# TELEVISION

## *STATIONS*

***Personnel*** ***Facilities***

•

***F.C.C. Regulations***

•

***Facsimile Broadcasting***

•

*Television Progress in*

***England*** ***Germany***

***France*** ***Italy***

# TELEVISION
## BROADCASTING STATIONS

As of Feb. 1st, 1938

*Group A*—2050 to 2100 kc ; *Group B* 42000 to 56000 kc ; *Group C* 60000 to 86000 kc ; *Group D*—Any 6000 kc frequency band above 110000 kc, excluding 400000 to 401000 kc

| *Licensee and Location* | *Letters Call* | *Frequency (kc) or Group* | *POWER Visual* | *Aural* |
|---|---|---|---|---|
| Columbia Broadcasting System<br>New York, N. Y. | W2XAX | B, C | 50 w<br>C. P. granted for 7560 w | |
| Don Lee Broadcasting System<br>Los Angeles, Calif | W6XAO | B, C | 150 w | 150 w |
| Farnsworth Television, Inc., of Pa<br>Springfield, Pa. | W3XPF | B, C | 4 kw | 1 kw (C.P. only) |
| First National Television, Inc.<br>Kansas City, Mo | W9XAL | B, C | 300 w | 150 w |
| General Television Corp.<br>Boston, Mass. | W1XG | B, C | 500 w | |
| The Journal Company<br>Milwaukee, Wis. | W9XD | B, C | 500 w | |
| Kansas State College of A. & A. S.<br>Manhattan, Kansas | W9XAK | A | 125 w | 125 w |
| National Broadcasting Co., Inc.<br>New York, N. Y. | W2XBS | B, C | 12 kw | 15 kw |
| National Broadcasting Co., Inc.<br>New York, N. Y. | W2XBT | 92000, 175000-180000 | 400 w | 100 w (C.P. only) |
| Philco Radio & Television Corp<br>Philadelphia, Pa. | W3XE | B, C | 10 kw | 10 kw |
| Philco Radio & Television Corp.<br>Philadelphia, Pa. | W3XP | 204000-210600 | 15 w | (C.P. only) |
| Purdue University<br>West Lafayette, Ind. | W9XG | A | 1500 w | |
| Radio Pictures, Inc.<br>Long Island City, N. Y. | W2XDR | B, C | 1 kw | 500 w |
| RCA Mfg. Co., Inc. (Portable)<br>Bldg. No. 8 of Camden Plant | W3XAD | D (124000 to 130000) | 500 w | 500 w |
| RCA Mfg. Co., Inc.<br>Camden, N. J. | W3XEP | B, C | 30 kw | 30 kw |
| RCA Mfg Co., Inc.<br>Portable—Mobile | W10XX | B, C | 50 w | |
| The Sparks-Withington Co.<br>Jackson, Mich. | W8XAN | B, C | 100 w | 100 w |
| University of Iowa<br>Iowa City, Iowa | W9XK | A | 100 w | |
| University of Iowa<br>Iowa City, Iowa | W9XUI | B, C | 100 w | |
| Dr George W. Young<br>Minneapolis, Minn. | W9XAT | B, C | 500 w | |

C P denotes that an authorization has been issued to construct a television broadcast station Upon completion of equipment tests and license application filed, Commission may grant license for television broadcast.

# F. C. C. REGULATIONS

## Applicable to Television and Facsimile Broadcasting Stations

*The term "visual broadcast service" means a service rendered by stations broadcasting images for general public reception. There are two classes of stations recognized in the visual broadcast service, namely: Television broadcast stations and Facsimile broadcast stations.*

### Television Broadcast Stations

The term "television broadcast station" means a station licensed for the transmission of transient visual images of moving or fixed objects for simultaneous reception and reproduction by the general public. The transmission of the synchronized sound (aural broadcast) is considered an essential phase of television broadcasting and one license will be issued for both visual and aural broadcast as hereinafter set out.

A license for a television broadcast station will be issued only after a satisfactory showing has been made in regard to the following, among others:

1. That the applicant has a program of research and experimentation which indicates reasonable promise of substantial contribution to the development of the television broadcast art.

2. That the program of research and experimentation will be conducted by qualified engineers.

3. That the applicant is legally and financially qualified and possesses adequate technical facilities to carry forward the program.

4. That the public interest, convenience and/or necessity will be served through the operation of the proposed station.

(a) A licensee of a television broadcast station shall not make any charge, directly or indirectly, for the transmission of either aural or visual programs.

(b) In the case of experimental televising of the production of a commercial broadcast program, all commercial announcements not a part of the entertainment continuity shall be eliminated from the television broadcast except the mere statement of the name of the sponsor or product or the televising of the trade-mark, symbol, slogan or product of the sponsor; provided, however, that when the program transmission is incidental to the experiments being conducted and not featured, and subject to interruptions as the experiments may require, the commercial announcements may be broadcast aurally.

(c) No licensee of any other broadcast station or network shall make any additional charge, directly or indirectly, for the simultaneous transmission of the aural or visual program by a television broadcast station, nor shall commercial accounts be solicited by the licensee of another broadcast station or network, or by others acting in their behalf upon the representation that the commercial program will also be transmitted by a television broadcast station.

(d) The synchronized sound (aural) program of a television broadcast station may be broadcast by a regular broadcast station, provided:

1. That no announcements or references shall be made over the regular broadcast station regarding the operation of the television broadcast station, except the mere statement that the program being transmitted is the sound or aural program of a television broadcast station (identify by call letters).

2. That the call letter designation when identifying the television broadcast station shall be given on its assigned frequency only.

(a) The following groups of frequencies are allocated by bands for assignment to television broadcast stations on an experimental basis:

| *Group A* | *Group B* |
|---|---|
| 2000 to 2100 kc | 42,000 to 56,000 kc |
| *Group C* | *Group D* |
| 60,000 to 86,000 kc. | Any 6,000 kc frequency band above 110,000 kc excluding 400,000 to 401,000 kc. |

(b) A licensee of a television station for Group A shall carry forward a comprehensive program of experimentation to determine the secondary or rural coverage of the station, and shall suitably locate receiving equipment and other apparatus, and shall make the necessary measurements to determine the quality and characteristics of the secondary or sky-wave service area. Television transmission only will be authorized in this band, and each license will authorize the entire band. No aural broadcast will be authorized therein

(c) A license for a television broadcast station in groups B, C or D will specify a frequency band wherein two adjacent carrier frequencies shall be selected, one for the visual and one for the aural broadcast. The lower carrier frequency shall be for visual broadcast and the higher carrier frequency for the aural broadcast.

(d) A licensee will be granted only one station in each frequency group for operation in the same service area.

(e) An application may be made for one frequency band (to include the visual and the aural carriers) in groups B, C and D. However, if it is desired to operate in more than one group, it will be necessary to make separate applications for a station in each group.

(f) Applicants shall specify the band width of the emissions required for the proposed transmission.

(g) Carrier frequencies shall be so selected and emissions controlled that no emission from any cause will result outside the frequency band authorized by the license.

(h) An applicant shall select a frequency band in the group which is believed best suited for the experiments to be conducted and will cause the least or no interference to established stations.

The power output rating of a television broadcast station shall not be in excess of that necessary to carry forward the program of research. The operating power may be maintained at the maximum rating or less, as the conditions of operation may require.

A supplemental report shall be filed with and made a part of each application for renewal of license and shall include statements of the following:

1. Number of hours operated for transmission of television programs.
2. Comprehensive report of research and experimentation conducted.
3. Conclusions and program for further developments of the television broadcast service.
4. All developments and major changes in equipment.
5. Any other pertinent developments.

## Facsimile Broadcast Stations

The term "facsimile broadcast station" means a station licensed to transmit images of still objects for record reception by the general public.

A license for a facsimile broadcast station will be issued only after a satisfactory showing has been made in regard to the following, among others:

1. That the applicant has a program of research and experimentation which indicates reasonable promise of substantial contribution to the development of the facsimile broadcast service.
2. That the program of research and experimentation will be conducted by qualified engineers.
3. That the applicant is legally and financially qualified and possesses adequate technical facilities to carry forward the program.
4. That the public interest, convenience and/or necessity will be served through the operation of the proposed station.

(a) A licensee of a facsimile broadcast station shall not make any charge, directly or indirectly, for the transmission of programs.

(b) No licensee of any other broadcast station or network shall make any additional charge, directly or indirectly, for the transmission of programs by a facsimile broadcast station, nor shall commercial accounts be solicited by any licensee of another broadcast station or network, or others acting in their behalf, upon representation that images concerning that commercial program will be transmitted by a facsimile station.

(a) The following frequencies are allocated for assignment to facsimile broadcast stations on an experimental basis provided no interference is caused to the television stations operating in the band 2000-2100 kilocycles:

2012 kc 2016 kc 2096 kc

(b) If the facsimile program of research and experimentation cannot be

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# MODERN TELEVISION SYSTEMS

By HARRY R. LUBCKE

Director of Television of the Don Lee Broadcasting System, Los Angeles

Modern television systems may be divided into two groups: the electronic, and the mechanical. In the first group are found the Image Dissector tube of Philo T. Farnsworth, of Farnsworth Television, the Iconoscope of V. K. Zworkyin, of the Radio Corporation of America, and the cathode ray tube of antiquity. In the second group, recent advances have made the mechanical disk a superior means for scanning motion picture film, and the Scophony method of multiple light control is a competitor of the cathode ray tube for exhibiting the received image.

The Image Dissector is a glass enclosed vacuum tube containing a uniform photoelectric surface at one end and a tiny aperture at the other. The scene to be transmitted, either live or film, is focused upon the photoelectric plate by a lens. Electrons are given off at each and every point on the surface according to the light intensity striking that point. The "electron image" of the scene thus created is caused to traverse the tube to the aperture, being focused to a sharp image thereat and being deflected systematically thereover to accomplish scanning, thereby producing a television signal. The traverse is effected by applying voltages to the tube electrodes, and the focusing and deflection by magnetic fields produced by current flowing through coils surrounding the tube.

A device known as an "electron multiplier," a current amplifier as distinguished from the ordinary radio tube which is a voltage amplifier, has been developed and made a part of recent Dissector tubes.

The Iconoscope is also a glass enclosed vacuum tube, but contains a special photoelectric surface in its principal enclosure and a cathode-ray "electron gun" in a narrow extension thereof. The special surface is known as the "mosaic" and is composed of an innumerable number of minute photoelectric globules, each insulated from the other, and forming in effect an innumerable number of separate photoelectric cells. The scene to be transmitted is again focused upon the photoelectric surface by a lens. Electrons are given off as before, but this time each globule, since it is insulated, assumes a positive potential proportional to the light that falls upon it. Once each complete scanning of the image, an electron beam constantly emitted from the electron gun discharges each globule and thereby produces the television signal. The charging process takes place all the time, except the instant when the beam discharges the particular globule. This storage process is an important one, although its full possibilities have not been attained at the present time.

These two devices are truly "electric" eyes. They are creations of the modern age. All credit is due the inventors, and the organizations behind them, in making these devices practical tools in the hands of present-day television engineers.

In the transmission of film, certain characteristics of the mechanical arrangement cause the result to be accomplished in a particularly satisfactory manner. Although the modified motion picture projector required to run off the film is a mechanical device itself, the advantage of mechanical pickup is not because it coacts efficiently with another mechanical device, but because a true shading of the image is secured.

The mosaic type pickup tube does not produce the electrical representation of the background of the scene being transmitted. This must be inserted dur-

ing each performance by operation of the "shading controls" which introduce compensating electrical waveforms into the television signal. With the mechanical scanner this manipulation is not required.

The use of this scanner is particularly prevalent in Germany. The Fernseh A. G. ("Television Corporation"), where over one hundred men are engaged in research on all systems of television, have recently made known their high-definition mechanical film scanner. The work of the D. S. Loewe organization in this regard is also known.

In England, "Television" reports that the mechanical film transmissions of the Baird System were more clearly received by the public than the present film pickup with the Emitron mosaic tube. The Scophony System utilizes a mirror drum for film transmission.

In the United States the Bell Laboratories of the American Telephone & Telegraph Company have developed a mechanical film scanner for use in their coaxial cable work. The Don Lee Broadcasting System uses the mechanical method for film scanning and the mosaic tube for direct pickup.

The modern mechanical scanner is, however, a far cry from its low-definition predecessors. Low-definition television, formerly in use throughout the world, may be defined as television systems employing a standard of from 30 to 120 lines. The present high definition television may be defined as any greater lineage than this, but is usually taken to mean standards of from 240 to 441 lines.

Without new principles of operation, the fundamental scanning disk or mirror drum would be incapable of transmitting an accurate image. The mechanical tolerances required transcend the art of the skilled machinist. The manner in which these limitations are overcome has not yet been disclosed by those who have developed this equipment.

In order that the subject matter seen by the electric eyes or taken from motion picture film be reproduced at a distance requires the coaction of a host of cooperating devices

Scanning sources, which produce electrical waveforms of special shapes, are required to operate pickup tubes and also the cathode-ray tubes at the receiver. Amplifiers, developed from the type utilized in radio, but capable of amplifying a band of frequencies from thirty to over two million cycles per second are used at both transmitter and receiver. Television transmitters and receivers, or a coaxial cable handling this wide band width, must be utilized to transport the television signal from the point of origination to the distant point of observation. Finally, the receivers must be held in step with the transmitter by a process called synchronization, and the foundation upon which modern television has been built, the cathode-ray tube, is required to display the image.

If sound is to accompany the visual performance, microphone, amplifiers, a transmitter, receivers, and loudspeakers must be provided for a second channel of communication.

The perfection of several of these devices has been required in order to make present high-definition television possible.

Considering these devices in order, we find that present-day scanning sources produce rectilinear (straight-line) "sawtooth" waveforms, to the end that the scanning spot in the camera and on the cathode ray tube screen moves from one side to the other fairly "slowly" (in one thirteen-thousandth of a second!) but returns to start the next trace in less than one-tenth that time. "High vacuum" thermionic tubes are now largely utilized, replacing the former gas triodes, or Thyratrons, although the latter may still be used in simplified receivers.

The amplifiers are usually of the resistance — capacitance coupled type with compensating inductances or feedback to secure the wide frequency band. Transformer coupling, as widely used in radio, is not suitable. It falls to the amplifier, in cooperation with the scanning sources, to provide the various blanking, pedestal, and synchronizing waveforms which must be inserted in the television signal.

The modern television signal is a composite of several waveforms, assembled in a manner hardly known ten years ago. It is universal practice to place the image signal on one side of the axis and the synchronizing pulses on the other side. In usual radio broadcasting, both sides of the axis are occupied by the more or less "sine wave" quality of speech and music. In television, the two sides of the axis are utilized for separate functions, one side for carrying the image variations of intensity, the other side for synchronization purposes. At the receiver the waveform is essentially "split in half" by the synchronizing equipment. The two parts are directed to the proper portions of the receiving apparatus to make the receiver operate as a whole. The synchronizing equipment is nearly human in carrying out this process.

The television transmitters invariably operate on ultra-high frequency chan-

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# THE PROBLEM OF SYNCHRONIZATION

By

R. LORENZEN

Television Engineer

REGARDLESS of what type of television system is used, the key problem is always the synchronization of the transmitted and received images. That such is the case is obvious when it is remembered that the image is transmitted point by point. Each point in the picture received must correspond with the one transmitted not only in the intensity of illumination but also as regards its location on the viewing screen. If the received image does not correspond point for point in its position on the viewing screen with the image at the transmitter there will result only a jumble of light and dark areas. This point for point correlation of received and transmitted images is effected by synchronizing the received and transmitted video impulses.

## TECHNIQUES EMPLOYED

The techniques employed in obtaining synchronization are largely determined by the manner in which the televised picture is scanned.

## SCANNING WAVES

Until relatively recently sine wave scanning, or some variant thereof, was used almost exclusively. Certain apparently insoluble problems temporarily retarded the further development of this method and investigators turned to saw-tooth scanning. By using saw-tooth scanning the problem of synchronization was solved, but only by making the television receiver complicated, critical, expensive, and entirely unsuited for public consumption.

Any worthwhile television system for the home must employ a synchronization technique of such nature that the synchronization is entirely accomplished at the transmitter. From this point of view, a television system which uses saw-tooth scanning is only pseudo-synchronized for, although the transmitter sends out synchronizing impulses, final synchronization is effected at the receiver.

Fortunately, the difficulties encountered in using sine wave scanning have been eliminated and it is now possible to construct a television system in which the synchronization is entirely controlled at the transmitter. Furthermore, when sine wave scanning is employed the television receiver requires less complex circuits and is much simpler to operate. In consequence of this, the receiver could be sold at a lower price than when saw-tooth scanning is used.

## FCC AND TELEVISION

The Federal Communications Commission to date has wisely refrained from issuing commercial television licenses for it does not wish the public to spend its money on unsatisfactory television apparatus. Many large corporations, however, have spent huge sums in developing television systems based on saw-tooth scanning. They are now demanding a standardization of television usage which depends on this method despite its proven deficiencies.

The future of commercial television therefore depends largely upon the stand to be taken by the Federal Communications Commission regarding its practice in licensing commercial television stations.

THE A B C OF

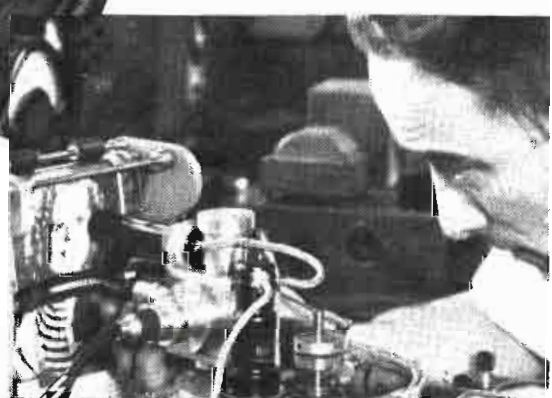
# Finch Facsimile

RADIO'S MOST DRAMATIC FORWARD-STEP OF THE YEAR!

**Facsimile Recorder** which, early in 1938, pioneer broadcasters will place in test homes for experimental transmission. Hardly more than a foot square, complete in a single unit, automatic, works on any radio.

Electric "Pen" in Recorder which, actuated by signals from broadcasting station, swings to and fro in automatic step with transmitter, silently printing while citizens sleep. With few moving parts, these simplified Recorders make facsimile possible in remote districts.

**Facsimile Copy** as it issues from the Recorder. Two columns wide, carries news bulletins, photographs, advertising, opening up tremendous new sources of revenue to broadcasters. Recorder holds a week's supply of paper; cost to consumer, approx. 20c a week.



Radio facsimile as a vital public service is here now. Under Finch patents the following stations have been licensed for facsimile broadcasting, FCC having granted permits for experimental use of regular frequencies, full power, from midnight to six a m.

WGH—250 watts—Newport News, Va.
KSTP—[illegible] watts—St. Paul, Minn.
WHO—50,000 watts—Des Moines, Iowa
WSM—50,000 watts—Nashville, Tenn.
WCLE—500 watts—Cleveland, Ohio
WHK—2,500 watts—Cleveland, Ohio

The laboratories are open to licensed broadcasters for demonstration, by appointment. Call PLaza 5-8570.

William A. Finch

Scanning Head with photoelectric eye in compact, easily operated transmitting apparatus, which plugs into ordinary broadcasting amplifiers without equipment changes; translates printed matter, line-cuts, half-tones, photos, into electrical signals which can be sent over regular channels.

**FINCH TELECOMMUNICATIONS LABORATORIES, INC.**

37 WEST 57th STREET, NEW YORK CITY

## FCC REGULATIONS - - - - (Con't from page 446)

properly carried forward on the frequencies in subsection (a) of this rule due to the characteristics of these frequencies, applicants may request and be assigned any frequency specified in Rule 1073 on an experimental basis.

(c) Other frequencies under the jurisdiction of the Commission may be assigned for experimental operation of facsimile broadcast stations on an experimental basis provided a sufficient need therefor is shown and no interference will be caused to established radio stations.

(d) Each facsimile broadcast station will be licensed for only one frequency except in subsection (b) of this rule more than one frequency may be licensed to one station if need therefor is shown.

(e) Each applicant shall specify the frequency or frequencies desired and the maximum modulating frequencies proposed to be employed.

(f) The operating frequency of a facsimile broadcast station shall be maintained in accordance with the frequency assignments as shown by Rule 980, provided, however, where a more strict adherence to the assigned frequency is necessary to prevent interference, the Commission will specify the tolerance.

(g) A facsimile broadcast station authorized to operate on frequencies regularly allocated to other stations or services shall be required to abide by all rules governing the stations regularly operating thereon, which are applicable to facsimile broadcast stations and are not in conflict with Rules 980 to 986, inclusive, and Rules 1030 to 1039, inclusive, excluding Rule 1035.

The power output rating of a facsimile broadcast station shall not be in excess of that necessary to carry forward the program of research. The operating power may be maintained at the maximum rating or less, as the conditions of operation may require.

A supplemental report shall be filed with and made a part of each application for renewal of license and shall include statements of the following:

1. Number of hours operated for transmission of facsimile programs.

2. Comprehensive report of research and experimentation conducted.

3. Conclusions and program for further developments of the facsimile broadcast service.

4. All developments and major changes in equipment.

5. Any other pertinent developments.

## MODERN TELEVISION SYSTEMS - - (Con't from page 448)

nels, usually from 44,000 to 72,000 kilocycles. This removes troubles from sky waves and fading, such as found in broadcast and short wave radio, but restricts the useful range of a transmitter to a future maximum of probably eighty-five miles. Compared to present fifty kilowatt broadcast transmitters, most television transmitters are of medium power, rarely exceeding eight kilowatts.

New methods of modulation are often employed. A modified grid bias method has been employed by the Don Lee organization for several years. The Philco organization has recently made known a "transmission line" method where the modulator is placed at the end of a quarter wavelength line properly connected to the transmitter-antenna transmission line.

The original filamentless cathode ray tube of Braun of a half-century ago little resembled the precise instrument of today. Usually employing electrostatic focusing taken from the new field of electron optics, an "electron gun," powered by a heater type cathode filament, produces a small but intense beam of electrons at the narrow end of a cathode-ray tube. This beam is deflected, either by deflection plates or by deflection coils, over the fluorescent screen which is located on the large or viewing end of the tube. The output of the receiver scanning sources, synchronized by the incoming synchronizing pulses being applied to the plate or coils, causes the moving spot of light, formed on the fluorescent screen by the impact of the electron beam upon it, to be at all times in the same relative position on the receiver screen as is the exploring spot at the transmitter pickup tube or film scanner.

The sound channel of television is essentially a duplicate of present high frequency broadcasting, "apex," facilities.

In this way is modern television accomplished. It employs instrumentalities previously unknown, and others borrowed from parent arts which have been perfected to an unbelievable degree. All this to accomplish a fundamental human desire, the ability to see at a distance, as we are now able to hear at a distance over the radio.

# EXPERIMENTAL FACSIMILE BROADCAST STATIONS

(Authorized by FCC as of Jan. 15, 1938)
AUTHORIZED TO USE REGULAR BROADCAST BAND

●

*The Federal Communications Commission, realizing the value of facsimile broadcasting, has granted 17 experimental licenses to stations to further the advancement of the ever growing service. Eight important stations, servicing rich commercial markets during the regular broadcast periods, are now experimenting with facsimile during the early morning hours. Seven short wave stations are also licensed by the FCC for experimental work in facsimile.*

*1938, with its many promises for the added advancements in all phases of broadcasting, is already well on its way insofar as facsimile is concerned. Major manufacturing companies are confident that the current year will find the creation of a new market, facsimile, and that by 1939, facsimile will be a household byword.*

●

| Call Letters | Licensee and Location | Frequency Kilocycles | Power Authorized Watts |
|---|---|---|---|
| WGH | Hampton Roads Broadc. Corp., Newport News, Va. | 1310 | 100 |
| WHO | Central Broadcasting Co., Des Moines, Ia. | 1000 | 50000 |
| WOR | Bamberger Broadcasting Service, Newark, N. J. | 710 | 5000 |
| KSTP | National Battery Broadcasting Co., St. Paul, Minn. | 1460 | 10000 |
| KFBK | McClatchy Broadcasting Co., Sacramento, Calif. | 1490 | 5000 |
| KMJ | McClatchy Broadcasting Co., Fresno, Calif. | 580 | 1000 |
| KSD | Pulitzer Publishing Co., St. Louis, Mo. | 550 | 1000 |
| WSM | Natl. Life & Accident Ins. Co., Nashville, Tenn. | 650 | 50000 |
| WHK | Radio Air Service Corp. | 1390 | 1000 |
| WGN | WGN, Inc., Chicago, Ill | 720 | 50000 |

## Short Waves

| Call Letters | Licensee and Location | Frequency Kilocycles | Power Authorized Watts |
|---|---|---|---|
| W2XBK | W. G. H. Finch Labs., Inc., New York, N. Y. | 1614, 2389, 3492.5, 4797.5, 6425, 8655 | 250 |
| W10XGU | W. G. H. Finch Labs., Inc., New York, N. Y. | 31600, 38600, 41000 | 250 |
| W1XMX | Yankee Network, Inc., Boston, Mass. | 41000 | 500 |
| W7XBD | Oregonian Publishing Co., Portland, Ore. | 1614, 2012, 3492.5 | 1000 |
| W2XR | Radio Pictures, Inc., New York, N. Y. | 1614, 2012, 2398, 23100, 41000, 86000-400000 | 1000 |
| W9XAG | The Journal Co., Milwaukee, Wis. | 1614, 2398, 3492.5, 4797.5, 6425, 8655 | 1000 |
| W9XAF | The Journal Co., Milwaukee, Wis. | 41000 | 500 |

# FACSIMILE BROADCASTING

*By*

W. G. H. FINCH

President and Technical Director, Finch Telecommunications Labs., Inc.

During the early months of 1938 pioneering broadcasters in many sections of the country will inaugurate a new form of radio transmission with vast potentialities for public service and augmented revenue. The name of this new service is facsimile, "first cousin" of television since it shares with it some of the same basic principles.

Unlike its more glamorous and well-publicized relation, facsimile steps into broadcasting service from other communications fields in which it has already proved its capabilities in a quiet but exceedingly effective manner. For facsimile, as most radio men know, has been in daily commercial use for several years in speeding news photos back and forth across the country via telephone circuits, and across the Atlantic by short wave radio.

In spite of the rapid development and use of everyday wire and radio facsimile service, few are aware of its greater capabilities as a mass communications medium in the broadcasting field. This is largely because of the fact that facsimile transmissions have been almost entirely employed to handle press photographs for subsequent newspaper reproduction, and in the average layman's mind this is the limitation of the method. Many, also, confuse television with facsimile and ask why television will not ultimately perform the same duty.

For these reasons, the first questions to be answered are, "What is facsimile, how does it differ from television, and how does it fit into the radio broadcasting picture?"

## FACSIMILE OPERATION

Briefly, in non-technical language, facsimile in its electrical communications sense, involves the conversion of illustrations, or other copy such as printed matter, into an electrical signal which can be sent over telephone or radio communications circuits. At the receiver the signal is automatically converted back into its visible form, appearing as a recorded replica of the original copy. The received copy is permanent and like a printed page can be handled, observed or read whenever desired. It is somewhat as if an amazingly compact printing press, installed at the receiving location, were to be remotely controlled by the distant transmitter and in the process effected the printing of a duplicate of the copy seen at the distant point.

## TELEVISION AND FACSIMILE

Television, like facsimile, involves the conversion of visible aspects of subjects into electrical signals which can be sent to distant points. However, the speed of this conversion is such that ordinary telephoto circuits or conventional aural broadcasting equipment cannot handle the signal. Costly co-axial cables with associated high frequency signalling ap-

paratus or special ultra-high frequency radio transmitters and receivers are therefore called in to do this difficult job.

In addition, there is as much difference in the technique of the two communications mediums as there is between the making of a newspaper and a motion picture. For primarily, where facsimile is concerned only with the transmission and subsequent recording of copies of still subjects such as pictures, and printed pages, television deals with moving objects or persons. The image on the screen of a television receiver has the basic qualities of a motion picture. The image moves, it is transitional, and when the show is over the screen is blank. Since nothing has been recorded the images will not be seen unless someone watches the screen when they are received.

Facsimile and television thus perform widely different functions. Each will fit into the communications picture as separate services, having fundamental distinctions as widely divergent as those of the public press and the motion picture.

## FACSIMILE TRANSMISSION

The more technical phases of facsimile transmission and reception are generally understood by radio and sound engineers. For those who want to know just how radio facsimile transmission is effected a brief description of the Finch Facsimile Transmitter, to be used by the majority of the pioneering facsimile broadcasters as licensees under the Finch patents, will probably clarify some points in question.

The facsimile transmitter of the type to be employed by the pioneering stations in the forthcoming experimental service employs a scanning machine in which the copy to be sent over the air is inserted in what is termed the "copy head." This holds and advances the copy in front of a "scanning head," consisting of a small electric bulb, lens system and photocell. Light from the bulb is focused as a small spot on the surface of the paper carrying the copy, and the reflected light is picked up by the light-sensitive photocell. The scanning head is moved from side to side by an electric motor so that the spot of light traces a series of parallel paths across the copy, which is moved upwards through a distance equal to the diameter of the light spot at the end of each scanning stroke. In this manner, the entire surface of the paper is scanned, line by line, the black, half tone and white areas reflecting to the photocell varying amounts of light ranging from minimum to maximum. These variations in reflected light effect a change in the amount of electric current flowing through the photocell, which in turn controls the loudness of a high-pitched, whistle-like tone. The tone, called the "facsimile carrier" with its rising and falling aural characteristics, is then applied to ordinary broadcast amplifiers. These deliver it to the radio transmitter in the same manner in which aural broadcast signals are handled. Any conventional broadcasting receiver tuned to the frequency of the transmitter will then pick up the signals. However, in order for the broadcasting listener to utilize these signals he must have a recording machine to convert them back into their visible equivalents on paper.

## FACSIMILE RECORDER

The Finch Home Facsimile Recorder is used for this purpose. The recording machine in many ways is similar to the scanning instrument. What is termed a "receiving copy head" holds the dry electrosensitive recording paper, which is fed as a continuous strip two columns wide from a roll carried in the lower part of the machine. A recording stylus is then moved by a small electric motor from side to side across the surface of the paper, forming marks on the paper corresponding in position and quality to the elements of the copy at the transmitter. When the incoming signal is loudest the line traced is darkest, when it is weakest no trace is formed. At the end of each of these recording strokes the paper is moved up by an amount equal to that of the width of each line element. By means of extremely short low-tone synchronizing control impulses sent out by the transmitter just before the start of each recording stroke and by the use of a small motor turning over at a predetermined speed the recording stylus always moves across the paper in step with the scanning head of the transmitter, recording copy in its proper position, regardless of the type of electrical power supply of the different states in which transmitter and receivers may be located. The recorded copy is built up line by line to appear as a duplicate of the original

## HOME RECORDING SETS

The actual home recording machine, which at present costs $125.00 because it is made in limited quantities, is small enough to be housed as a complete unit in a cabinet approximately a foot square. It may be connected without auxiliary amplifying equipment to the output circuit of any broadcast receiver having a

power rating of three watts or more. A switch in the loud speaker circuit is then employed to cut the speaker off during the recording of facsimile broadcasts. The broadcasting station from which facsimile signals are sent is tuned in with the receiver as if regular aural programs were to be received. The facsimile recorder is switched on and the volume control of the receiver is turned to the point where copy has the desired contrast. The actual recording operation is wholly automatic and requires no attention.

## AUTOMATIC RECORDING

The simple statement that recording is automatic may seem relatively unimportant to the average reader, but it is largely the solution of the automatic recording problem that has made it possible for Finch Telecommunications Laboratories to pioneer in its present work in opening the home facsimile field. For until the development of an automatic machine and inexpensive dry recording paper of wide latitude which requires no liquids for moistening or smudgy carbon transfer for printing, the adaptation of facsimile recording methods to home service seemed rather remote. These conditions were recognized as prerequisites as early as 1933 when first radio tests of the basic Finch Facsimile system were conducted over station W10XDF, located at Teterboro Airport. The result is that the home facsimile machine safely operates without attention throughout long facsimile broadcasting periods. The machine holds a roll of dry recording paper which is automatically fed as long as facsimile signals are received. Each roll holds enough paper to provide for a week's recording operations without reloading. Recording papers in a number of different color combinations have been developed, but it is believed that stock on which the facsimile copy appears as black on either a white or orange background will be most popular. Other combinations include red on a white background, green on white, yellow on white, and blue on white.

## ACTUAL FACSIMILE BROADCASTING

The obvious questions at this point are, "When will facsimile broadcasts occur and what stations will handle them?" The answer is that during the experimental period and probably thereafter facsimile broadcasts will take place during the early morning hours between midnight and 6 A.M. when aural broadcasting facilities are ordinarily idle. Simple time clocks will turn the radio receiver and recording motor on and off at specified hours. "Printing" of illustrated news bulletins, with latest news flashes, photographs, market reports, weather maps, cartoons, recipes, aural program announcements and illustrated advertisements of all sorts, will thus be effected in homes while their occupants sleep, the machine being practically silent in operation and entirely automatic in its operation. The result is a complete up-to-the-minute two column illustrated news bulletin ready to read at breakfast time.

## GENERAL

This, to some who are not familiar with facsimile developments, sounds like one of H. G. Wells' prophecies. That it is not is attested to by the fact that at the present writing some of the leading broadcasting stations in the country have already been granted FCC permits to inaugurate such a service using regular broadcasting frequencies and full power between midnight and 6 A.M. in experimental transmissions to determine public reaction and to obtain basic engineering data for future facsimile services. Stations already licensed on this basis are: WGH, Newport News; KSTP, St. Paul, Minneapolis; WHO, Des Moines; WSM, Nashville; WOR, Newark; WCLE, Cleveland; WHK, Cleveland; WGN, Chicago; KSD, St. Louis; KFBK, Sacramento; and KMJ, Fresno. In addition, other important stations have applied to FCC for similar facsimile permits.

Facsimile transmissions of these stations will start as soon as the necessary equipment has been delivered and installed.

When the experimental period has demonstrated the value of facsimile broadcasting service and when publicity and advertising to consumers gets under way, we anticipate great difficulty in supplying public demand for home recorders. Because facsimile, like television, will inevitably capture the public imagination and when it does another dynamic new industry comparable to aural radio broadcasting will be born.

# TELEVISION ☆ ABROAD ☆

*Foreign television during the past year made numerous advances technically. Construction was begun on the most powerful commercial television station yet announced, in Paris. Germany and Italy matched strides in their television advances.*

## ENGLAND

The decision in England on the advice of the Television Advisory Committee, to adopt a single standard of television transmission for the London station at the Alexandra Palace has had one important immediate effect. The prices of television receiving sets manufactured by "His Master's Voice" and the (British) General Electric Co., Ltd., have been reduced and it is expected that the other manufacturing companies will follow suit shortly.

The "H.M.V." sets are priced at 80 guineas for the model 900, which is a television sight and sound receiver with long, medium and short wave radio, and 60 guineas for the model 901, which is a television sight and sound receiver only. Identical prices have been made by the General Electric Co., Ltd.

Scophony Television, Ltd., has stated that provided demand expands sufficiently, the price of its set may be reduced within 12 months to £50.

### Extension of Service

These reductions in price form the first step to popularize television and bring it within the reach of the average listener. The size of the market will depend on price of receivers, quality of programs, and the number of people brought within receiving distance of stations.

The quality of the program depends entirely on the future policy of the B. B. C. and the amount of money made available for program material. Improvement has been noticeable recently and it is obvious that the B. B. C. producers at the Alexandra Palace are benefiting by experience and criticism, despite the fact that they are laboring under severe handicaps of lack of sufficient money and limitations of stage. The number of people now within reach of the programs emanating from the London station is somewhere between 8,000,000 and 10,000,000. Other stations will be erected in the large cities of the provinces when, in the opinion of the Television Advisory Committee, it is advisable to do so.

When further broadcasting stations are erected, it is by no means unlikely that the Baird Company, which suffered a blow to its prestige by being superseded at the Alexandra Palace by Marconi-E.M.I., will have its share of them. The patent situation is complicated but it is assumed that Baird, being one of the pioneers of television, is in a strong position with respect to patents. In this connection it is interesting to note that the B. B. C. is indemnified against any patent infringement and pays no royalty for its use of television transmitting apparatus.

Television can be extended by the use of the coaxial cable which has been developed in England by Standard Telephones and Cables, Ltd. Birmingham has been connected with London by one such cable and extensions are planned to Manchester and Leeds. While it is possible to transmit television signals over this cable, it will probably not be done for some time.

### The Future of Television

Sir Noel Ashbridge, chief engineer of the British Broadcasting Corporation, recently addressed the Royal Empire Society, his subject being television. Most of his talk dealt with what television actually is and how it is done. He was quite frank in discussing the difficulties encountered at present and emphasized the limitations of stage, lighting and make-up. The small size of the stage, he said, was a distinct handicap to artists, although the conditions under which they worked apart from that were no less comfortable than those prevailing in the average motion picture studio.

Speaking of the future, Sir Noel said that he was confident that these difficulties would be overcome and that television could be carried out under ordinary lighting conditions. He felt

that difficulties of depth and focus would eventually be surmounted and that a consequent improvement in program would be made possible.

Mentioning the use of the coaxial or concentric cable, as he called it, Sir Noel said that it would make possible outside broadcasts of such events as the Cup Final (football) or the tennis championships at Wimbledon. Closing his address he said that television had advanced further in England than in any other country.

### Strata in the Atmosphere

New radio reflecting layers have been discovered in the upper atmosphere, according to Mr. R. A. Watson Watt, superintendent of the Bawdsey Research Station of the Air Ministry. These new layers were discovered, apparently, at about the same time by himself and his colleagues in England, Mr. Colwell and Mr. Friend in the United States and Professor Mitra in India.

The most important of the new layers is said to be well within the altitude of ordinary winds and meteorological effects and produce the effect of "ghost" visages in television. A second image, slightly displaced, has appeared on some television receiver screens, notably in Bristol. Apparently one beam from the London television station goes direct to Bristol and another goes up to the layer and then down again, coming in late on the receiver, giving the effect of an "echo" picture or "ghost."

Although Scophony Television Limited was not entrusted by the Government with the provision of the first television broadcasting station of the British Broadcasting Corporation, the company has continued its researches and is now producing receiving sets capable of receiving the broadcasts from the Alexandra Palace. The system is different from that used by the Baird Television Company and the E.M.I. Marconi Company in that the principal involved is mechanical rather than based on the cathode ray tube.

It is the view of the Scophony engineers that if television is to have a permanent value as entertainment the screen must be enlarged from its present proportions. It is understood that the object is to obtain a screen about the size of the home moving picture and the Scophony engineers believe their system alone is capable of producing this.

The company claims to hold certain basic patents in the optical-mechanical field of television, the number being 130 in this country and abroad, not including over 100 applied for and pending.

## FRANCE

The most powerful commercial television broadcasting station yet announced, to be installed at the foot of the Eiffel Tower with the antenna projecting from the top of the flagpole of this structure, has been ordered by the French Ministry of Posts, Telephones, and Telegraphs from the Materiel Telephonique.

The transmitter will have a peak power of 30,000 watts, fully modulated, at the feeder of the antenna, and will be capable of transmitting television images having a definition of 405 lines. The equipment is the product of research work in the Laboratories of the L. M. T. organization in Paris. The contract specified that the station be put into limited service by July first and operate with full power by the fall.

According to the Ministry of P. T. T., which has been active in presenting transmissions to the public, television has emerged sufficiently from the laboratory to present definite entertainment possibilities. The Ministry has endeavored to keep its equipment abreast of the developments. In 1932 the first transmission was inaugurated using a medium wave sound broadcaster with a power of 10 KW. A mechanical direct pickup device was employed having a definition of 30 lines per picture. This equipment was gradually improved as it was found that higher definition pictures could be successfully received and produced. Early in 1935 a 2 KW transmitter was installed to operate on a wavelength of 200 meters and transmission was begun with a definition of 60 lines per picture. In December 1935 a 2 KW ultra-short wave transmitter operating on 8 meters was inaugurated at the Eiffel Tower, with a scanning definition of 180 lines per picture, and in March 1936 the power was increased to 20 KW.

The technical experts of the Ministry now feel that the progress registered has been of such importance as to warrant the substitution of a more modern and powerful station as an aid and encouragement to the study and popularization of this newest adaptation of electricity to the general diffusion of entertainment and instruction.

For several years the laboratories of "Le Materiel Telephonique" have been engaged in developing high definition television scanning and transmitting equipment. The first field tests of such

equipment were conducted in 1935, when a transmission with 180 lines per picture was made from the company's laboratories to a demonstration receiver at a distance of several miles. In 1936 further field tests were made over the same distance but using a transmitter of 8 KW peak power and a scanning system with a definition of 240 lines per picture. Since that time development has been continuing on increasing both the transmitter power and the scanning definition.

## GERMANY

There seems to have been a subtle change in the development of television in Germany. There is very little that publicity points to this change, but the fact that television developments have been taken over by the German War Department seems to be explanation enough for an extraordinary veil of secrecy which has fallen over efforts in the German television field. The following facts seem self-evident.

1. Publicity regarding television service for the general public has declined tremendously in the local press;

2. Although many radio manufacturers had received virtual instructions from the Government to place television apparatus on sale, not one retail store is carrying any models and not one manufacturer has any price list to offer;

3. It is unofficially reported that present television experiments made either by private companies or by the Post Office Department, which is in charge of all radio-technical matters in Germany, are directed toward the application of radio and television to military purposes;

4. Among television technicians interest now seems to be directed not toward public entertainment programs but toward the development of apparatus for airplanes, especially in the development of appartus to transmit facsimiles between airplanes and ground stations.

When television was introduced to the public it proved vastly disappointing. Newspapers during 1935 were filled with publicity regarding Germany's leadership in television developments and flowery stories promised television receivers in public homes at fair prices and daily programs broadcast from 12 different German stations. Most people who saw television receiving apparatus on display marvelled not at the fact that they were seeing something that happened in another section of the country. They expressed disappointment at the size of the image, the flicker of the picture, and the size and tremendous cost of the apparatus itself.

### Facsimile

It is rather natural that recent developments behind the public scenes have also included the perfection of apparatus for the transmission of facsimiles. Dr. Arthur Korn, who maintains a laboratory at 25, Schlueterstrasse, Berlin, is the leader in these developments. He is known throughout the world, since in 1906 he obtained world patents covering apparatus for the dispatch of facsimiles by wire. The equipment that is used in the transmission of photographs to newspapers in the United States is based on Dr. Korn's original but now expired patents.

Dr. Korn has been experimenting with facsimile sending equipment for 30 years, and, although he has no commercial company for the production of his apparatus, he nevertheless receives and executes an order about twice a year. The German Police Department uses his equipment between various cities, notably between Berlin and Munich. This is used principally for the fast transmission of photographs and fingerprints of criminals and of photographs and drawings of scenes of crimes.

Television pictures on a screen 1 x 1.20 meters are said to be possible through an invention of Telefunken Gesellschaft, Germany. Heretofore, limits to the possible size of the television tube have kept the dimensions of pictures to within 8 x 10 inches.

With the new instrument, the tube is very small. The end is absolutely flat instead of curved and is 10 mm. thick to withstand outside air pressure. The picture thrown on the end of this tube is only 5 x 6 cm., about 2 x 2½ inches. The end of the tube is fitted to a projection camera lens of large size and picture is thus enlarged and thrown upon a screen which stands separate from the receiver. The loudspeaker is located at the base of the screen.

In order to obtain a particularly clear, sharp and contrasting picture on the end of the tube the tension was stepped up to 20,000 volts. The advantage of this receiver is that the picture thrown upon the screen can be viewed by a large number of people sitting even 6 to 8 meters away.

# ITALY

Italian television activity in industry had its inception with SAFAR early in 1930. This is the only firm in Italy which is concerned with television. This company follows courses parallel with those of Baird in England and Telefunken in Germany. It worked in collaboration with the first Italian laboratory of television researches, that of Engineer Arturo Castellani. To this initial activity belong the first successful public tests of television in Italy, carried out in October of the same year at the first National Radio Show at Milan.

In this first display the apparatus employed, constructed entirely in Italy, used both in reception and transmission the Nipkow disk, coupled with a new system of synchronization between transmitter and receiver, supplied by Ing. Castellani, and employing the so-called canalized signals now widely used in various systems of transmitting and receiving by cathode rays.

After these first public tests, the Castellani Laboratory constructed a new complete disk transmitter-receiver, but of 60 lines and 25 images per second, for the transmission of real scenes. As a salient feature this new complete apparatus presented, among the first on the transmission side, the new types of amplifiers equalized by broad bands of frequencies and the batteries of cells with broad luminous spectrum.

On the reception side was brought to notice the first Italian commercial televisor, with mechanical reconstruction of the image, completely on a printed plate and utilizing a flexible disk of great precision, obtained photomechanically, coupled with a new type of luminous mercury vapor lamp with hot cathode and control grid.

During the year 1931, the whole television activity of the SAFAR was concentrated, still under the direction of Ing. Castellani, creating also in its own establishments the first vacuum experimental laboratory for the study and construction of luminous gas lamps.

Various types of bulbs were constructed and experimented with, and in the meanwhile repeated studies and experiments were carried out on various types of amplifiers for television currents. Moreover, in order to try out the commercial possibilities of various types of televisors, there were constructed, according to more modern concepts of rationality, two types of television receivers with drum of mirrors and spiral of mirrors.

In the year 1932 noteworthy improvements and additions were applied to the existing 60-line disk transmitter, and there was created a new model disk receiver and a mercury vapor lamp, with hot cathode and grid. The complete transmitter-receiver thus perfected functioned in public in October of the same year 1932, at the 3rd National Radio Show at Milan, and a successful regular experimental service was effected throughout the duration of the Show.

Immediately after the said Show there was projected and inaugurated the construction of a new 90-line disk transmitter intended for a circular experimental service of radio-television.

In October, 1933, at the 4th National Radio Show at Milan, experiments took place in radio-television with SAFAR apparatus operated by the Italian Radiophonic Auditions Association and the first SAFAR radio-receivers with the Braun tube were displayed there. The apparatus was operated during the whole of the Show, arousing enormous public interest.

While the new equipment permitted the construction of a perfected cathode ray transmitting tube, Castallian system, construction was also begun of a telecinema transmitter for 180 and 240 lines. This new set permitted the study of televisive currents aroused by analysis of great fineness, and therefore made possible the execution of tests of amplification and modulation with bands from 25 to 1,000,000 periods.

In view of the good results obtained at 180 lines of analysis, the new set for telecinema was presented in public in April, 1934, at the 15th Milan Fair. These receivers employed receivers with Braun gas tubes, Cossor and Ediswan type, the SAFAR types with induced vacuum not being yet ready.

The experimental service was effected alternately at 120 and 180 lines and during the whole period of the Fair enjoyed brilliant success.

The period following this 15th Fair found the television activity of SAFAR directed toward the perfecting of a television cathode tube radio-receiver, with tube of its own manufacture and to tests of a new Castellani tube transmitting system, the "Telepantoscopio" obtaining very satisfactory results in both branches of research.

# TELEVISION STATIONS

## IN THE UNITED STATES

## LOCATION — PERSONNEL — FACILITIES

## W2XAX

### NEW YORK CITY

FREQUENCY: 52.5 Mc. POWER: 50 Watts (Construction Permit for 7500 watt transmitter to be located in Chrysler Bldg.). OWNED AND OPERATED BY: Columbia Broadcasting System. BUSINESS ADDRESS: 485 Madison Ave. PHONE: Wickersham 2-2000. STUDIOS: Same. (New studios will be located in Grand Central Terminal Bldg.). TRANSMITTER and ANTENNA LOCATION: Same. (New Transmitter and Antenna will be located in Chrysler Tower).

### PERSONNEL

Director of Television Programs,
Gilbert Seldes

Chief Television Engineer,
Dr. Peter C. Goldmark

Assistant Chief Television Engineer,
John N. Dyer

### FACILITIES

The Columbia Broadcasting System, Inc., has designed and built a complete experimental 50-watt television transmitter suitable for the present standards of 441 lines, 30 frames per second, operating on a frequency of 52.5 Mc. This transmitter is located in the Columbia Broadcasting System building and is connected by an open wire transmission line to an antenna mounted on the roof.

The system consists of a film scanner using a dissector tube in conjunction with continuously-moving 35 mm. or 16 mm. film. There are no rotating optical elements involved. The dissector is of the Farnsworth type, and is a 9-stage multiplier. The output from the film scanner, after being suitably amplified, is fed to an amplifier in which, after stabilization, the horizontal synchronizing and blanking pulses are injected. The D.C. component is transmitted by cutting the first with plus voltage to zero. After passing aperture correctors and equalizers, the video signal goes through a specially loaded coaxial cable to the modulator, where the signal is again stabilized and the vertical synchronizing pulses are injected. Variable amplitude, single pulse synchronizing system is utilized. The carrier may be modulated in either positive or negative direction.

A great portion of the activity during the past year was represented in the preparation of plans in connection with the new Chrysler Building transmitter and antenna and the Grand Central studio installations.

The transmitter to be installed in the Chrysler Building is now undergoing tests at Camden, N. J., where a complete "electrical reproduction" of the top floors of the Chrysler Tower has been constructed on a baseball field near the manufacturing plant. The test tower of wood and steel covered with wire netting is used for trying out various types of antennas under conditions almost identical with those on the upper floors of the Chrysler Tower itself.

Each of the two transmitters, video and audio, when unmodulated delivers a power of 7500 watts. The output stages are so designed that the video signals can be injected in either "D.C." or "A.C." fashion. The D.C. type of transmission is that in which the carrier amplitudes, when measured from the zero axis, represent the absolute illumination of that portion of the transmitted picture.

The studio will be located in the Grand Central Terminal building where a space 270x60 feet and 45 feet high is available. The studio equipment will comprise live pickup camera and motion picture film channels. The video signal will be carried at a 10 volt peak-to-peak level from the studio to the transmitter through a special coaxial cable.

Transmissions at present are at irregular times.

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## W6XAO

### LOS ANGELES—EST. 1931

FREQUENCY: Sight, 45,000 Kc. Sound, 54,000 Kc. POWER: Sight, 150 Watts; Sound, 150 Watts. OWNED AND OPERATED BY: Don Lee Broadcasting System. BUSINESS ADDRESS: Don Lee Bldg., Seventh & Bixel Sts. PHONE: VAndike 7111. STUDIO AND TRANSMITTER LOCATION: Same. TIME ON THE AIR: Nightly (except Sundays and holidays), 6:30 to 7:15 P.M. Monday, 9:00 to 10:00 A.M. Wednesday, 11:00 to 12:00 A.M. Saturday, 2:00 to 3:00 P.M. Other times experimentally, which are announced on regular schedules.

### PERSONNEL

Director of Television.....Harry R. Lubcke
Assistant Director of Television Wilbur E. Thorp
Television Engineer .....William S. Klein

### FACILITIES

SYSTEM IN USE: High-definition cathode-ray, 300 lines, 24 frames standard, on account of widespread 50 and 60 cycle power systems in and surrounding Los Angeles. Within the service area of W6XAO one million persons are supplied with 50 cycle power and one million with 60 cycle power.

Film equipment for broadcasting newsreels, shorts and test items.

Mosaic live-pickup camera equipment to be completed and in use during first half of 1938.

PATENTS: United States and foreign patents covering film and live pickup, amplification, scanning sources, synchronization, receivers and cathode-ray tubes of Harry R. Lubcke are used in the work. The methods and equipment of the Don Lee System, though amenable to standardization, are considerably different from those of other television organizations.

RECEIVERS: Over three thousand diagrams on how to build a cathode-ray television receiver have been sent without charge to persons who have sent a large self-addressed envelope to the Television Division. Of these, approximately one hundred are estimated to have television receivers in successful operation in Los Angeles, Hollywood, Inglewood, Wilmington, Long Beach and elsewhere. Reports on reception are invited.

DISTANCE: Mr. Roger Howell, of Long Beach, California, twenty miles airline from W6XAO, has, upon his own initiative, demonstrated his television reception to the officials of his city and to the press, who were favorably impressed.

PUBLIC DEMONSTRATIONS: Since June 4, 1936, public demonstrations of Don Lee high definition television have either been held daily, or at stated intervals, at distances from 1-10 to 10 miles from W6XAO. Approximately ten thousand persons have witnessed the receptions. Requests are currently being handled by ticket, for which a stamped self-addressed envelope is to be sent to the Television Division.

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# W3XPF

## SPRINGFIELD, PA.

This station has been granted a Construction Permit by the Federal Communications Commission.

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: Sight, 4000 Watts: Sound, 1000 Watts. OWNED AND OPERATED BY: Farnsworth Television Inc.

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# W9XAL

## KANSAS CITY, MO.—EST. 1932

FREQUENCY: Sight, 42000 to 56000 Kc. and 60000 to 86000 Kc.; Sound, same. POWER: Sight, 300 Watts; Sound, 150 Watts. OWNED AND OPERATED BY: First National Television Inc. BUSINESS ADDRESS: 22nd floor, Fidelity Bldg., Ninth and Walnut Sts. STUDIO LOCATION: Same. TRANSMITTER LOCATION: 34th floor, Fidelity Bldg.

### PERSONNEL

Chief Engineer and Technical Director, C. E. Salzer

Technical Director of Resident Training, Everett L. Dillard

Chief Operator.....Franklin Burnett

### FACILITIES

This station has been operating continuously since October of 1932 and at the present time is undergoing installation in the new quarters of Radio Station KXBY which, along with a technical training school, is operated by the same management.

Numerous systems and ideas have been used since the establishment of the station; however, the Sanabria system of triple spiral 45-line has been used as the basic system. The transmitter under construction will use a system designed for 441-line operation, complete electron scanning, both for transmission and reception and should be complete and in operation about the first of April, 1938.

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# W1XG

## BOSTON

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: 500 Watts. OWNED AND OPERATED BY: General Television Corp.

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# W9XD

## MILWAUKEE—EST. 1931

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: 500 Watts. OWNED AND OPERATED BY: The Journal Co. BUSINESS ADDRESS: 33 West State St. STUDIO AND TRANSMITTER LOCATION: Schroeder Hotel.

### FACILITIES

As the owner of this station is not a manufacturing or research organization the work that has been done has been devoted to the propagation characteristics of television (i.e. effectiveness of antenna, coverage studies and transmission characteristics). Most of the studies made have been on a frequency of 26400 Kc. using the ultra high frequency experimental transmitter, W9XAZ.

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# W9XAK

## MANHATTAN, KANS.—EST. 1932

FREQUENCY: 2000 to 2100 Kc. POWER: 125 Watts, Sound and Sight. OWNED AND OPERATED BY: Kansas State College of Agriculture and Applied Science. BUSINESS ADDRESS: Department of Electrical Engineering, Kansas State College. PHONE: 3-7182. STUDIO AND TRANSMITTER LOCATION: Same. TIME ON THE AIR: Monday and Wednesday, 7:00 P.M. to 8:00 P.M.

## PERSONNEL

Head of the Dept. of Electrical Engineering
R. G. Kloeffler
Chief Operator . . . M. W. Horrell

## FACILITIES

This station at the present time is using mechanical scanning, 60 lines, with 20 frames per second.

The circuits and equipment for the use of an iconoscope are being built and a transmitter using this device will be put into use about March 1, 1938. Arrangement can be made for synchronizing sight and sound in conjunction with radio station KSAC of the Kansas State College of Agriculture and Applied Science.

The reception from this station is reported from points as far distant as Houston, Texas, points in Michigan and Ohio, as well as various districts in Illinois.

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# W2XBS

## NEW YORK CITY—EST. 1928

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: Sight, 12000 Watts: Sound, 15000 Watts. OWNED AND OPERATED BY: National Broadcasting Co. BUSINESS ADDRESS: 30 Rockefeller Plaza. STUDIO ADDRESS: Same. TRANSMITTER LOCATION: Empire State Bldg. TIME ON THE AIR: No regular scheduled programs.

## PERSONNEL

Chief Engineer . . . . . O. B. Hanson

## FACILITIES

This station uses the RCA television system. Broadcasts are experimental and made to a number of experimental receivers at the homes of NBC and RCA officials and technical personnel.

Reception of this station has been reported in approximately a 45-mile radius.

Besides this station the National Broadcasting Co. has been granted a Construction Permit for another television station which will be operated on 92,000 Kc. and from 175,000 to 180,000 Kc. with a power of 400 Watts for sight transmission and 100 Watts for sound transmission.

## HISTORY

Experimental television station W2XBS was originally installed at the RCA Technical and Test Laboratory, Van Cortlandt Park, New York City. The first construction permit was granted on April 4, 1928 and the first temporary license was issued in June, 1928. From time to time various station permits allowed television experimental transmission on 4800 Kc., 2300 to 3300 Kc., 2050 to 2150 Kc., 2000 to 2100 Kc. and 2100 to 2200 Kc. The first permanent license was issued on December 1, 1928 with an assigned frequency band of 2100 to 2200 Kc. In the latter part of 1928 the station was moved to the RCA Photophone Building, 411 Fifth Avenue. On June 27, 1930, it was moved to the Times Square Studio of the National Broadcasting Company, where on July 7, 1930 it passed from RCA to NBC management.

In 1931 NBC television was carried on from W2XBS's present location on the top of the Empire State Building.

During 1936 and 1937 NBC operated with the new high definition standards, demonstrating television to groups representing the following interests.

a. Political
b. Motion Picture
c. Foreign (political and commercial)
d. Press
e. Advertisers (manufacturers)
f. Advertising agencies
g. Artists (talent and musicians)
h. Naval and Military
i. Educational
j. Financiers, Bankers
k. Retailers
l. Radio Station men
m. Trade associations
n. Institutional (4H Club, Atlanta School of Air winners, etc.)

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# W3XE

## PHILADELPHIA—EST. 1931

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: Sight, 10000 Watts; Sound, 10000 Watts. OWNED AND OPERATED BY: Philco Radio & Television Corp. BUSINESS ADDRESS: Tioga and "C" Sts. STUDIO AND TRANSMITTER LOCATION: Same. TIME ON THE AIR: No stated schedule.

## PERSONNEL

Engineer in Charge . . . . . Albert F. Murray

## FACILITIES

This station uses the Philco Television System. Reception which is heard in the homes of the company's engineers has been reported from points 12 miles from the transmitter.

This station which is used for experimentation and research in connection with television development radiates signals in accordance with the proposed RMA Television Standards. It uses 441 lines and the narrow vertical synchronizing system; it employs the newly developed modulation system and is operating in the 50-56 Mc. channel.

Besides this station the Philco Radio & Television Corp. has been granted a Construction Permit for another television station which will be operated on 204000 to 210000 Kc. with a power of 15 watts.

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# W9XG

## LAFAYETTE, IND.—EST. 1932

FREQUENCY: 2000 to 2100 Kc. POWER: 1500 Watts. OWNED AND OPERATED BY: Purdue University. BUSINESS ADDRESS: Elec-

tric Bldg., Purdue University. PHONES: 6475, 2917. TRANSMITTER LOCATION: West Lafayette. TIME ON THE AIR: Tuesday, at 7:30 P.M. Thursday, at 8:00 P.M.

### PERSONNEL

Head of School of Electrical Engineering
C. Francis Harding
R. H. George H. J. Heim

### FACILITIES

This station uses a television system that has been developed at Purdue University.

## W2XDR

### LONG ISLAND CITY, N. Y.

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: Sight, 1000 Watts; Sound, 500 Watts. OWNED AND OPERATED BY: Radio Pictures, Inc.

## W3XAD

### CAMDEN, N. J.—EST. 1931

FREQUENCY: 124000 to 130000 Kc. POWER: Sight, 500 Watts; Sound, 500 Watts. OWNED AND OPERATED BY: RCA Manufacturing Co. BUSINESS ADDRESS: RCA Frequency Bureau, 30 Rockefeller Plaza, New York City. TRANSMITTER LOCATION: Portable Laboratories in Camden, N. J. TIME ON THE AIR: No stated schedule.

### FACILITIES

This station is an experimental portable unit and no one system is strictly adhered to; a complete description of the basic method used in transmission is given in the Proceeding of the Institute of Radio Engineers (Vol. 22, No. 1, November, 1934).

Several experimental television receivers have been set up within a 2 or 3 mile radius for experimental purposes.

The frequency band occupied by this transmitter is 2.5 mc. on each side of the carrier. This band width is determined by measuring the overall frequency characteristics of the system.

## W3XEP

### CAMDEN, N. J.—EST. 1935

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: Sight, 30000 Watts; Scund, 30000 Watts. OWNED AND OPERATED BY: RCA Manufacturing Co. BUSINESS ADDRESS: RCA Frequency Bureau, 30 Rockefeller Plaza, New York City. TRANSMITTER LOCATION: Camden, N. J. TIME ON THE AIR: No stated schedule.

### FACILITIES

This station is experimental and no one system is strictly adhered to; a complete description of the basic method used in transmission is given in the Proceeding of the Institute of Radio Engineers (Vol. 22, No. 11, November, 1934).

Several experimental television receivers have been set up within 2 or 3 miles of each other. The receivers are a part of the equipment used in television research.

The frequency band occupied by the transmitter is 2.5 mc. on each side of the carrier. This band width is determined by measurements of the overall frequency characteristic of the system.

## W8XAN

### JACKSON, MICH.

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: Sight, 100 Watts; Sound, 100 Watts. OWNED AND OPERATED BY: The Sparks-Withington Co. BUSINESS ADDRESS: Jackson, Mich. STUDIO AND TRANSMITTER LOCATION: Same. TIME ON THE AIR: No stated schedule.

### PERSONNEL

Chief Engineer, Radio Division . . H. V. Nielson

## W9XK

### IOWA CITY

FREQUENCY: 2000 to 2100 Kc. POWER: 100 Watts. OWNED AND OPERATED BY: University of Iowa.

## W9XUI

### IOWA CITY

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: 100 Watts. OWNED AND OPERATED BY: University of Iowa.

## W9XAT

### MINNEAPOLIS—EST. 1933

FREQUENCY: 42000 to 56000 Kc. and 60000 to 86000 Kc. POWER: 500 Watts. OWNED AND OPERATED BY: Dr. George W. Young. BUSINESS ADDRESS: WDGY Bldg. TRANSMITTER AND STUDIO LOCATION: 909 West Broadway. PHONE Cherry 3377. TIME ON THE AIR: No stated schedule.

### PERSONNEL

Manager . . . . . Dr. George W. Young

### FACILITIES

This station is using 125-line definition with a triple, spiral, multiple disk, although it is equipped to use better than 400 lines by making a slight adjustment in the scanning apparatus. Patents on a transmitter have been applied for which will allow scanning at eighteen different points twenty-four frames of continuously moving standard motion picture film and at the same time permit broadcasting from the sound track on the film.