Philco Television Receivers

DESIGN • ENGINEERING • MANUFACTURE

CONTENTS

Reprinted from the November 1948 issue of

TELE-TECH Magazine

480 Lexington Ave., New York 17, N. Y.

Designing & Engineering

SOME PHILCO PRODUCTION STATISTICS

An idea of the size and scope of Philco Corporation is gained from the fact that the Company has produced nearly 23,000,000 radios and radio-phonographs during the 20 years since it entered the industry in 1928. Throughout the past 18 years, Philco has led the industry in radio production, and in 1947 manufactured over 2,700,000 sets. Entering the refrigeration industry in 1938, Philco in only six years of production has also achieved a leading position in this field.

Wide engineering interest has been aroused by the application of this unique manufacturing experience to the mass production of television receivers.

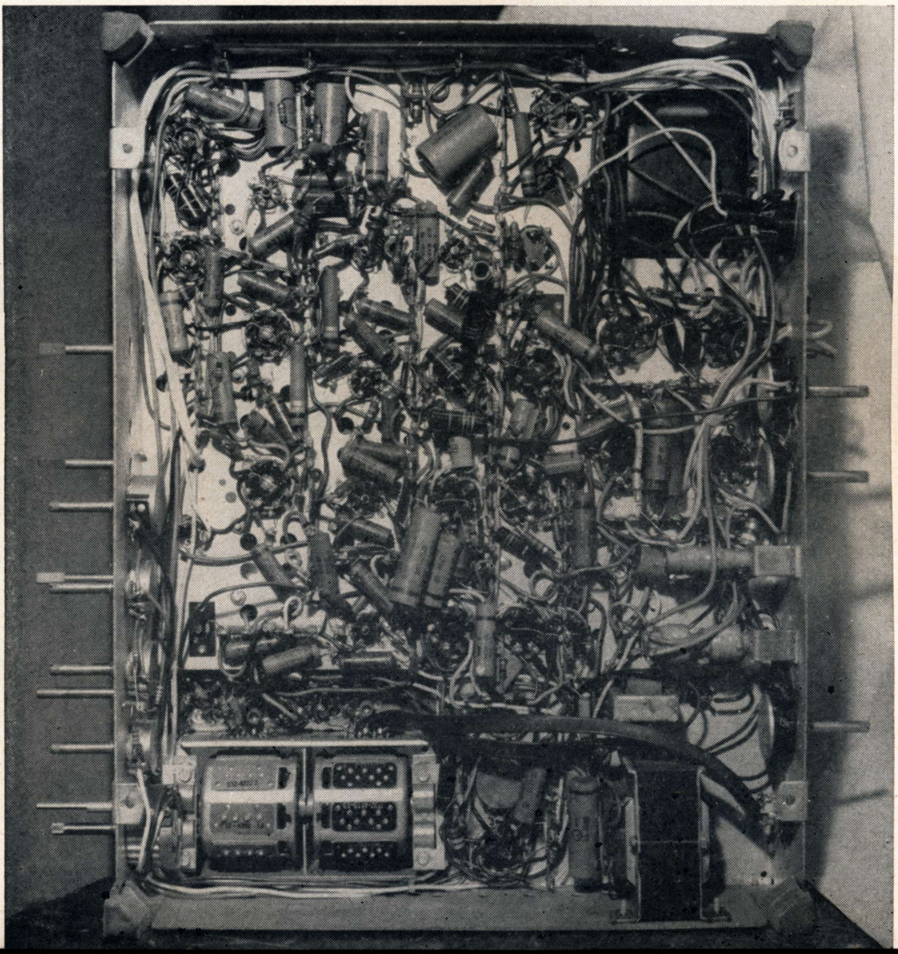
With its conveyorized television operations expanding rapidly, Philco expects to reach a production rate of 10,000 TV sets a week in the first quarter of 1949.

To realize this production level, the Company has invested more than $15,000,000 in television research and engineering and in production facilities. Its contributions to the fundamental advances making possible modern television have been outstanding, and today hundreds of members of its research and engineering organizations are working on the design, development and mass production of television receivers. Over 5,000 employees (of the 20,000 men and women employed by Philco) are engaged in the diversified television production activities outlined on following pages.

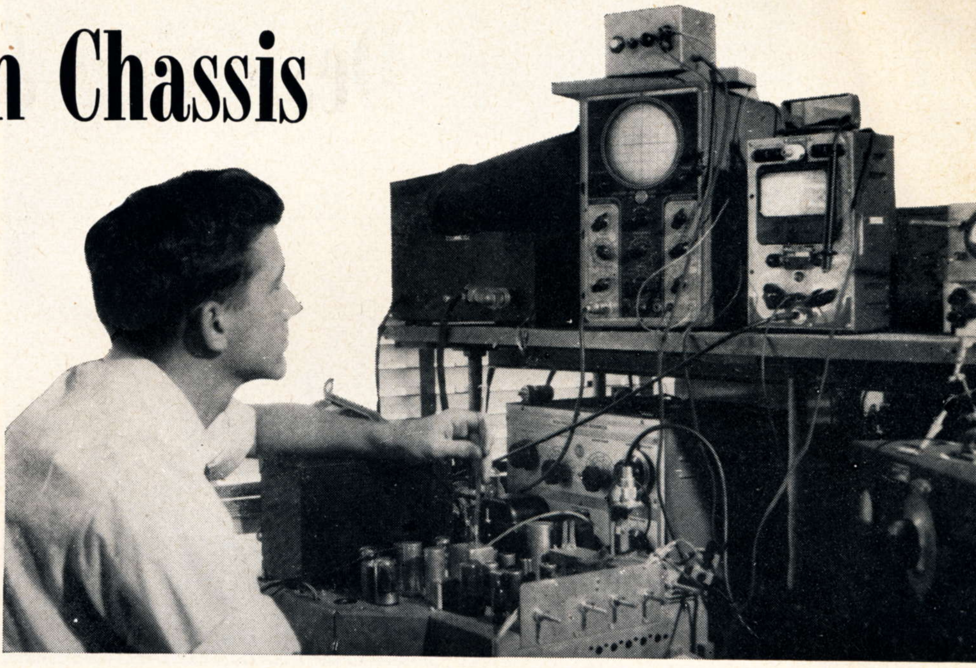
During 1949, the pace of Philco television manufacturing will be still further accelerated, and the Company's 1949 production schedule calls for an output of about 600,000 receivers, three times the production of the entire industry in 1947.

Left: Engineering design sample meeting the required performance characteristics as forwarded to Factory Engineering. Right: Modifications in wiring and component layout are apparent in sample which has been suitably adapted for technics used in mass-production

Engineers discussing circuitry of new TV receiver. Development of IF system having correct gain characteristics and frequency response is a major phase of design.



the Television Chassis

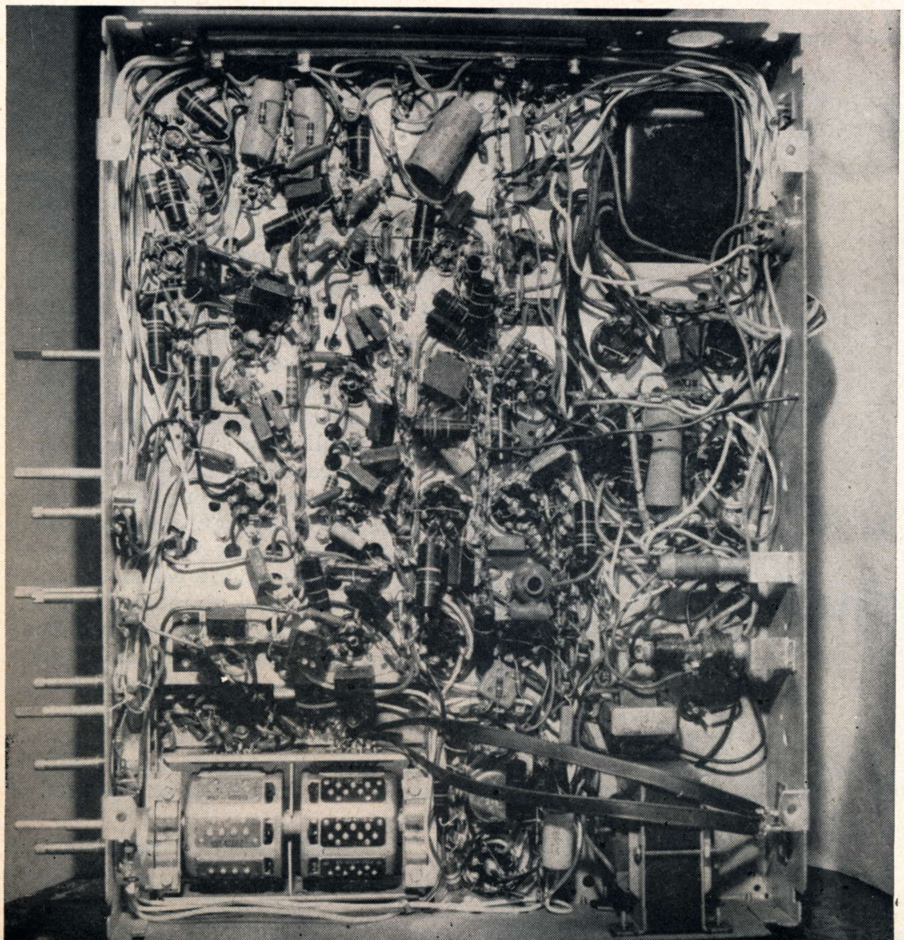


Circuit measurements with precision test equipment assure correct design specifications

THE development of the design of a Philco television-receiver chassis is an evolution that involves the teamwork of a considerable number of groups of research scientists and engineers, each with a different approach to the basic problem of creating a new and even better television set.

Fundamentally, the Design Engineering Department is faced with two problems. One is the need to develop new ideas for new television features, or even completely new receivers, which will have wide popular appeal. The second requirement is to incorporate these new ideas in functionally sound form so that the completed product will deliver satisfactory performance.

The start of the process of developing a new television receiver comes in a series of informal conferences among the wide variety of research scientists and engineers attacking the problem. Ideas are collected from groups in the Philco Research Division, for instance, on cathode-ray picture tubes and associated deflection and focusing circuits; on wideband amplifiers; on RF sections and tuners; on optics, if the model is a projection receiver. Some of these ideas may lead to improvements in existing models; others may contain so much basically new thinking that an entirely new type of television set evolves.



Other ideas come from several groups within the Engineering Department. The group working on Advanced Studies, for example, may contribute entirely new circuitry for an IF amplifier and perhaps suggest some new tubes and associated circuits for other sections of the receiver. Similarly, the components group frequently suggests modifications and improvements in both the designs and application of the hundreds of parts used in designing a complete television chassis. Engineering specialists in tooling and fabrication add their suggestions as to the mechanical layout and the incorporation of new features in an efficient way. Field engineers working with the field representatives of the Philco Service organization and with the company's distributors often suggest ideas based on experience with all sorts of operating conditions.

From all these sources and many others comes a wealth of ideas applicable to the design of a new television receiver. The Television Design Engineering group acts as the clearinghouse and coordination point where all these diversified concepts are considered, discussed, tested, and combined into a complete television system for a new model. As a result, this design engineering group of necessity includes a considerable number of specialists in various phases of television video and audio circuitry and components, as well as other engineers with experience in overall systems design.

When the ideas assembled by

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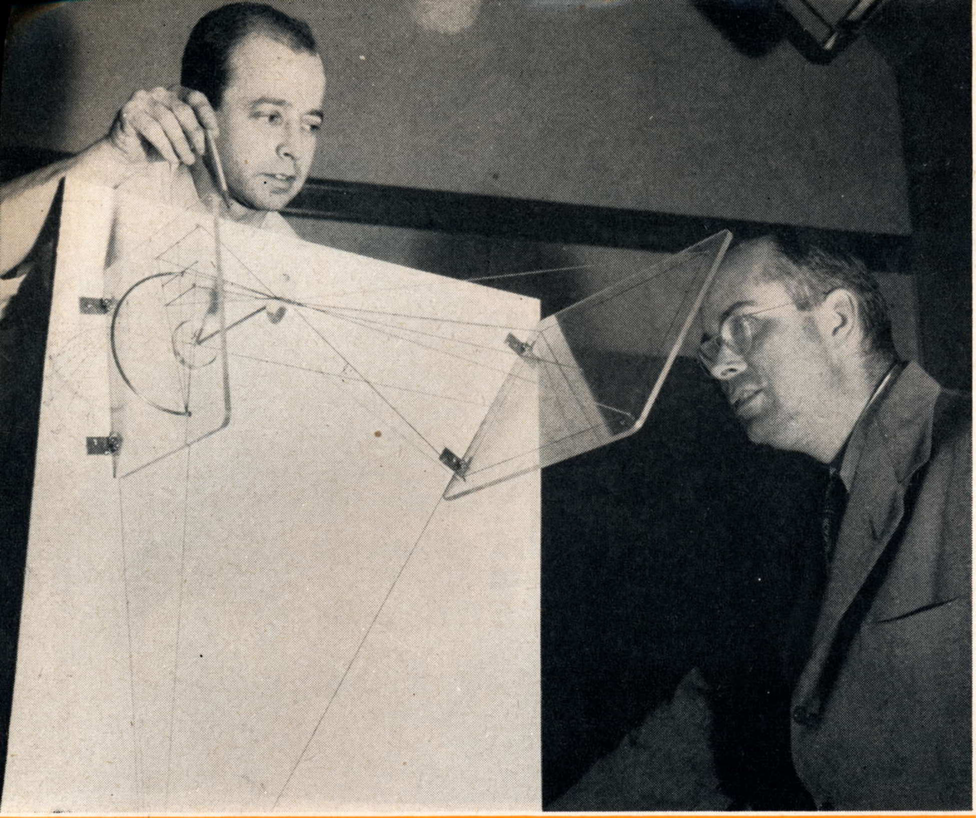
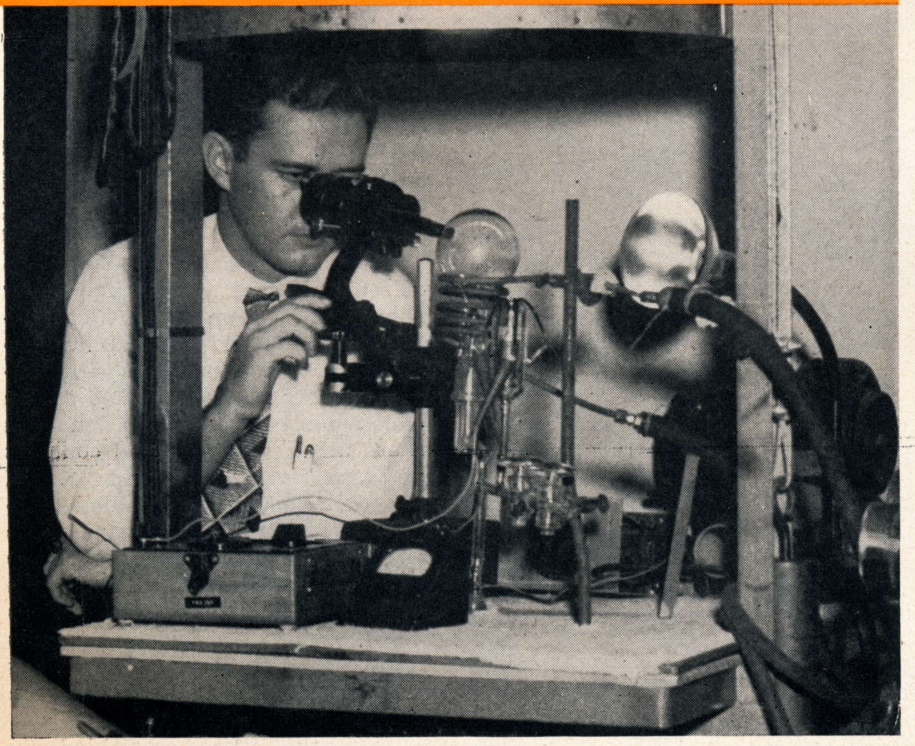


Ernest Traub, optical project engineer, and William E. Bradley, director of research, discuss projection-TV system. Wires delineate rays from keystone image to form rectangular picture

TV Research

A valuable and complete equipment of laboratory apparatus in the fields of optics, electronics, chemistry, and general physics, facilitates quantitative checking of results



Underlying present Philco receiver designs are broad scientific studies which go back 20 years in all of the branches of physics, electronics, chemistry, mechanics

MUCH of the basic technical work required for developing the variety of television receivers produced by Philco is the outgrowth of carefully planned research by groups of scientists and engineers. This work, during the past 20 years, has covered every field of physics, chemistry, electronics, electrical and mechanical engineering applicable to the fundamental problems of television transmission and relaying, as well as reception.

The breadth of this continuing research is emphasized because it illustrates the philosophy underlying the Philco Research Division. Scientists and engineers working there are encouraged to compare notes and find out what other groups are doing. There is a premium on teamwork.

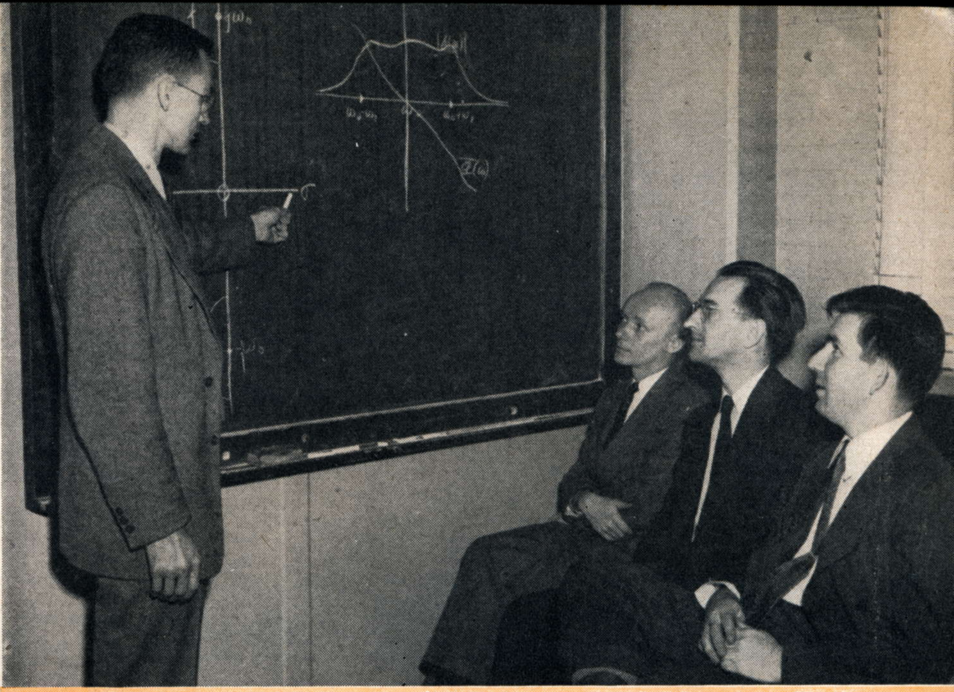
To implement this philosophy, the Research Division holds frequent progress meetings to discuss each of the many projects under way in the laboratories. These meetings have two principal functions. One is to examine the progress of the scientific project and analyze the information being obtained by the research. The other purpose of these meetings is to eliminate any technical bottlenecks encountered in the work. This is accomplished by getting the advice of the director of research, and perhaps the assistant director and other senior members of the Division, who have a broad grasp of the principles to be applied in seeking a solution to the problem, as well as specialists in applied mathematics, circuitry, tubes or any other applicable subject.

The present Philco Research Division was formed in 1941 by gathering into one organization all the groups engaged in research in special subjects, among them the television, radio and phonograph fields. Prewar television research was concerned with developing and building complete electronic television systems, including transmitting and relaying equipment as well as receivers and antennas. Much of this work was pioneering and proved of great benefit in developing industry standards for television. For instance, Philco was the first to transmit and receive 525-line pictures and pioneered in developing the use of FM sound for television.

During the war years, the Research Division did basic work in the development of circuitry, components and systems of many types of airborne radar equipments and VT fuzes, as well as some military applications of television. With the end of the war, extensive research was resumed in the fields of commercial radio, phonographs, television, communications, industrial electronics and allied subjects.

At present, the work of the Philco Research Division in television is of two general types. The first is the continuous fundamental exploration of new knowledge with some present or future bearing on television receivers. One of the groups concerned with this activity concentrates on developing new circuitry and associated components, especially in connection with RF, IF, video amplifier and sweep circuits for television receivers. A second group does basic tube development with emphasis on both projection and direct-view cathode ray picture tubes while another group of research scientists specializes on the problems of television optics. Television microwave relay development work by a fourth group has yielded some concepts and approaches, including subminiaturization of certain receiver sections, which may be of value in future television receiver design problems. Still another section, concentrating on test equipment, has developed such useful instruments as a flying spot scanner to provide pictures with varying amounts of contrast, an RF generator for signals on various channels and a monoscope generator for testing video response. This group also conducts propagation studies in various present and proposed frequency bands to determine propagation characteristics and study receiver and antenna response with a variety of designs.

Another general classification of the work done by the Research Division on television covers problems which demand an immediate solution rather than the long-range programs outlined above. Most of these problems involve aid to Design Engineering on some special feature of television receiver design on which trained research thinking is needed to provide clues toward a practical answer. For instance, new deflection and focusing circuits may be desired for a proposed new picture tube and chassis. Because of the tentative production schedule established, this becomes a "task force" project which receives top priority, with experts assigned to it who may, in turn, call on other groups in Research and Engineering for assistance. Special projects of this type also receive regular attention at progress meetings, as previously described, so that the thinking of Research Division leaders can be focused on the most difficult technical problems.



A group of research specialists discuss the "poles and zero" method of predicting TV IF amplification response, which can thus be determined without building an actual chassis

With projects consisting of long-range and immediate research studies, the output of the Division similarly divides itself into direct answers to assigned problems and basic reports which may cover a considerable section of a certain field and include answers to numerous questions or challenge further inquiry. In physical form, the Research Division builds experimental models of new circuits, components or systems to demonstrate the new principles which have been developed. These models often form the basis for parts of the future production designs evolved by Design Engineering.

Another tangible form of Research output consists of technical reports in which are contained full descriptions of the methods of analysis, technics and results obtained by each investigation. These reports

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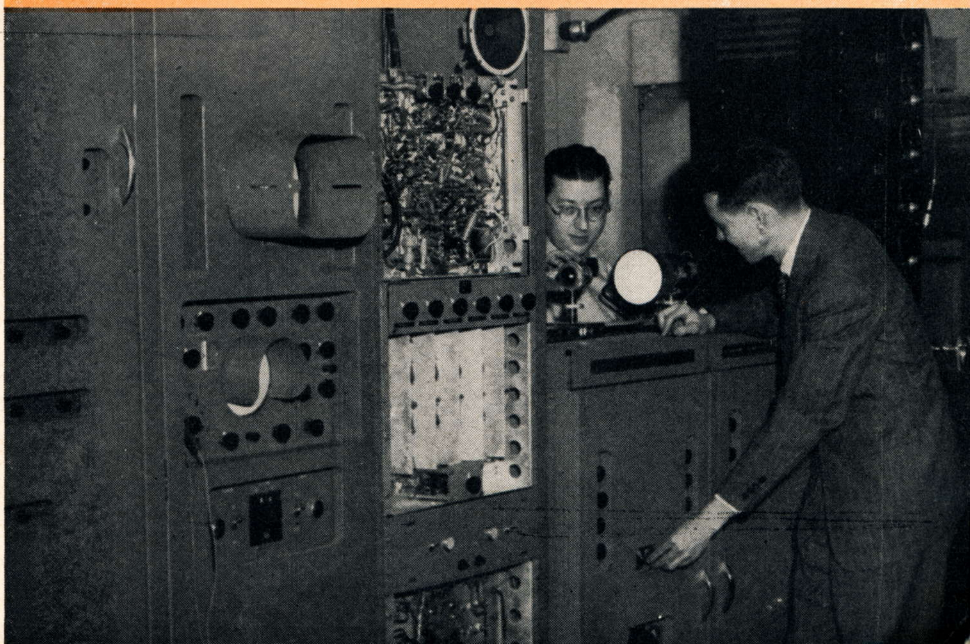
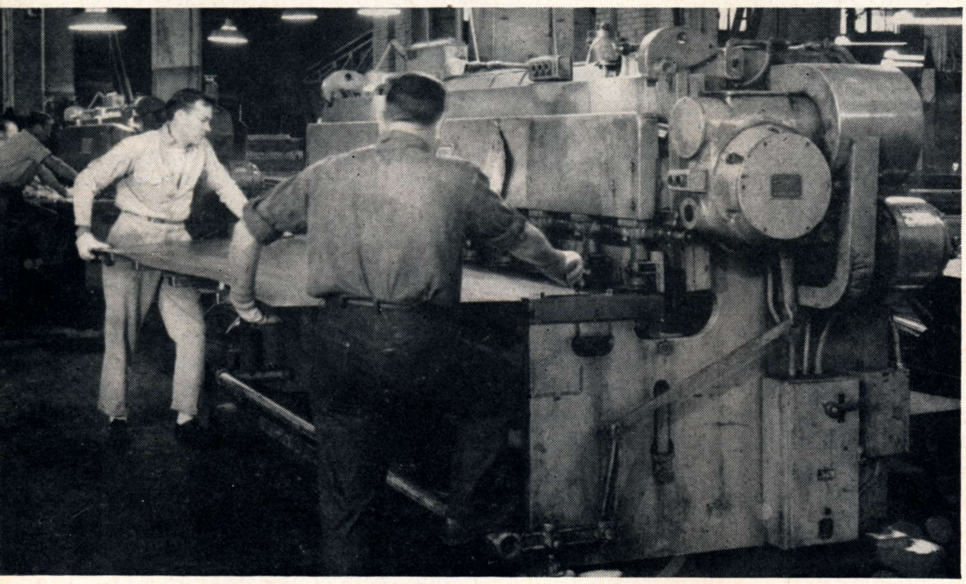
This flying-spot scanner, used to provide TV pictures of varying contrast range, is typical of aids to video development designed by the test-equipment section of the Research Division



Sub-Base Manufacturing

Modern machinery and mechanization in Philco's metal plant permits efficient cutting, stamping, shaping, welding and plating of all the metal chasses required in radio and in television production

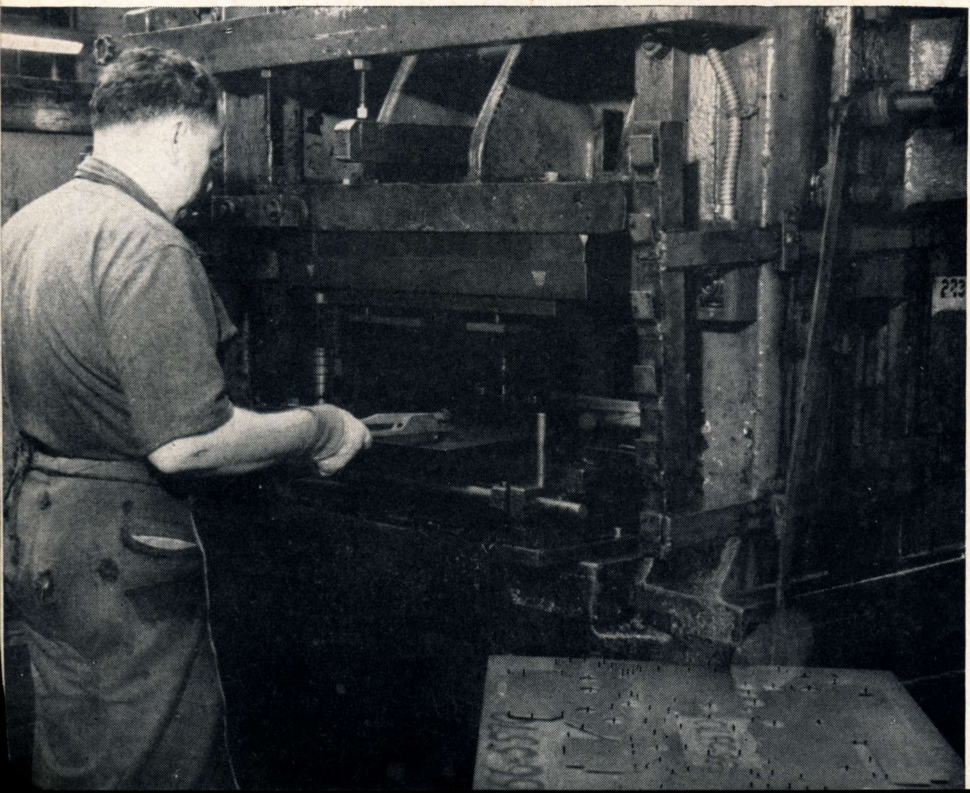


Incoming #16-gauge steel sheet metal being cut into blanks of the correct size for a television sub-base on a metal squaring shear. Foot-bar controls the machine's operation

PROBABLY the most outstanding individual component of a finished television receiver chassis is the metal sub-base, which in outward appearance is simply a piece of shaped and punched metal. Functionally, it has the all-important job of holding the assembled components rigidly in place. Sub-bases are a specialty at Philco, and the facilities provided at the Philadelphia plant allow for quantity production of almost any conceivable type of metal chassis. In the case of current television production, thousands of odd shaped sub-bases each having over 200 holes and cut-outs are made available to the main assembly line each week.

Sub-bases for television sets are ordinarily formed out of #16 gauge steel which is received at the plant in sheet form. Each steel sheet measures 48 x 120-in. An overhead crane delivers the incoming raw material directly to a bank of pow-

Press punching the larger holes and cut-outs. Operator's wooden handled suction cup facilitates handling of blanks while nailboard identifies any punch breaking during operation



Bending sides, inserting reinforcing indents, makes punched blank semi-rigid structure

Operations

er squaring shears, from railroad freight cars. These shears cut each of the large sheets into 22 x 24-in. blanks, the size required for a television sub-base, and these in turn are fed into the punching and forming presses.

The plant is equipped with 85 different presses that range in capacity from 10 to 500 tons. In passing through the plant, the television sub-base blank is first subjected to three piercing operations where different sized holes and cut-outs are punched. The larger holes are punched first while smaller and odd shaped holes are added in subsequent steps. Each punching operation has been carefully engineered to avoid any stretching or tearing of the metal between the adjacent holes. A spot check is made periodically by the operators of each of the presses to be sure that none of the punches in the machine have been broken. For this purpose nailboards are used, and these consist of a board larger than the sub-base in which brads or nails have been driven to outline each of the holes in their correct location as formed either by previous or current punching operations. If a punch has been broken, the sub-base will not fit over the nails and onto the board below, whereas if the press is operating normally a snug fit at all points is achieved. When a punch is broken, the press must be stopped until the die can be removed and the punch replaced. Philco, in maintaining its own tool and die shop, minimizes stoppages of this nature.

The tool and die shop employs 54 machinists and tool and die-makers. Their jobs, aside from repairing broken dies, include changing dies to conform with the latest engineering specifications and building new dies for each press operation when required. The construction of a new die or a new series of dies is both time-consuming and painstaking work, and accounts for a large percentage of the eight to ten weeks preparation time required before the plant can be geared to production.

At Philco, measurements for all dies are made by using the upper left hand corner of the die plate as a reference point. The die plates are drilled on a jig borer that has an accuracy of 0.0001-in. and is directly readable on an indicating gauge. The holes are drilled so that the punches will fit snugly and are countersunk to allow them to be flush with the back of the die plate. The die plates (upper and lower) are then mounted on die-sets which in turn are bolted into the presses. Tool and die-making requires considerable attendant machining equipment and consequently a variety of lathes, milling machines, shapers, and grinders are on hand.

Returning now to the television sub-base, after the piercing operations have been completed, the blank is fed into another press in which a forming die has been installed. It is at this point that the blank begins to take on the appearance of the component observed when looking at the finished television chassis. As the die descends into the center of the blank, all of the sides are

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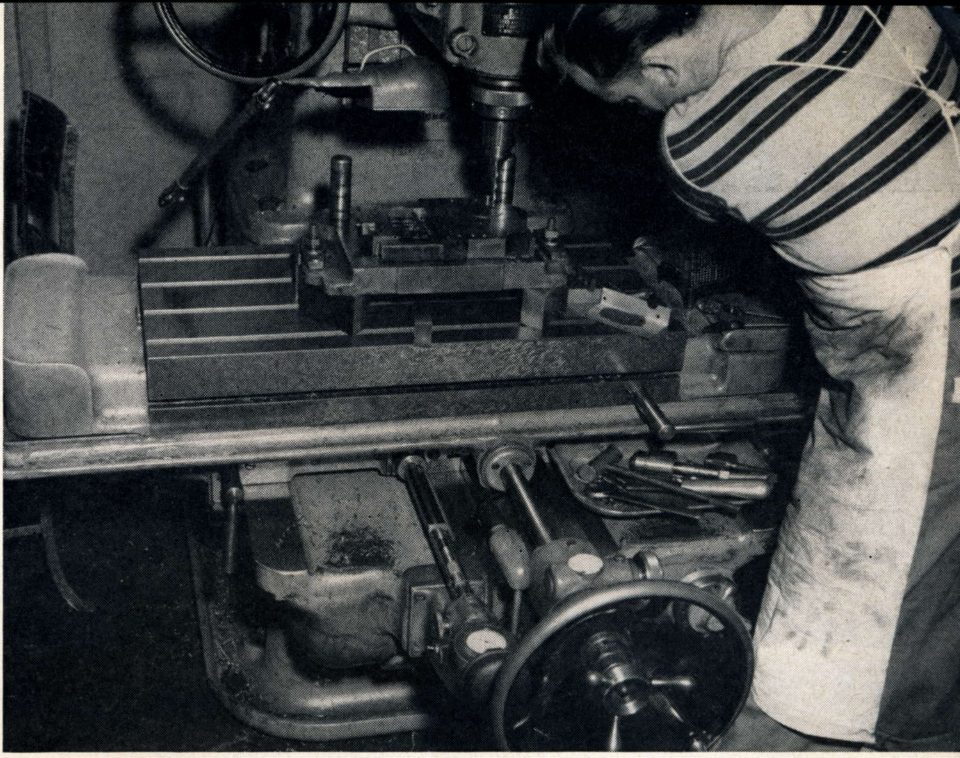
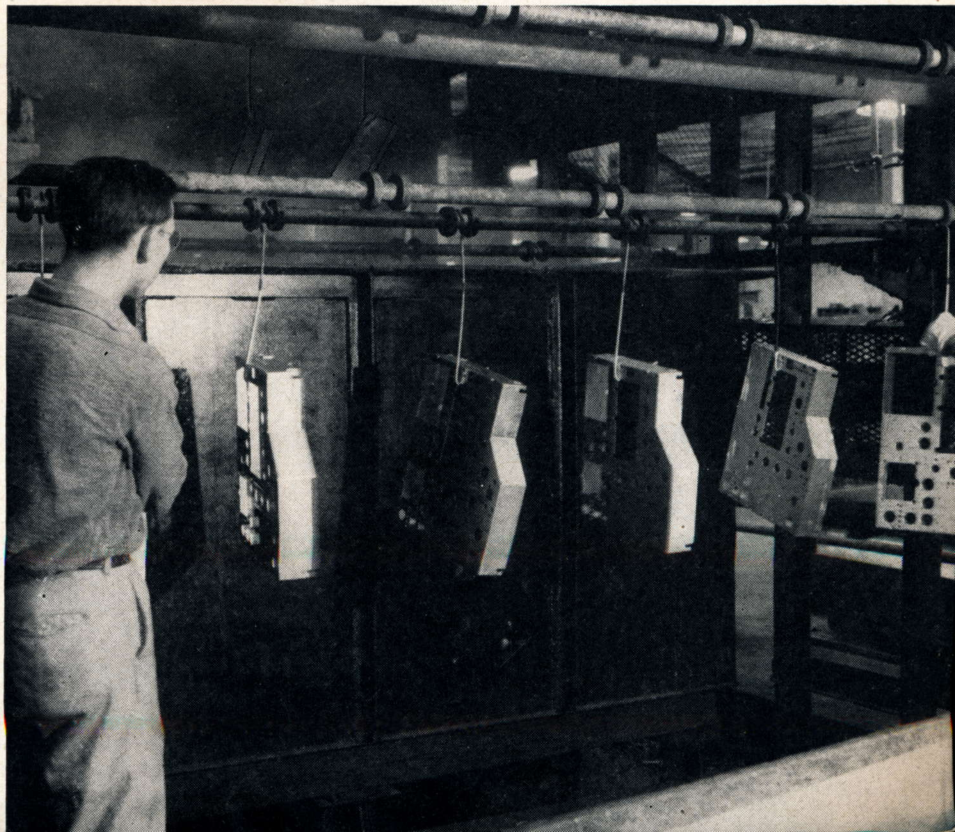
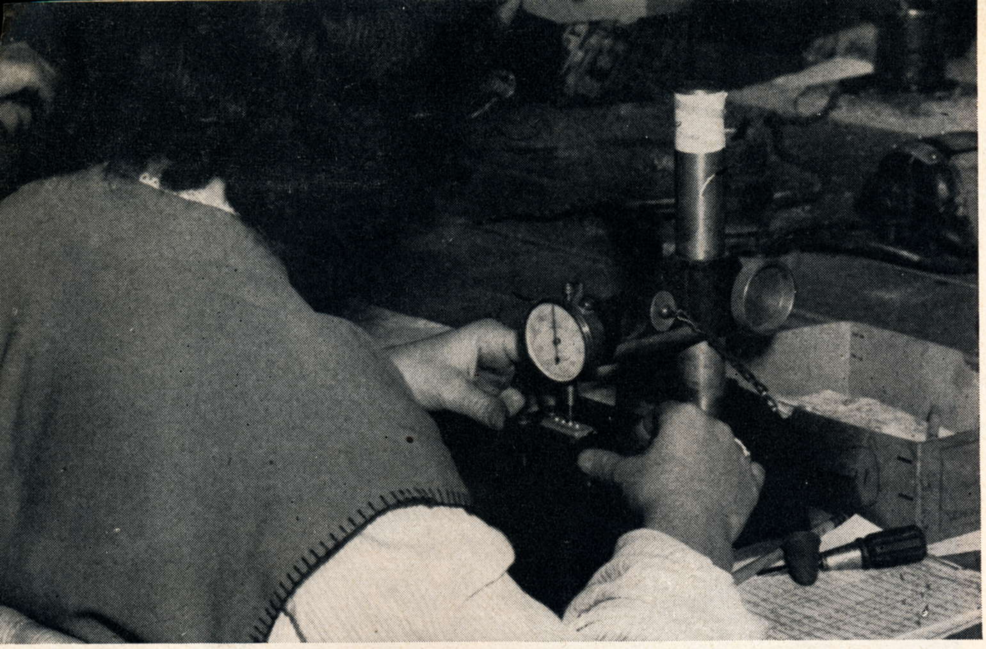


Drilling a die plate in a jig-borer. All die measurements are made from the upper left corner of the plate. Gauge in center foreground reads directly in 0.0001-in. graduations

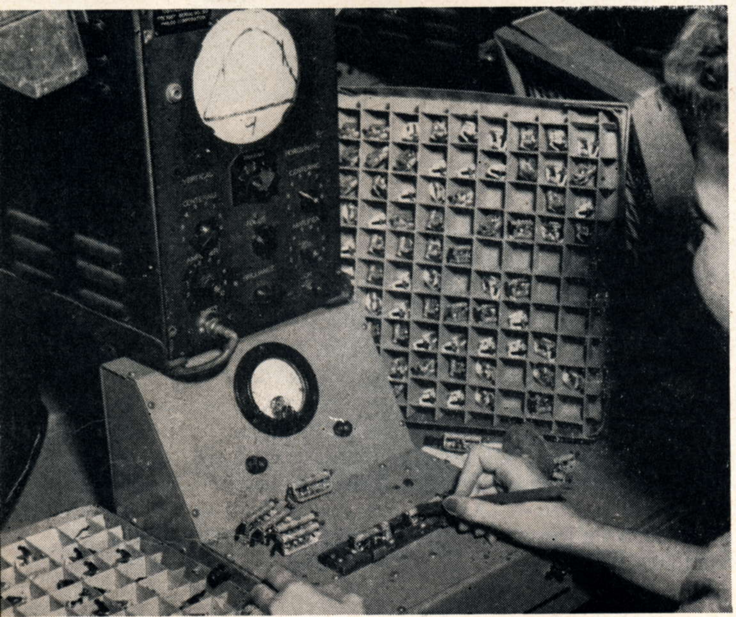
Finished television sub-bases emerging from one of the two automatic electroplating machines in Philco's plant 6. Standardized zinc plating prevents subsequent rusting of metal





Coil & Transformer Manufacture

Nearly 50% of total RF, IF and special coil assemblies required for radio and television sets are produced at Plant 20



↑ Direct reading mechanical gauge measures height of contacts in turret switch wafer

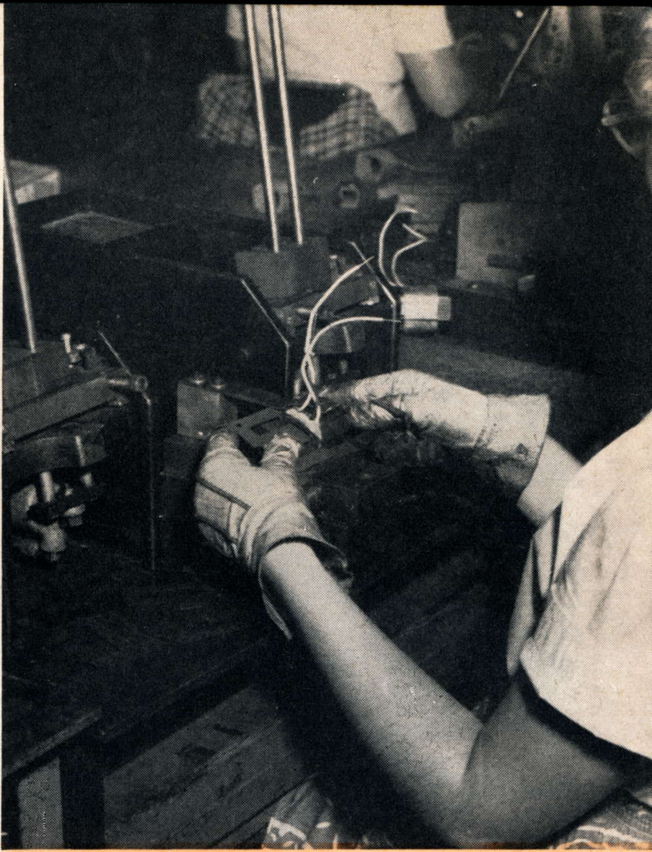
← Crayoned pattern on oscilloscope screen indicates response limits for correct location of the coils on the form

NEARLY 50% of Philco's total coil requirements come from its subsidiary plant No. 20 located between Trenton and Philadelphia, at Croydon, Pennsylvania. The two-story plant provides approximately 70,000 square feet of floor area and some 85% of its 1200 employees are actually engaged in producing various types of power transformers and rf and IF coil windings.

Each week Croydon ships production quantities on some 200 different coil components. New orders take about five weeks for deliveries.

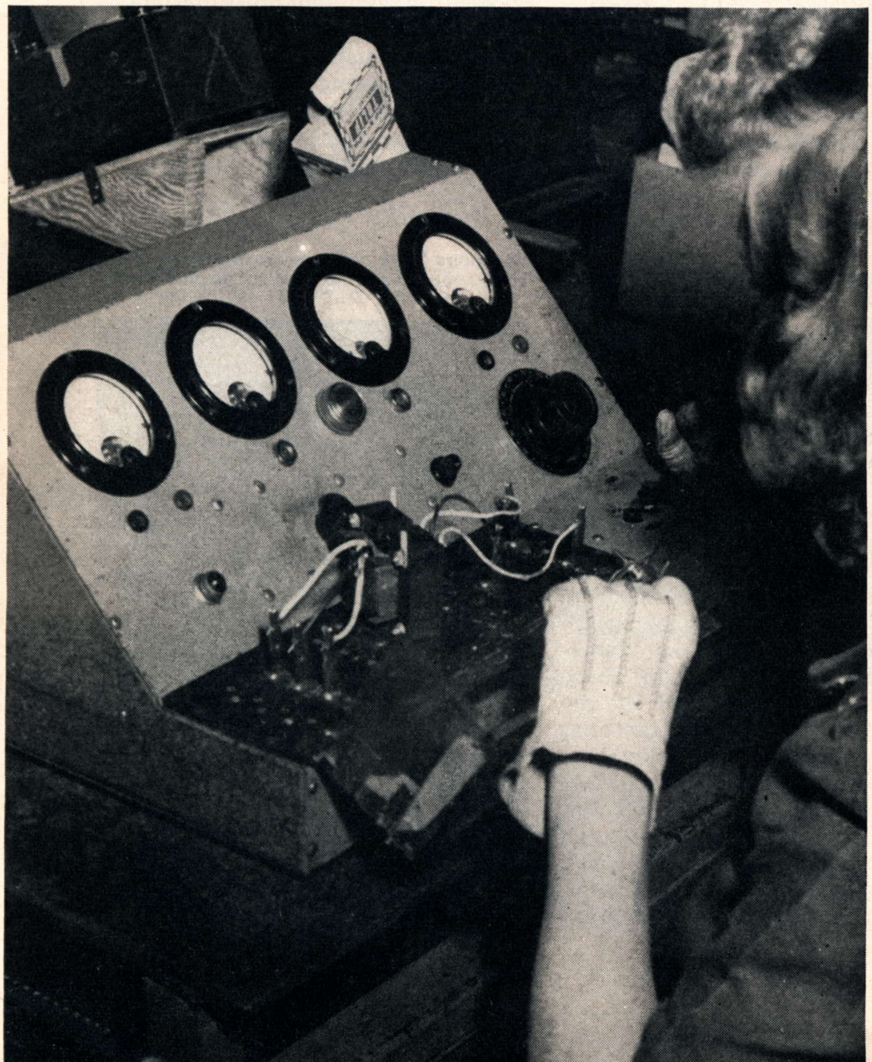
Three cathode ray tube focusing coils being wound simultaneously. Machine stops automatically when required turns are wound

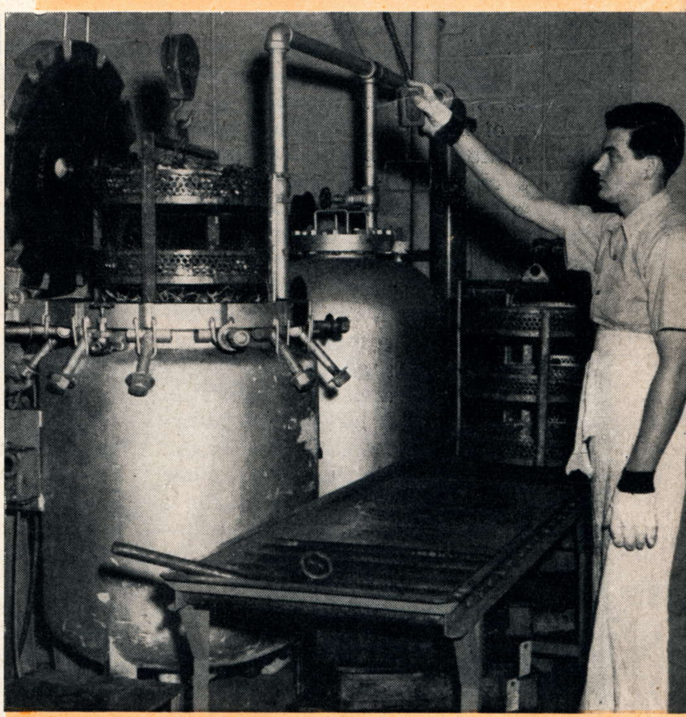
After connecting leads have been soldered to the start and finish of focus coil windings, unit is assembled into metal housing as shown



Above: "E" laminations are inserted through the superimposed primary and secondary windings alternately, as shown, and form the magnetic core of the transformer

Left: 19 secondary coils for small power transformers being wound on single form. In subsequent operation a band saw is used to separate each of the windings





Above: In order to seal transformer windings against moisture, units are impregnated with hot wax in evacuated vats

Left: Completed transformer being tested for power output. Connection clips are dead until operator closes the cover

Cabinet Design &

Heads of cabinet design section employ rough sketches as visual aids in determining which solution best meets desired specifications in new cabinet design

"Mock-ups" of new TV cabinets illustrate all design features and aid in establishing production methods

THE television receiver, in addition to being a device for receiving pictures and sound through the air, must also function as an article of furniture in the consumer's home. Furniture styles and trends change from year to year, and so it becomes the function of the cabinet design department to develop new cabinets that will be in line with current style trends.

The design of a new cabinet begins when, after a meeting with top management, the general performance and appearance characteristics of the new model have been determined. A product assignment sheet is then issued which directs the development of a new cabinet for a chassis that will be under simultaneous development in the television receiver design section.

The product assignment sheet will indicate the tentative price and the tentative production date of the new model. These two factors establish important boundaries for those responsible for cabinet design. The tentative price sets an approximate cost limitation, while the tentative production date defines when the new cabinet design must appear in quantity production.

Upon receipt of a production assignment sheet, a meeting is held between the chief technical director and styling director of the cabinet design section, and the desired features, characteristics, and materials of the new design are discussed. When the details have been organized they are turned over to an individual designer, or a selected combination of designers for development.

The number of industrial designers employed on any specific assignment is not fixed but will vary in accordance with the tentative production date. If this date is scheduled sufficiently in advance, the assignment may be given to only one designer, whereas if the production date is in the immediate future, as many as three or five designers may get the same problem at the same time.

The designers involved on the project prepare a series of rough sketches showing a number of possible solutions to the problem. These sketches are then screened by the chief designer and the better ones are selected for further development. Sometimes when a cabinet design involves unusual shapes that are difficult to illustrate in sketch form, modeling clay is used to work out an illustrative example.

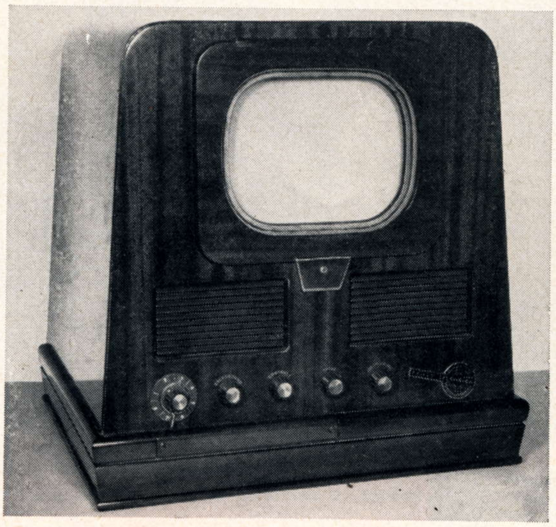
The rough designs selected are then worked out into full-size, accurate, detailed drawings from which a full-size model, or "mock-up", is made. The model shop available to the design group employs production type woodworking machinery. This minimizes production difficulties that might be encountered in translating a hand-built cabinet into a production model.

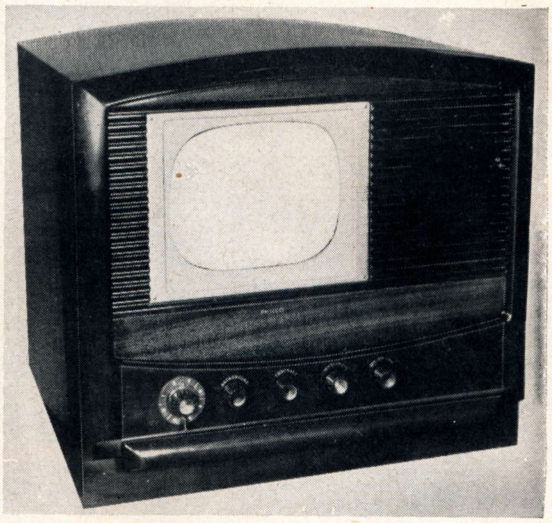
During the time that a new cabinet design progresses to the detailed drawing stage and to the model stage, close liaison between the chassis design group and the cabinet section is necessary to assure that the cabinet model will be of the correct size and shape for mounting the chassis assemblies.

Cabinet finishing is a major consideration in developing a design model and in fact a design's fate is often determined by the selection and execution of the finish. The cabinet design section at Philco has access to a complete finishing laboratory where nearly every type of production finish is stocked, and facilities for mixing any desired finish are available. Wood cabinet finishes usually consist of the toner stain for overall color, filler to close up the

Designers have quick reference to the latest cabinet hardware mounted on display boards

Product Development





At left is the original model of a 1001 cabinet which never reached production. The design was abandoned in favor of the cabinet style shown at right

pores of the wood, sealer to seal the wood against moisture, and several coats of clear lacquer to present a tough surface treatment. Plastic mock-ups are usually made from wood and finished to simulate the desired plastic.

A satisfactory appearance having been attained in the finishing process, the model is taken to the "fit-up" room. At this point the designer must see to it that every desired detail has been incorporated and must be satisfied that the model looks exactly like an operating model, even though it is only a mock-up. All knobs, dials, dial pointers, grille and grille cloth, must be absolutely perfect in appearance so that the model will be ready to be shown.

New models are shown to a group of sales executives at a special meeting where all factors such as saleability, cost, and tie-in with other current models are considered. If the model is not approved, modifications are studied that might make it acceptable when presented at a later showing, or the model is abandoned altogether and a fresh approach to the design is started.

After the sample cabinet model has been approved, it is turned over to the furniture engineering section where production drawings are prepared and production samples are developed based on the newly designed model.

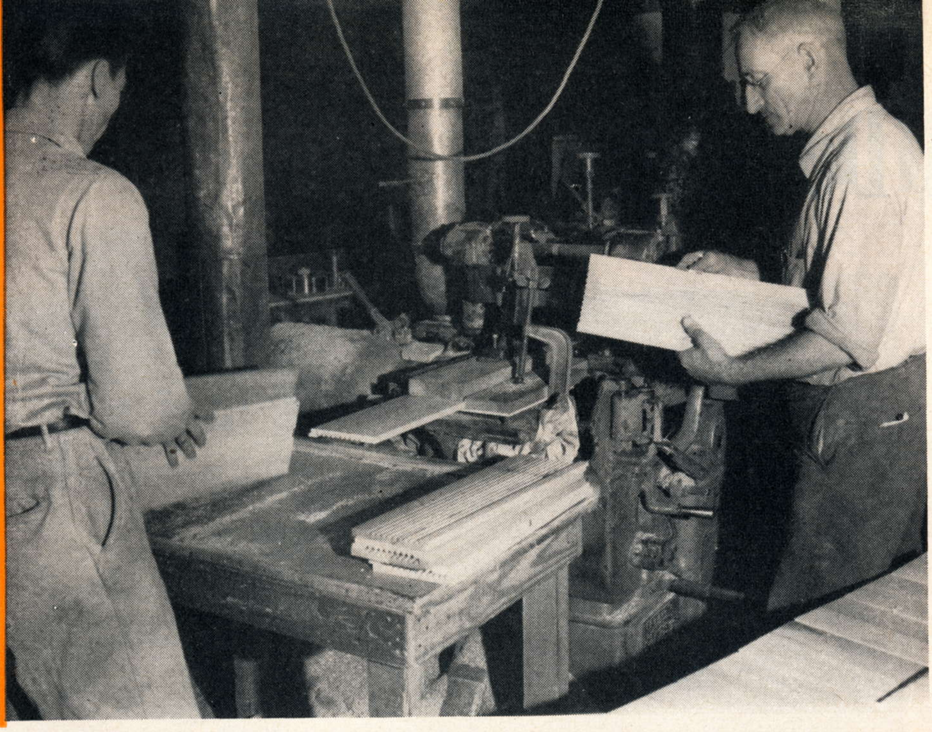
The cabinet sample forwarded to furniture engineering is closely studied for production methods which, incidentally, may vary from manufacturer to manufacturer. For example: some manufacturers may prefer to make the base of the cabinet out of one piece of material,

(Continued on page 87)

After a design has been approved, full-scale detailed drawings are prepared for use by model shop in constructing design sample

Cabinet-makers check the size of each component part against full-scale drawing and use production types of woodworking machinery

Back posts for the consolette cabinets are glued, clamped together, and then placed in position on this sub-assembly clamp carrier which rotates slowly. The glued posts dry in one 30-minute revolution ↓



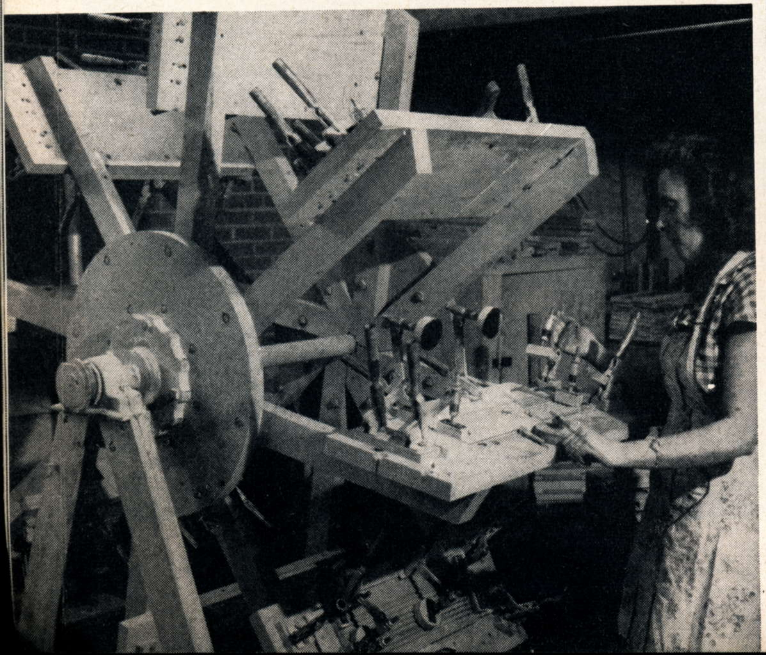
← Machining instrument rail panels for a Philco television consolette is efficiently done in this automatic moulder at Watsontown. Note workman at right checking typical panel dimensions

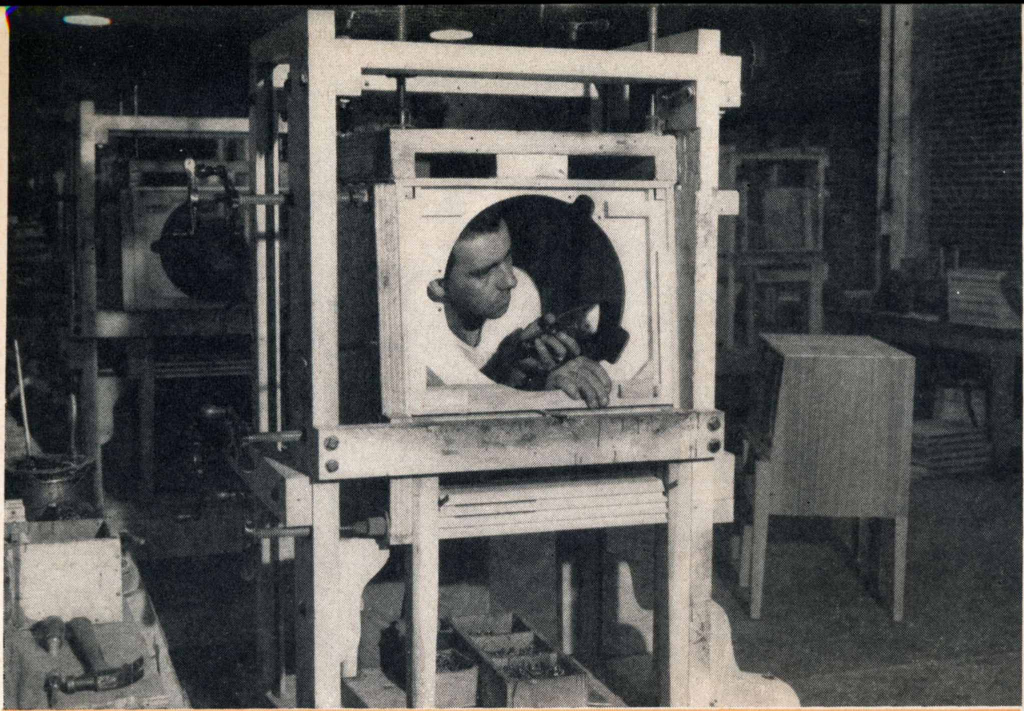
TV Cabinet Manufacturing Methods

525 different construction operations required for consolette type cabinets

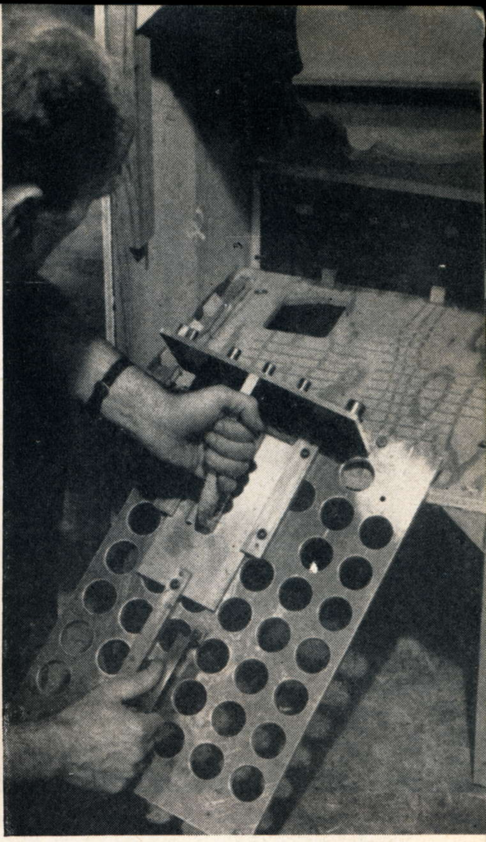
Grille overlays and top cleats are glued and then clamped together on this "merry-go-round." As the device revolves, the sub-assemblies dry →

Dial inserts are glued into the instrument rail panel and this sub-assembly is clamped on a "ferris-wheel" for drying as wheel revolves





A specially built press holds the parts of a Philco model 1240 during major assembly operations



This special jig checks cabinet size and panel hole locations to assure a precise chassis fit →

WATSONTOWN Cabinet Division of Philco Corporation produces a large number of the cabinets for Philco television receivers, utilizing 365,000 sq. ft. of working space in several modern plant buildings located on a 13-acre site in Watsontown, a small town in north-central Pennsylvania.

The entire process of making television cabinets is well integrated so that the 525 different operations required to produce a typical consolette flow smoothly, from the basic raw material—lumber in a huge seasoning shed—to packing the gleaming hand-rubbed finished cabinet in its carton.

At Watsontown, over 1,500,000 board-feet of gumwoods, walnut and mahogany are air-drying at any given time, or more than three months' supply at the average consumption rate of 100,000 bd. ft. each week. This lumber is all first air dried, then kiln-dried, and tempered for several weeks before cutting, so that the wood will not change dimensions when the completed cabinet is in the customer's home. Incidentally, it takes about 9 board feet of lumber to produce a typical Philco television receiver consolette.

Seasoned lumber, its moisture content carefully checked, is cut and ripped in the "dimension plant" where any defects are removed and the wood is faced to level it, then put through moulders to give it the desired profile. Next step is the wood mill or "machining plant" where the final machining operations take place and some sub-assemblies are glued together. Careful planning to determine which parts can best be made by cutting and which should be glued, results in the most effi-

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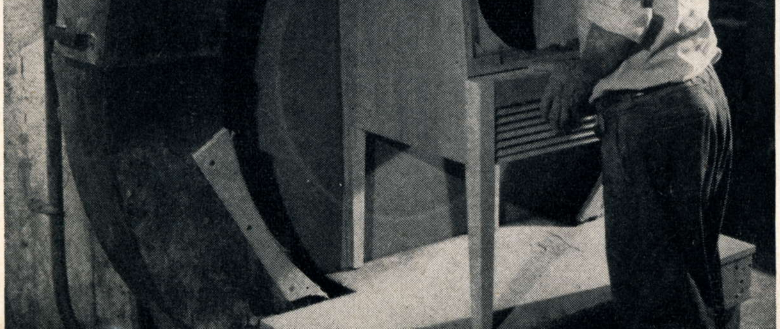
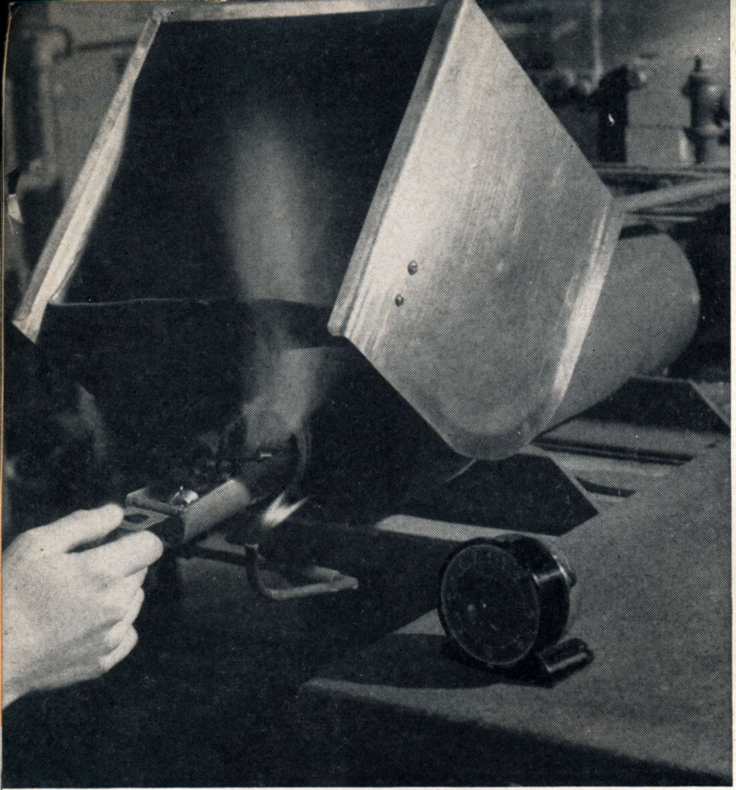
One of the large sanding machines used to quickly remove rough spots and do the final trimming on backs of television consolette cabinets



Consolette cabinets are carried by monorail conveyor to a specially designed spray booth where a final lacquering operation is performed



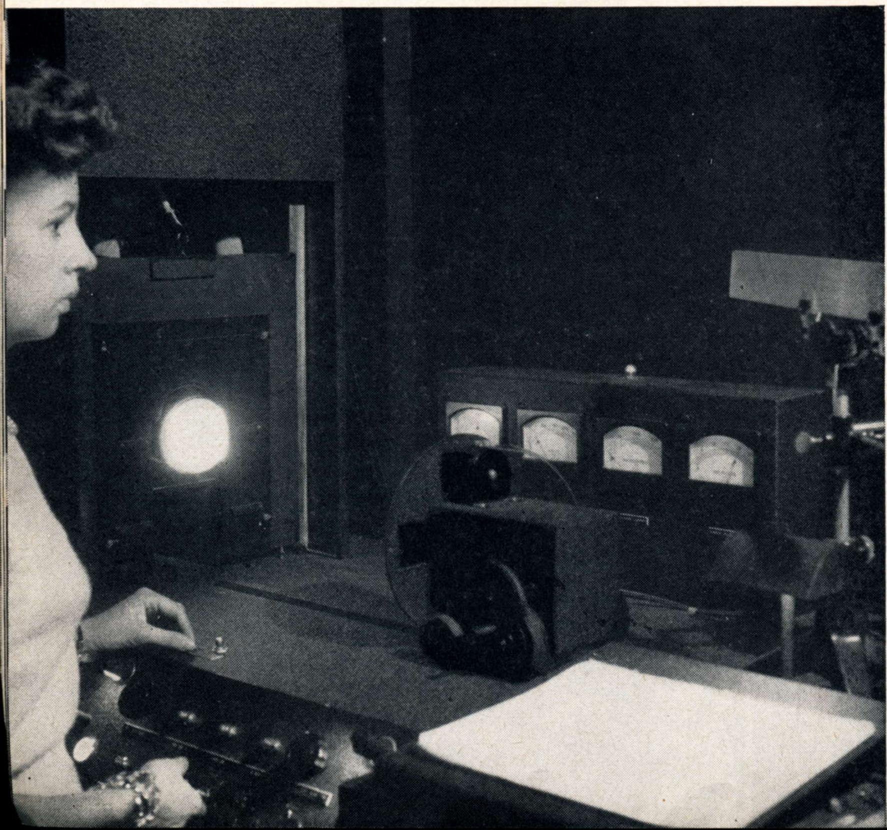
Clean, oxide-free parts are produced in hydrogen fired ovens at Lansdale. If oil, lint, oxides or finger smudges are not removed arcing, stray emission or leakage might occur in finished tubes

Cleaned, metallic parts, welded together, and mounted to a glass stem from the electron gun. Due to high voltages, careful 100% inspection is performed to assure freedom from quasi-short circuits

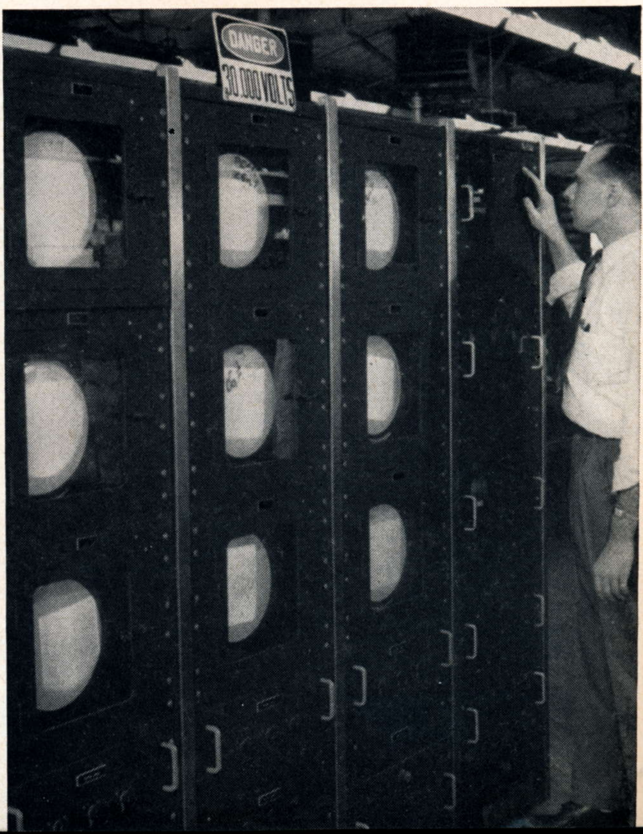
TV Tube Manufacturing

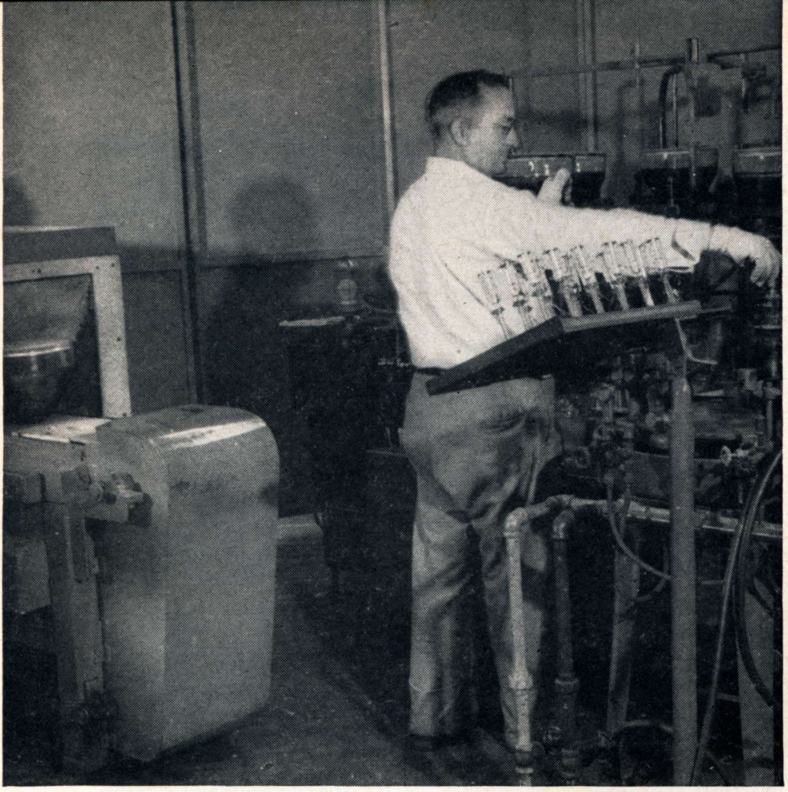
Modernization and mechanization plans now underway will result in lower

In order to assure good black-and-white pictures the color content and screen coating of cathode ray tubes must be uniform. Here the operator checks the ratio of green, blue and amber against a standard illuminant

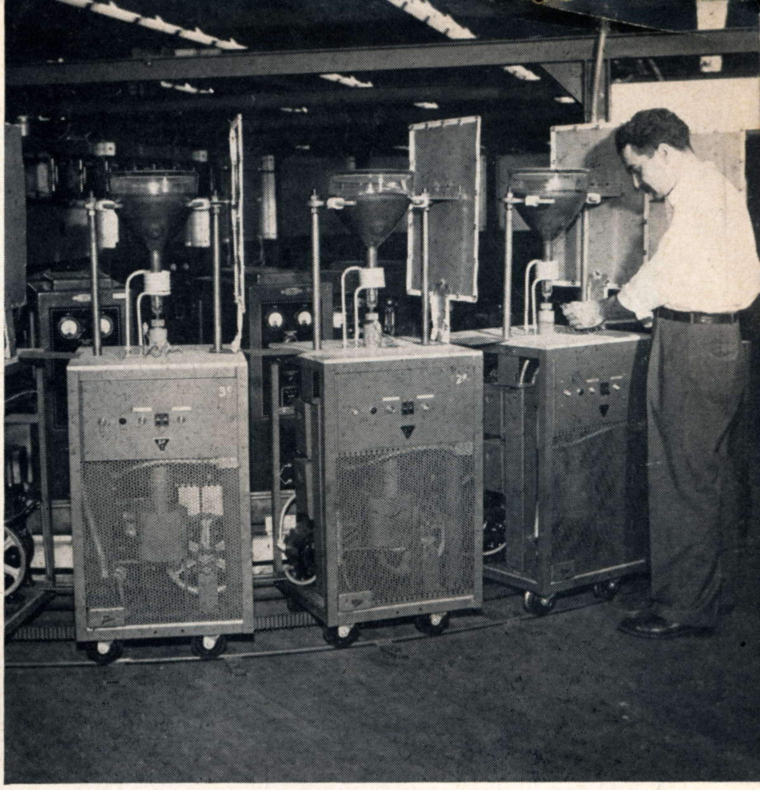


Samples of each production lot of picture tubes are life tested as long as 1000 hours at maximum voltage. Frequent readings indicate life expectancy





Carefully pre-heated tube gun stems and bulb necks melt together at proper sealing temperature. In the annealing furnace, at left, tubes are cooled gradually to prevent strain patterns in the seal



50 trolleyed evacuation pumps are pulled through temperature controlled ovens to bake out bulb gases. Simultaneous RF heating of gun assembly removes occluded gases in metal components

Operations at Lansdale

production costs of cathode-ray "picture tubes", 90% of which are of 10-inch type

Typical of performance testing on miniature tubes used in television receivers are the measurements for diode balance and hum. Tubes are used in discriminator circuits of the audio section.

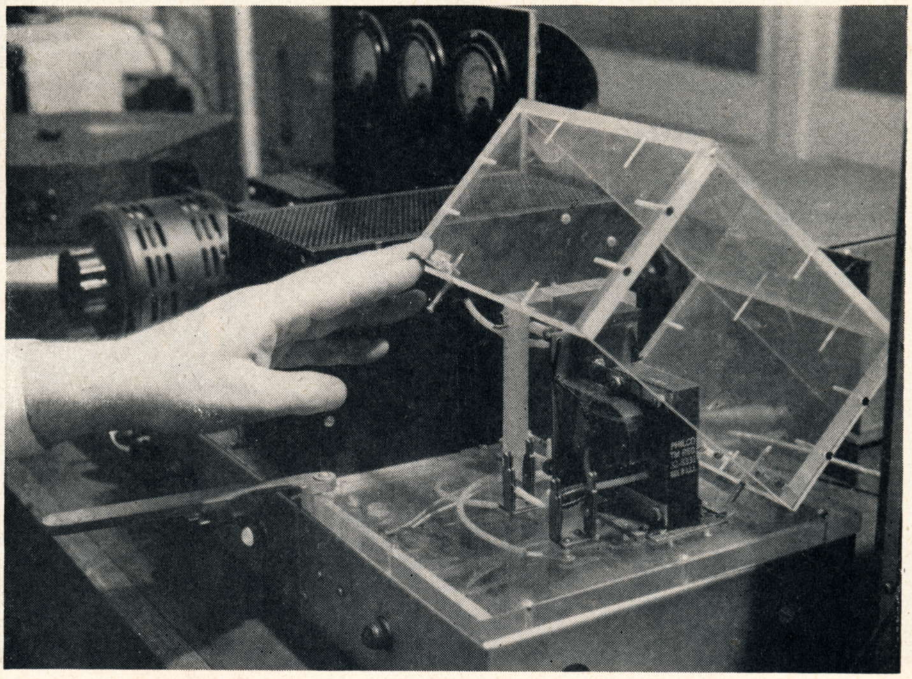
THE Lansdale Tube Corp., at Lansdale, Pa., as a subsidiary of the Philco Corp., is one of the important sources of the company's supply of television tubes, including picture tubes and other tubes, and a vital link in Philco's television operations of the future.

Extensive modernization and mechanization plans now under way will make it one of the most up-to-date television tube production facilities in the country. The new mechanization planned will result in a substantial reduction in the manufacturing costs of cathode ray tubes.

The plant with its present facilities is turning out many thousands of cathode ray tubes per month ranging in size from four to 12½-in. in diameter, and of these approximately 90% are of the 10BP4 type (10 in.). Some 35 other tube types, totalling 40,000 per day, are also manufactured in Lansdale and one half of these are used in television sets.

By April, 1949, present facilities will be increased to provide greater cathode ray tube production capacity. These extensive improvements, as already pointed out, will result in important reductions in the production costs of picture tubes for Philco television receivers, some 600,000 of which receivers are scheduled for 1949 production.

Unusual Test Equipment

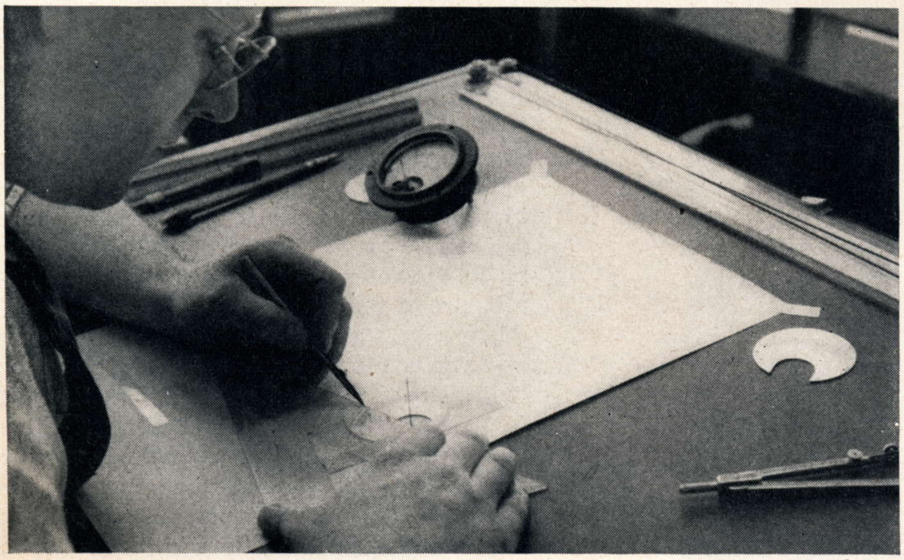


High-voltage TV transformer test equipment typifies precautionary design practice. Unit is powered when lower plastic cover screws actuate interlocking switches beneath chassis

PROBABLY the most important phase in the manufacture of a television receiver, aside from actual assembly operations, is that of testing the various sub-assemblies that go into the finished product, and testing to see that the new receiver performs within the engineering specifications. Commercial test equipment for the most part is extremely expensive and not always adaptable for use on assembly production lines. At Philco test problems are divided between two engineering groups, the first of which is concerned with the design of production test equipment while the second builds and maintains the required number of equipment units.

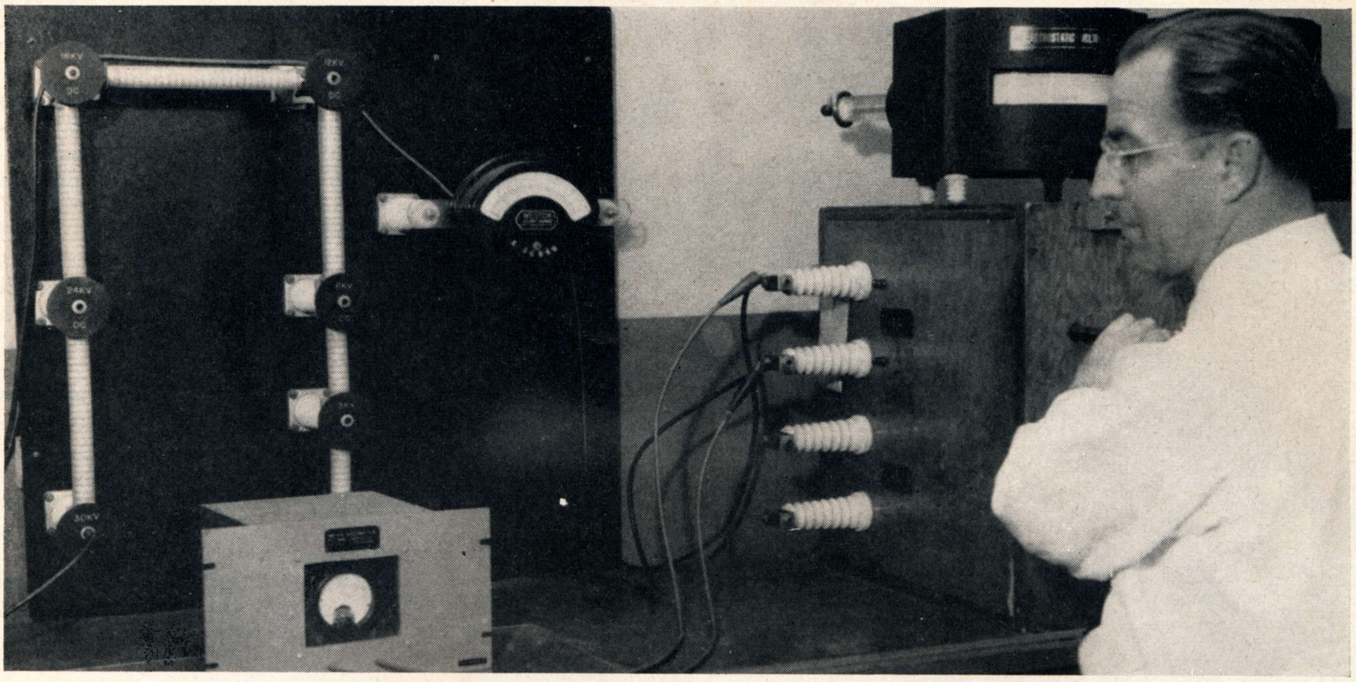
The design group, composed of approximately 25 engineers, prepares the detailed drawings of the equipment to be used in the various test operations. The basic design information is furnished to this group by the Factory Engineering Section who in turn compile the data from the various laboratory tests performed on the engineering samples. On a television receiver, test operations begin with simple circuit resistance checks that are made on the chassis before the tubes are inserted and before any power is applied. When a receiver has successfully passed this point, the tubes are inserted and power applied. In the absence of any obvious defects such as "smoking" or "burning", the set then progresses through the various alignment positions, and after the chassis has been installed in its cabinet, final checks are made using both artificial and transmitted signals.

Preparing new meter dial scales in Philco's meter laboratory. Use of the instrument in production is simplified when direct readings of the desired measurements are obtained



Since television transmission standards have been established by the FCC and since all television receivers will be operating within those standards, Philco has found it expedient to install a central signal cage which houses all the signal generators required for testing. Coaxial transmission lines carry the signals from the central signal cage to test points on the main production line and to operators in trouble shooting areas. This practice eliminates duplication of equipment and offers greater flexibility for extending any test signal to another position.

With a central signal generating system in operation, it becomes possible to minimize the required number of new test equipment designs by re-designing portions of existing equipments or by re-setting the signal levels in the transmission lines. New test equipment, aside from having to fulfill a test requirement, must also include other considerations. In the case of television this sometimes involves designing intricate power interlocking systems because of the high voltages employed, and because of the non-technical or semi-technical personnel operating the equipment. Production schedules and non-technical personnel also make simplicity



Calibrating a production kilovoltmeter. Calibration equipment was designed to produce known high voltages ranging from 3 to 30 kilovolts and consequently can be employed to test instruments used on production lines manufacturing both direct view and projection TV receivers

in all designs a key-note.

In general all production test equipment, including the signal generators for the central distribution system, is designed and built at the Philco plant. Occasionally a requirement for a piece of standard commercial test equipment is established, and under these circumstances the Test Equipment Design Section determines which of the available models shall be purchased from outside sources.

Philco test design engineers devote a great many hours to the development of specialized production-test equipment because of the need for specific types of precision tests to maintain high quality standards of performance and to achieve large-scale production efficiently on moving test conveyors.

Construction and Maintenance

The construction and maintenance shops and laboratories for production test equipment operate as six separate sub-groups. The first of these, called the metal group, constructs the metal cabinets and sub-bases needed to house the test equipment. The units are made from sheet metal stock and all processing equipment necessary is at hand. Raw material is cut to size in a squaring shear and the resulting blank is punched with the required mounting holes on a power press. Several different types of hand operated brakes are available to bend the metal into the desired shape and drill presses are used to bore the mounting holes for the front panel and all of the necessary components.

After the sub-base has been formed it is forwarded to a second group for insertion of components and for wiring. Each unit is individually wired and checked and is then brought into the laboratory and calibrated for the job the unit was designed to perform on the precision signal generating and test equipment available. The completed instrument is then installed at desired points along the assembly line by members of the installation sub-groups.

A jig and fixture sub-group operating independently prepares the necessary cord ends and test jigs or fixtures required to operate in conjunction with each unit of test equipment. Primarily the group is concerned with the development of

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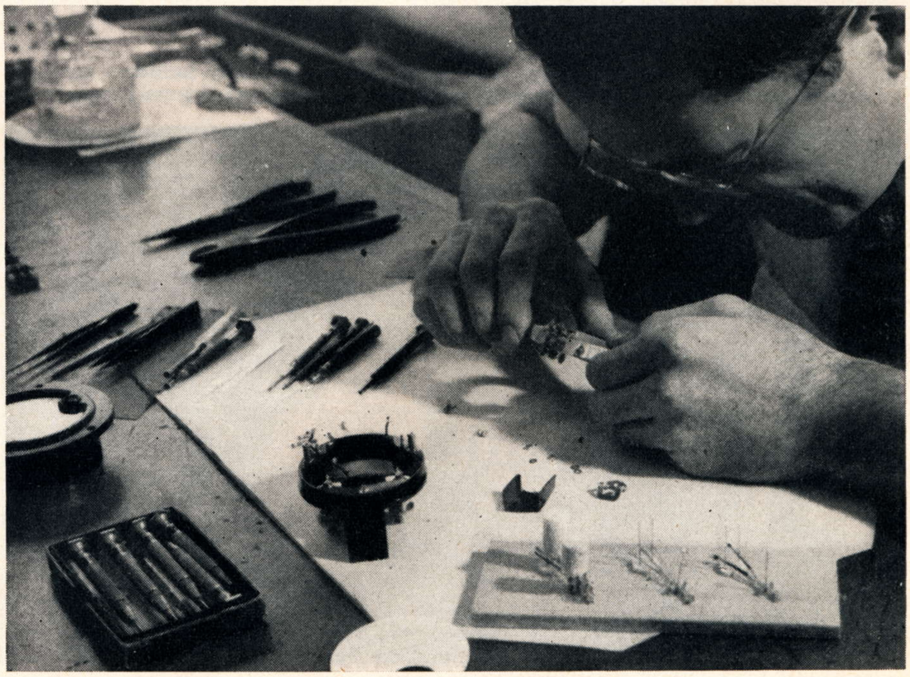
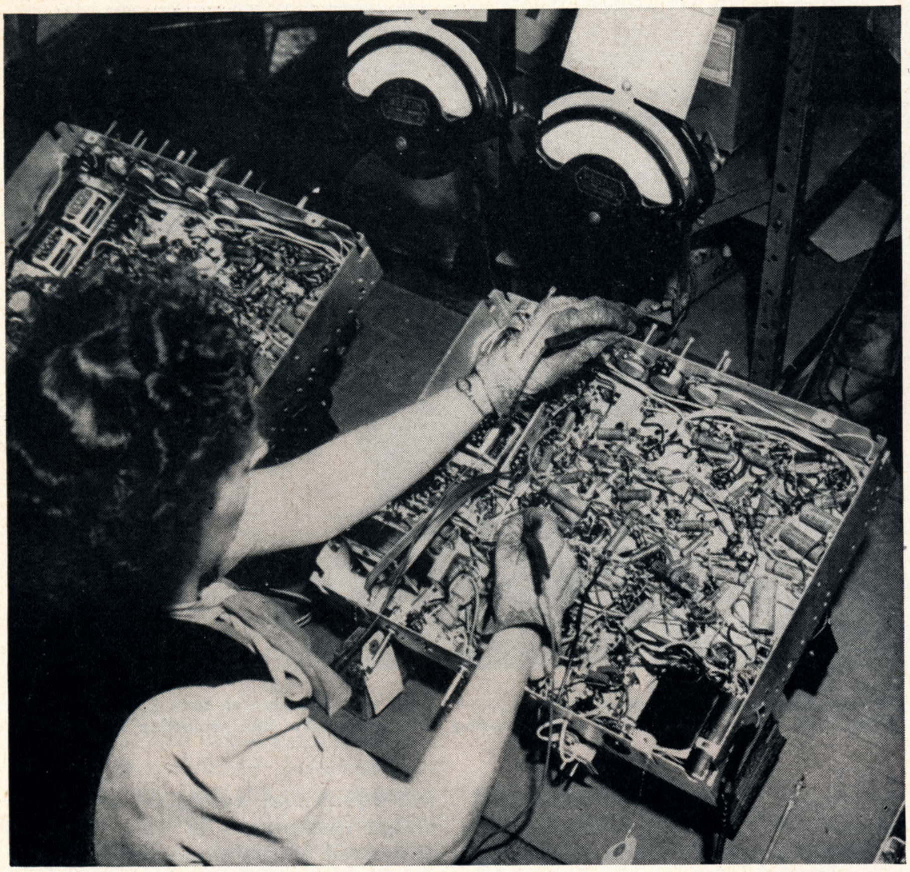
A complete stock of spare parts for all basic meter movements used is maintained so that necessary repairs can be effected promptly. Note jig for holding pointers, bottom right





Using an ohmmeter on production line for checking continuity and resistance of various TV circuits. Removable meter scales show "Go" and "No-go" limits

cord ends to enable rapid connection of test equipment to points in the chassis where test signals have to be applied or where signal strength or frequency response measurements have to be made. The construction of these items must be such that the unit will withstand rugged treatment in production, maintain its accuracy, and permit connections to the chassis under test without undue handling of the assembly.

Broken items of test equipment are referred to a repair sub-group who effect the necessary repairs with a minimum delay to avoid production stoppages. Usually this involves installing a spare model of the equipment kept on hand for such eventualities.

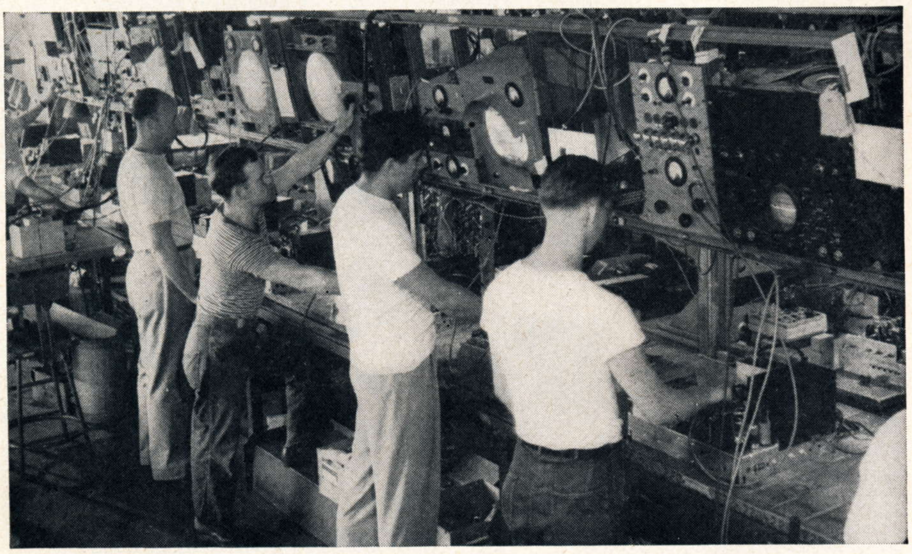
Philco has standardized the size of test equipment as much as possible in order to minimize construction, installation and maintenance costs. All equipment is designed for rack mounting and a standard panel mounts on 12" centers. Larger units vary in height but not in the width dimension. Test equipment has a standard color throughout the plant and for this reason is readily identified. Vista green was chosen as the standard because tests have indicated it to have a beneficial psychological effect on the employees and also because it is easier to clean than some of the other colors, notably black.

There are two auxiliary groups which are connected with the Test equipment Construction and Maintenance Section. The first, called the transmission line group, is concerned with transmitting tests signals from a central signal cage to the various points along an assembly line. This group also maintains the equipment in the contral signal cages.

The second group, called the continuity group, studies circuit diagrams of new television receivers and determines the resistances which would be encountered in connecting a test voltage to different portions of the assembly. From these studies the group determines the various test points which would yield the maximum information on wiring continuity when using an ohmmeter as a test instrument. Preliminary resistance checking saves time and money in production since it serves to check on wiring, short circuits, and soldered joints before the chassis is sent along for final test and alignment operations.

The final auxiliary sub-group is the meter laboratory which maintains all the meters used for measurement throughout the plant and builds such special meter circuits as may be required. This laboratory also builds more complex equipment for basic meter movements. A set of electrical standards is maintained so that new instruments can be easily calibrated, and these standards are rechecked periodically by the Bureau of Standards in Washington. New dial scales for the various instruments are also constructed in the meter laboratory as are such special shunts or multipliers as may be required when building more complex instruments from basic meter movements.

Test equipment mounted at eye level above chassis conveyor facilitates set alignment. Celluloid masks on oscilloscope screens show desired curve shapes



Cathode ray tubes, ready for mounting in new television receiver cabinets, being tested enroute to the main production lines.

Television Receiver Production

Efficient plant layout and coordination of activities assure scheduled outputs

PRODUCTION-LINE operations are so scheduled that each worker performs a separate operation. These operations are flexible so that the line and output can be contracted or enlarged on short notice without loss of assembly or production time.

In general, all processes involving the manufacture of the receiver from component parts and bare chassis to the packing and shipping are determined and specified by the Industrial Engineering Department. Meanwhile, the Production departments are consulted and are eventually given complete operational layouts, with the associated facilities, to do the job. Changes in the basic design, with a view toward reducing costs, are studied; and the various departments affected, such as Engineering or Purchasing, are consulted to consider the feasibility of the suggestions.

A close study of all the factors involved in the mass production of an intricate television receiver entails such items as: allocation of production areas; the determining of plant facilities; type and dimensions of moving conveyors and other specialized equipment needed. Plant revision costs must be kept as low as possible by utilizing the area most adaptable to the manufacture of a specific receiver. If the receiver is a new model which supplements or follows an existing model, relatively few major changes are needed; however, an entirely new receiver requires complete facilities of its own.

In processing a new model for production the Factory Staff Organization, Design, Engineering, Purchasing, Material Control, Operations Planning and other interested departments will confer to establish actual production dates and schedules. Such matters as the release of engineering specifications, completion of tools and fixtures, comple-

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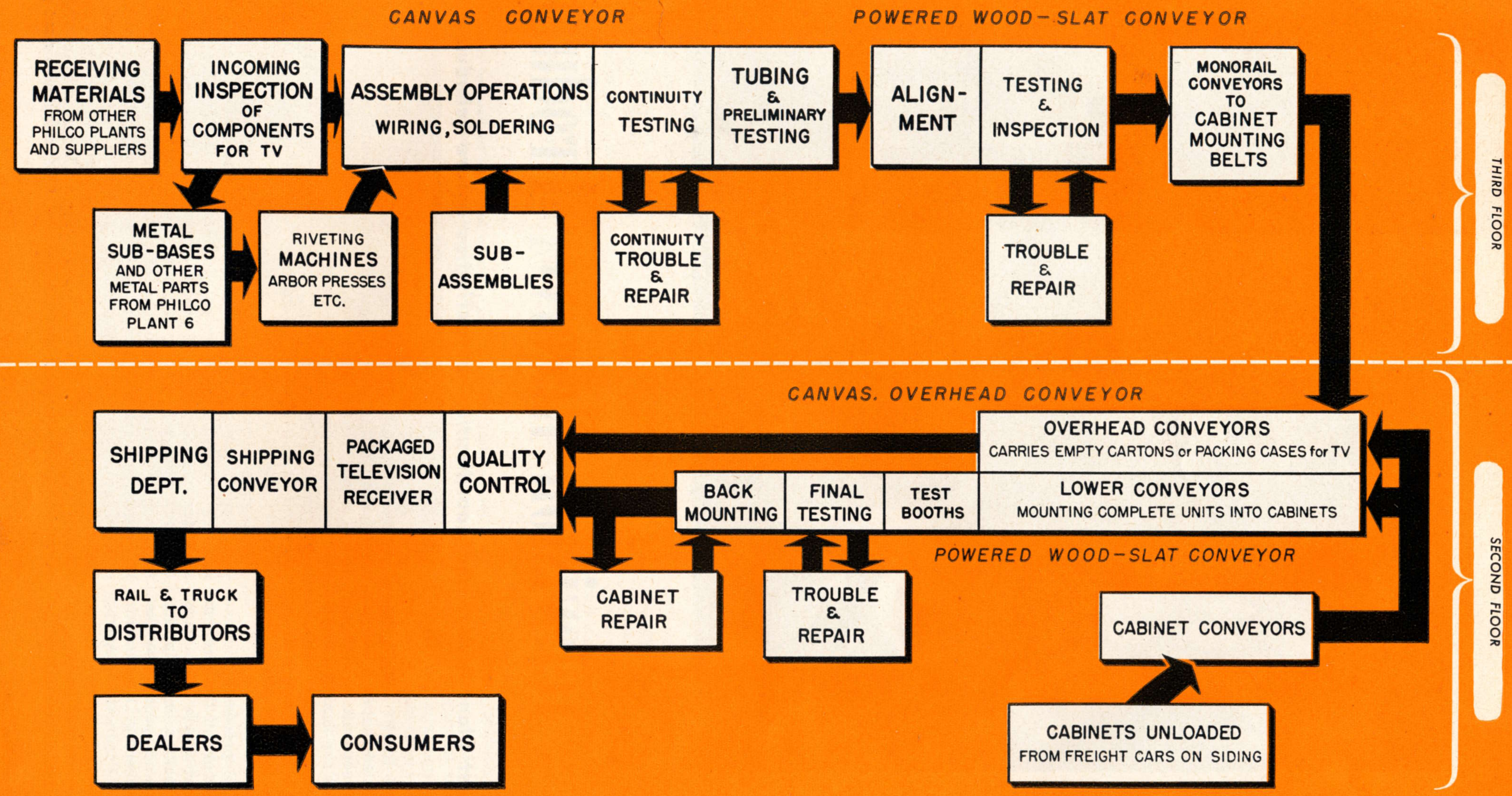
PHILCO TELEVISION RECEIVER PRODUCTION — *Flow Diagram* — PLANT #3



TV RECEIVER PRODUCTION (Continued)

tion of plant re-arrangements and layouts, personnel requirements, and supplier dates for receiving cabinets and other materials, are discussed and considered.

The next major step is the submitting of an approved Factory Engineering sample of the receiver to the Industrial Engineering Department. The sample is used as a guide for making out the operational layouts to be followed by Production in the manufacturing of the receiver. The most efficient sequence of operations, which includes assembly, wiring, inspection, testing, and mounting, is strived for. This involves establishing a precise running rate for each moving conveyor and determining the proper station time from time-study data developed over a period of years, complemented by continued time studies for each new product.

The main Philco final production areas comprise the second and third floors of Plant 3. The first floor is utilized for storage and incoming inspection of components from suppliers, the second floor for mounting chassis in cabinets and packing, while the entire third floor is devoted to the assembling, wiring, and testing of receiver chassis and various sub-assemblies. This plant, which covers an entire city block, was designed and constructed especially for mass production of television receivers.

At the present time, nearly two-thirds of this plant is being utilized for television receiver production. Schedules exceeding eight thousand completed receivers per week are planned for the immediate future, with further expansion being contemplated for 1949.

The third floor, or chassis floor, contains eleven long belt conveyors, eight of which are each over 450 feet long. Each long conveyor is divided into three parts for assembly and wiring, visual inspection and continuity tests, and finally electrical tests and alignment. The chassis, on which the riveting operations have been performed previously by a progressive riveting line, are loaded at the beginning of the conveyor. Usually the large bulky components, such as power transformers, choke coils, I. F. transformers, etc., are mounted to the chassis first, with the multitude of resistors, condensers, wires, and numerous other components installed progressively later on.

Sub-assemblies, which are part of the main chassis, are assembled on separate conveyors while the whole receiver chassis is manufactured on sets of two conveyors operated in tandem. This makes possible effectively doubled belt length and hence a greater number of relatively simple operations, resulting in speedier production and better quality.

Banks of materials are stored adjacent to the respective conveyors, with each assembly operator supplied with a quantity of parts in trays or pans located conveniently near her. Large inventories of material are not stored on production floors to avoid waste of working space. Quantities sufficing for several hours to several days' production are supplied, and are replenished periodically as required, from the central "holdrooms".

When the television receiver has been completely assembled and wired, it is transferred from the wiring conveyor to a visual inspection and continuity conveyor. Here it is given a thorough visual inspection, where the workmanship of each operator is carefully scrutinized and where the receiver undergoes a point-to-point resistance continuity test. To pass these tests correctly, each circuit must conform to the wiring diagram of the receiver.

Each receiver is now completely tubed and the chassis then undergoes an additional visual inspection for loose, missing, or damaged parts. As a supplementary aid to the inspection and continuity operation, a completed chassis is given a preliminary "hot" or signal test, where any other faulty circuit constants are intercepted before the chassis

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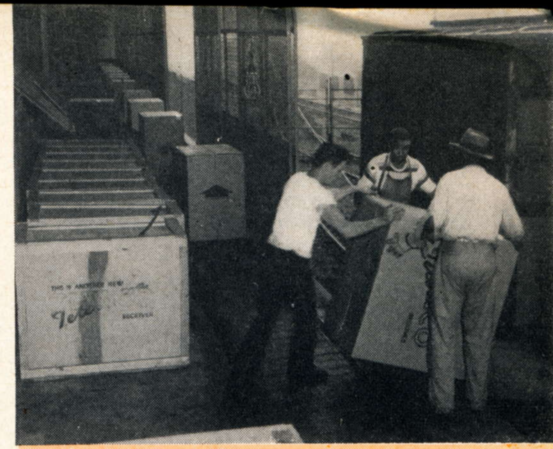
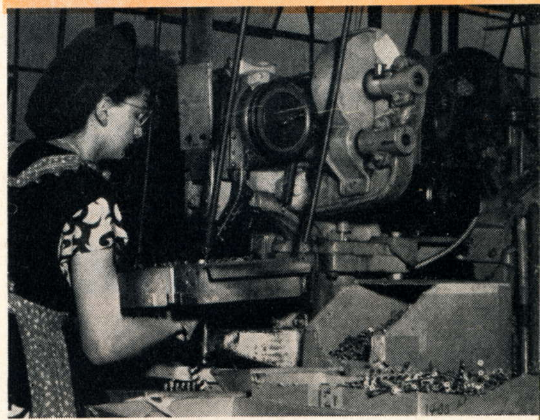


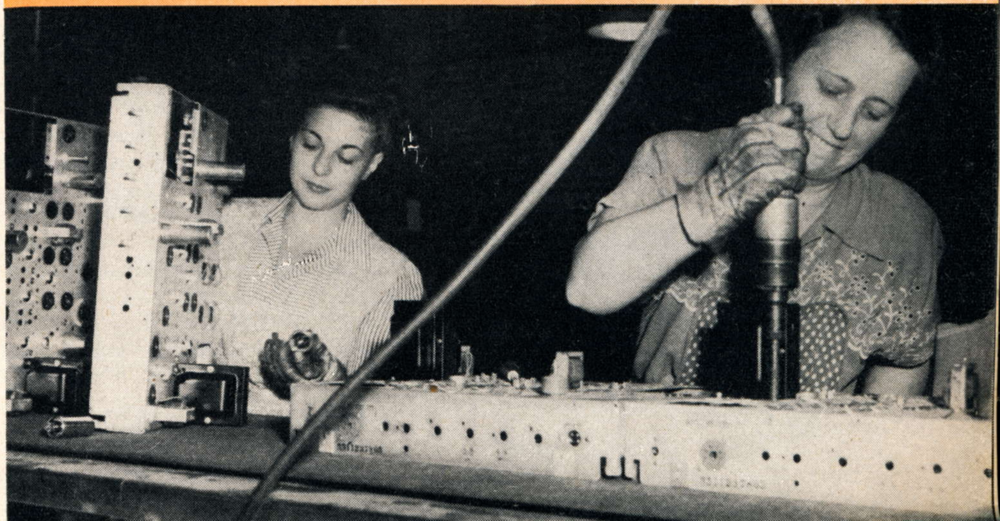
Platform conveyor transports new TV cabinets in final shipping cartons directly into plant

TV components that are sub-assemblies are constructed on auxiliary production lines

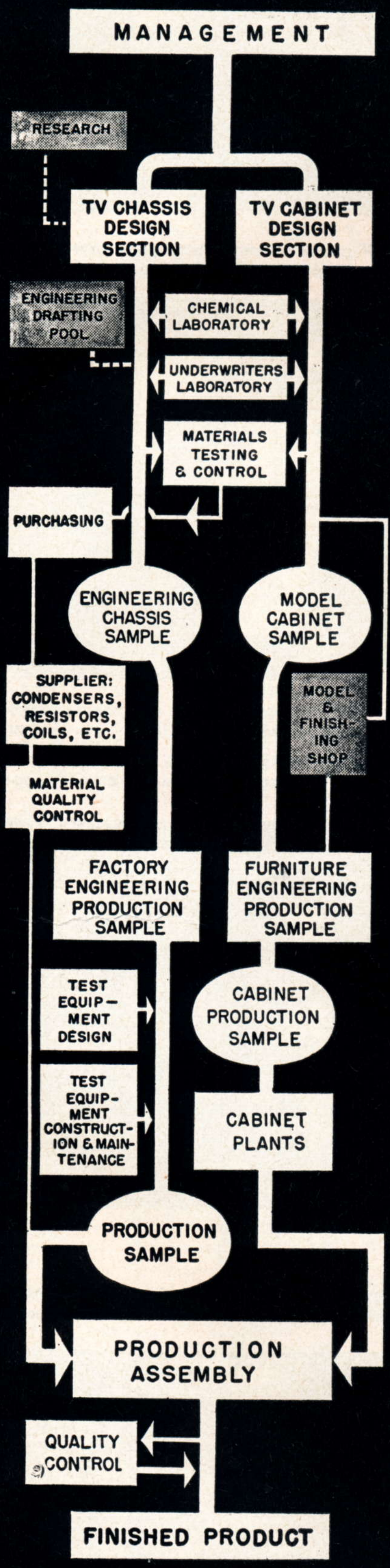
Riveting tube sockets and terminal strips onto the main chassis is primary operation



Larger components, such as chokes, power transformers and electrolytics, are then mounted. Small risistors and coupling capacitors are added during the various wiring operations.



PRODUCT DEVELOPMENT CHART



Installation of IF amplifier strips (at operator's right) and tuner assembly completes chassis construction. After wiring continuity tests, tubes are inserted and power applied

Trouble shooting area located near preliminary "hot" or signal test point. Chassis with any faulty circuit constants are intercepted before proceeding for final test operations

is loaded on the test conveyor.

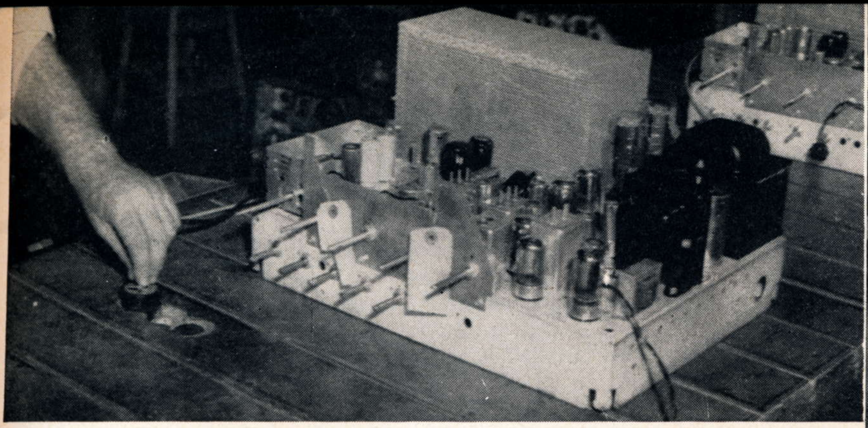
The flexible test conveyor, which is separate from either the wiring or inspection conveyors, but in direct line, consists of a series of hardwood panels fastened to endless chain couplings. Each panel contains a fused electrical receptacle that supplies power to the receiver while it moves along the conveyor.

The alignment and test operations are broken down as efficiently as possible to include all the adjustments and tests specified by the Factory Engineering Department. The sequence of operations, test equipment, test jigs, and fixtures are laid out to accomplish all alignment and testing with a minimum of time and expense. Electrical test equipment is mounted on a superstructure situated in front of the operator at eye level, and controls are placed so as to be within easy reach of the tester.

Oscilloscopes are used in nearly every position as visual alignment indicators to supplement the readings on various meters. Fastened to the face of each oscilloscope is a transparent celluloid mask, on which is inscribed a number of curve shapes and patterns. A radio frequency sweep test signal, applied to the receiver by means of specially designed test fixtures which contact the proper input and output terminals, causes an output wave form to appear on the oscilloscope screen. The tester then adjusts the various stage alignments specified and in order to meet the required curve shapes on the mask. Test standards, such as band pass characteristics, amplitude, rejection trap attenuation, and relative responses of different peaks, etc., are charted on the mask, enabling the tester to determine whether the set is up to specifications.

Receivers, after successfully passing all the rigid tests, are re-inspected at the end of the conveyor for possible damage to components during the testing and alignment process. They are then unloaded from the test conveyor and placed on an overhead tray attached to a monorail conveyor, which tranports the chassis to the next lower floor for the final mounting operations.

Cabinets arrive in railroad cars on a siding adjacent to the plant. The cartons containing the cabinets



TV chassis, connected to receptacles in wooden conveyor slats, receive power while moving through copper brushes which contact bus-bars beneath belt

After alignment, chassis are loaded on a monorail conveyor that transports them to second floor for cabinet mounting

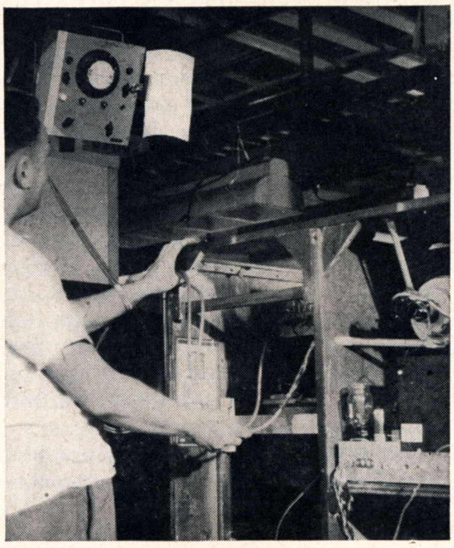
are transported by means of moving conveyors to one end of the building. Here the cartons are transferred to and conveyed by a moving belt to a position close to the beginning of the mounting conveyors.

The cabinets are carefully removed from the cartons and loaded on a low, wooden panelled mounting conveyor. The empty carton is simultaneously placed on an overhead canvas conveyor, which runs just above and parallel to the mounting conveyor. At the conveyor's end, the empty carton is unloaded and used again to store the same cabinet, which now contains the finished television receiver. The cabinet is conveyed down the mounting line where the various mounting operations are performed. These include installation of the receiver chassis, cathode ray tube and assembly, speaker, and automatic record changers or radio chassis in the case of combination receivers.

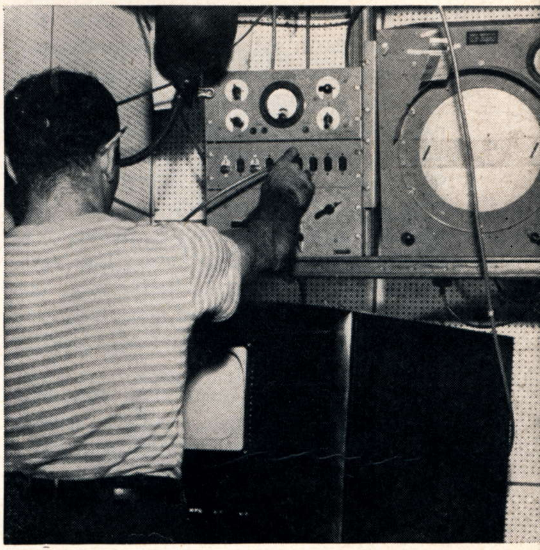
After all the parts have been installed and the associated cables and wires attached, the cabinet undergoes a rigid visual inspection to check mechanical operation. Then each set undergoes a series of electrical tests, during which time the various television controls are adjusted and the receiver double-checked for video performance. Next, thorough listening tests are made in soundproof booths to insure adherence to the highest standards of audio performance.

The final assembly operations, such as installation of various instruction and warranty labels, tying of cables, positioning of back cover, etc., are now performed. The completed receiver is again thoroughly inspected, and the cabinet is cleaned and polished to a high lustre.

The completed instrument is now ready for careful packing, which is the last in the series of operations on the mounting conveyors. After being sealed in a carton or "shook", the receiver is conveyed directly to the shipping room.



Complete operational checks are made after the chassis has been mounted in the cabinet



Quality Control uses both transmitted and artificial signals in retesting finished sets

Shipping cartons traveling on an overhead conveyor, meet the finished instruments at the end of the production line. With sealing of the carton, set is ready for shipment

QUALITY CONTROL

Visual, mechanical and electrical testing systems, applied to both components and finished products, assure quality performance of TV receivers

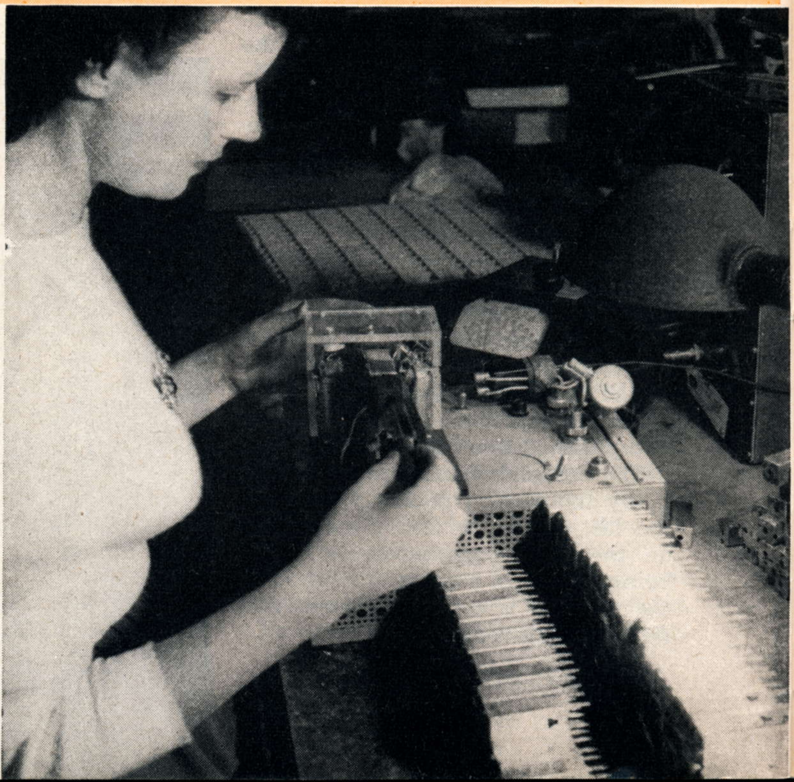
THE final appearance and performance qualities of a television receiver are dependent on the amount of control exercised in the selection and purchase of materials and in the care exercised in processing these materials to become the end product. At Philco two distinct organizations are in operation to maintain a maximum of quality on all models being produced at all times. The first group insures the receipt of materials from outside vendors or subsidiary plants that are in accordance with prescribed engineering specifications. The second group concerns itself with the quality of the finished product, using the customer's point of view as its yardstick.

When a new television receiver chassis is designed, process sheets are forwarded to factory management where they are studied to determine which items will be produced in subsidiary plants, such as metal parts, coils, etc. and which parts will be purchased from outside suppliers, such as speakers, resistors, capacitors, etc. Drawings for these items to be procured from outside manufacturers are prepared and submitted to the suppliers who in turn develop and submit a finished sample of the desired item. These samples are thoroughly checked against the engineering specifications, and where the item meets the specification, approval to manufacture is forwarded. If the sample fails to meet specifications, the item is returned to the supplier with an explanation as to why the sample was rejected, and the supplier in turn must submit a new and satisfactory sample.

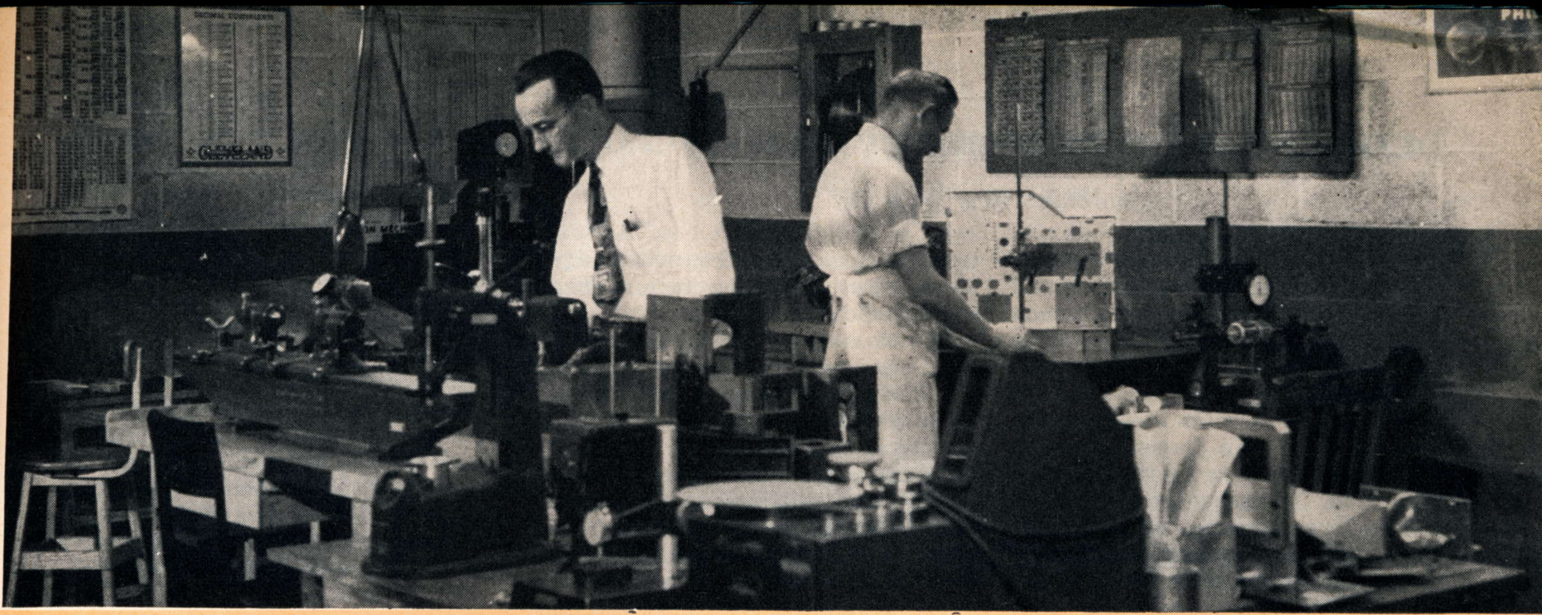
Incoming products from outside suppliers may be checked statistically or completely depending on the past records of the supplier concerned. When a new or unknown supplier is involved, a Philco field engineer contacts the plant that will manufacture the desired item to review its manufacturing processes and the provisions employed for quality control. If necessary the existing quality control system is modified to assure the receipt of products that are within Philco specifications. In some cases special test equipment will be made available to the supplier to assist him in carrying out the necessary quality checks. In special cases, field engineers will be on continuous duty with supplier plants because of the critical nature of the components being manufactured.

The type of inspection performed on incoming components at the main assembly plant depends, of course,

Production type comparator test equipment checks RF turret tuner switch contacts before mounting sub-assembly on receiver chassis



Incoming shipment of IF transformers for TV receivers being checked for frequency response and output by correctly pre-tuning each unit



Mechanical testing laboratory makes precision measurements on components and develops modified precision measuring equipments

on the function of the item involved. In general, however, the tests are either visual, mechanical or electrical, or a combination thereof. When the statistical method of check is employed, measurements are ordinarily made with precision equipment but when greater sampling percentages are involved modified versions of the equipment are constructed to facilitate checking operations.

With the development of television many new quality control problems have been encountered and overcome. Components not employed in radio (cathode ray picture tubes, deflection and focusing coils, and high voltage transformers) have presented problems not known in radio production.

In manufacturing television receivers, it must be kept in mind that since the consumer can see as well as hear the program material, a close examination of all cathode ray tubes must be made to be sure that there is no astigmatism and that there are no face plate marks or blemishes in the viewing surface of the tube.

Considering quality control from a customer's point of view, when production starts on a given model, two main check-points are set up on the production line. The first of these points follows the last wiring operation while the second succeeds the final test point on the line.

At the first point the wiring of each chassis is carefully examined before the tubes are inserted. At the final quality control check point, the statistical method of checking is again employed. This means that a good percentage of the sets receive an extra quality check in addition to the normal line inspection and final test operations. Where production difficulties are encountered,

(Continued on page 90)

New tubes undergo an actual operation test in radio receiver chassis before they are released as production components

Drop tests performed on new and completely packed TV receivers, simulates abuse instrument may receive in shipment

DESIGNING & ENGINEERING TV CHASSIS

(*Continued from page* 63)

these design specialists and systems experts have been sifted and refined into the tentative outline of a promising new chassis, the concept is presented to Philco engineering executives for further discussion. If they like this new approach to the problem, they will present the new idea to management for further consideration. If it is accepted by management, production of the new model is promptly authorized, and arrangements are made for purchasing materials, for tooling and other planning of production facilities.

As an example of how the various elements in this process of evolution of a design function, consider briefly the Philco projection television receiver, Model 2500. An entirely new optical system, including a new 4-inch projection picture tube, a "keystone" optical design for front projection, and a "microlens" screen, was conceived by groups in the Philco Research Division. Several models were constructed with the help of Design Engineering. After months of testing, the performance of this entirely new type of television receiver was accepted by engineering executives and then demonstrated to management. A favorable decision was reached as to probable acceptance of this large-screen receiver with its special brightness, contrast and clarity of picture. Plans for production were therefore authorized.

It must be emphasized that after management approves of the basic idea of a television model, the responsibility of making the design functionally sound so that it delivers excellent performance for the customer is placed squarely on Design Engineering. Most of the decisions as to the ways in which this performance is to be achieved are made by project engineers within the section. Thus the Philco design engineers have great freedom in their approach to solving the variety of problems encountered in developing a television chassis; they can call on many groups of other engineers and research scientists for help in solving these problems; but the ultimate responsibility for performance is theirs. Other work of the group is in liaison with Factory Engineering to assure efficient production, and with Field Engineering to assure customer satisfaction; and this liaison contributes ideas in both directions, toward making design improvements within the laboratories and toward making new design ideas effective in the factory and in the field.

The flexibility and teamwork of the Philco engineering organization and their close liaison with engineering in the factory and field may also be illustrated by the fact that minor changes are frequently made during the production of various television receiver models to improve their functioning and reduce their cost; major revisions, requiring a complete chassis modification, are also made without waiting for a change in models. Thus Design Engineering is continuously responsible for improvements, from the inception of the basic idea until the final unit of a given model rolls off the production lines.

With this responsibility, the first consideration of Design Engineering is always to achieve performance of high quality. The secondary consideration is to develop the desired performance at reasonable cost. In so doing in the case of each model, the design engineers develop sample chassis for Cabinet Design and for planning by other departments of the company, including Factory and Industrial Engineering.

TV vs Radio Manufacture

In order to build a Philco model 49-1001 television receiver, 692 mechanical components, including hardware, 280 electrical components, 27 tubes (including CR tube), and 10,392 ft. (almost 2 miles) of wire are required. In contrast, an average table-model radio set needs 87 mechanical components, 37 electrical components and 6 tubes.

Factory Engineering

It might be supposed that when the basic design features of a television receiver chassis have been completed all that remains is for the factory to start duplicating the sample submitted. Actually, however, mass production practices impose many limitations which reflect themselves as changes in component and wiring layout and in performance modifications of the finished product. It is the function of the Factory Engineering Section to adapt each new television receiver chassis for mass production, and to insure that each final product performs within the range of test specifications established by this section.

Normally the Television Receiver Design Section provides Factory Engineering with two working samples of each new chassis. One of these, termed the "electrical" sample, is turned over to the factory test laboratory where its electrical operating characteristics are measured. The "mechanical" sample is used to study production layout problems.

The electrical tests are made with precision laboratory test equipment and aside from the usual voltage, current, and resistance checks, the various portions or sub-assemblies of the chassis are subjected to extensive performance measurements. For example, the sound and video IF channels are checked for gain, bandwidth and stability. Measurements are made on all channels in the RF system and tests similar to those used in conjunction with the IF portions of the receiver are performed. The sample is then rechecked in exhaustive field tests for overall performance.

Meanwhile the mechanical sample is studied by the factory production group from the standpoint of developing a component layout that will speed unit construction. At a meeting attended by the chiefs of the various sections concerned with the actual production, layouts and recommended changes in design are discussed and recorded. Such problems as changes in tube layouts to avoid breakage when chassis are stacked for transport or for temporary storage; repositioning of components to speed wiring operations; redesign or relocation of components to permit the use of time-saving jigs or fixtures, are studied and solutions are mutually agreed upon.

The completion of these tests on the electrical and mechanical samples enables the Factory Engineering Section to originate a request for design changes. The Television Receiver Design Section authorizes such changes in the form of engineering change notices after both groups have agreed that the changes will not interfere with the performance and price considerations encompassed by the basic design and that the changes recommended will materially assist production.

A pre-production run of 10 to 25 additional samples is now made incorporating the approved design changes. These pilot samples are then retested in the factory engineering laboratory in exactly the same manner as was the original "electrical" engineering sample. Measurements of the same circuits on different chassis will yield varying results and it is the average of these results that establishes the test standards for use in actual manufacture. As the standards are developed it also becomes possible to determine the alignment procedure, and to create what is known as a master wiring standard. The latter is forwarded to production and all chassis being assembled are wired in strict accordance with this standard. With the issuance of a bulletin from Factory Engineering containing the Test Procedure and Specifications and the Test Standards, production is ready to start.

Cabinet Manufacture

(*Continued from page* 73)

cient utilization of the wood.

In the "assembly plant", parts such as end panels and posts, top panels, instrument panels and doors, tube baffles and frames are put together and then assembled as a complete cabinet, using a special jig which holds all the parts together during assembly. Each cabinet is carefully checked for dimensions, sanded where necessary, and then passed along to the "finishing plant".

Finishing a television cabinet includes two staining operations; a lacquer glaze and then sanding; filling, with the filler applied and padded into the wood by hand; lacquer sealing and sanding; trimming to decorate such parts as the instrument panel and tube frame; first and second coats of lacquer; hand rubbing; and polishing by hand. After hand rubbing, the cabinets are allowed additional drying overnight before packing.

While many operations throughout the Watsontown plants are mechanized, it is actually more efficient *not* to conveyorize such processes as the finishing of cabinets because of variations in the color and hardness of the woods which make it impossible to assign exact times for certain operations. A uniform quality of product may require more detail work on one cabinet than another.

The craftsmanship and precision work that go into the manufacture of the cabinet are important factors in the beauty and handsome appearance of the finished television receiver.

CABINET DESIGN & PRODUCT DEVELOPMENT

(*Continued from page* 71)

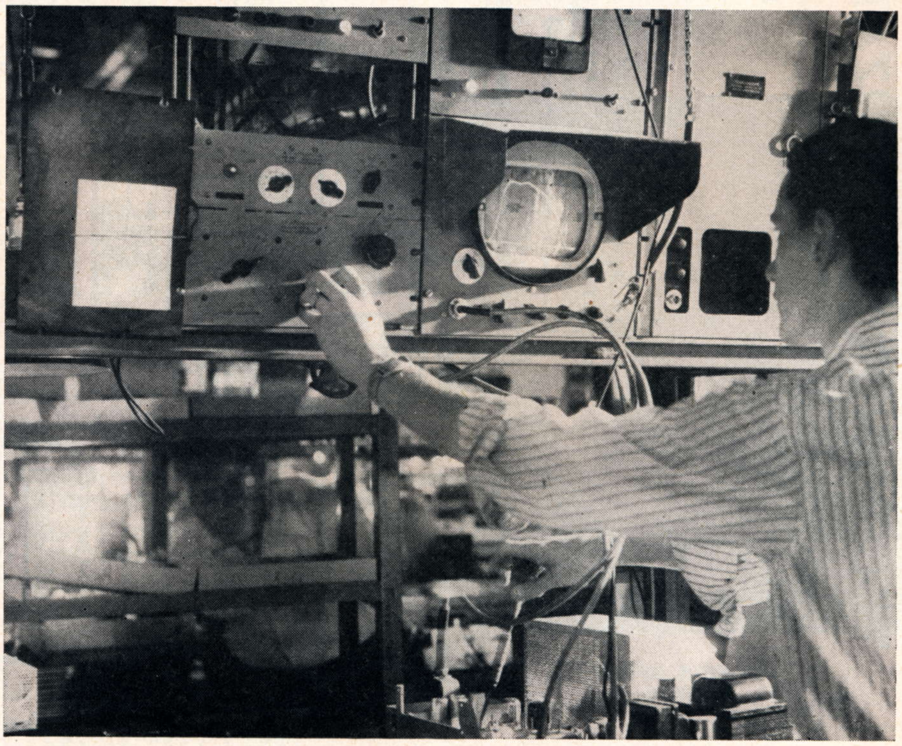
whereas others may desire to use two. As the production methods are decided upon, measurements are made for the exact sizes that will be involved. The sample receiver cabinet is ordinarily a close approximation to the required size but for exact measurements it becomes necessary to consult the chassis design group again to be sure that the chassis will fit in the cabinet. When the exact measurements are determined, production drawings are prepared and four engineering cabinet models are developed. The first of these, known as the "blue-line" sample, is scheduled in advance of the other samples. When received, an engineering chassis sample is mounted in the unit and the sample of the final product is examined by all concerned to see what changes, if any, have to be made.

When the blue-line sample has been thoroughly checked and the necessary changes have been incorporated, a "red-line" sample is built, which is made available to the servicing group. Following this, two other samples are built, one of these being a color sample which goes to the outside cabinet supplier, while the second becomes a sample for production design.

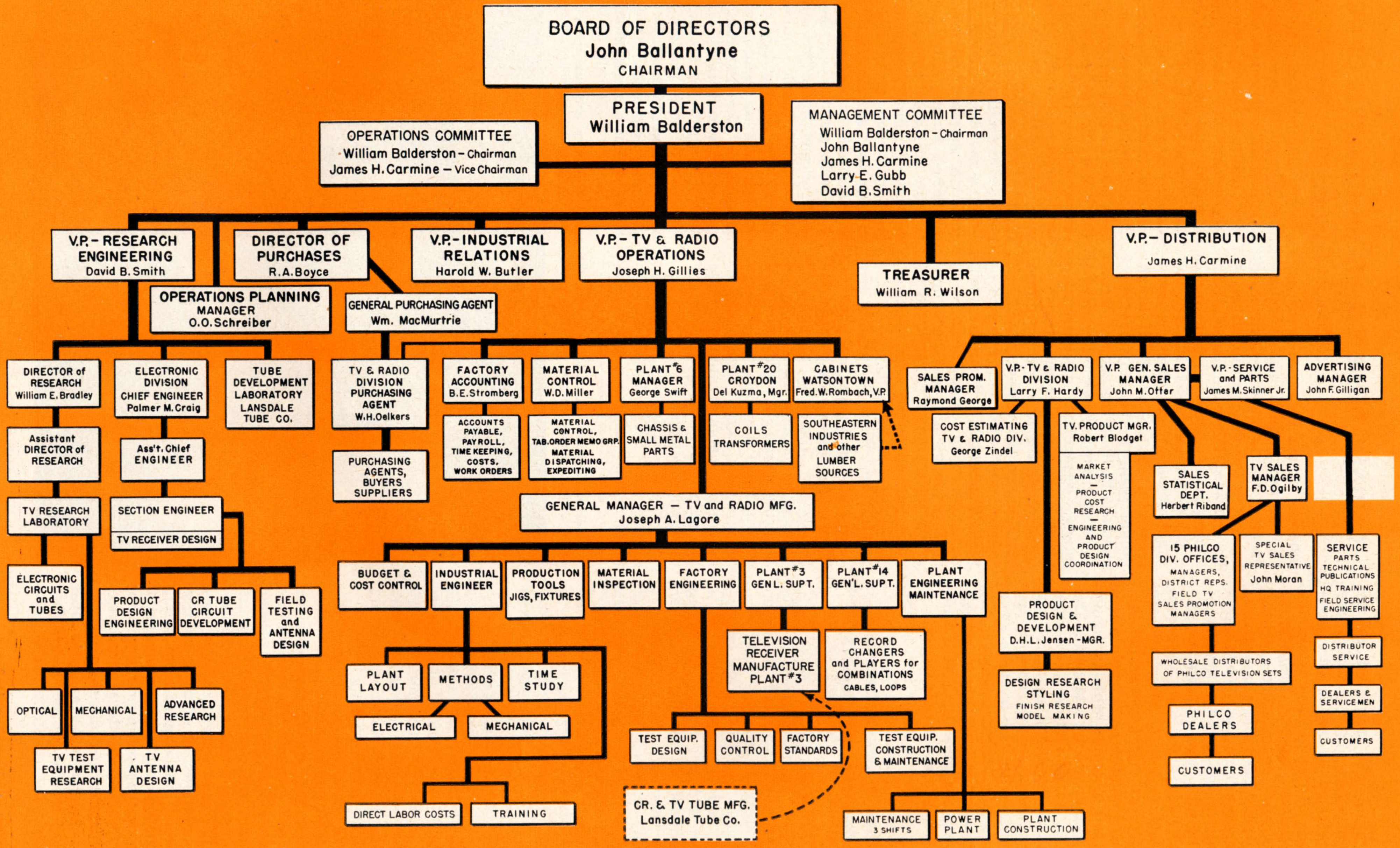
When a satisfactory production sample has been developed, the problem that remains is getting the cabinet suppliers tooled up for mass production. Since tooling involves time and since production dates are scheduled it is customary to issue a "see-release" at about the same time a "blue-line" sample is tested. This release does not permit the supplier to go ahead with any kind of production, but it does inform him as to what the new cabinet will look like so that he can go ahead and order the necessary materials. Also, the supplier may, as a result of reviewing the "see-release", make recommendations to the furniture engineering section for changes to facilitate production.

After the final drawings are issued, the supplier will prepare one unfinished sample only; and when this is available, a field engineer from the furniture engineering section calls to check the sample thoroughly against all drawing specifications. If the sample is mechanically satisfactory, the manufacturer can proceed to develop 25 additional finished samples from which the Philco representative chooses three as representative color samples. The first color sample chosen remains with the manufacturer as a guide for his future production. The other two are returned to the Philco plant where they are made available to factory engineering groups as desired color samples.

A receiver alignment operation showing the actual frequency response curve on oscilloscope screen. Superimposed celluloid mask shows the desired alignment characteristics.



TELEVISION ORGANIZATION CHART of PHILCO CORPORATION



Philco Operations Committee—The Men Responsible for TV Design, Production and Sales. From left to right: David B. Smith, Vice-President Research and Engineering; James H. Carmine, Vice-President Distribution; James M. Skinner, Jr. Vice-President Service and Parts; William Balderston, President and Chairman of Operations Committee; John M. Otter, Vice-President and General Sales Manager; Larry F. Hardy, Vice-President TV and Radio Division; Joseph H. Gillies, Vice-President TV and Radio Operations.

Management and Organization

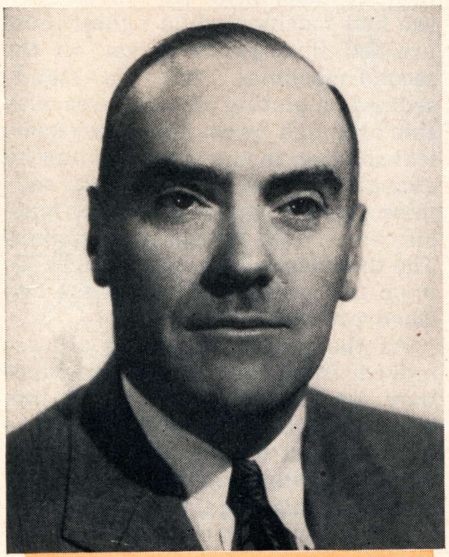
As shown by the organization chart opposite, operating authority for the Philco Corporation and its television activities stems from the Board of Directors, John Ballantyne, Chairman; the President, William Balderston; and the Operations Committee and Management Committee. Principal operating activities are under the supervision of vice presidents in charge of Research and Engineering, Television and Radio Operations, and Distribution.

Aiding Vice President David B. Smith, in charge of Research and Engineering, are Director of Research William E. Bradley and Chief Engineer Palmer M. Craig, with their staffs and large technical organizations of engineers, researchers, scientific specialists, and technicians.

Joseph H. Gillies, Vice President—Television and Radio Operations, is assisted by Joseph A. Lagore, General Manager, Television and Radio Manufacturing, who heads an outstanding team of experts in all phases of production.

James H. Carmine, Vice President—Distribution, has the responsibility for the development and distribution of all the Company's television receivers. Directly responsible for the creation of the line, under Carmine's direction, is Larry F. Hardy, Vice President Television and Radio Division. Heading sales is John M. Otter, Vice President and General Sales Manager, with James M. Skinner, Jr., Vice President in charge of Service and Parts. John F. Gilligan is Philco advertising manager and Raymond George, sales promotion manager.

Principal executives and managers in the Philco organization are all veterans with many years in the employ of the Corporation. Throughout, the organization has been carefully streamlined for most effective and smooth-working operation. And there is close coordination and pooling of ideas between Engineering, Manufacturing and Sales, so that Philco designs and products may incorporate newest technical advancements and production economies, while keeping in closest possible touch with the demands of the purchasing public.



John Ballantyne, Chairman of the Board

William Balderston, President

TV Research

(*Continued from page* 65)

are made available to research scientists and engineers working on all allied subjects, to keep them informed on progress in the Philco laboratories. The staff is also encouraged to keep abreast of technical developments by others in industry, the universities and in Government laboratories, and the Division maintains an extensive library of reference books and subscribes to some 80 technical journals. As still another method for stimulating teamwork in ideas and the spread of useful information, special conference rooms are used for seminars where senior scientists or engineers lecture on their fields.

Beyond well-equipped physical facilities, and the assistance of a fully staffed drafting room, machine shop and model shop, engineers of the Research Division are aided in their projects by a number of special groups acting in a consultant capacity. Among these groups are the sections working on test equipment, vacuum tube research and applied mathematics. This latter group is given increasing prominence since Philco is making highly successful use of advanced mathematical theory in such fields as the design of wideband amplifiers, where the development of the "pole-and-zero" theory has made it possible to design on paper amplifiers with optimum performance, as just one example applicable to television.

To develop new research talent, Philco has been expanding its Research Division for some time, and this process is still under way. One aspect of this "talent hunt" is the successful college cooperative program whereby students at M.I.T., Cornell and Drexel spend a part of their academic years working in the Philco laboratories. For example, a typical M.I.T. undergraduate in electrical engineering will spend 18 months or one-half of the final three years of his five-year course at Philco. His time with the company will be divided into four periods: the first spent in design engineering, the second in factory and industrial engineering, and the third in research, while during the fourth he selects, with help from the employer, the type of work for which he is best suited. Students demonstrating aptitude for research thus have two full periods or about nine months of work in the Research Division; and then may be assigned to this work, if they choose and prove suitable, upon graduation. Meanwhile they also receive instruction in theory while at Philco by senior scientists and engineers on subjects assigned by the university.

Philco research in television is, like the television industry itself, a dynamic thing. The spirit of the company is to encourage research in every possible way.

Quality Control

(*Continued from page* 85)

double quality control points may be set up in order to raise the check rate.

The tests that a receiver must undergo at a quality control check point require the use of both artificial and natural signals. On the production line the alignment points and the final test operational points are supplied with signals coming from a central signal generator room. In order to avoid any irregularities which might be the fault of the central signal distribution system, quality control check points are equipped with individual sets of precision test equipment. The receivers are first given an overall instrument performance test to determine the frequency response, selectivity and sensitivity, and when the measured results are within specifications they are rechecked for performance, using the transmitted signals from local stations. All these tests are conducted from the consumer's point of view and gauge the acceptability of the product.

In addition to its duties on the assembly line, Quality Control is concerned with several other activities. The first concerns packing and shipping. Quality Control personnel who are thoroughly familiar with the regulations of shipping carriers determine if the packing is in conformity with existing requirements. Drop tests are also performed to simulate the abuse the finished product will undergo during the shipping process.

Quality Control also conducts very extensive field tests on finished products. These tests may involve sending trial production sets to different executives' and engineers' homes for operation under normal conditions. Another type of field test may request field service engineers to spot check a group of receivers arriving at any distributor's warehouse. Such checks are performed in lots that involve as many as 400 sets at one time and are very valuable in maintaining the high quality standards of the products.

Sub-Base Manufacture

(*Continued from page* 67)

bent up and the finished operation results in a semi-rigid sub-base, the rigidity being created by the reinforcing indentations that have been simultaneously forced into each of the bends. Spot welding the corners completes making the sub-base a single rigid component.

Before the sub-base can be spot-welded, however, a washing operation must be performed so that the joints formed will remain bonded. During the punching and forming operations, the blank was coated with oil to minimize premature wear on the various punches, and also, since the steel is not plated when received, rust and other foreign particles may be present. After a water wash the sub-bases are fed to one of three spot welders. The final production step before the sub-base appears on the main assembly line is that of electro-plating to prevent rust and consequent weakening of the chassis assembly after the receiver has left the plant.

For these relatively large television sub-bases, Philco operates two automatic, conveyorized plating units. The first, a cleaning, pickling and plating unit has a duty cycle of 14 minutes with 27 carrier bars each of which can be loaded with five square feet surface area of parts. Adjacent to this equipment is a fully automatic unit which has a 19 minute duty cycle and in addition incorporates a hot air dryer at the unloading end. Those items of equipment that are heavy enough to dry from residual heat are fed through the first machine while lighter units are fed through the dryer on the second machine. Philco has standardized on plating all sub-bases with zinc although by changing the chemical solution in the machines and by changing the plating elements, cadmium, copper, silver and other metals can be used for plating purposes. The thickness of the plating depends upon the anticipated use of the finished product.

As the plated sub-bases are removed from the plating machines they are loaded into castered tote bins and rolled into waiting trucks for transport to the main television manufacturing plant across the street. At this stage, the Metalworking Division, which maintains its own quality check-point for finished items, takes samples from a group ready for shipment and checks them on all counts.

PHILCO CORPORATION

Philadelphia, Pennsylvania

TELEVISION AND RADIO DIVISION

Philadelphia, Pennsylvania
Sandusky, Ohio
Croydon, Pennsylvania

REFRIGERATOR DIVISION

Philadelphia, Pennsylvania
Connersville, Indiana

INDUSTRIAL DIVISION

Philadelphia, Pennsylvania
Detroit, Michigan

PHILCO DISTRIBUTORS, INCORPORATED

New York, Chicago, Philadelphia, Detroit, Toledo

PHILCO TELEVISION BROADCASTING CORPORATION

Philadelphia, Pennsylvania

PHILCO CORPORATION OF CANADA, LIMITED

Toronto, Ontario, Canada

PHILCO INTERNATIONAL DIVISION

New York, Philadelphia

WATSONTOWN CABINET DIVISION

Watsontown, Pennsylvania

LANSDALE TUBE COMPANY

Lansdale, Pennsylvania

SOUTHEASTERN INDUSTRIES, INCORPORATED

Conway, South Carolina

REAL ESTATE INVESTMENT CORPORATION OF PHILADELPHIA

Philadelphia, Pennsylvania

PHILCO PRODUCTS

RADIO RECEIVERS

AUTO RADIOS

RADIO-PHONOGRAPHS

TELEVISION RECEIVERS

REFRIGERATORS

FREEZERS

AIR CONDITIONERS

DRY BATTERIES

TELEVISION & RADIO TUBES

REPLACEMENT PARTS

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RADIO COMMUNICATIONS EQUIPMENT

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