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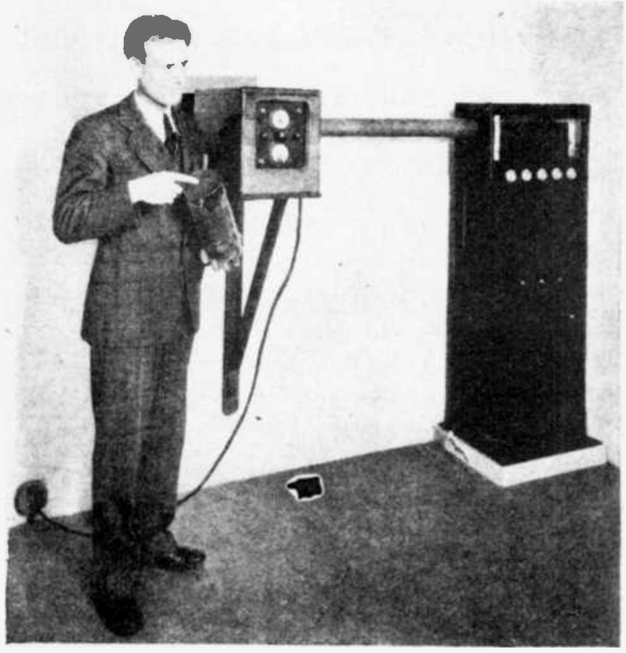
THE HORN SPEAKER

THE NEWPAPER FOR
THE HOBBYIST OF VINTAGE
ELECTRONICS AND SOUND

"Scanning WITHOUT a DISC"



Philo T. Farnsworth and a television transmitter employing the electrical system which he invented and which is described in this article

Much interest has been evinced in the Farnsworth system of television because of its many unusual features. The Farnsworth system probably offers television experimenters more food for thought and study than any of the other systems to date, for which reason this article should be of more than usual interest

By Arthur H. Halloran

FOLLOWING his announcement before the Federal Radio Commission that he is actually transmitting a 200-line moving picture along a 6-kilocycle channel, Philo T. Farnsworth has now authorized this explanation of the principles which he employs.

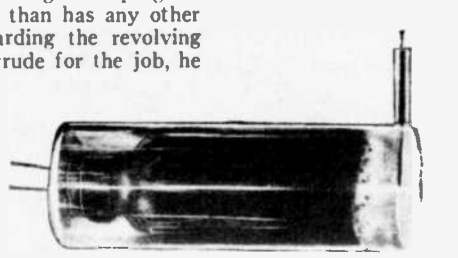
A youthful chief engineer of Television Laboratories, Inc., backed by a group of financiers at San Francisco, Philo T. Farnsworth has made what some have termed greater progress in solving the basic problems of television than has any other research investigator in the world. Discarding the revolving disk scanner as being too clumsy and too crude for the job, he scans a scene at the transmitter and at the receiver with a cathode ray beam. The two rays are kept in exact step by means of a control current which is transmitted along with the currents which reproduce the moving picture. Whenever a ten-kilocycle channel is allocated for his work, he can readily transmit a 400-line picture.

When this feat, which is accomplished with inexpensive equipment, is compared with the 72-line picture for which contemporary experimenters require a 40-kilocycle channel, it may be realized that television is progressing rapidly. Negotiations which are now under way may result in the availability of this receiver system for home use before the end of this year. Consequently the readers of RADIO NEWS will want to know how and why it works.

Perhaps the easiest way to acquire this knowledge is to follow through the simplified circuit diagram shown in Figure 1. This diagram illustrates a specialized and limited case which has been set up to facilitate an explanation. It by no means defines the entire procedure nor shows the various other means whereby Mr. Farnsworth is able to transmit radio movies without the necessity of modulating a carrier. So with the understanding that it merely typifies one of a great variety of methods, let us follow it through.

An optical image of a moving object 5 is focused through a lens 3 on to a silvered mirror 6, this being coated with a material which emits electrons when exposed to light. These parts constitute a sensitive photo-cell of a vacuum type, enclosed in a cylindrical glass tube 1. The mirror 6 is the cathode. Closely adjacent and parallel to it is an anode 7, which is maintained 500-volts positive with reference to 6, by means of a direct-current source 8. The anode consists of a finely-woven wire cloth through whose interstices the liberated electrons are projected into the equi-potential space formed by the shield 10.

Sweeping across the equi-potential space are two electromagnetic fields which are set up by "saw-tooth" alternating currents, in two sets of coils placed at right angles around the tube. When one set of coils, diagrammatically represented by 15, is supplied with a 16-cycle current from an oscillator 16, it causes a magnetic field to sweep vertically across the tube 16 times per second. When the other set of coils, which is not shown in the diagram but which can be seen in the perspective view in Figure 2, is supplied with a 3000-cycle



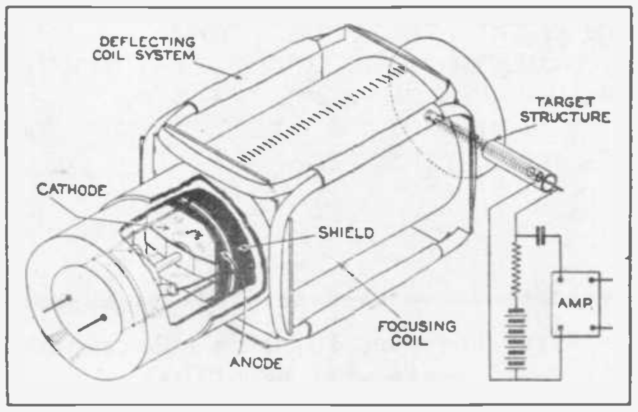


Figure 2. The actual appearance of the "Dissector Tube" employed in the Farnsworth system and, below, a perspective drawing of the tube showing the design details

(Continued on page 5)

The "MAN IN THE MOON"

Dear Man in the Moon: I am a little boy nine years old and I listen on my wireless every night you talk. As we have numerous stars shining over our house, I wish you would name one of them after me. My house is on the corner of John Street and Franklin Avenue.

—HAROLD A. HERBERT

THAT is the way the letters are coming in to the Man in the Moon. Little Harold was so anxious to have a star named after him that he went out and looked up and sure enough—right over his house—there were many stars shining. So Harold wrote the great and wonderful Man in the Moon and told him exactly where his house was located.

This great and wonderful man, who is known to thousands of children, lives in Newark, New Jersey. Twice a week he gives children the newest and most successful kind of juvenile entertainment—a bed-time story by radio. Tonight thousands of children will want to hear what the Man in the Moon has to say, and when he comes away down from the moon and talks to them in their own home they will be as happy as only children can be. One mother wrote in that her little girl—we will call her Sarah Smith—would not eat her oatmeal and could the Man in the Moon help her out? That night the Man in the Moon spoke into the transmitter:

"Is Sarah Smith listening? Well, the Man in the Moon wants to tell Sarah that she must eat her oatmeal if she wants to grow up to be big and strong. That is what the Man in the Moon says to Sarah."

A few days later the Man in the Moon received a letter from the girl's mother saying that Sarah was practically living on oatmeal!

That is how impressive the radio is to children. Thousands of letters pour in from children. In fact, the Man in the Moon has received as many as 1,800 letters in one week.

Who is this Man in the Moon who is bringing joy into the lives of so many

(Continued on page 3)

TUBES-Data

I felt the need to write an inventory program to keep track of my early vacuum tubes on a micro-computer. Every commercial inventory program I considered used random access filing, which meant they went hunting through the disk for every item sought. The result in this application is SLOW. All I wanted to know about each tube type was how many I had.

The program on the enclosed listing was written for the Apple II computer. It recognizes tube types from a Canadian Westinghouse tube manual of the 1950's. I omitted the G and GT designations for glass tubes resulting in 846 types. When a tube type is entered, the program matches it against a list and adds or deletes a count against that item, depending on the instruction given. The user can also query the quanity of a particular tube in inventory or direct the entire inventory to be listed to a printer. The progam runs rapidly because the entire inventory is located in a single sequential file, which is read once at the beginning of a session and saved once at the end if it has been modified.

```
10  REM  INVENTORY PROGRAM FOR VACUUM TUBES
15  REM  RECORDS TUBES OF TYPES LISTED IN THE
17  REM CANADIAN WESTINGHOUSE 1955 TUBE MANUAL.
20  REM  BY R. MURRAY, APRIL 1984
30  REM  **********************************
40 X = 571: REM  TOP OF LIST WITH 1 DIGIT VOLTAGE (9U8)
43 Y = 837: REM  TOP OF LIST WITH 2 DIGIT VOLTAGE (89)
44 Z = 846: REM  TOP OF LIST
45 C = - 936:D$ =  CHR$ (4)
50  DIM TYPE$(1000),NBR(1000)
60  FOR I = 1 TO Z
70  READ TYPE$(I)
80  NEXT I
90  DATA 00A,01A,0A4,0Y4,0Z4,0Z4A,1A3,1A4P,1A4T,1A5,1A6,1A7,1AB5,1AB6,1AC5,1AC6,
1AD4,1AD5,1AE4,1AE5,1AF4,1AF5,1AG4,1AH4
100  DATA 1AH5,1AJ4,1AJ5,1AK4,1AK5,1AX2,1B3,1B4,1B5,1B7,1B8,1C3,1C5,1C6,1C7,1C8,
1D3,1D5,1D7,1D6,1E3,1E4,1E5,1E7
110  DATA 1E8,1F4,1F5,1F6,1F7,1G4,1G5,1G6,1H4,1H5,1H6,1J5,1J6,1L4,1L6,1LA4,1LA6,
1LB4,1LB6,1LC5,1LC6,1LD5,1LE3,1LF3,1LG5
120  DATA 1LH4,1LN5,1M3,1N5,1N6,1P5,1Q5,1Q6,1R4,1R5,1S4,1S5,1S6,1SA6,1SB6,1T2,1T
4,1T5,1T6,1U4,1U5,1U6,1V,1V2
130  DATA 1V5,1V6,1W4,1W5,1X2,1X2A,1X2B,1Y2,1Z2,2A3,2A4,2A5,2A6,2A7,2AF4,2B7,2C4
,2C21,2C22,2C51,2C52,2D21,2E5,2E30
140  DATA 2E31,2E35,2E41,2G21,2S4S,2T4,2V2,2V3,2W3,2X2,2Y2,2Z2,3A2,3A3,3A4,3A5,3
A8,3AL5,3AU6,3AV6,3B2,3B4,3B5,3B7
150  DATA 3BA6,3BC5,3BE6,3BN6,3BY6,3BZ6,3C4,3C5,3C6,3CB6,3CF6,3CS6,3D6,3DT6,3E5,
3E6,3LE4,3LF4,3Q4,3Q5,3S4,3V4,4A6,4BC8
160  DATA 4BQ7A,4BS8,4BZ7,4BZ8,4CX7,5A6,5AM8,5AN8,5AQ5,5AS4,5AS8,5AT8,5AU4,5AV8,
5AW4,5AX4,5AZ4,5B8,5BE8,5BK7A,5BR8,5BT8,5CL8,5CM8,5J6
170  DATA 5K6,5R4,5T4,5T8,5U4,5U8,5V4,5V6,5W4,5X3,5X4,5X8,5Y3,5Y4,5Z3,5Z4,6A3,6A
4,6A5,6A6,6A7,6A8,6AB4,6AB5,6AB6,6AB7,6AB8,6AC5,6AC6,6AC7,6AD4,6AD5,6AD6
180  DATA 6AD7,6AD8,6AE5,6AE6,6AE7,6AE8,6AF4,6AF5,6AF6,6AF7,6AG5,6AG6,6AG7,6AH4,
6AH5,6AH6,6AH7,6AJ4,6AJ5,6AJ7,6AJ8,6AK4,6AK5,6AK6
190  DATA 6AK7,6AK8,6AL5,6AL6,6AL7,6AM4,6AM5,6AM6,6AM8,6AN4,6AN5,6AN6,6AN7,6AN8,
6AQ4,6AQ5,6AQ6,6AQ7,6AQ8,6AR5,6AR6,6AR7,6AR8,6AS4
200  DATA 6AS5,6AS6,6AS7,6AS8,6AT6,6AT8,6AU4,6AU5,6AU6,6AU8,6AV4,6AV5,6AV6,6AW7,
6AW8,6AX4,6AX5,6AX6,6AX7,6AX8,6AZ5,6AZ6
210  DATA 6AZ8,6B3,6B4,6B5,6B6,6B7,6B8,6BA4,6BA5,6BA6,6BA7,6BA8,6BC4,6BC5,6BC7,6
BD4,6BD5,6BD6,6BD7,6BE6,6BE7,6BE8,6BF5
220  DATA 6BF6,6BF7,6BG6,6BG7,6BH5,6BH6,6BH8,6BJ5,6BJ6,6BJ7,6BJ8,6BK4,6BK5,6BK6,
6BK7,6BL4,6BL7,6BM5,6BN5,6BN6,6BN7,6BN8
230  DATA 6BQ6,6BQ7,6BR7,6BR8,6BS5,6BS7,6BS8,6BT4,6BT6,6BT8,6BU5,6BU6,6BV7,6BW4,
6BW6,6BW7,6BX4,6BX6,6BX7,6BY4,6BY5
240  DATA 6BY6,6BY7,6BZ6,6BZ7,6BZ8,6C4,6C5,6C6,6C7,6C8,6CA5,6CB5,6CB6,6CD6,6CF6,
6CG6,6CG7,6CH6,6CJ5,6CJ6,6CK5,6CK6,6CL5,6CL6
250  DATA 6CL8,6CM6,6CM7,6CM8,6CN6,6CN7,6CQ6,6CR5,6CR6,6CS6,6CS7,6CU6,6CX7,6D4,6
D6,6D7,6D8,6DA6,6DB6,6DC6,6DE6,6DN6,6DQ6,6DR6
260  DATA 6DT6,6E5,6E6,6E7,6E8,6F4,6F5,6F6,6F7,6F8,6G5,6G6,GH4,6H5,6H6,6H8,6J4,6
J5,6J6,6J7,6J8,6K4,6K5,6K6
270  DATA 6K7,6K8,6L4,6L5,6L6,6L7,6M5,6M8,6N4,6N5,6N6,6N7,6N8,6P5,6P7,6P8,6Q4,6Q
5,6Q6,6Q7,6R4,6R6,6R7,6R8
280  DATA 6S4,6S5,6S6,6S7,6S8,6SA7,6SB7,6SC7,6SD7,6SE7,6SF5,6SF7,6SG7,6SH7,6SJ7,
6SK7,6SL7,6SN7,6SQ7,6SR7,6SS7,6ST7,6SU7
290  DATA 6SV7,6SZ7,6T4,6T5,6T6,6T7,6T8,6U3,6U4,6U5,6U6,6U7,6U8,6V3,6V4,6V5,6V6,
6V7,6V8,6W2,6W4,6W5,6W6,6W7
300  DATA 6X2,6X4,6X5,6X6,6X8,6Y3,6Y5,6Y6,6Y7,6Z4,6Z5,6Z7,6ZY5,6Z84,7A4,7A5,7A6,
7A7,7A8,7AB7,7AD7,7AF7,7AG7,7AH7
310  DATA 7AJ7,7AK7,7AN7,7AU7,7B4,7B5,7B6,7B7,7B8,7C4,7C5,7C6,7C7,7E5,7E6,7E7,7F
7,7F8,7F8W,7G7,7G8,7H7,7J7,7K7
320  DATA 7L7,7N7,7Q7,7R7,7S7,7T7,7V7,7W7,7X6,7X7,7Y4,7Z4,9AK8,9AQ8,9BM5,9BW6,9U
8,10,11,12A,12A4,12A5,12A6
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(Continued on page 7)

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children? Where is he? And what does he do between moons?

This is where the disillusioning part begins. He is William F. B. McNeary—a bachelor. But we mustn't hold that against him. For that matter, so is Santa Claus. The Man in the Moon, in real life, is the last person in the world that you would ever think of as being the greatest radio story teller for children. To part the curtains a little more: a person would probably think of him as being a kindly old gentleman walking slowly down the street, cane in hand, possibly on his way to feed the pigeons; but this is not the Man in the Moon. No indeed. Instead of that he used to be a detective.

During the war he was in Russia and Poland in the United States intelligence service—and it is due to that fact that we now have the Man in the Moon stories. It came about more by accident than anything else. In Poland he was living with a Russian family, and in the family was a daughter who could speak fluent English. She used to tell Mr. McNeary fairy stories and folk stories that her nurse had told her. These stories interested Mr. McNeary and he encouraged her to tell him more. And so she did. After a time he came back to the United States and, severing his connection with the intelligence office which he had joined as a war time measure, looked around for a job, as so many men had to do on their return. One evening he went to visit a friend near Newark who had a radio outfit and McNeary was invited to listen in. He knew nothing about radio. With idle curiosity he put on the headpiece.

"Who wants to buy a variometer? Who wants to buy a variometer?"

That was all he could hear. He had expected sweet music and instead of that all he could hear was some bug wanting to dispose of his variometer. He kept repeating it over and over and giving his call number. Then suddenly, as McNeary listened, an idea hit him: Why not put a newspaper into the air with all features—news, sports, editorial, comment, fashions—in short, everything from front page to back?

It was a hazy idea, but the more he thought about hooking up with a newspaper with this queer unknown thing called "radio" the better he liked it. Before he had gone abroad for the Government he had been a member of the editorial staff of the Newark *Sunday Call*, so he put up the idea to the editors.

But how could they send messages? Where could they be sent from? How much would it cost? He had about as much idea as the man in the moon. But the paper was interested. So he took his idea to the Westinghouse Company in Newark, but it had no sending station; only the one in Pittsburgh. At last a hook-up was agreed upon and the Westinghouse Company established a broadcasting station. He would announce in his paper what could be heard

I wish to thank you for naming a star for me which you did a few weeks ago. You had my name printed in the Sunday Call as Louis McMullen and I hope you didn't name a boy star for me as my name is Lois McMullen and I am a girl.

I am going to be seven years old on Friday March 3rd and my Aunt Caroline in Jersey City gave me a little Fox Terrier seven weeks old for my birthday. I call him Buster. If you have any more dog stars left I wish you would name one for Buster.

I listen in to your stories every Tuesday and Friday nights and I haven't heard you name any doll stars. If you have any I would like to have you name one for my doll Janice and one for my walking doll Lois.

Please stand by for the party.

This is E. Lois McMullen signing off.

Good evening.

P.S. My daddy is writing this for me.

A MIX-UP IN THE HEAVENS

If the Man in the Moon named a boy-star after little Lois—who is a girl—there will have to be a lot of explaining done and the astronomical charts will have to be made over completely.

and the night that the company would broadcast it.

At once his talk became a success. Newark became the center of the radio industry. But what to send? That was the question and a stumper it was. At first he sent out weather reports, sermons, news brevities, music records. But the big idea hadn't yet come along.

Then he hit upon the idea of broadcasting a bed time story for children.

The wiseacres in the game nearly laughed themselves sick. Who in the world would want to listen to a silly sandman story? But McNeary stuck to it. By this time he was radio editor of the *Sunday Call*, and found himself put to it for time. But he was not able to get any one else to tell the bed time stories so it fell to his lot to get up one himself. He hadn't the slightest idea for one—and then he remembered the stories he had heard in Poland. He picked out one and then thought of the name the Man in the Moon—and that night he put it on the radio.

A few letters came in reply. Next week he tried it again—and more letters came in. Soon his paper was getting more Man in the Moon letters than any other kind.

The first Man in the Moon story was told in October, 1921; after a time their popularity was such that they had to be moved up to two a week, and thus they stand to-day. But soon the supply of Russian fairy stories ran out; McNeary was now busy scratching around getting out his radio department—and yet the stories must be done. Finally arrangements were made for Miss Josephine Lawrence, editor of the children's page of the *Sunday Call*, to write the stories—and thus it is being done to-day. At seven o'clock Tuesday and Friday nights each week, McNeary takes the story in manuscript form, goes to the Westinghouse broadcasting station and there puts it into the air.

Imitators soon sprang up, until now bed time stories are being sent out by eight broadcasting stations in the United States, but Mr. McNeary remains the original Man in the Moon. He has had the title copyrighted so that there is little danger of the moon ever becoming full of men.

Merely telling stories wasn't enough, so another idea struck him. For the children who were good he named a star after them—and that day assured the success of bed time stories by radio.

The children went wild about it. How wonderful it was to think that the man in the moon had named a star after them—and that it would twinkle as long as the child was good! It beat a shoe-horn or a hairbrush all hollow. It became the new way to correct children. Immediately the children fell in with it and the Man in the Moon became a person more wonderful than Santa Claus—for Santa Claus comes only once a year. Now there are thousands of children in the United States who, if they had to choose between Santa Claus and the Man in the Moon, would probably give their fond and doting parents a surprise.

What amusing, ingenuous stories the letters tell! How they reach the heart! We wish we had more space for them, but as we have not we will have to cut them short.

IN ONE WEEK HE RECEIVED 1800 LETTERS FROM CHILDREN

Santa Claus comes but once a year. But the Man in the Moon (alias W. F. B. McNeary) comes by radio twice a week.

From a photograph made for POPULAR RADIO

I am sending you a few lines to ask you if you have three more stars left of which you can name one for me and one for my little sister and brother. My name is Emma Clodius and my sister's name is Hazel Clodius and my brother's name is Henry Clodius.

EMMA, HAZEL and HENRY CLODIUS

What a hurry they were in to write to the Man in the Moon before all the stars were gone!

I have a little cousin whose name is Peggy Chapman, and she lives in Jersey City. She listens and loves your stories too, just as I do, and she wishes you would name a star for her, but she is so bashful that she wouldn't ask you.

ROBERT STORK

I have a little sister named Natalie. Would you please name a baby star after her.

NORMA MATTE

We listen to your stories every Tuesday and Friday night. I live with my grandma on Princeton Street. My uncle has a wireless set and lets me use it. My uncle is fourteen years old.

JENNIE MAY NELSON

Won't you please name a star after me? It need n't be a very large one, as I am only seven years old. If you have any tiny stars left up there you might name one for my baby sister, Elaine. She can't hear your stories, for she must go to bed at six o'clock, but I know she would like to have a star for her very own.

JANE LORSON

What a wonderful feeling it must be to have a star of your very own!

My name is William Terry, but I like to be called "Bill Soldier," because I like horses. I am just four years old, but I will be five on August 11th, 1922.

WILLIAM TERRY

What a long time Bill will have to wait to be almost a man—until August 11th.

My brother Vincent and myself would be very proud to have stars named after us and hope you will name them this Friday. We have a baby sister named Anita, but as she only came from the stars three months ago, I guess she isn't very anxious to have a star named for her. Are you so busy naming stars that you can't find time to shine any more? It seems like a long time since we saw you shining in the sky.

THEODORE and VINCENT BROUN

I am getting my sister to write and ask if you will name a star for me, as I am a little boy seven years old and have no mother or father and I am sure that if I hear my name over the wireless it will make me happy.

ARTHUR DULL

What a story in this! It could serve as a fiction writer's inspiration—the little boy whose father and mother are dead and who would be happy if he had a star named after him—a star from up where *they* are! It almost brings a tear to one's eye to think of the tragedy in the home—and the little boy so anxiously waiting for his star.

Note and Personal: I can tell you, little girls, little boys, if you ever read this article, that the Man in the Moon is real. I have seen him. He lives and eats and has to go to bed just the same as anybody else does. He is a nice man and he wants to name a star after every good boy and girl. If it takes him a long time to get to you it will be because he has so many, many friends. Just keep right on believing in him—and some day there will be a star twinkling for you.

P. S. Don't worry. He says that he has lots and lots and lots of stars that have never been used.

Good night, I must stand by.

"Scanning" Without a Disc

Radio News for May, 1931 999

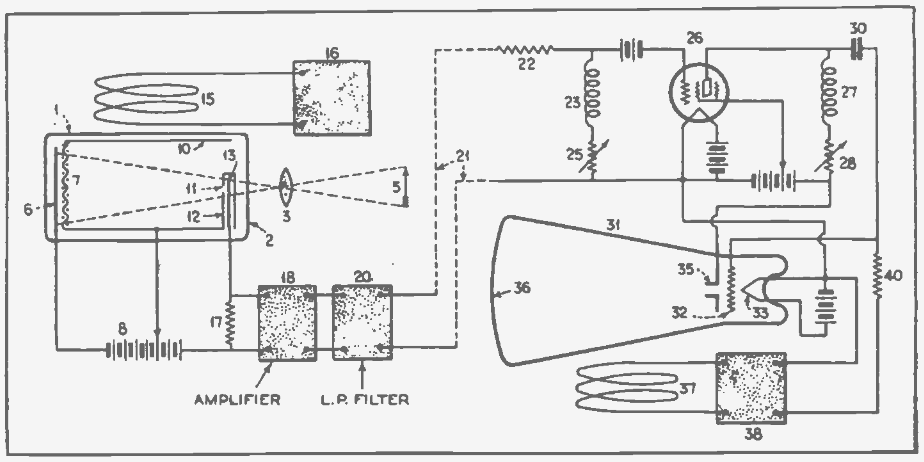


Figure 1. The simplified schematic layout of the Farnsworth system for narrow band transmission of moving pictures. The portion to the left of the dotted connecting lines is the transmitter while the receiver is to the right

THE Farnsworth developments mark another step in the forward march of television, bringing still closer the practical reality of television in the home

current a magnetic field is swept horizontally across the tube 3000 times per second. Their resultant effect upon the electrons in the equi-potential space is to form them into a cathode ray image which successively issues from each tiny element of picture area. This cathode ray is then magnetically focused through the small aperture 11 onto the target or electron collector 13.

Hereon is produced a random series of electrical pulses, each having a square front wave $(200)^2 \times 16 \div 2 = 320.000$ cycles in width. Each pulse corresponds to an instantaneous change in light intensity in each element of area which is successively scanned by the cathode ray. The variations in light intensity are thus converted into corresponding variations in current intensity. These current pulses are passed through a 5-stage admittance-neutralized amplifier (18) which is capable of passing a 600-kilocycle wave-band, with a practicaly straight frequency characteristic. (No small feat in itself.)

Neglecting for the moment the filter 20 and the intervening network 21-40, and assuming that a 320-kilocycle distortionless channel were available to transmit the amplified current through the receiver, let us see what happens. The receiver is another cathode-ray tube through which sweep two sets of magnetic fields, one vertically and the other horizontally. The currents to establish these fields are 16-cycle and 3000-cycle "saw-tooth" components of the 320-kilocycle band. Because of their peculiar shape they are readily extracted from among the other frequencies and are used to locally generate or amplify, through oscillators 38, sufficient current to induce the required magnetic fields which cause a cathode ray to sweep across a fluorescent screen 36, thus reproducing a moving picture in exact synchronism with the original moving object 5.

In this vacuum tube, or oscillite, the electron-emitting element is a hot filament 33. The emitted electrons are attracted to and projected through the aperature of a plate 35, the

An unretouched photograph of an image transmitted over the Farnsworth system. The screen effect shown here is the result of the printing, and did not appear in the photographic print from which the cut was made

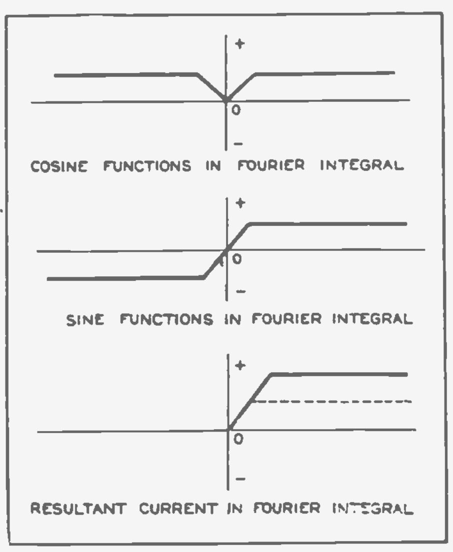
number of projected electrons being controlled by the current pulses on the grid 32. The intensity of these current pulses, it will be remembered, depends upon the intensity of the light which initiates them. Consequently as they emerge from the plate into the space through which the two magnetic fields are sweeping, they are formed into a cathode ray which rapidly scans the area of the fluorescent screen 36, thereby forming the moving picture.

But our assumption of a 320-kilocycle distortionless channel is not justified for either radio or wire transmission. In the entire 960-kilocycle spectrum, used by American broadcasters of speech and music, there are only three such channels possible. So the greatest problem in television, and the one which Mr. Farnsworth is probably the first to solve in a practical manner, is how to utilize a narrow channel for the production of a moving picture which has sufficient clearness and detail.

The manner in which he accomplishes this seemingly impossible feat is an interesting story in itself, entirely aside from his remarkable success with the cathode-ray tube. His work is based upon a painstaking study of the Fourier integral theorem, one of the most complex and baffling of all mathematical conceptions. In his study of this theorem he discovered an error and in its correction realized the possibility of suppressing all frequencies beyond the limits of a very narrow band, and then to supply the missing frequencies from derived components of the distorted pulse which is received.

As it would take an accomplished mathematician to understand Mr. Farnsworth's analysis, no attempt will be made to present it here mathematically. Yet it is possible to give an interpretation which can be understood by any student familiar with trigonometry.

Mr. Farnsworth starts with the fact that the abrupt changes in light intensity during the scanning of a picture cause corresponding abrupt changes in the pulses of electric current into which the picture is converted by the scanning process. Each signal wave is characterized by an abrupt square front which suddenly increases from zero to a maximum value, or likewise suddenly decreases from a maximum to zero, in an instant of time. These are the changes that correspond to an instantaneous change from black to white, or vice versa, in a picture. For less intense changes in light intensity there are less intense changes in current. But always each (*Continued on page* 1015)



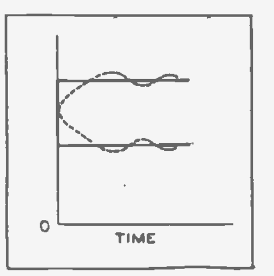


Figure 3. (Above) Form of wave from single pulse. Heavy line shows desired vertical wave front. The broken line indicates sloping wave front from filter. Figure 4. (At left) Sine and Cosine functions in Fourier Integral showing cancellation and addition

change is characterized by a vertical wave front.

But the straight wave front, as indicated by the heavy lines in Figure 3, becomes distorted in the electrical system and also in the transmitter aperture, so that the pulse which arrives at the receiver has a sloping wave front, somewhat as indicated by the dotted lines of Figure 3. It causes a badly blurred picture. Only by filling in the gap of missing frequencies can the oblique front be changed to a vertical front and the blurred picture converted into one whose details are clear and distinct.

This filling-in can be done in various ways. The general idea can be understood by considering one method which happens to be applicable to the wire transmission of a moving picture. This method uses a low-pass filter in the transmitter as shown at 20, Figure 1. Incidentally it is of interest to know that a band-pass filter, calculated to pass frequencies in the neighborhood of 2100 kilocycles, would enable the pulses to be radiated directly without the necessity of modulating a separate carrier.

Assume that a low-pass filter, such as an audio-frequency transformer, suppresses all frequencies above 6 kilocycles, and that a distorted wave pulse of the general form shown in curve 47 of Figure 5 enters the network defined by 21 in Figure 1. At this stage of the explanation someone may well ask why the distorted wave pulse has the form shown. In order to answer this question, as well as to explain the corrective action of the network, it is necessary to digress for a moment.

All communication engineers agree that a random pulse with a vertical wave front, such as that used in television, can be represented by the Fourier integral theorem. This theorem defines the current as a function of time, during infinite time before and after zero time. Zero time denotes the start of something, in this case the beginning of an electron attack on a fluorescent screen. During the World War the zero hour marked the beginning of an attack from the front-line trenches.

Anyone who understands the integral calculus recognizes this particular integral as being the summation from minus infinity to plus infinity of an infinitely long series of sine and cosine functions of ωt, where ω is equal to 6.28 times each infinitesimal frequency. For negative time, *i.e.*, for all time prior to zero time, the sum of the sine functions is numerically equal and algebraically opposite to the sum of the cosine functions. Consequently, they cancel each other, and there is no actual current prior to zero time.

During positive time, *i.e.*, all time after zero time, the sine functions are equal to the cosine functions both numerically and algebraically. Therefore the current resulting from their super position is equal to twice that represented by the sum of the sine functions. These several relationships are graphically illustrated in Figure 4.

By evaluating this integral and plotting the values for different values of ωt, the sine wave form of the current pulse shown in curve 47 of Fig. 5 is obtained. It will be noted that at zero time it rises obliquely from a zero value and continues as a series of decaying oscillations along a straight line.

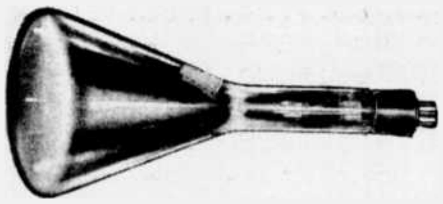
The mathematical derivative, of an integral which involves sine functions, is also a sine function which lags 90 degrees behind the integrated sine function. A plot of its successive values shows zero value for negative time and an instantaneous rise from zero to a maximum at zero time and then a gradual falling back to zero through a series of damped oscillations. 90 degrees behind those of the original pulse. as shown in curve 48 of Figure 5.

The mathematical derivative of this second sine function is a cosine function whose value is zero prior to zero time and then at zero time it rises instantaneously to infinity and instantaneously falls back to zero, finally dying out through a series of damped oscillations 180 degrees behind those of the original pulse. as shown by curve 49 of Figure 5.

By superposing the first derivative I′ and the second derivative I″ in proper proportion on the original pulse I, a wave is obtained which for all practical purposes is the desired square wave front form. I′ compensates for the sloping cut-off due to frequency attenuation in the filter and I″ compensates for aperture and other distortion in the original pulse.

The electrical equivalent of obtaining the mathematical derivative of a sine function which represents an electrical current is to pass the current through an inductance. Similarly the electrical equivalent of integration is performed by a condenser. These facts are indicated in the elementary expression for voltage drop through an impedance.

So finally, after many digressions, we are at last ready to consider the differentiating network which is installed in the receiver. Connected in series with the line is a resistor 22 which feeds a shunt circuit consisting of an inductance 23 and a variable resistor 25. The resistive impedance of 22 is of sufficiently high value to control the current independently of the effect of the inductive impedance 23. The flow of current I through 25 causes a voltage drop e = IR and through inductance 23 a voltage drop e″ which is proportional to the rate of change of current I. It thus becomes the first derivative of I.



The cathode ray tube employed for "scanning" in the Farnsworth receiver system, illustrated at 31 in Figure 1

The sum of the two voltages e + e′ is impressed upon the grid of a vacuum tube which has a high output impedance. Its plate current, which is an amplification of I and I′, in flowing through resistor 28 causes a voltage drop e″ which is proportional to I and I′. The same currents in inductance 27 cause a voltage drop proportional to their rates of change, thus producing the differentiated currents I′ and I″, which are fed into the condenser 30 which stores or integrates the pulses fed to it, converting part of the second derivative back to the first derivative and part of the first back to the fundamental.

The pulses which are fed to the grid 32 control the intensity of the cathode ray which creates the picture, as already explained. Resistors 25 and 28 are variable so that the values of the several components can be adjusted until the picture has the best appearance.

It should be remembered that this example merely defines one case of Mr. Farnsworth's invention. His entire idea cannot be fully understood, without greater recourse to mathematics than is here possible. But it is hoped that this qualitative analysis of how the warp and woof of the moving picture is first formed by a cathode ray, then cut into a mere scrap of the original, and finally patched so as to reproduce the original pattern, may pave the way for an understanding of the quantitative analysis that will probably be available as soon as the transmitted pictures are ready for reception in the home.

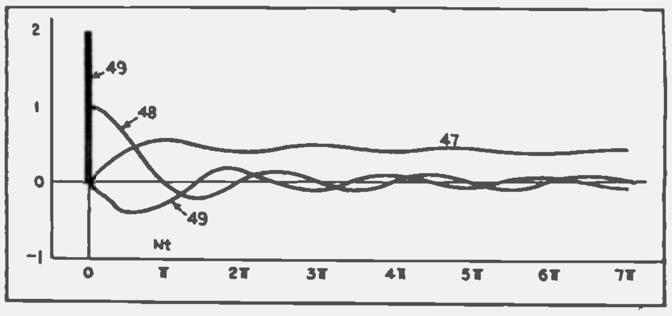


Figure 5. Plotted values of original and derived pulses

Radio News for May, 1931

Readers can key in the BASIC program from the listing provided, making changes if they wish to the tube types available and changing the disk commands if they have a different computer. Apple II users can send me an initialized diskette with a dollar to cover Canadian return postage and I will copy the program onto their diskette and return it.

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October 2, 1984

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330  DATA 12A7,12A8,12AB5,12AC5,12AC6,12AD6,12AD7,12AE6,12AF6,12AG6,12AH7,12AH8,
12AJ7,12AL5,12AQ5,12AS5,12AT6,12AT7,12AU6,12AU7,12AV5,12AV6,12AV7,12AW6
340  DATA 12AX4,12AX7,12AY7,12AZ7,12B3,12B4,12B6,12B7,12B8,12BA6,12BA7,12BD6,12B
E6,12BF6,12BH7,12BK5,12BK6,12BN6,12BQ6,12BR7,12BT6,12BU6,12BV7,12BW4
350  DATA 12BY7,12BZ7,12C5,12C8,12CA5,12CM6,12CR5,12CR6,12CS5,12CS6,12CU5,12CU6,
12DQ6,12E5,12F5,12F8,12G4,12G8,12H4,12H6,12J5,12J7,12K5,12K7
360  DATA 12K8,12L6,12L8,12Q7,12S7,12S8,12SA7,12SC7,12SF5,12SF7,12SG7,12SH7,12SJ
7,12SK7,12SL7,12SN7,12SQ7,12SR7,12SS7,12ST7,12SW7,12SX7,12SY7,12U7
370  DATA 12V6,12W6,12X3,12X4,12Z3,12Z5,14A4,14A5,14A7,14AF7,14B6,14B8,14C5,14C7
,14E6,14E7,14F7,14F8,14H7,14J7,14K7,14L7,14N7,14Q7
380  DATA 14R7,14S7,14V7,14W7,14X7,14Y4,15,15A6,15A8,16A5,17Z3,19,19AU4,19AQ5,19
BG6,19C8,19J6,19T8,19V8,19X3,19X8,19Y3,20,21A6
390  DATA 22.24,25A6,25A7,25AC5,25AV5,25AX4,25B5,25B6,25B8,25BK5,25BQ6,25C5,25C6
,25CD6,25CR5,25D8,25DN6,25DQ6,25F5,25L6,25N6,25U4
400  DATA 25W4,25W6,25X6,25Y4,25Y5,25Z4,25Z5,25Z6,26,26A6,26A7.26BK6,26C6,26CG6,
26D6,26E6,26Z5,27,28D7,28Z5,30,31,31A3
410  DATA 31BX7,32,32L7,33,34,35,35A5,35B5,35C5,35L6,35W4,35Y4,35Z3,35Z4,35Z5,35
Z6,36,37,38,39,40,41,42,43
420  DATA 45,45A5,45Z3,45Z5,46,47,48,49,50,50A5,50AX6,50B5,50BK5,50C5,50C6,50CD6
,50L6,50X6,50Y6,50Y7,50Z6,50Z7,52
430  DATA 53,55,56,57,58,59,70A7,70L7,71A,75,76,77,78,79,80,81,82,83,83V,84,85,8
5AS,89,117L7/M7,117N7,117P7,117Z3,117Z6,182B,183,485,950
500  CALL C
510  INPUT "DO YOU WANT TO USE A NEW OR EXISTING     INVENTORY (N/E)?";R$: PRINT
520  INPUT "ENTER THE INVENTORY FILE NAME";FI$
530  IF R$ = "N" THEN  GOTO 640
540  INPUT "PUT DISKETTE CONTAINING INVENTORY IN     DRIVE 1 AND PRESS 'RETURN'";
R$
550  PRINT D$;"OPEN ";FI$;",S6,D1"
560  PRINT D$;"READ ";FI$
570  INPUT LG$
580  FOR I = 1 TO Z
590  INPUT NBR(I)
600  NEXT I
610  PRINT D$;"CLOSE ";FI$
620  CALL C: PRINT "MOST RECENT FILE UPDATE LOG:": PRINT
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630  PRINT LG$: PRINT
640  PRINT "DO YOU WISH TO:": PRINT
650  PRINT "ADD ITEMS          1": PRINT
660  PRINT "DELETE ITEMS       2": PRINT
670  PRINT "PRINT A LIST       3": PRINT
680  PRINT "SAVE THE FILE      4": PRINT
685  PRINT "QUERY A TUBE TYPE 5": PRINT
687  PRINT "GET TOTAL OF TUBES6": PRINT
690  PRINT "QUIT               7": PRINT : PRINT : PRINT
700  INPUT "(ENTER SELECTION)";N
710  IF N < 1 OR N > 7 THEN  PRINT  CHR$ (7): GOTO 700
720  ON N GOTO 730,800,850,950,1200,1300,1500
730  GOSUB 1000
740  IF TUBE$ = "MENU" THEN  GOTO 620
750 NBR(YM) = NBR(YM) + 1
```

(To be concluded next month)

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WE 271A........$12	WE 274A/B......$13
WE 275A........$12	WE 276A........$20
WE 284.........$26	WE 293A........$4
WE 300A/B......$55	WE 301A........$10
WE 339A........$10	WE 345A........$8
WE 347A........$7	WE 348A........$7
WE 349A........$7	WE 350B........$17
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WANTED: ANY AND ALL INFORMATION on the "Radio-Pen" facsimile receiver by John V. L. Hogan, August 1934 Radio News. Anyone who owned and operated? D'Arcy Brownrigg, P. O. Box 292, Chelsea, Quebec, Canada, J0X 1N0.

WANTED: VT-1 AND VT-2 TUBES, RADIO NEWS FROM 1919 TO 1928, MATTE FINISHED AERIOLA SR., JR. AND AERIOLA AMPLIFIER CARDS, AK-9, CROSLEY HEADPHONES, CROSLEY 50. ERICH BRUESCHKE, 314 N. LINCOLN STREET, HINSDALE, IL 60521, SASE, WILL ANSWER ALL LETTERS, (312) 325-9259.

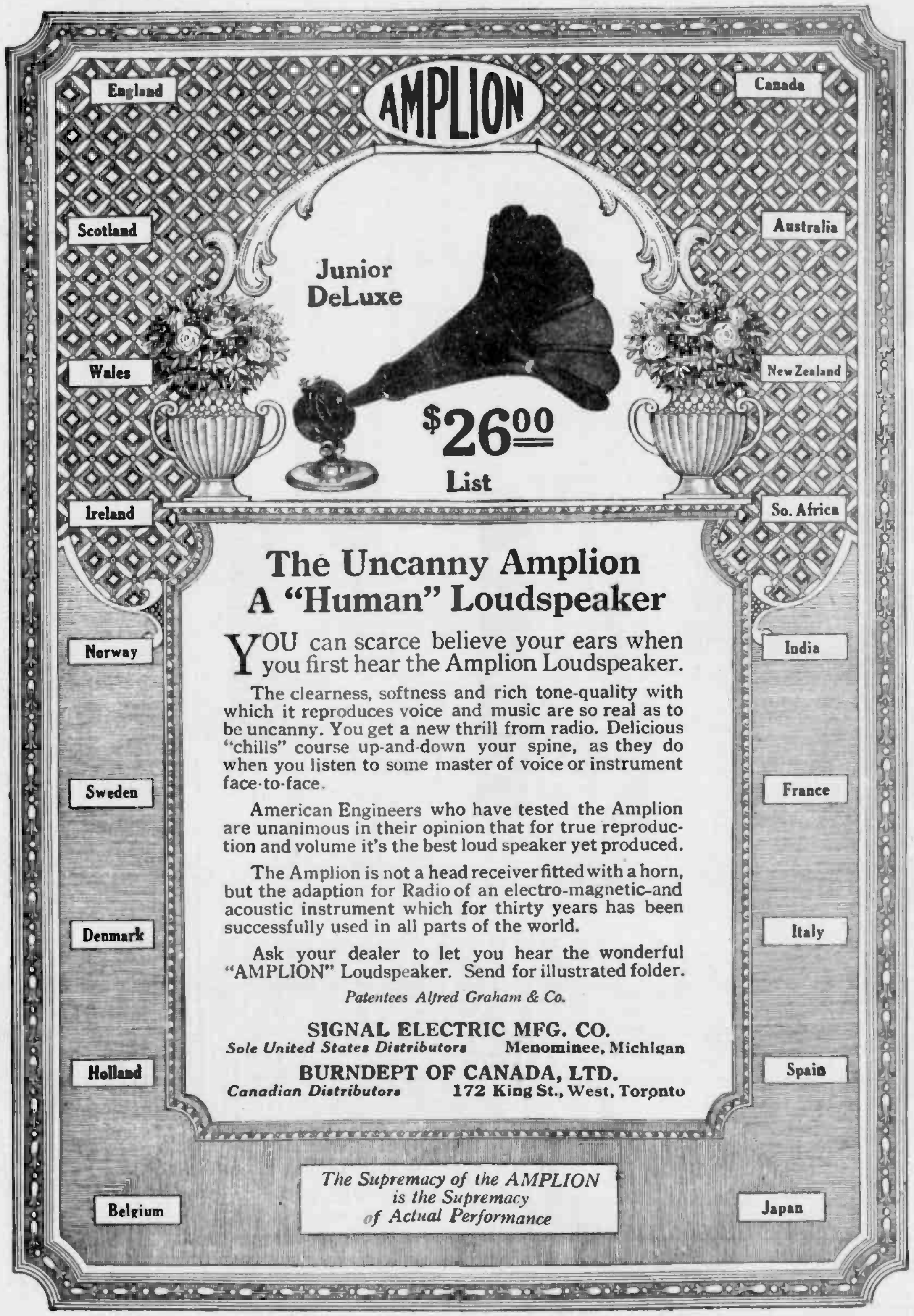
We take liberty herewith to introduce ourselves as being a long establisher importer of antique mechanical music. ALWAYS WANTED: VINTAGE AND ANTIQUE RADIO, HORN SPEAKER, VINTAGE T.V., CATHEDRAL RADIO, GRAMOPHONES, PHONOGRAPHS, POLY PHONE, JUKE BOX, CRYSTAL SETS, MUSICAL BOXES, TYPEWRITER, SEWING MACHINES, TELEPHONES, WESTERN ELECTRIC AUDIO PRODUCTS, AMPLIFIER, DRIVERS, HORN AND SPEAKER SYSTEMS, ANY SPARE PARTS, OLD CATALOGUES AND POSTER, AND ALL OTHER OLD MECHANICAL ITEMS. TOP CASH PRICES PAID, Whole collection or single items. We will travel any where to collect, if you have them in hand. Please contact us with prices and photograph to: MR. PIPAT W. POOLPOL, 9 Soonthon Kosa Road, Klong toey, Bangkok 10110 Thailand. Tel. 2863947.

RCA RADIO, Model 121, ca. 1934, two band, AC, Cathedral. good, very good or excellent condition. Gary Higginbotham, 471 Gorenflo Avenue, North Biloxi, Mississippi 39532.

WANTED: HEATHKIT SIGNAL TRACR, MODEL NO. IT-12 AND GENERATOR NO. IG-102, JACK WALLACE, 5516 GILBOW AVENUE, RIVER OAKS, TX 76114. (817) 732-5189.

WANTED: PHILLIPS 2401A, or N4504 or D2924. Send SASE for list. Box 836224, Richardson, TX 75083.

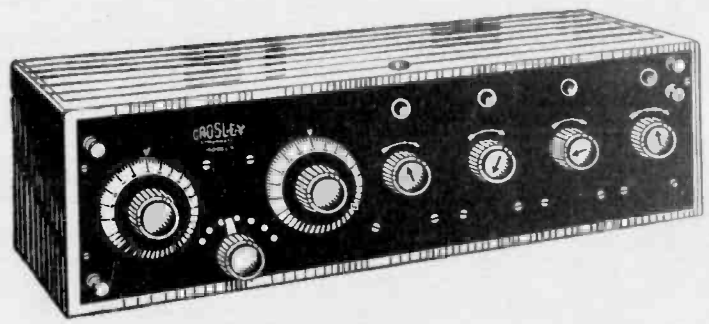
WANTED: ATWATER KENT AK5, AK10, AK 12 MAGNAVOX R2, R3, MEAPON CRYSTAL SET. WILL PAY HIGH PRICE IF GOOD CONDITION 102 KOKUBUHIGHTS, 316-13 YAMAGUCHI, TOKOROZAWA-SHI, SAITAMA-KEN JAPAN

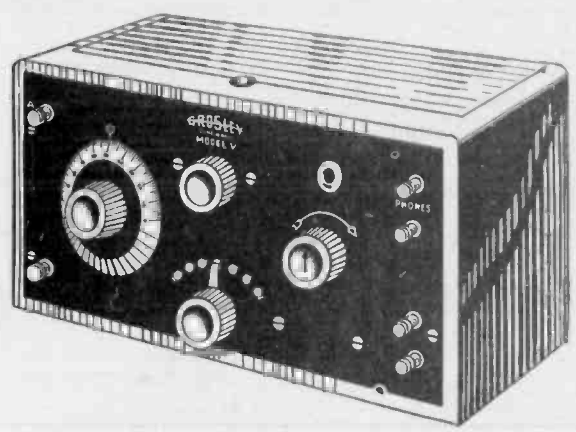


OCTOBER

THE HORN SPEAKER

1984





MR. GARY B. **51284
SCHNEIDER *73*
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NORTH ROYALTON OH -44133