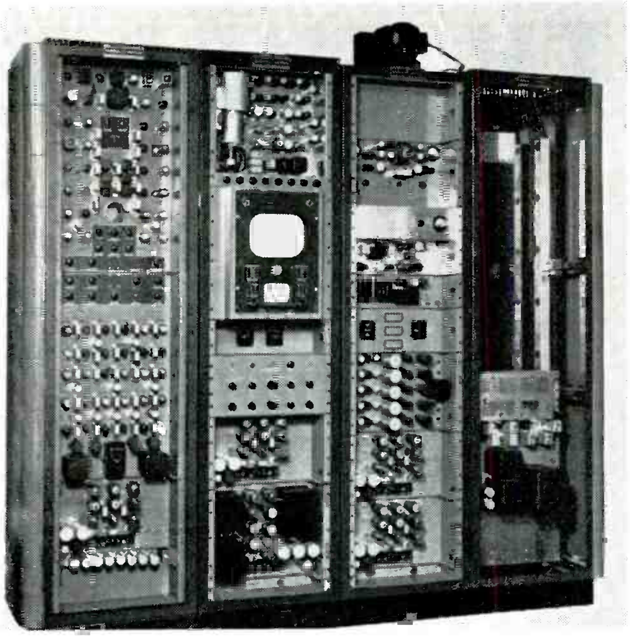
The *quality-control* pre-production functions of reviewing the engineering models, the methods models and pilot runs, including full factory and field tests should be strategically located in the master schedule in such a way that an unsatisfactory design can be stopped by management or engineering, upon advice from quality control. early in the pre-production phases of the product. The schedule should not be so inflexible that with or without quality control approval it is too late to stop the wheels of production. This means that before the pilot run is begun, quality control should be able to assure management that the product is satisfactory and may need at the most, very few minor changes as a result of pilot run findings. Here, the human aspect centers again. There must be time to send an unsatisfactory design back to engineering. without causing a major upheaval in the plant operations.

[*To Be Concluded in January*]

Mass Production

(*Continued from page 16*)





Picture and sound generator used in the video, chassis and final test.

rf signals on each of the four output lines are modulated with a different audio tone. A 'scope and *VoltOhmyst* are used as output indicators during these adjustments.

For video, chassis and final test operations there are available a complete picture transmitter, with monoscope and sync generator, and a sound transmitter.

In the video and chassis test position, the video amplifier and deflection circuits within the receiver chassis are checked and adjusted for proper operation. An overall operating test is then usually applied.

A video test pattern signal, consisting of the standard indian-head test pattern (generated by a monoscope) mixed with blanking and synchronizing pulses (generated by sync generator) is available as one of the outputs from a picture and sound generator.[8] A grating pattern is also transmitted from this unit. These two video output signal are distributed over coax lines to a video amplifier.[9] A built-in selector switch on this unit permits instantaneous selecion of either signal. The signal chosen is then fed to the video amplifier in the receiver chassis under test and all necessary checks and adjustments are made for proper definition and linearity.

An overall chassis sound and picture test is made by feeding *rf* signals into the antenna terminals. The source of these *rf* signals is two low-power transmitters built into the picture and sound generator, adjusted to the desired picture and sound carrier frequencies. The picture transmitter is modulated by the monoscope and sync generator; the sound transmitter can be modulated from any available source of speech, music, or audio tones.

The four input lines on the attenuators[7] go back through distribution transformers[6] into the sound carrier generator. These sound carrier signals are used to check the local oscillator alignment on all channels. A complete final test can be applied after mounting the receiver chassis in its cabinet. This test is made by supplying picture and sound signals (from the picture and sound generator) as well as sound carrier signals (from the sound carrier generator) through the attenuator to the final test position.

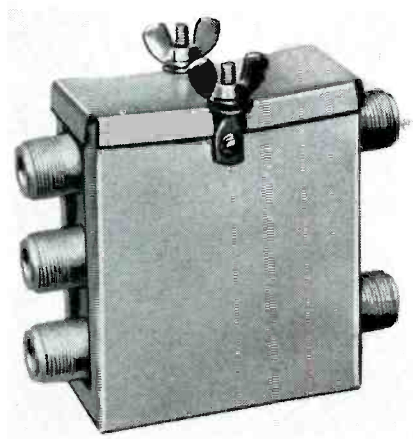
The equipment employed for the video, chassis, and final tests is similar to that used by many TV broadcasters and thus the plant can become completely independent of broadcast signals for test operations.

A large number of test stations can be served from the single generator units, and the entire system can be expanded through the use of additional test station equipment.

[8]RCA TX-6378. [9]RCA TX-6440.

Attenuator employed in the trap checks.

Distribution transformer required in the final test procedures.



TV TUBE Developments

by P. B. LEWIS

Design and Application Features of UHF Magnetron Developed for Local Oscillator and Low-Powered Oscillators

WITH ULTRAHIGHS now being considered more seriously than ever as a commercial lane, industry has accelerated its *uhf* developmental activities and as a result many interesting products have appeared. In one instance, a miniature magnetron[1] has been evolved, not only for use in receivers, as a local oscillator, but for low-power oscillator applications. According to the designers of the tube, the magnetron which is of glass construction, is capable of operating continuously from 30 to 900 mc at 250 milliwatts output.

In a discussion of the tube[2] at the recent IRE-RTMA Syracuse meeting, H. W. A. Chalberg, of the G. E. receiving tube advanced circuit lab. said that the magnetron is a cylindrical multi-vane structure which is commonly called an interdigital magnetron. It is essentially a simple device, consisting of eight vanes anchored alternately to two end rings and supported by mica spacers around a large diameter (0.100″) cathode in a conventional cage construction. Cathode-to-anode spacing is 0.040″, the vanes are 0.060″ wide, and vane-to-vane spacing is about 0.010″, so that clearances and tolerances are relatively wide. Non-magnetic material is used for the vanes and rings, and a reverse-coil heater will be used to minimize magnetic hum effects, although no broadening of the spectrum has been observed on sample tubes made with folded heaters. A T-5½ bulb size was chosen to reduce the magnetic path length to a minimum, since the magnetic field must be axial to the cathode and in a horizontal plane.

Declaring that if a magnetron is operated over the negative-resistance region with a high Q tuned circuit, sustained oscillations can be maintained, Chalberg pointed out that the necessary difference in anode potential can be supplied by the *r-f* voltage across the tuned circuit acting in series with the *dc* voltage.

Describing the use of the tube in a tuner, Chalberg said that if the oscillator is loaded down heavily enough to stop oscillations, the current will drop to a point falling somewhere on the static plate characteristic curve. The decrease in plate current results in a lower drop across the series resistance and a higher drop across the tube. This higher plate voltage may be in excess of the maximum voltage for stable oscillations at 600 mc. Theoretically, the tube will not start oscillating again under this voltage condition upon removal of the load. However, in practice, the tube has been found to start, and it is believed that this was the result of the negative resistance characteristic of the tube.

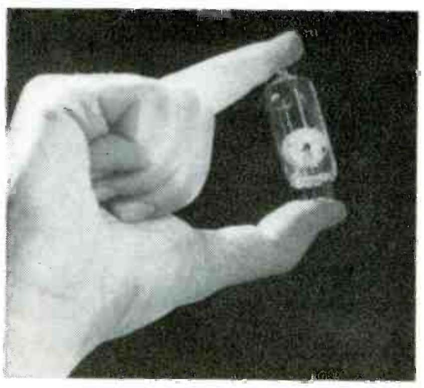
It was pointed that the magnetron was found to oscillate more easily and with larger power outputs if a small capacitor and series inductance were connected from one anode to chassis ground. This was especially true at frequencies higher than 800 mc. Explaining the function of this capacitor, Chalberg said that the magnetron probably operates as a neutrode; i.e., with one anode at *rf* ground. Additional investigations may show that better impedance matching to the magnetron will eliminate the need for the capacitor-inductance combination.

The tube has been made to oscillate at frequencies from 30 to over 1,000 megacycles. For a change in line voltage of ±10% the change in frequency at 650 mc has been found to be ±150 kc.

Initial measurements of sixty-cycle hum indicated that the hum level was down more than 60 db below the carrier level.

[1]Essentially, a magnetron is a diode which is used with a magnetic field acting at right angles to the electric field plus a tuned circuit to generate radio frequency oscillations. The frequency of oscillations is determined by the magnetic and electric field intensities, the tube geometry, and the tuned circuit. [2]G.E. Z-2061.

The G.E. uhf magnetron.



H. W. A. Chalberg (center) an engineer in the G. E. receiving tube division at Owensboro, Ky., explaining operation of magnetron to Kenneth Weitzel (right) commercial engineer for the tube divisions and J. M. Lang (left) manager of the tube divisions.

VWOA News

Election Time Again

NOMINATIONS for officers and members of the board were made during a recent meeting held in New York Ctiy. . . . W. J. McGonigle was renamed to the post of president. A. J. Costigan was selected as first vice president; H. L. Cornell, second vice president; W. C. Simon, secretary; R. J. Iversen. assistant secretary and R. H. Pheysey, treasurer. . . . Twenty were nominated for the board, with eight to be elected: L. Arnson (Radio Recptor.), Rodney Chipp (Dumont), Geo. H. Clark (RCA-Ret.), A. J. Costigan (RMCA), Walter C. Evans (Westinghouse), C. D. Guthrie (USMA-Ret.), Raymond F. Guy (NBC), Wm. J. Halligan (Hallicrafters), G. W. Johnstone (N.A.M.). T. R. McElroy, W. J. McGonicle (NY Tel. Co.), Fred Muller, Capt. (USN-Ret.), E. A. Nicholas (Farnsworth), Frank Orth (CBS), Jack R. Poppele (WOR-Mutual), Haraden Pratt (Mackay Radio), D. W. Rentzel (C.A.B.), E. H. Rietzke (CREI), W. C. Simon (TRS-UFCO), and G. E. Sterling (FCC).

Personals

CONGRATULATIONS TO VWOA member Delos W. Rentzel upon his recent appointment by the President as Chairman of the Civil Aeronautics Board. Rentzel had been Administrator of the CAA. . . . Joe H. McKinney, regional manager of the FCC Gulf States Region, has asked for VWOA membership forms. In a letter to ye secretary, McKinney stated that the application had been deferred in fear that he would not be classed as an old-timer or veteran in the same category as Dr. De Forest and E. N. Pickerell. Lately, however, he reported that he noted mention as old-timers such infants as George Sterling, A. J. Costigan, and Fred Muller. So. he said, he decided to shed his inferiority complex and ask to be admitted to the halls of the great. Since '19 he has held a commercial license, and since '28 he has been with the FCC. . . . At the recent Fall meeting in N. Y. City were VWOA treasurer and director C. D. Guthrie: VWOA director Haraden Pratt; VWOA assistant secretary R. J. Iversen, VWOA director George H. Clark, VWOA prexy and director William J. McGonigle, ye secretary and director William C. Simon. . . . Arthur J. Costigan was unable to attend due to the illness of his wife. FCC Commissioner George Sterling was away attending FCC hearings. . . . Upon the retirement of VWOA member Tom Stevens from the FCC, a dinner was tendered him by his associates, who also presented him with a handsome watch. Tom, who for many years has been an outstanding personality in coastal telegraph and marine radio, was with RCA-RMCA for many years. His early days in radio began during the days of World War I. Congratulations to you, Tom, and a happy retirement.

Father of Radio

VWOA HONORARY prexy Lee de Forest's autobiography, published recently, has been acclaimed by many as an outstanding contribution to both literature and science. Reporting that Doc is an excellent writer, one reviewer declared that the facts in the story of the audion are presented with the exactness of a patent presentation, and the lucidity of an experienced reporter.

Members, officers and guests at the VWOA fall meeting in N. Y. City. In first row are Ericson and Orth; second row, Fischer, Tamburino, Lohman, Gillule, Williams and Cochrane; third row, DeGraw, Koch, Shanholtzer, Elliott, Mathers, and Davis; fourth row, Zegouros, Nelson, Hayden, Cooly, Fitchett and Ridley; fifth row, Johnstone, Klingenschmidt, Quimby, Sadenwater, Savick, and Woods; sixth row, Iversen, Duvall, Schneider, Horneij, Muller, Guthrie, Pratt, Capt. McDonough and McGonigle.

VIDEO

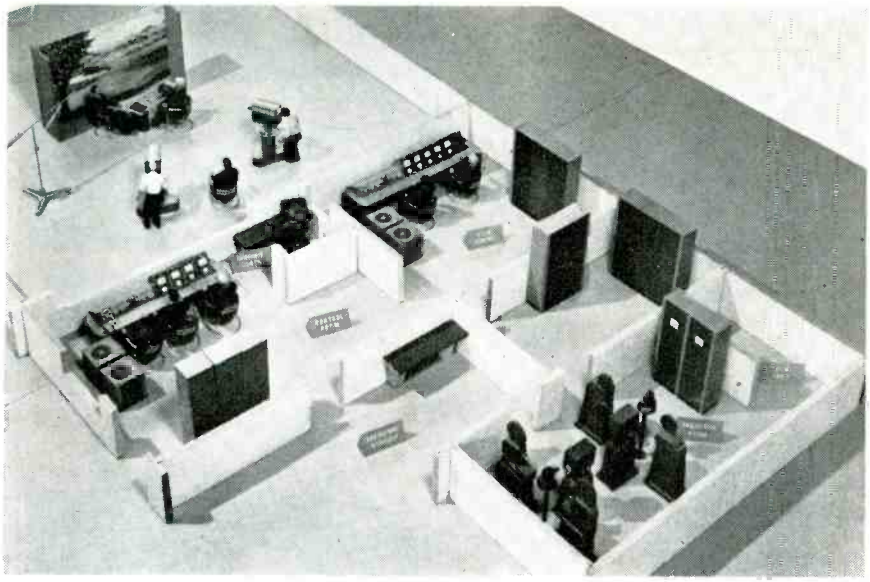


Figure 1
Layout of a typical TV broadcasting plant. At lower right, projection room and film vault; at left of projection room, engineering workshop; in front of workshop, control room in the right hand corner of which is the announce room; at control room's right, film control.

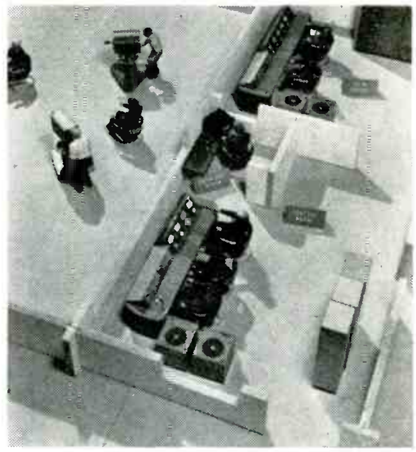


Figure 2
Live talent studio control-room facilities, where the program director finds himself the center of all activity. Control room and announce booth is at left and film control at right.

Television broadcasting has come into its own as a dynamic force in the entertainment and advertising world. Using the talents and techniques of its contemporaries in these fields, it offers an endless variety of program material. Many stages, many performers, are needed to supply the needs of the industry and its audience of several million people.

Behind the scenes appears a complex maze of electronic equipment linking the TV cameras to the transmitter. Pictures from many sources must be combined, edited, and routed to the transmitter and network according to a split-second time schedule. Any transition from one scene to the next or from one show to the succeeding show must be made with no gaps or unsightly splices, and with no chance for retakes of mistakes. Fleeting seconds ticked off on the clock mean the difference between a hit show with pace and mood and a show which drags and loses its audience. So, too, does the clock measure dollars of income from advertising spots as short as 10 seconds.

One can see, therefore, that success in such an activity must be based on a well-planned interconnection of the available facilities. This is the function of swithcing and distribution equipment in the TV broadcasting plant, logically arranged and dependable to permit smooth operation day after day, yet flexible so as to accommodate such requirements as rehearsals and new program material, and provide spare equipment for emergencies. The degree of versatility is, of course, dependent upon immediate program requirements and the budget set up in the beginning. Fortunately, required video and audio units are available in the form of *building blocks*, which, with a measure of planning beyond the present needs and budget, can serve as basic units to which additions may be made in the future.

It is not due to the proverbial lazy man's dream that so many push buttons are found in a broadcasting system. Rather, it is a matter of necessity to provide means of control and organization over the many elements of program production and distribution.

Let us consider first a typical station as illustrated in Figure 1. Here are all the elements of a permanent installation, arranged in compact form. It is not the smallest station, nor is it a large one, but the studio facilities shown will handle the basic requirements for live talent shows and film presentation. In addition, switching and monitoring equipment is provided to handle the outgoing lines to the transmitter and network and also the incoming pictures from remote pickups, theatre shows,

Figure 3 ‡
Switching equipment layout which provides for six incoming lines.

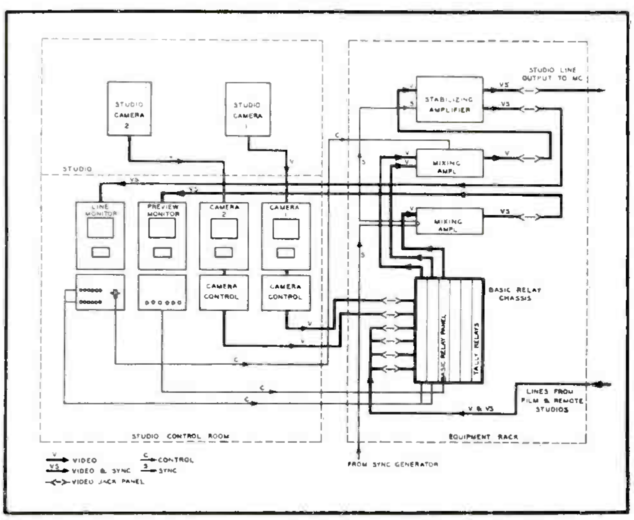
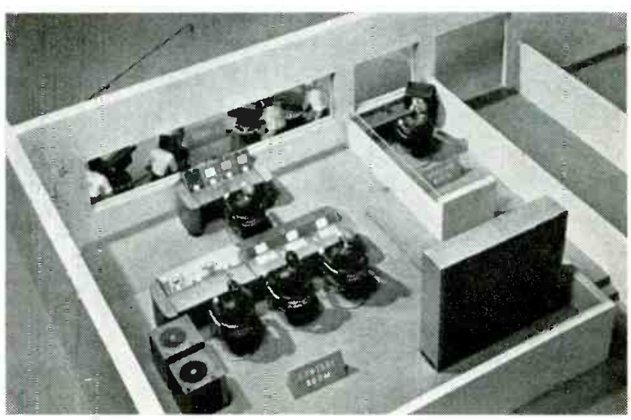


Figure 5
Audio and video console position, on a raised platform behind the camera controls which may be adopted to permit program and technical directors to see their own monitors, the camera monitors and also into the studio. Control room in front seats audio operator, program director and technical director. Announce booth is at left.



RELAY SWITCHING

by C. R. MONRO, Television Terminal Equipment Engineering
Engineering Products Department, RCA Victor Division, RCA

Push-Button Switching Technique Found to be Particularly Appropriate to TV Operations, Permitting Unlimited Flexibility, Centralization of Control and Operations and Provision for Long-Range Future Planning.

and network. The electronic units used to provide these facilities for both pictures and sound are only partly shown. Many separate units are in the cabinet racks, and in addition the required interconnecting power and signal cables are run below the floor in trenches and conduit.

To provide control over all these elements, two major tools are given to the operating personnel. First, we have the monitoring equipment to see and hear the program material coming from the various sources. In the second instance is the switching equipment to permit selection of the right material at the proper time. Bringing all these loose ends into compact switchgear, which may be located in a desk top, soon becomes impossible due to the number of cables required for sufficient versatility of control.

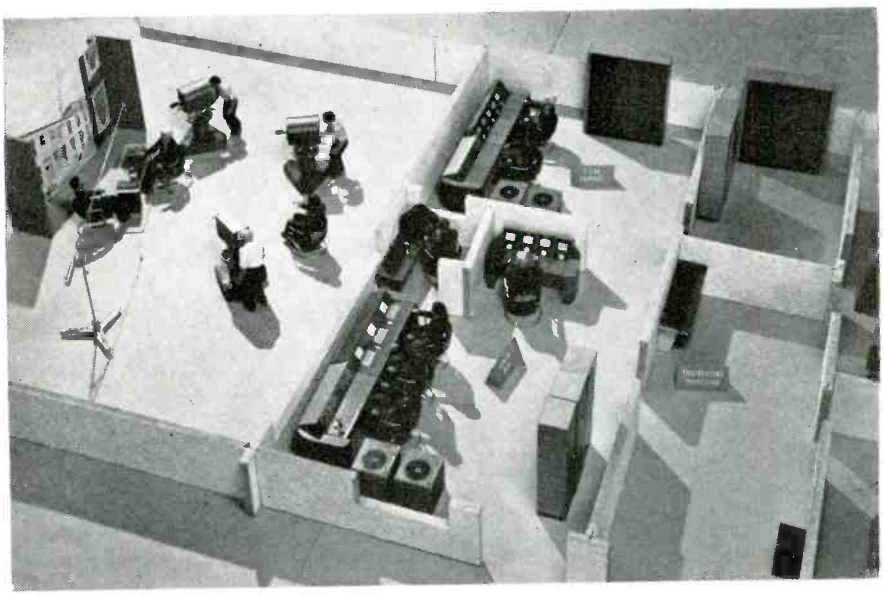
Remote control has been found to be the answer.[1] With such an arrangement, the operators may be seated at consoles designed for comfort and convenience, while by means of push buttons, switching equipment can be operated in its logical physical location in the plant.

In live-talent studio control-room facilities as shown in Figure 2, the program director finds himself the center of all activity. Following the script or continuity, orders must be issued to each cameraman to set up each scene desired; then, having seen the pictures produced on monitors placed in easy view, it is necessary to determine which is to be used and sent out on the air. To control the transition between scenes or to produce superposition and dissolve effects, switching and fading equipment is available in the form of push buttons and fader levers. Depending upon the size and operating personnel of the particular station or network center, the program director may or may not actually operate this console. In some cases a technical director performs this function, the two sitting at the same desk so as to see all the monitors.

In Figure 3 appears a switching equipment layout which provides for six incoming lines which would include the cameras in the studio, direct lines to the film cameras for slides and movie portions of the show, and other lines to remote inputs if pictures from other studios or outside the station are to be used. The console is arranged so as to permit viewing both camera pictures on their own camera control monitors and the line output of the studio on another monitor. It is made up of standard camera control and monitor console sections. The actual push buttons and fader unit mount in one of the console housings with the line monitor. Incidentally, an improvement in operation has been effected by the addition of a third panel of relays on the relay bank to feed a separate monitor which may be switched to any of the inputs. This is termed the *preview monitor,* since it permits viewing the other incoming pictures before switching them on the air.

[*To Be Continued in January*]

Figure 4
Basic elements of a larger studio layout with three monitors in the director's console.



[1]Broadcast News, No. 58, March-April, 1950, contained a paper detailing the circuits and physical arrangement of the RCA TS20A video switching system. This is a building block item, since the system type number covers a wide assortment of switching and control units to meet various specific needs. It is built around a relay switching circuit for video, which is made in units of six inputs and one output with an electrical, self-latching arrangement to control timing. For camera switching, the overlap sequence is used to eliminate breaks completely. This, however, cannot be used in all applications since undesirable cross-ties during switching might occur. One solution is to reduce the gap to a minimum value. The RCA video switching relay banks offer a choice of an overlap or gap sequence approximately 1 millisecond in duration.

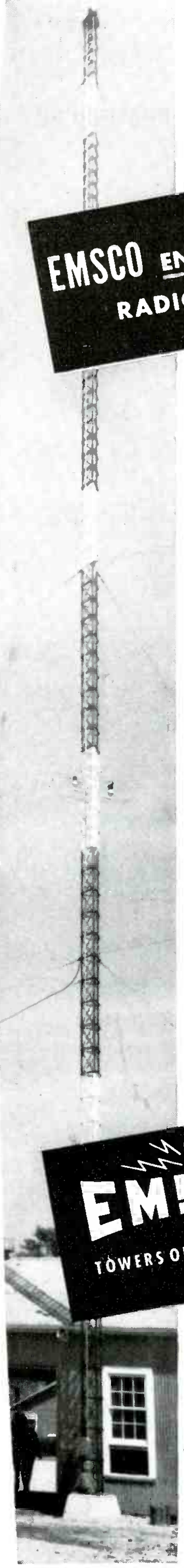
‡ Circuit extremely simplified; one relay in drawing may actually be two, or more in a special interlocking circuit or in identical circuits for other channels.

TeleVision Engineering Index, 1950

CUMULATIVE INDEX

Alphabetically Arranged For Authors and Subjects

(Continued on page 26)



Index

(*Continued from page* 25)

(Continued on page 28)

Index

(Continued from page 27)

Resonant Coax Lines

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

Instruments

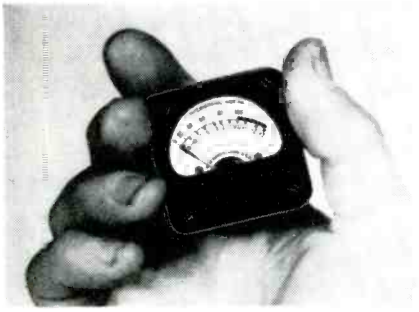
Miniature Meters

PRODUCTION OF 1½" VU meter and 1½" db meter, has been announced.

Instruments are made to conform to the applicable sections of specification JAN-1-6. Available in three case styles: 1½" square waterproof case (as illustrated), 1½" round waterproof case complete with "O" ring for making a waterproof seal to the panel, and 1½" round flange mounting case with commercial type of seal.

Meters contain *sub-miniature meter* with D'Arsonval-type movement. Meter is said to have a dielectric strength sufficient to withstand 1500 volts.

Scales, with an arc length of 1.3", are obtainable black on white, or in reverse treatment with black background.—*International Instruments, Inc. (attention R. C. Livingston), 331 East Street, New Haven 11, Connecticut.*



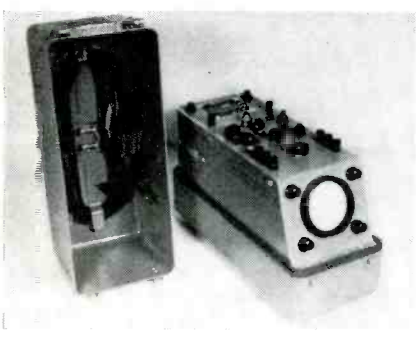
International Instrument Midget Meters

Miniaturized 'Scope

A MINIATURIZED 'SCOPE which weighs 17 pounds, measures 9" high x 6" wide x 14½" long, and contains nine tubes, including rectifiers, is now available.

Has a sweep frequency range of from 3 to beyond 50,000 cps. Vertical amplifier response is said to be flat within 3 db from *dc* to 2 mc, while horizontal response is said to be flat within 2 db from *dc* to 100 kc. Uses direct coupled amplifiers.

Has a blanking and synchronizing amplifier. Circuit design is said to maintain a sweep return time ratio of not less than 5 to 1 at all frequencies. Deflection sensitivity exceeds 0.5 volt per inch at all line voltages from 105 to 125 volts and at all line frequencies from 50 to 1000 cycles—*Hycon Mfg. Company, 2961 E. Colorado Street, Pasadena 8, Calif.*



Hycon 'Scope

Production

Finished-Print Recording Camera

AN OSCILLOGRAPH-RECORD CAMERA which provides, in one minute, a complete record of an oscillograph image, has been developed. No darkroom facilities are said to be required; waveform comparison is immediate. The camera is designed specifically for application with any standard, 5" scope.

Camera employs the Polaroid-Land process for delivering a finished print at the termination of each completed exposure or set of exposures. By means of a sliding mount, the camera may be positioned so that several traces can be recorded on a single print, for side-by-side comparisons. There is also a built-in detent which divides a single print into one, two, or three separate exposure areas.

An illuminated data card provides a method of photographically recording information on each print.

The lens aperture is f/2.8, and the lens is coated to minimize halation. Shutter settings are 1/100, 1/50, 1/25, time, and bulb. Size of print is 2¼" x 3¼", with a ratio of dimensions from trace to recording of 2.25:1.—*Allen B. Du Mont Laboratories, Inc., 1000 Main Ave., Clifton, N. J.*

Impregnators

A LINE OF EQUIPMENT FOR IMPREGNATION of electrical coils, carbon parts, wood and a wide variety of other materials, has been announced.

Equipment is said to provide a quick opening vacuum and pressure closure, allowing the tank cover to be opened or closed in a matter of seconds without manual effort. The door is opened and removed by push button control.

Equipment is available in a complete range of sizes for vacuum and pressure operation, and for use by heating with steam, electricity or Dowtherm, or for non-heated operations.

Complete units include structural steel, piping, insulating casings for tanks and all accessories.—*Complete details in bulletin B-30; Struthers Wells Corp., Warren, Pa.*

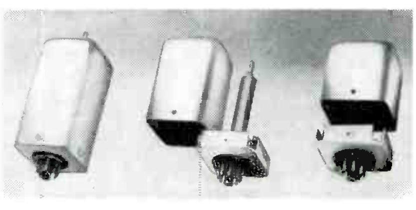
Plug-In Housings and Assemblies

PLUG-IN HOUSINGS AND ASSEMBLIES for coils, filters, relays, etc., are now available in thirty models ranging in height from 2" to 4", and 1⅜" or 2" square.

Housings have removable aluminum shield can on an aluminum base, with a ground lug and an octal-type plug mounted in the base. The base is threaded to provide stud mounting.

Assemblies can be had with or without adjustable powdered iron tuning cores.

Available on order are units having 11-prong plugs, special plating finishes or other special requirements.—*Desco; Dietz Design and Manufacturing Co., Grandview, Missouri.*



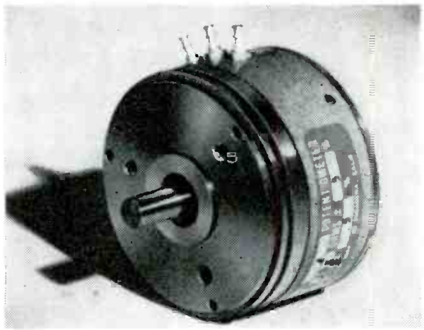
Desco Plug-in Housings

TV Parts

Single-Turn Pot

A SINGLE-TURN POTENTIOMETER equipped with ball bearings as a standard feature, is now available.

Pot is 2" in diameter, resistances 100 to 50,000 ohms and has a five-watt rating. —*Bulletin No. 107 illustrates and describes unit. Model J; Helipot Corp., South Pasadena, Calif.*



Helipot Single-Turn Pot

Multi-Section Electrolytics

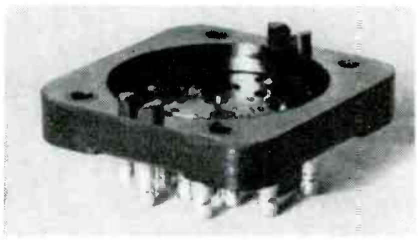
TWIST-PRONG-BASE MULTI-SECTION ELECTROLYTICS with a special internal construction that is said to provide low *rf* impedance and minimum coupling between sections, have been announced. Feature applies to selection of capacitance and voltage combinations in electrolytics suited for television applications and will withstand temperatures up to 85° C.—*Type AFH; Aerovox Corporation, New Bedford, Mass.*

Miniature Rack and Panel Connectors

MINIATURE RACK AND PANEL CONNECTORS which accommodate 14 to 20 contacts, 5- and 10-amp for 120 volt service, have been developed. Contact terminals have eyelet, hook, turret and standard solder pot design. Insulation is molded melamine. The socket contacts float.—*Types DPM-14 and DPM-A20; Cannon Electric, P. O. Box 75, Station A, Los Angeles 31, Calif. (DPM-2 bulletin contains complete details.)*

Non-Interchangeable Base and Sockets

A 20-PIN BASE, with matching sockets, has been designed for plug-in unit construction. Design of the base is said to eliminate difficulties encountered with conventional type bases. By selcting variations of pin layout of less than 20 pins, critical voltages and frequencies can be isolated and the base can be made non-interchangeable so that it will mate only with correct socket.—*Type 20; Alden Products Co. (attention Norman Curtis), 117 N. Main St., Brockton, Mass.*



Alden 20-Pin Base.

Personals

Ted Kwap, Walter Zimny and Alfred Ossoff, have been added to the staff of the Franklin Airloop Corp., 43-20 34th St., Long Island City 1, N. Y., to assist in the television stamped circuit development program. Development of the 41.25-45.75 mc stamped *if* circuit is being emphasized.

William E. Ruder has been named manager, and Dr. John Herbert Hollomon assistant manager, of the newly organized metallurgy and ceramics divisions of the G. E. Research Laboratory.

Dr. Harry Stockman has been appointed director of research of the Tobe Deutschmann Corporation, Norwood, Mass.

Prior to his present position, Dr. Stockman served as consulting engineer and scientist of several industrial firms in the greater Boston area. He was, during the period '45-'48, associated with USAF Research in Cambridge and taught 1941-1945 pre-radar and other courses at Harvard University.

Dr. Harry Stockman

I. S. Coggeshall

Ivan S. Coggeshall, general traffic manager of Western Union Telegraph Company's overseas communications, has been elected president of the IRE.

William P. Hilliard, formerly with Bendix Radio Division of Bendix Aviation, has been appointed to the newly created post of director of enginering and research at General Instrument Corp.

Louis Martin, formerly manager of the Equipment Field Force for RCA, has been named sales manager of General Instrument. Martin succeeds D. J. Phelps who resigned.

Martin Vogt has been named district manager for the National Union Michigan and Northern Ohio territory. Martin will handle renewal sales of receiving tubes, Videotron television picture tubes, and panel lamps. His headquarters will be at 1328 Maxwell Ave., Royal Oak, Mich.

Robert B. Dome, electrical consultant for G. E. will receive the IRE Morris Liebmann Memorial Prize for 1951 for his TV contributions including the intercarrier sound system and wide-band phase-shift networks. Award will be presented at the annual banquet on March 21, 1951, at the Waldorf-Astoria Hotel in N. Y. C.

Walter Sterling is now a development engineer at Cinema Engineering Co., Burbank, Cal.

G. F. Wunderlich has been appointed vice president and general manager of Eitel-McCullough, Inc. *Harold E. Sorg* has been named vice president in charge of research.

ADVERTISERS IN THIS ISSUE

TELEVISION ENGINEERING

DECEMBER, 1950

Briefly Speaking . . .

THE FIVE-STATION antenna for New York City's Empire State Building underwent a final test recently at Camden, N. J., with General Hugh A. Drum, prexy of the building; C. W. Lyon, Jr., executive vice prexy, and Bernard Lewis, publicity director, viewing the last minute study. . . . RCA and I. T. and T. have signed a licensing exchange agreement involving radio, television and electronic inventions. The agreement extends to Dec. 31, 1954. . . . Philco has signed a five-year license agreement with Hazeltine covering use of their patents and services. . . . Hoffman Radio Corp., 3761 S. Hill St., Los Angeles 7, have issued a 40-page booklet describing their military production facilities. Copies are available from Berkley Fuller, sales manager of the special apparatus division. . . . The Dallas-Fort Worth section of the IRE will hold its annual southwestern conference at the Southern Methodist University, Dallas, April 20-21, '51. . . . The G.E. tube plant at Utica, N. Y., is being reopened for the production of communications equipment. . . . Hudson Wire Co. has opened a new magnet wire plant at Cassapolis, Mich. General offices of Hudson Wire are at Ossining, N. Y. . . . Thompson Products, Cleveland, Ohio, have entered into a license agreement with Designers for Industry, Inc., providing for the development, manufacture, sales and service of coax switches, as a function of an electronics division. The operation will be under the direction of Len W. Reeves, vice-president. . . . Standard Coil Products Co., Inc., 2329 N. Pulaski Road, Chicago, Ill., recently shipped their three-millionth television tuner. Standard Coil reports that over 75 TV set manufacturers are now using their tuners. . . . The Lansdale Tube Co., subsidiary of Philco, will soon occupy a new building at Frederick, Maryland, in which will be made an assortment of tubes for the armed forces and civilian requirements. . . . Rinehart Books, Inc., Technical Division, is the new name of Murray Hill Books, Inc. Offices remain at 232 Madison Avenue, N. Y. 16. . . . A new plant, including general offices, was opened recently by Electrical Reactance Corp. at Olean, N. Y. The plant, located on Seneca Ave., comprises 10,000 square feet of office space and 60,000 square feet of factory production area. Plant is equipped with four ceramic tube firing ovens and a plastic curing oven 132 feet long, which can handle 100,000 capacitors per day. . . . Simpson Electric Co. has leased a new plant at 932 Benton St., Aurora, Ill. The plant, covering an area of 31,000 square feet, represents the fifth under operation by Simpson. There are three in Chicago, and the fourth is at Lac du Flambeau, Wisconsin.

The Simpson plant at Aurora, Ill.

Switches

FINEST QUALITY

Immediate Delivery from Our Huge Stock... All New and Unconditionally Guaranteed!

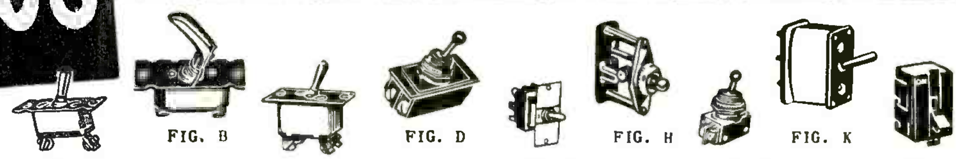


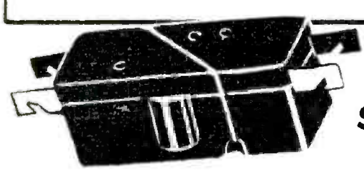
FIG. A FIG. B FIG. C FIG. D FIG. G FIG. H FIG. F FIG. K FIG. L

WIDE SELECTION OF ELECTRONIC COMPONENTS AT WELLS

Tubes • Resistors
Condensers
Wire and Cable
Volume Controls
Co-ax Connectors
Relays • Rectifiers
Transformers • Chokes
Micro Switches, Toggles
Antennas, Accessories
Electronic Assemblies
Dial Light Assemblies

TOGGLE SWITCHES

STOCK NUMBER	FIG.	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	PRICE EACH
PH-500	A	SPDT.	B1B.	$0.35
PH-503	A	SPDT Center Off Mom Each Side.	B11.	.32
PH-505A	A	SPDT Momentary.	B21.	.30
PH-505	A	SPST.	AN-3022-2B.	.30
PH-506	A	SPDT Center Off.	AN-3022-1.	.35
PH-507	A	SPDT Center Off Mom Each Side.	AN-3022-7B.	.32
PH-513	A	SPDT Center Off.	Cutler Hammer AN-3022-1B.	.38
PH-514	A	SPST.	Cutler Hammer B-5A.	.35
PH-516	A	SPST.	B5.	.35
LT-104	A	SPDT One Side Momentary.	Cutler Hammer 8905K568.	.35
309-168	A	SPST.	168553.	.30
309-178	A	SPDT Momentary.	AN-3022-11B.	.35
309-181	A	SPST Momentary.	Cutler Hammer 8211K6.	.35
305-172	A Spcl.	SPST Momentary.	Cutler Hammer 8905K531.	.35
305-182	A Spcl.	SPST Momentary.	Cutler Hammer 8905K630.	.45
370-14	A	SPDT Center Off 1 Side Mom.	Cutler Hammer B-7A.	.30
370-4	A	SPDT Center Off.	Cutler Hammer B-9A.	.35
370-25	A	SPST Momentary.	Cutler Hammer B-6B.	.25
309-169	B	SPST Momentary.	Cutler Hammer B-19	.35
PH-509	C	DPST.	AN-3023-2B.	.45
PH-510	C	DPDT Momentary.	Cutler Hammer 8715K2.	.50
PH-511	C	DPDT Momentary.	Cutler Hammer 8715K3.	.50
PH-512	C	DPST Center Off.	Cutler Hammer 8720K1.	.55
303-65	C	DPST.	Cutler Hammer AN-3023-2.	.45
309-163	C	DPDT Center Off Momentary.	Cutler Hammer C-11.	.55
309-162	C	DPST.	Cutler Hammer C-1.	.45
309-164	C	DPST Momentary.	Cutler Hammer 8711K3.	.40
305-87	D	1 Side DPST Mom, 1 Side SPST.	AH & H.	.95
LT-100	F	SPST.	Cutler Hammer.	.22
LT-101	F	SPST Momentary.	AH & H. W/Leads.	.20
301-51	G	4PDT Momentary.	Cutler Hammer 8905K12.	.75
305-140	H	DT No Make Each Side.	Open Frame.	.25
309-161	K	SPST.	Cutler Hammer 8781K3.	1.95
309-170	K	SPST.	Cutler Hammer 8905K656.	2.25
301-41	L	DPST.	AH & H	.75
305-76	L	DPST.	AH & H—Open Frame.	.75
319-50	L	SPST.	Allied Elec. Mfg. Corp.	.28
305-170	Spcl.	SPST.	Cutler Hammer Type B13.	.40



SWITCHETTES

STOCK NUMBER	MANUFACTURER'S TYPE NUMBER	CONTACTS	TERMINAL LOCATION	UNIT PRICE
303-20	CR1070C103-A3	N.C.	Side	$0.47
301-29	CR1070C103-B3	N.O.	End	.47
303-34	CR1070C103-C3	1-N.O. 1-N.C.	End	.47
303-18	CR1070C103-F3	1-N.O. 1-N.C.	Side	.47
303-19	CR1070C103-E3	N.O.	Side	.47
303-43	CR1070C123-B3	N.O.	End	.47
303-23	CR1070C123-C3	1-N.O. 1-N.C.	End	.47
305-83	CR1070C123-J2	SPDT	End	.47
303-22	CR1070C123-J4	SPDT	End	.47
303-17	CR1070C124-M4	SPDT	Side	.47
303-16	CR1070C128-C3	1-N.O. 1-N.C.	End	.47

LEAF SPRING SWITCHES

STOCK NUMBER	CONTACT ARRANGEMENT	SPEC. INFORMATION	BACK OF PANEL DIM.	PRICE EACH
303-96	HPDT One Side.	. . . .	3¼x1¾x¾	$1.65
311-58	1A Momentary & 1A.	W/Escutcheon Plate	3¼x¾x¾	1.35
309-167	2C One Side.	. . . .	3x9/16x1 1/16	1.25
305-183	3A Momentary & 3A Momentary.	. . . .	3⅛x1⅛x¾	1.50
319-43	DPDT Center Off.	Mossman.	3⅞x2x1⅜	.85
319-42	4PDT Center Off Mom One Side.	Mossman.	3⅞x2x1⅜	.95
309-159	3B.	Mossman.	3⅞x2x1¼	.85
309-158	2D.	Mossman.	3⅞x2¼x1⅜	.85
309-165	1A.	Mossman.	3⅞x1 5/16x1¼	.75
311-96	4PDT.	Bakelite Actuator.	3 7/16x1⅜x⅞	.85
305-164	3A.	. . . .	3⅛x11/16x11/16	1.25
319-43A	DPDT Center Off Mom Each Side.	Mossman.	3⅞x1⅜x2	.95
305-165	3A & 3A.	Switchboard Type.	4¾x1½x¾	.95

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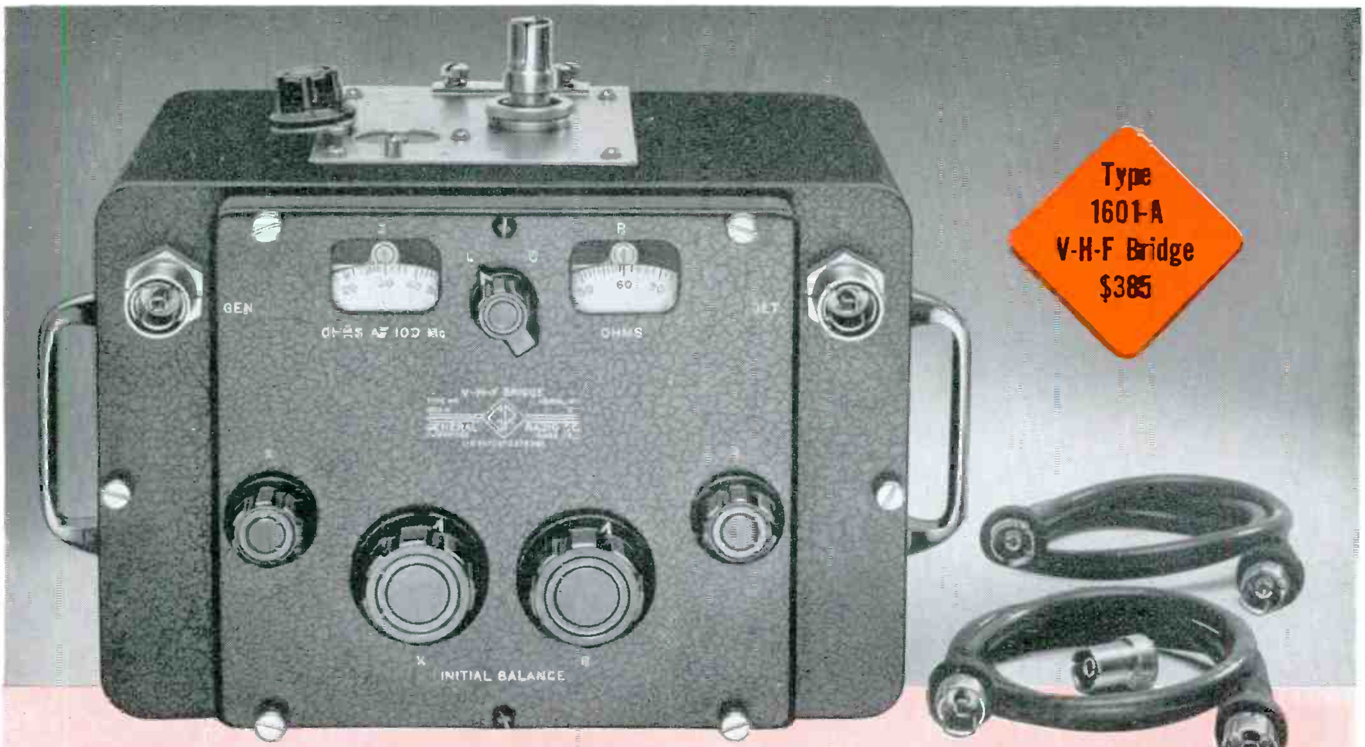


for Bridge Measurements of Impedance
BETWEEN 10 AND 165 Mc

Direct-Reading Resistance Range 0 to 200 OHMS — *independent of frequency except for small corrections.*

Direct-Reading Reactance Range 0 to ±230 OHMS at 100 Mc — *inversely proportional to frequency.*

Coaxial Adapter Supplied for Measurements on Coaxial Systems — *eliminates errors from connecting leads and from residual terminal capacitance. Standing-wave ratio of unknown coaxial system unaffected by terminal capacitance of bridge.*

THE new Type 1601-A V-H-F Bridge brings to the v-h-f frequencies a means for measurements of impedance of antennas, lines, networks and components, having the same accuracy and simplicity of measurement enjoyed by users of the popular G-R low-frequency Type 916-A R-F Bridge.

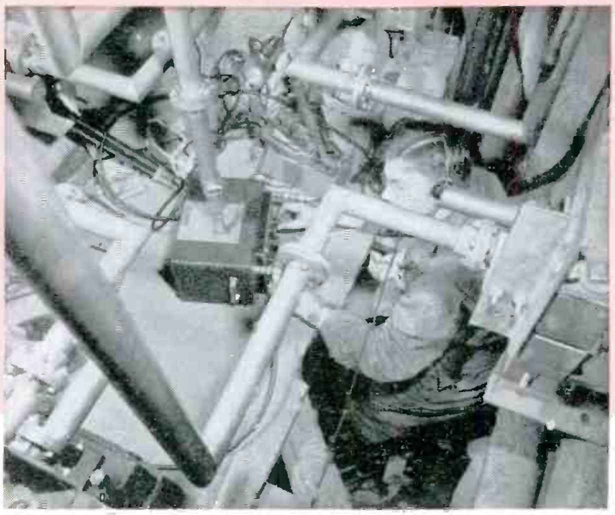
With this bridge the range of conventional bridge techniques is extended to 165 Mc. It is equally suited to measurements on coaxial-line systems as on lumped parameter circuits.

It is designed for direct-reading measurements of relatively low impedances, but measures high impedances indirectly and equally well.

For resistance measurements the accuracy is $\pm(2\% + 1\ \Omega)$, subject to correction for inductance in the capacitor used to measure the resistance. A correction chart is supplied with the instrument. The ohmic portion of the accuracy statement varies between 0.1 and 1.0 ohm.

For reactance measurements the accuracy is $\pm(5\% + 2\ \Omega)$. The ohmic uncertainty varies between 0.1 ohm at 100 Mc and 2 ohms.

This bridge is especially suited to measurements of resistors, capacitors, inductors, transmission-line networks and antennas.



The Type 1601-A V-F-H Bridge set up to measure the antenna of WCBS-TV on the Chrysler Building, New York City. The antenna consists of 16 radiating elements. Measurements of the impedance variation of an individual element over the operating frequency band as well as impedance measurements of the whole array were made easily and accurately.

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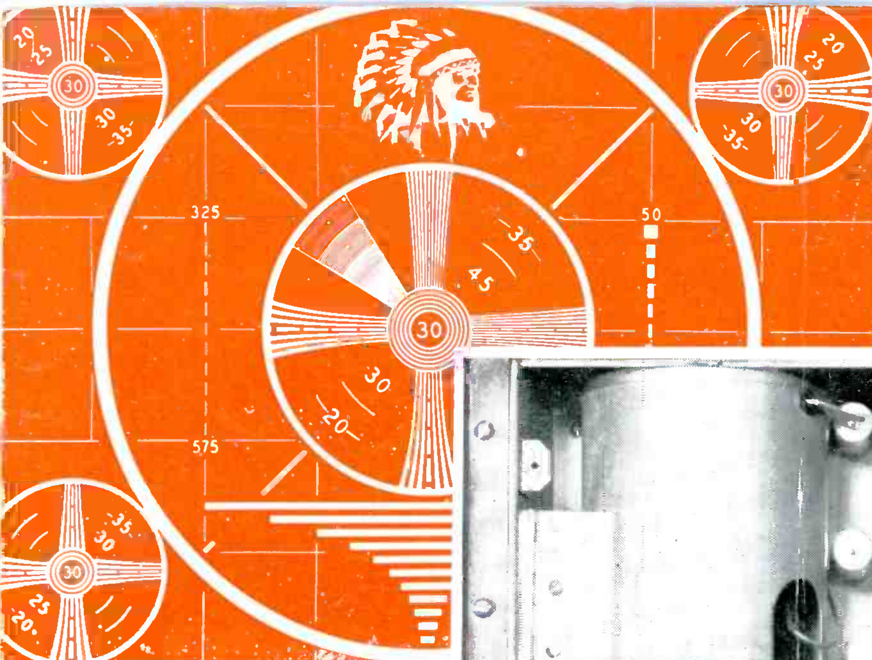
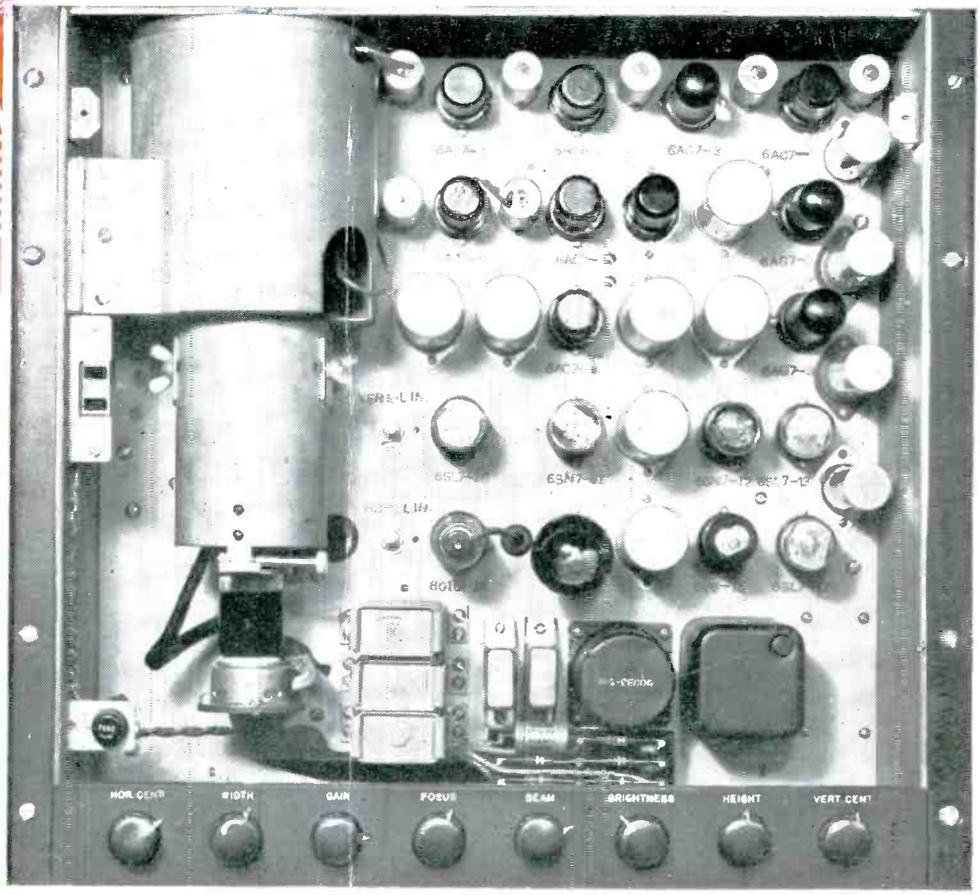


Video
Monoscope
Camera
TK-1A



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