Television Engineers Undecided on the Best Waves for Transmitting Motion Picture Films

CHARACTERISTICS OF IMAGES DETERMINED BY SCANNER USED

Number of Lines in Disk Govern Detail of Picture.

LIGHT SOURCE FACTOR

Angle of View Is Affected By the Size of the Picture Shown.

There are certain characteristics to be looked for in judging the merit of a scanning device as in the case of a radio receiving set. These are the size, brilliance, detail, steadiness and manner of presentation of the image, the number of observers who can see it, as well as the ease of operation, size and quietness of the machine. These are normally the items to be judged in the opinion of engineers of television station W2XR, but there are other defects which may appear in scanners, lengthening the list of points requiring appraisal.

For instance, a scanner may produce an image with ragged vertical lines, or one which is dark in the corners or edges; or it may show a picture correctly framed and focused for one observer, but entirely out of frame or partly visible to another observer. The scanning motor may draw a huge current when starting and burn out a fuse occasionally or the ratio of height to width of the image may be other than the standard ratio used at the transmitter. Dozens of types of scanners can be built just as dozens of radio circuits were invented and each can be modified in hundreds of ways as were the hookups of the early broadcasting days.

Angle of View.

It is not always possible to state exactly the "angle of view" of a scanner, in general, the vertical angle of view and the horizontal angle of view differ in degree. The horizontal angle of view is the angle through which an observer may move in a horizontal direction and still be able to see the complete image. Thus if the observer is six feet from the scanner and finds he can move to either side of the center line of the image a distance of three feet before the image grows dim and distorted or partly invisible, the horizontal angle of view is about sixty degrees, since this is the angle through which the observer has moved with respect to the scanner. The vertical angle of view is defined and measured in a similar manner with respect to a vertical movement of the observer. It is evident that the angle of view determines the number of persons who may see the picture at one time.

If the picture is to be viewed from a considerable distance, say six or eight feet or even ten feet, the vertical angle of view need not be very large, perhaps not more than 20 degrees, because ordinarily the limits of the observer's vertical movements are his sitting and standing positions. Ordinarily it may be considered desirable for the horizontal angle of view to be as wide as 180 degrees. Various types of mechanical scanners provide horizontal angles of view from 5 to about 180 degrees.

Lines Govern Detail.

The factor usually supposed to determine the detail in the picture is the number of lines per picture, but this factor is not the only one that limits the perfection of the detail to be reproduced. The shape, size and sharpness of the elementary scanning spot and the accuracy of its movement, as well as the modulation characteristic of the light source and the perfection of the receiver which supplies the picture current to the light source (even assuming a perfect transmitter were used with no static or local noise) frequently reduces the image detail considerably below that which could ideally be obtained with any number of scanning lines used.

The vertical overlap of the scanning spot should not normally exceed 20 per cent if the greatest possible detail is desired. The spot should have a sharp outline and its brilliance should be uniform as it moves over all the field.

Brilliance Important Factor.

Since a person's eyes are able to adjust themselves to an extremely wide range of sensitivity, i. e., to extreme ranges of brilliance in the subjects viewed, the factor of picture brilliance becomes a relative thing. A scanner may appear to furnish a very bright picture in a semi-darkened room, but an almost invisible brilliance in a room flooded with sunlight. It is, therefore, much more practical to operate a scanner in a semi-darkened room just as a motion picture theater is usually operated.

In the scanners available on the market today the optical efficiency of the machine, or the ratio of the light received by an observer's eye to the total light emitted from the light source, is surprisingly low even when the movable scanning members are stationary and adjusted for only a single observer. When the scanning motion is started the efficiency drops still further, and adjusting the scanner to serve several observers may reduce the efficiency even more. Although the source itself looks bright, when scanned it may appear very dim.

In the case of a flat plate neon lamp used with a scanning disk having a spiral of small holes, the amount of light seen by an observer is still further lowered by the fact that only about 1-4000th of the light from the source is allowed to pass through one of the scanning holes, i. e., to appear in an elementary spot of the picture. These conditions explain clearly the fact that a much brighter light source is the prime necessity for television receivers today. In general, in any given scanner the larger the picture the less is its apparent brilliance. In some types of scanner the image size can be easily increased or decreased within wide limits by adjusting or focusing the machine, while in other types it may be varied over a moderate range by moving a viewing lens placed before the image. In still other types the size of picture can be increased only by building the scanner larger.

Further, in many types of scanners the angle of view is affected by the picture size and the larger the image is made, the smaller becomes the angle of view in either or both dimensions. In this case they claim the picture of maximum practical size is one in which the angle of view (in one or both dimensions) has decreased to zero, so that only one observer can see the image and even he may see it with only one eye.

Thus it appears that the maximum size of picture obtainable may be limited, in various types of scanners, by any one or more of the factors of (1) brilliance, (2) angle of view, and (3) size of the apparatus.

Robert Crawford Offers Two Voice Scholarships

Two scholarships in the Estelle Liebling Summer Radio School, to be awarded to the two voices best adapted for radio transmission, have been offered by Robert Crawford, president of a well-known music publishing firm. The contest will take place on Wednesday, July 6, with Miss Liebling and a committee acting as judges. Applicants must register at the Summer School, 145 West Fifty-fifth street, not later than next Tuesday.

Police Band in Concert Over WNYC This Evening

The New York Police Band will play an hour of military and classic music over WNYC, beginning at 6 o'clock this evening, under the direction of Capt. Fritz Forsch.

Trade Notes

L. Slowinski of Detroit has been appointed representative for the Triad Manufacturing Company, makers of vacuum tubes, for the Michigan territory; Eris C. Matchette of Cincinnati, for the territory of southern Ohio and southern Indiana; E. C. Blackman of Atlanta, Ga., for the Southeastern States, and Frederick Palmer of Minneapolis, as representative for South Dakota and Minnesota.

LOOKS AHEAD

B. A. Rolfe, who believes that television when it comes will sound the death knell of the one-night stand, one of the hallowed institutions of the stage.

ROLFE FAVORS VISION

Orchestra Leader Sees Bad Effect on Theaters.

The one-night stand in theater business is doomed as soon as television is perfected. This is the opinion of B. A. Rolfe, one of radio's best-known orchestra leaders. By supplying theatrical entertainment from central television studios the demand for traveling companies will be practically eliminated, he believes.

"You mark my words," he said, "within a number of years plays and musical shows will be produced in central studios and distributed directly over the air to theaters in all parts of the land. There will be no more traveling companies to speak of. Instead, entire productions acted in studios will be offered to the screen.

W2XAB CLOSES FOR REPAIRS

Sound Will Be Part of Sight Channel When It Reopens.

Alterations in equipment to make way for summer experiements with simultaneous sight and sound transmission on one frequency and certain improvements in its present transmitter will be made at television Station W2XAB in New York city, it was announced today. While these alterations are being made W2XAB will be off the air from July 4 to July 20.

On Thursday, July 21, the station will reopen and celebrate its first anniversary by transmitting a synchronized sight and sound program over WABC and W2XAB. Thereafter it is said it will maintain daily schedules of operation, utilizing for sound part of its regular sight channel.

"Although most of our regular television acts which have proved so popular with lookers-in will be continued," declared William Schudt Jr., television director of the station, "many new and novel presentations will be added. For the remainder of the summer we will be on the air daily, except Saturday and Sunday, from 8 to 10 P. M.

"We do not plan," he continued, "to change our sixty-line, twenty frames standard of visual broadcasting at the present time, although, should experiments prove that listeners and lookers-in are prepared to receive pictures projected at higher standards, we then will make the necessary changes."

Television for All in 1933, Says English Almanac

According to "Old Moore's Almanac," television for all will definitely arrive in the month of May, 1933. This statement appeared in the Broadcaster and Retailer, an English publication for June 18, 1932.

TROUBLE WITH DISK SCANNERS

Pictures Reversed Or Inverted May Be Easily Corrected.

In operating a television receiver one is often perplexed upon discovering that the received images appear upside down. If the order of scanning at the transmitter is from left to right and from top to bottom, then the neon light source at the receiver must be scanned in that same order. If the light source is scanned from bottom to top the image will be inverted. If the first requisite is observed and scanning is not carried out from the top to the bottom but from right to left, the image will be erect but reversed. The image will appear the same as observed when one looks through a photographic negative from the wrong side.

Now when a disk is used it is obvious that the direction of the spiral governs whether the scanning shall be from top to bottom or from bottom to top. If the spiral runs inward the scanning is from top to bottom; if the spiral progresses outward the scanning is from top to bottom to top. Similarly, if the direction is right hand, then the scanning will be from left to right and vice versa.

Thus if the image or picture as received is upside down it can be easily corrected by taking the disk off the shaft of the motor and mounting it the other way around. This reverses the spiral without affecting the horizontal direction of scanning. If the picture is reversed, then reverse the direction of rotation of the motor and the disk. Both of these changes are essential. If the picture is reversed and inverted, then it is only necessary to reverse the direction of the motor.

When turning the scanning disk around on the shaft to mount it the other way around, it is often necessary to remove the hub and attach it to the other side of the disk. In doing this care should be taken to find the position that provides the best static balance for the disk.

WHEN PICTURES DRIFT AWAY

Proper Motor Speeds Are Essential to Synchronization.

When the scanning disk at the receiver end is in synchronism and in step with the scanning disk used at the transmitter, the result should be perfectly framed television pictures. The looker-in at the television receiver sees the reconstructed image located within the frame of the observing section or opening of the cabinet of the radiovisor. If the scanning disk at the receiver falls out of step with the disk at the transmitter the result will be a drift of pictures toward one side or the other of the frame. Unless it is brought back into frame by an adjustment of the speed or rotation of the scanning disk the entire picture or image will begin to drift out of frame only to be replaced by another image going faster than the first and so on until the images fly across the field of the frame of the scanner.

It is, therefore, of utmost importance then too hold and maintain the scanning disk at the receiver in step with the scanning disk at the transmitter.

If the motors that turn the disks at both receiver and transmitter are connected to the same source of power supply line and synchronous motors are employed, synchronism is automatic. A snap of the switch will bring the scanning disk of the receiver into frame should it be slightly out of frame when looking in.

Police Choristers on WNYC.

The Police Choristers will be heard in a half hour of solos and ensemble singing over WNYC from 8 to 8:30 o'clock tonight.

Coil Data for Sight Receiver

Coil Turns and Size of Condensers Are Given for a Television Set to Operate on the 1,500-3,000 K. C. Band.

The wave channels as now used by experimental television broadcasting stations are not so very different from those at the upper end of the broadcast spectrum. Consequently, the best receiving antennas for television do not differ greatly from those used with modern broadcast receivers. The same tendency toward the use of smaller antennas is now being applied to television. On the other hand, because present day television transmitters are much less powerful than many of the broadcast stations, it is sometimes helpful to use antennas of 100 or 150 feet in length and elevated from 40 to 50 feet in height in order to get good signals. Within ten miles or so of a television station an indoor wire about 30 feet long and run about fifteen to twenty feet above the receiving set will give good results, except in unfavorable locations. Such an antenna is suitable for connection to a 1,500-3,000 kilocycle receiving set having at least two tuned radio frequency stages of amplification.

Radio Frequency Amplifiers.

Selection of the number and style of the r. f. stages for a visual receiver is necessarily guided by the distance and power of the stations it is desired to receive, as well as by the interference conditions encountered. While reports are sometimes heard of visual reception at great distances such cases are comparatively few and the experimenter cannot usually expect consistent results at distances above 100 miles from a 500-watt transmitter. The noise level usually prevents more distant reception; excessive fading may also occur. The interference level likewise limits distance, because of the many broadcast harmonics and the cross modulation of broadcast stations. The received signal strength should be at least 100 microvolts per meter at a receiving location free from local noises and interference and much higher where these factors are encountered. Thus a very sensitive receiver cannot usually be operated as such.

Characteristics of Circuit.

As in broadcast reception, the superheterodyne receiver offers advantages in selectivity which are not found in the ordinary tuned radio frequency receiver, and its use may allow reception under difficult conditions. The desired band pass tuning is more nearly realized in the superheterodyne and, of course, the amplification per stage is higher at the intermediate frequency than at 3,000 kilocycles.

It is said that in the event the scanner and audio amplifier are defective, the selectivity of the radio frequency amplifier will not have much effect on the received picture. But if a good scanner and audio system are used and the transmitter delivers a well detailed visual signal, the selectivity of the receiver comes into prominence and can be seen greatly to affect the detail of the image. The same is true of a strongly regenerative detector, although slight regeneration, which can hardly be avoided, does not show up in the picture.

Distortion is liable to occur in the r. f. stages if the operating voltages are not correctly adjusted, particularly in the case of screen grid tubes. The grid bias should not be allowed to fall below rated value, and the screen voltage should not normally fall below fifteen volts. Thus there is a limit to the range of volume control possible by means of screen voltage control if distortion is to be avoided.

Again there is the factor of cross-modulation in the r. f. stages which may occur if an undesired transmitter causes a large signal on the grid of the first r. f. stage, and that signal is partially rectified, modulating the carrier of the desired station. The common method of preventing cross-modulation is to provide two or more stages of tuned radio stages ahead of the detector so that undesired signal is suppressed. A more recent method is to employ r. f. tubes of the variable mu type, which are designed to eliminate rectification.

The coil-condenser combination in each tuned radio circuit for the television band 1,500 to 3,000 kilocycles may utilize .00025 mfd variable condensers. The coil to fit these condensers for these wave bands should have about 37 microhenries inductance. They may be made of 25 turns of number 28 enameled wire wound on a 1½-inch diameter insulating tube. This is the tuned secondary. The primary may be of 20 turns of number 36 enameled wire, providing screen grid tubes are used and 12 turns of number 36 wire if three-element tubes are used. The primary of the antenna coil should consist of 10 turns of number 32 enameled wire for the input circuit. In each case the primary may be wound directly over the secondary with a layer of insulating paper between the primary and secondary if desired.

Two stages of radio frequency amplifications are usually recommended for local reception, and three or four for long distance reception, although great sensitivity is not always useful. The selectivity and sensitivity of the set may be adjusted over wide limits by means of the trimmer condensers on the gang tuning condensers.

FRAMING THE VISION IMAGE

Two Methods Are Now Being Employed for Centering Picture.

A requirement of visual entertainment is that only one complete picture or image shall appear in the scanner and shall be easily moved to the center of the viewing aperture. In television this is called "framing of the image." If no mask were used in front of the neon lamp more than one complete image would be visible. The field then must be limited to the proper size by placing a flat sheet of metal or cardboard between the neon lamp and the observer close to the scanning disk, this mask having a rectangular viewing aperture the size of one picture. The method of supporting the mask will depend on the method used in framing. It may be fixed or movable in one or both directions as by a gear system or lever. The picture must be centered in the viewing aperture both vertically and horizontally, and this may be accomplished by either or both of two methods: namely, moving the mask or the disk. When the mask is moved the neon tube must move with it unless the plate of the tube is much larger than the aperture, in which case the neon tube may be stationary.

Framing Depends on Disc.

Assume now that a picture is being received, say engineers of Radio Pictures, Inc., on a disk with a single spiral of holes and the disk is running in synchronism, but is somewhat "ahead" or "behind" in the proper angular position, so that the image is out of frame both vertically and horizontally. To frame it the disk may be made to fall back in phase by a large angle, causing the picture to rise, until it is in frame vertically. Then the disk may be made to fall back in phase very slightly, causing the picture to move to the left, until it is in frame horizontally. This last may be accomplished by moving the mask slightly to the right instead of moving the disk, and if there is a double spiral of holes in the disk, even vertical framing may be accomplished by moving the mask vertically. In general, the method of framing depends on the type of disk and motor used.

A large synchronous motor normally operates at synchronous speed, but can be made to drop back or "slip" one or more poles by turning off the current an instant, then turning it on again. It can also be made to drop back by a small angle for horizontal framing, by means of a series rheostat in the power supply line, which shifts its phase slightly. The rheostat must be able to carry the whole current of the motor, however, and have from twenty to fifty ohms maximum resistance. Another convenient method of framing with this motor is to mount the motor in a rotatable holder, with a hand wheel, lever, or gear system for turning it around its axis by hand, so that it can be made to fall back by a large angle for vertical framing or a small angle for horizontal framing.

How to Adjust Speed.

The combination of a variable-speed motor and a small self-synchronizing motor cannot usually be made to "slip" poles for vertical framing by switching, or even to shift phase slightly for horizontal framing by the series rheostat method, but the self-synchronizing motor may be mechanically rotated as in the case of the large synchronous motor mentioned above, for both vertical and horizontal framing.

A variable-speed motor is always operated with a series rheostat to control its speed, and sometimes with a friction brake or with hand braking on the shaft. It can be made to run at synchronous speed by very careful adjustment, and can (with difficulty) be made to drop back considerably in angular position by slowing down for an instant and resuming synchronous speed again.

O'Hara Guest Soloist On Goldman Program

Geoffrey O'Hara, baritone, is to be guest soloist during the intermission of the Goldman Band concert, which is to be broadcast next Wednesday evening, beginning at 8:45 P. M. over WEAF.

PIANIST WAS COUNT

WBBR Artist Was Titled Noble in Czarist Regime.

Once a full fledged count in the Russian Empire, Alexis Pavlovitch, pianist at WBBR, is now an American citizen and proud of it. Back of him are centuries of titled forbears in both Russia and Italy, but neither ruling power nor intrigue interested him greatly. From his youth his artistic talents expressed themselves through the pianoforte. And now the expression of this talent through his broadcasts and in his instructions for the younger generation of pianists continue to occupy his full time.

Alexis de Lenzi Zbinden, formerly the Count de Lenzi, studied for many years under Anton Rubenstein. The classical inspiration which he received from this master of the piano is still evident today in the selections chosen by him for his broadcasts. He does recognize the catholic makeup of his listeners by inserting an occasional variation upon some well-known American composition, but it is in the classics that he finds opportunity to express his moods.

Mr. Pavlovitch is regularly scheduled at WBBR each Wednesday evening at 7 o'clock.

PROGRESS MADE IN RAY TUBE

Engineers Say They Have Made Some Advances.

An improved method of coating the end of a cathode ray tube thereby giving much more brilliance to the television picture, and a new method of modulation which greatly increases the contrast and details of the reproduced image are two of the advances developed in cathode ray television by engineers of the Short-wave and Television Corporation.

The fundamental idea of the cathode ray tube, they say, is an old invention which has needed much refining to bring it into useful practice. A number of research organizations which have worked on mechanical television are now developing cathode ray work.

"The new ideas that we have developed put the cathode ray art well ahead. Our new coating system gives us a tube of good brilliancy. Secondly, all of our cathode ray experiments have presented some problems in modulation, but we have improved this to such an extent that future progress will be more rapid."

BETTER MUSIC IN EUROPE

(Continued from Preceding Page.)

greatest possible audiences inasmuch as they would not satisfy the entertainment requirements of unaccustomed concertgoers.

"But instead of educating listeners in the appreciation of good music, the advertiser gives them music of less cultural value and lets it go at that. The air schedules contain commonplace programs where there is room for presentations of a higher order.

"In Europe, broadcasters strive to educate listeners into appreciating good music, and thereby a great demand for the better selections is created.

"I am very glad that Europe is blessed with no advertising on the air.

"If radio is to be considered a cultural asset, broadcasters should give listeners the best possible programs and educate them into the merits of such offerings."

Mr. van Hoogstraten admitted that the majority of American broadcast programs are passable as entertainment, but not as constructive recognition of the great masters of music.

Tax Is Justified.

The conductor emphasized that the small listeners' taxes required in European countries were indeed bargain prices to pay for the banning of commercial announcements.

"Not only are advertisers banned from the radio," he said, "but every program is carefully guarded against the least possible mention of a commercial name or product. Not one commercial word can get by the observant broadcasting executives."

Mr. van Hoogstraten said he obtains great enjoyment out of listening to programs in Europe on account of the numerous countries that can be tuned in by a single receiver.

"Whereby in the United States a listener has to be content with receiving domestic stations, the European listener can tune in several countries.

"I can tune in Budapest, Stockholm, Copenhagen, London, Russia and Finland with my receiver in Germany. It is wonderful to have all types of music at your finger tips. I listen to gypsy music from Budapest and then can immediately switch to an entirely different type of program in London. It's a thrilling experience."

The radio listener, Mr. van Hoogstraten believes, cannot be given classical music all of the time. He must have some variety. In the lighter types of music, particularly dance music, the conductor believes America leads the world. European dance music, he declared, attempts to follow the American style.

Tonight's initial broadcast from the Stadium will include Tschaikowski's F Minor Symphony No. 4, Nicolai's Overture to "The Merry Wives of Windsor," ballet music from Delibes's "Sylvia," three rhythmic Slavonic dances by Dvorak and Strauss's "Tales from the Vienna Woods."

Tomorrow night's broadcast will open with a suite of selections from the works of Gluck in an arrangement by Felix Motti. Schumann's Symphony in E Flat will be the second selection on the program.

OPINIONS ON IDEAL VISION BANDS DIFFER

Proper Waves for Pictures Still Undecided.

The division of opinion over what section of the wave spectrum is to be the locale for permanent television continues.

Some think that the allotted bands between 100 and 200 meters are just the thing, while others speak as strongly for the wave bands under ten meters, says C. E. Butterfield, radio editor of the Associated Press.

One argument for the higher waves is the demonstrated fact that they are ideal for distance transmission of 100 miles or more. The other side admits this condition, but retorts with the statement that they tend to skip over local areas, giving poor reception results. The tiny waves under seven meters are the ones that can be depended upon to deliver a good signal to this local area, they contend. But tests have demonstrated that sixty miles is the maximum distance that can be obtained at present.

May Reach Agreement.

These varying opinions may yet be brought together, for there's a belief among some engineers that one wave spectrum could be used for relay transmission such as would be required for chain television, while the shorter waves could serve the immediate vicinity of the network transmitter.

The higher waves have the backing of the engineers who have devoted most of their time to the investigation of mechanical scanning, while the group working on cathode rays has been more active in probing the new territory below ten meters.

The cathode ray workers have been dealing with high-line television, 120 lines or more. This system requires fairly wide transmission channels, 500 kilocycles at the least. Mechanical scanning has stuck to sixty lines, with allotted channels 100 kilocycles wide, about the maximum that can be used successfully above 100 meters.

Wide Channels Permissible.

The main reason why the ultra waves have been investigated lies in the fact that in this territory wide channels are permissible because frequency there in relation to wave length is so great. For example, from five to seven meters there are thirty-two 500-kilocycle channels, compared with a fast decreasing number as the wave length increases numerically.

Another point in favor of the tiny waves is that, because of the limited area covered, stations on the same wave can be duplicated within a hundred miles or so without causing interference. About 100 meters interference might result if transmitters were located a thousand miles or more apart.

In the Studios

(Continued from Preceding Page.)

eratic tenor, Julian Oliver?...and that equally swell contralto Devora Nadworney...and what has happened to that Voters' Service program series of 1928...And the Gold Spot pals...radio's first kid gang have they all grown up?...Five years ago! It might as well be a century in radio.

THE MEDAL.

This week's medal for outstanding achievements by radio entertainers must go to Miss Diana Deering, who sings with Teddy Black's orchestra down at the Village Barn, a Manhattan play spot. Miss Deering sang "My Silent Love," and when she came to that certain line that offends the purists she sang it "I reach for you AS I reach for a star!"

ABOUT BROADCASTERS.

Norman Sweetzer knows a lot about designing stage settings, which will come in handy when we get around the corner to television... Eddie Thorgersen once was featured as a concert pianist in a series of broadcasts...Phil Cook has had three musical shows produced on Broadway...Irene Beasley once taught school in Mississippi...Bing Crosby's main interest this summer is in breaking the 77 he shot on a Hollywood golf course.

IMPROVE RADIOPHONE

Compact Sets With Greater Range Pass Tests.

WASHINGTON, D. C.—Expansion of the radiotelephone to include two-way service with small coastwise fishing vessels and yachts, and even with lonely lighthouses, is the latest boon being held out by radio. Where formerly the loneliness of their isolation was relieved only by broadcast reception, occasionally of messages destined to them in particular, compact and relatively inexpensive radiophone transmitters are now being developed so that they can put in return calls to shore stations. In some cases their messages can be picked up on shore and linked into regular wire telephone systems.

Encouraged by wave grants by the Federal Radio Commission, tests have just been completed off the Massachusetts coast which herald a broadening of the telephone service already offered from many large transoceanic vessels. Small boat transmitters capable of sending voice up to 300 miles were used in the tests, which are expected to result in a regular ship-to-shore radiophone service for fishermen and yachtsmen, enabling them to call any land telephone via the Boston exchange.

Radiotelephones have been installed in a few lighthouses by the United States Lighthouse Service, and their efficacy has already been demonstrated.

TELEVISION PROGRAMS FOR THE WEEK

TODAY.

W2XR—New York.

Right on 399 meters. | Sound on W2XAR, 720 meters.

4:00—Experimental programs.
8:00—Films with sound.
9:00—Cartoons.

W2XCR—New York.

Right on 147 meters. | No Sound.

6:00 to 8:00—Direct pickup.

W1XAV—Boston.

Right on 179 meters. | Sound on W1XAV, 193 meters.

8:00 to 9:00—Experimental programs.
9:00 to 10:00—Same.

W2XAP—Washington.

Right on 147 meters. | Sound on WMAL, 423 meters.

5:00 to 6:00—Experimental programs.
6:00 to 9:00—Direct pickup.

W3XK—Washington.

Right on 142 meters. | No Sound.

9:00 to 11:00—Film presentation.

TOMORROW.

W2XR—New York.

4:00—Experimental programs.
8:00—Films with sound.
9:00—Cartoons.

W2XAP—Washington.

5:00 to 6:00—Experimental programs.
6:00 to 9:00—Direct pickup.

W3XK—Washington.

9:00 to 11:00—Film presentation.

MONDAY.

W2XR—New York.

4:00—Experimental programs.
8:00—Films with sound.
9:00—Cartoons.

W2XCR—New York.

6:00 to 8:00—Direct pickup.

W2XAP—Washington.

5:00 to 6:00—Experimental programs.
6:00 to 9:00—Direct pickup.

W3XK—Washington.

9:00 to 11:00—Experimental film programs

W2XAP—Washington.

5:00 to 6:00—Direct pickup.
8:00 to 9:00—Direct pickup.

W2XCR—New York.

6:00 to 8:00—Direct pickup.

WEDNESDAY.

W2XCR—New York.

6:00 to 8:00—Direct pickup.

W2XAP—Washington.

5:00 to 6:00—Experimental programs.
8:00 to 9:00—Direct pickup.

W3XK—Washington.

9:00 to 11:00—Film presentations.

W2XR—New York.

4:00—Experimental programs.
8:00—Films with sound.
9:00—Cartoons.

W1XAV—Boston.

8:00 to 10:00—Experimental program.

W1XAV—Boston.

8:00 to 10:00—Experimental program.

THURSDAY.

W3XK—Washington.

9:00 to 11:00—Film presentations.

W2XR—New York.

4:00—Experimental programs.
8:00—Films with sound.
9:00—Cartoons.

W2XAP—Washington.

5:00 to 6:00—Direct pickup.
8:00 to 9:00—Direct pickup.

W2XCR—New York.

6:00 to 8:00—Direct pickup.

W1XAV—Boston.

8:00 to 9:00—Experimental program.
9:00 to 9:30—Eroica Trio.
9:30 to 9:45—Ruth Renvick, soprano.
9:45 to 10:00—Gertrude Hintlian, violinist.
10:00 to 10:15—Robert Campbell, tenor.
10:15 to 10:30—Inez Arzillo, cellist.
10:30 to 10:45—William Searle, bass.
10:45 to 11:00—Renwick and Campbell, songs.

FRIDAY.

W2XR—New York.

4:00—Experimental programs.
8:00—Films with sound.
9:00—Cartoons.

W1XAV—Boston.

8:00 to 10:00—Experimental program.

W2XAP—Washington.

5:00 to 6:00—Experimental programs.
8:00 to 9:00—Direct pickup.

W2XCR—New York.

6:00 to 8:00—Direct pickup.

SETS HAIR STYLES OVER TELEVISION

Ferdinand Graf as he appeared while demonstrating hairstyling over television last Wednesday evening.