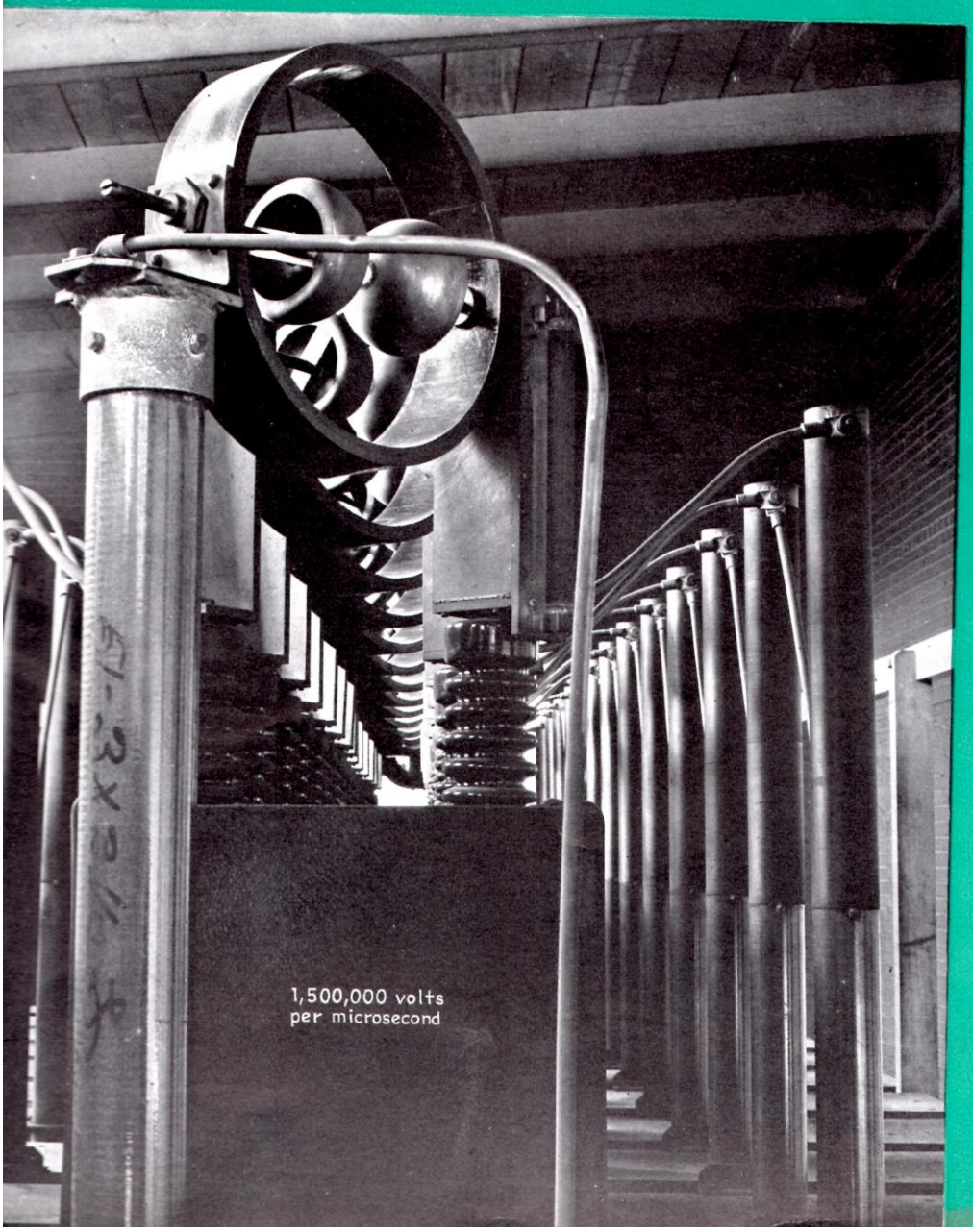
electronics

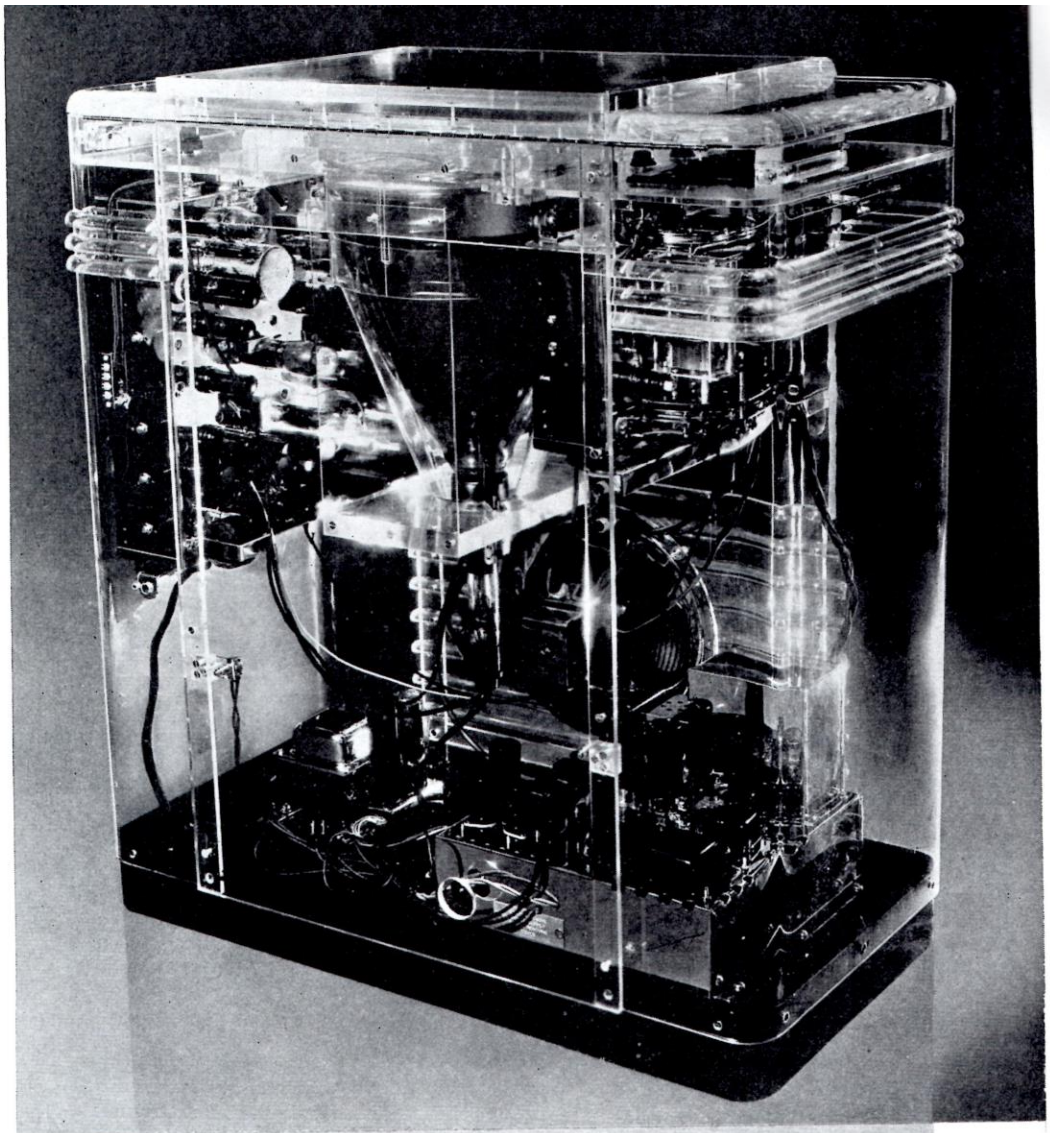
radio, communication, industrial applications of electron tubes . . . engineering and manufacture



JUNE
1939

Price
50 Cents

McGRAW-HILL
PUBLISHING
COMPANY, INC.



INSIDE STUFF—

RCA reveals all, with the aid of a lucite cabinet, in this 36-tube television-radio receiver on exhibit at the New York World's Fair. The receiver is a standard model, chromium plated, polished, and in working order.

TELEVISION in the FIELD

Public television service in New York is just one month old. Herewith is a brief report of its problems, as well as its accomplishments, in this initial period of growth

AS this issue of *Electronics* goes to press, television is just one month old as a public service in New York City. Within that time, receivers have been placed on the market, prices established, sales made, installations completed. The field experience of the television system, with the public as judge, has begun. While it is hard to collect conclusive evidence in so short a time the editors offer this brief report.

Sets and Prices

A trip to Macy's department store on May 25th revealed as of that date four manufacturers have models priced and for sale: Andrea, DuMont, and RCA and Westinghouse. The only Andrea model thus far announced is a table model with a five inch "short" cathode-ray tube, containing 16 tubes and equipped to receive two channels. The price is $189.50. The DuMont Line has four models, all employing the same 22-tube television-sound chassis with 14-inch picture tube. A table model sells for $395, two consoles for $435 and $445, and a large console with all-wave radio for $540. The RCA line includes a sight-only 5-inch picture-tube television chassis at $199.50, a 5-inch sight-sound console model with all-wave radio at $295, a 9-inch 36-tube console with all-wave radio at $495, and a 12-inch console all-wave at $600. The only Westinghouse receiver on display was a 5-inch sight-only unit at $199.50.

The kit prices are universally lower. A Meissner kit, sold complete with tubes for $134, contains 16 tubes, and can be assembled and put in working order without test equipment. The Andrea kit, price $79.95 without tubes (tubes about 50 dollars extra), has been widely sold through other outlets. The Fulton Radio Corporation has a kit for sale, $89.50 without tubes ($55 extra for tubes). Reports are that several hundred kits were placed within three weeks after program service began.

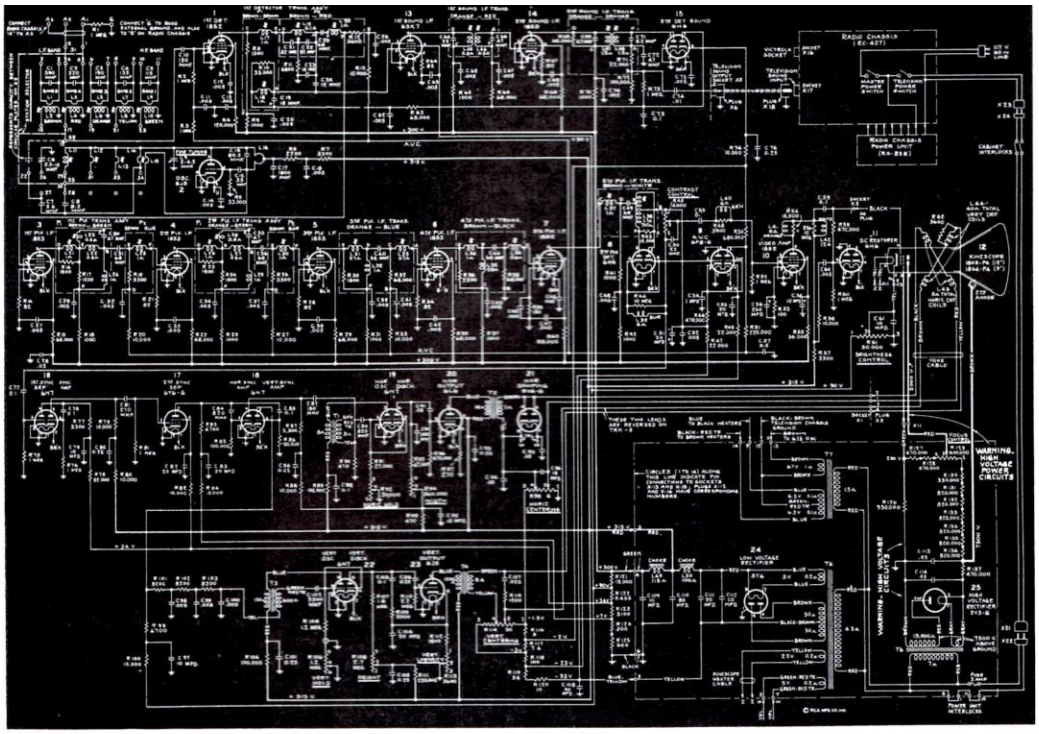
The sales of complete sets are difficult to estimate, but a rough checkup indicates that between 1000 and 2000 sets have been put in the hands of distributors and dealers by the manufacturers. Of these, only a small percentage, perhaps 300 or 400 in all, have been sold to the public. The total television audience, including field test receivers of the RCA system, is estimated at close to 500, exclusive of dealers. The dealers find as many as a thousand people a day dropping in to see the telecasts. A line of 100 people is usually on hand at Macy's before the 11:00 A.M. broadcast begins and later in the day the crowds increase.

Program Schedules and Techniques

The broadcast schedule at present maintained by NBC (the CBS transmitter is not expected on the air with programs until July) consists of a total of 25 hours per week. The "regular" programs, including variety acts, plays, etc., run from 8:30 to 9:30 Wednesday and Friday evenings. Saturday evenings have been occupied with sporting events picked up by the mobile units. Film transmissions, intended for use in demonstrating and installing receivers, are maintained from 11:00 A.M. to 4:00 P.M. Tuesdays and Fridays, and from 4:30 P.M. to 8:30 P.M. Wednesdays, Fridays and Saturdays. The film transmissions consist of approximately ten minutes of film (educational subjects for the most part) followed by a five minute intermission during which a standard test chart is displayed.

The programs are similar to those broadcast during the past year during the field tests of the system, but the advent of single-sideband transmission has considerably improved detail of the image and over-all quality. Remote pick-up broadcasts from the World's Fair have been made several times with good results. The mobile-unit trucks made a trip to Baker Field at Columbia University and were successful in radiating a broadcast of the Princeton-Columbia baseball game to the Empire State transmitter where it was rebroadcast to the public audience. The fact that only one camera was available to cover so large an area as a baseball field made it difficult to recognize the players and follow the detail of the plays but, with the aid of expert announcing by Bill Stern, the performance was projected satisfactorily, in the opinion of sports fans. Later, the trucks were run into the basement of Madison Square Garden, the camera placed on the grand-stand and a telecast of the six-day bicycle races broadcast at night, with the aid only of the standard projection lighting fixtures in the ceiling of the arena. The broadcast marked a milestone in remote pick-up practice, since ordinary telephone wires were used for the connecting video line, over a distance of more than a mile from the arena to Radio City.

The television signals were picked up by the NBC telemobile unit from the edge of the track at the Garden and were transmitted over existing telephone cables to the Circle central office on West 50th Street, and then over a similar circuit to NBC at Radio City. Special amplifier attenuation equalizers and their phase equalizers were provided at the Circle office and both the terminals. The adjustment of the over-all circuit was such that the signal was delivered at Radio City without noticeable impairment although the illumination available was far less than



Complete circuit diagram of the RCA Victor type TRK-12 television receiver, one of the most elaborate designs now available to the public. The physical arrangement of the receiver is shown in the frontispiece of this issue

was used for studio pickup, and thus made the undertaking a difficult one. The results were felt to be distinctly satisfactory.

This accomplishment has created considerable interest because of the use of pairs of ordinary telephone cable rather than the coaxial conductor which had been generally associated with the transmission of television signals. The use of ordinary telephone cables under certain conditions and properly arranged and equipped for the transmission of such a wide range of frequencies as television requires was discussed in a paper by A. B. Clark of Bell Labs before the American Institute of Electrical Engineers in January 1935. The recent experimental accomplishment is a practical demonstration of the possibilities which he then described. The energy loss of television current, however, in passage over a mile of ordinary telephone cable is about a million times greater than over a mile of coaxial cable. A series of measurements on the cable must precede its use. There must be some alterations in it, and the provision of amplifiers, and of special apparatus for equalizers of attenuation and phase. The recent experiment, therefore, does not imply that ordinary cable pairs can be economically used for television, except over comparatively short distances. What the experiment does show, however, is the possibility of using telephone cables to pick-up television news and carry it over short distances to main lines of coaxial cable or to nearby transmitting stations. At the time of the broadcast, the available amplifiers and equalizers were suitable for a maximum video signal of 3 Mc, and this range can be extended.

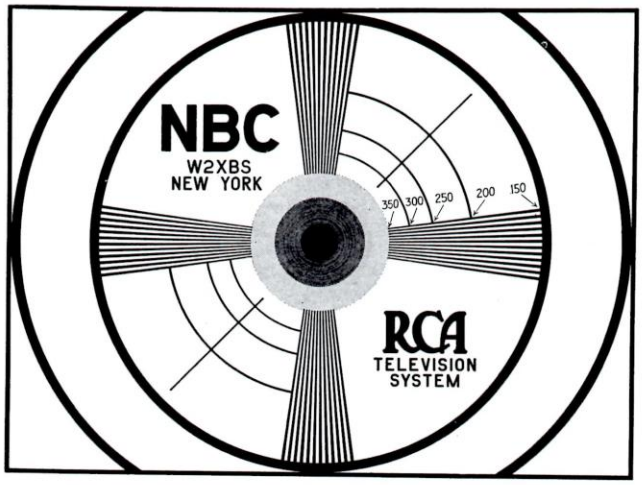
Installation Procedures and Problems

The first installations have brought out the serious nature of several forms of interference, all of which have been prominent in earlier tests but which were tolerated because the engineers understood their cause and the difficulty of avoiding them. The public cannot be expected to be so lenient. Ignition interference is apparently the most serious offender. In the writer's experience, a dipole antenna was installed on the roof of an apartment house, 60 feet above, and roughly 50 feet back from, a traveled highway about 10 miles airline from the transmitter. The signal level existing at the antenna, at the upper end of the transmission line, exceeded one millivolt. The ignition from trucks, buses, and early vintage passenger cars is the most serious. In the presence of the carrier, the ignition "rattle" can scarcely be heard in the loudspeaker, but its effect on the picture is definitely noticeable as a loss of line synchronization, which is restricted to small groups of lines (perhaps five or ten lines in a group). The frame sync is very seldom affected, however.

The troublesome nature of diathermy interference has been very well illustrated in *Electronics*' laboratory, where the television receiver described last year (July to December issues) has been used to receive the transmission from W2XVT, the DuMont station at Passaic, N. J. This station has an output power of

50 watts, and is located 9.5 miles from the McGraw-Hill Building. The antenna heights are 80 feet at the transmitter and 495 feet at the receiver. The calculated signal strength is approximately 500 microvolts, but substitution measurements indicate that the actual signal strength is in the neighborhood of 100 microvolts. The receiver is successful in reproducing a synchronized image, but the interference is, of course, very prominent. Diathermy interference destroys the image fully 25 per cent of the time. Ignition is much less prominent, due to the height of the receiving antenna above the street. Tube and circuit noise is plainly visible when the gain is maximum.

The reflection problem, which produces ghost images, may arise in a variety of guises. In the antenna system on the McGraw-Hill Building two separate dipoles are mounted on the same standard, nearly at right angles, one two feet above the other. One of the dipoles has an extremely low-loss lead-in composed of 50 feet of "twin" coaxial cable (two cables bound in a single sheath), balanced to ground. If the terminals of this cable are left open-circuited, a reflection is induced which completely obliterates the fine detail of the image when the receiver is connected to the other dipole. When the low-loss line is short-circuited, the reflection disappears. When two or more dipoles are installed near each other, as on the roofs of apartment buildings, this effect can readily occur, and it may be extremely difficult to find unless access to both lead-in terminations is available.

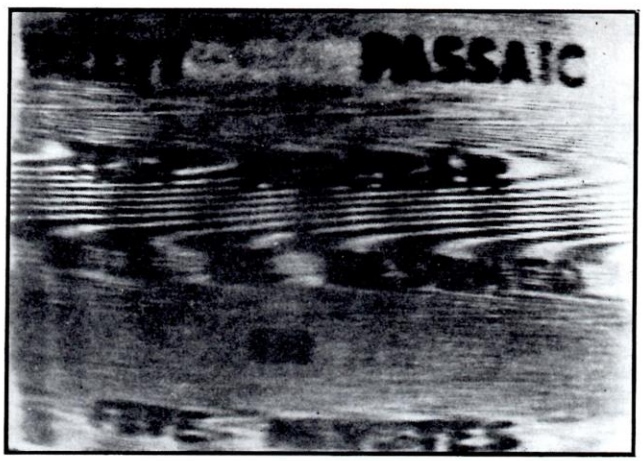


Standard test chart used during current NBC telecasts. The numbers indicate the degree of resolution, i.e., the number of times the width of the black lines is contained in the picture height (the numbers do not appear in the pattern as broadcast)

Sales Methods—and Mistakes

The demonstration of television receivers to the public is as yet not too thoroughly understood by many dealers. The necessity of shielding the face of the cathode-ray tube from external light has been recognized in most instances (most dealers have provided a darkened booth, or corner of the store protected by a heavy curtain in which to demonstrate the receivers). But the effect of the settings of the brightness and contrast controls on the appearance of the image is not so well appreciated. In one store visited by the writer, great care was taken to shield the receiver from stray light, but the brightness control was set at a level two or three times the maximum value for which the engineers designed the set. This made a very bright picture (there was plenty of gain to allow adequate contrast even with excessive brightness) But the excess current in the scanning beam caused the scanning spot to assume a diameter three or four times its normal value, and the detail of the reproduced image suffered in inverse proportion. When the test pattern appeared between the film transmissions, the resolution wedges for showing vertical detail showed less than 200-line resolution whereas 300- to 350-line resolution would have been normal performance. Had the demonstrator been aware of the trouble he could have corrected it by a twist of the brightness knob, and after the eye had accommodated itself to the decreased brightness (a matter of a few seconds only) the picture would have appeared nearly as bright and

(Continued on page 90)



This transmission from the DuMont station, of high quality when initially broadcast, has been impaired by interference almost beyond recognition. The signal level at the receiver was about 100 microvolts. Diathermy interference (center wavy lines) and circuit noise (note "I" in Passaic) are troublesome at such low signal levels

Control System. Automatic regulating apparatus comprising an electrically interpretable variable quantity to be regulated, a grid controlled space discharge tube, etc. R. W. Gilbert, Western Electrical Instrument Corp. No. 2,136,682.

Measuring Apparatus. Electron tube equipment for indicating the position of an object. R. E. Woolley, Bailey Meter Co. No. 2,136,900.

Oscillograph. Device for indicating oscillograph curves as stationary. F. Bedell, General Radio Co. Reissue No. 0,945.

Control Apparatus. No. 2,140,355 to F. H. Gulliksen and No. 2,140,350 to J. W. Dawson, both to WE&M Co.

Sign. A luminous discharge tube operated from high frequency current. Joseph Fodor, London, England. No. 2,139,815.

Wattmeter. Apparatus for measuring a high-frequency ac power quantity. Reuben Lee, WE&M Co. No. 2,140,364.

Light Control. A photoelectric relay adapted to be subjected to the varying intensity of daylight. Pieter Juchter, G.E. Co. No. 2,140,387.

RADIO TRANSMITTER DIRECTS AUTOISTS

W. S. Halstead, New York communication engineer, demonstrating new highway safety system he developed. The system employs a small automatic radio transmitter which may be mounted on telephone poles or traffic light stanchions. The unit warns pedestrians of impending signal changes and directs automobile traffic through radio system which makes use of automobile radio receivers. The unit also employs a magnetic tape recorder which effects continuous repetition of a given traffic bulletin addressed to the pedestrian or motorist

TELEVISION FIELD

(*Continued from page* 15)

several hundred per cent improved in quality. It is this sort of thing that makes engineers grind their teeth. The remedy seems to be more careful instructions, on the part of the manufacturer, to dealers. The same remarks apply of course to the instructions which go to the ultimate purchaser.

Those sets employing large picture tubes (12 and 14 inches in diameter) seem to be doing a uniformly good job in resolving the detail of the image. In one case, a receiver on demonstration in a midtown store was actually resolving *all* the detail in the test pattern (i.e. 350-line resolution in both vertical and horizontal directions). Other sets of the same type were limited to about 300-lines in the horizontal direction, while in a few cases the horizontal definition seemed to be no greater than 250 lines (in the latter case perhaps reflections were the cause). In the five-inch picture-tube receivers, the detail performance is considerably lower. In the first place, the spot size of the tube is large, rela-

tive to the picture dimensions, and the fine detail is not resolved for this reason. Also the band-width passed by these smaller receivers is purposely limited to meet the capabilities of the scanning spot, and to obtain the necessary gain in fewer tubes. About 250 lines, vertical resolution, is good performance, whereas 250 lines horizontally seems to be the best obtainable in models viewed by the writer. Some of the smaller sets resolve less than 200 lines, horizontally, but a very acceptable picture is nevertheless produced.

The scanning and synchronization performance seems to be on a high plane in nearly all of the commercial products. Accuracy of interlace, which can be judged carefully only on the larger tubes, seems to be somewhat less universal, although in one full ten-minute performance, during which the lines were viewed from a distance of four or five inches, the interlace remained substantially perfect.

The presence of slight interference from cw stations operating within the i-f pass band of the picture circuits can be discerned on receivers which do not employ an r-f stage. In these cases, the interfering station is usually within a few blocks of the receiving location.

Sight-sound reactions

Interaction between the sight and sound systems can be observed to a limited degree in nearly every receiver viewed by the writer. Most commonly this interference takes the form of a slight crossing of the sound modulation into the picture, but in most cases the amount is so small that it would not be noticed unless it were looked for. If the signal level is extremely strong, the picture signal may be heard in the loudspeaker, especially in receivers whose converter is connected directly to the antenna circuit. This effect was noticed in a set constructed by the writer for home use, when fed with a signal of about 0.2 volts. When the set was removed to the suburbs, where the signal is roughly 1/100th as strong, the trouble disappeared entirely. This suggests the utility of an attenuator in the antenna circuit to prevent excess signal voltage on the converter grid, which may cause cross-modulation.

Details of set designs are as yet

fairly scarce. We have permission to reproduce here, however, the complete circuit diagram of the type TRK-12 RCA receiver, whose interior arrangements are shown in the frontispiece. The complexity of the diagram and the small space in which it must be printed make the diagram somewhat difficult to read, but it will repay study on the part of engineers who desire to familiarize themselves the details of a modern television receiver. The circuit as shown includes the complete sight system, and the sound system up to the output of the second detector. An 11-tube all-wave radio receiver chassis, included in the cabinet, contains the audio output tubes and loudspeaker.—D.G.F.

PROGRESS REPORT

(*Continued from page* 27)

Recent developments in the production of ultra-steatite by the General Ceramics Corp., make it particularly suitable for critical insulation in the u-h-f range; the material displays a loss factor of 0.31 compared with 0.08 to 0.12 for fused quartz. General Plastics, Inc., announce the ability of Durez phenolics to mold accurately in extremely small parts, such as pins and tumblers of volume-control switches. New antenna relays using low-loss ceramic insulation and wide-spaced contacts are available from Guardian Electric Mfg. Co. Heintz and Kaufman have produced a six-position band-switch for use in high power transmitters, capable of handling a kilowatt of r-f power. Hygrade-Sylvania has just announced five-inch "short" cathode-ray tubes with green or white fluorescent screens. The newest tube in the Hytron line is an extremely compact pentode with control grid and plate brought out to grid caps, designed as a mate to the triode of similar construction which is already available.

The Megabridge, a new insulation resistance tester with ranges available up to 100,000 megohms, is made by Industrial Instruments, Inc. A new design of wire-wound resistance controls especially suitable for rugged service and minimum noise has been produced by the International Resistance Co. New indicator

New York World's Fair 1939 is an outstanding example of the success that results from skillful engineering. Not long ago the Fair's site was a swamp—a dumping place for refuse on Flushing Bay. Yet almost overnight skillful engineering transformed it into a place of beauty and wonder.

Skillful engineering is also responsible for RCA Kinescopes. The development of these tubes was one to which many engineers at the huge RCA tube plant in Harrison, New Jersey, contributed. It presented many difficult problems. But in the end, the ability of RCA engineers—plus the vast resources of RCA—conquered every obstacle.

Over 20,000 Years of Radio Experience Stand Behind RCA Tubes

That is not a boast. It is a fact. And a fact that means every tube bearing the RCA trademark is a tube you can depend upon to perform for you with unmatched efficiency! It is an "extra" that *only* RCA can offer you!

You know well the value of experience. It often spells the difference between perfection and mediocrity. With it a man acquires skill.

And it is this skill based on experience that you will find in the RCA tube plant in Harrison, New Jersey. Here work the world's foremost radio tube people . . . whose engineering and manufacturing experience totals more than 20,000 years. Many of them are RCA engineers, men who have been associated with radio tubes since the birth of broadcasting.

RCA radio tube engineers are pioneers, ever and always working toward the future, seeking, night and day, month after month to improve radio, to widen its scope. And as they explore new fields they achieve new goals, gain new knowledge that is applied to modern radio.

No limitations of support hinder the imaginations of RCA engineers. Behind them are the resources and the facilities with which to carry out their ideas. In Harrison alone the enormous facilities of RCA occupy 15 acres of floor space.

All for your benefit

No wonder RCA engineering is *skillful engineering.* With the men . . . and the machinery . . . both so necessary for success . . . RCA radio tubes are naturally better. Yet they cost the same, or but slightly more than other tubes—and offer you the perfection your customers want—the perfection that results from *skillful engineering.*

RCA Radio Tube Achievements—The Results of Skillful Engineering

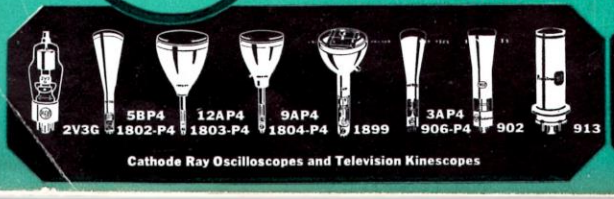
Listed below are 12 RCA tube "firsts." These and many others are the result of skillful engineering.

The first small size metal Cathode Ray Tubes. . . . The first complete line of Cathode Ray Tubes. . . . The first commercial 15,000-volt Cathode Ray Tubes. . . . The first ultra-high frequency tubes of acorn type. . . . The first Television Amplifier Tubes featuring high trans-conductance. . . . The first commercial Iconoscopes. . . . The first Beam Power Tubes. . . . The first Magic Eye Tubes. . . . The first Pentagrid Converters. . . . The first Metal Tubes. . . . The first Cartridge Phototubes. . . . The first Monoscope Signal Generator Tubes.

Over 335 million RCA radio tubes have been purchased by radio users . . . in tubes, as in parts and test equipment, it pays to go RCA All the Wa

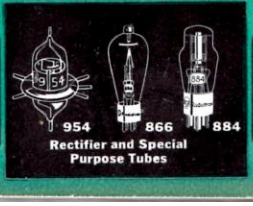
RCA **Radiotrons**

RCA Manufacturing Co., Inc., Harrison, N. J. — A Service of the Radio Corporation of America



Cathode Ray Oscilloscopes and Television Kinescopes

Phototubes



Rectifier and Special Purpose Tubes

Receiving Tubes