THE INVENTIONS OF DR. C. FRANCIS JENKINS
OF WASHINGTON, D.C.

A Thesis prepared by

William Hartge Fifer

as part of his initiation into the Maryland Beta Chapter of the Tau Beta Pi Association, the Honorary Engineering Fraternity of the University of Maryland.

1/10/30

DR. C. FRANCIS JENKINS

SUMMARY

Dr. Charles Francis Jenkins of Washington, D.C. has produced some of the most remarkable discoveries of this mechanical age. He is the father of the motion picture industry, having invented the prototype of the motion picture projector now used in every theater in the world. He invented the apparatus which sent and received the first radio photographs and a short while later produced an apparatus for viewing distant scenes by radio directly, and radio movies for home entertainment. Developing the spiral wound all paper container used the world over for the transportation of liquids in small quantities is to be also credited to him. He has been granted over four hundred patents and maintains a private laboratory in Washington. He owns and operates radio station W3XK where radio movies are broadcast at a regular schedule. He has made several important inventions pertaining to aviation. Here truly is a man that the world can give its thanks to for many of the luxuries and comforts that people today enjoy.

DR. C. FRANCIS JENKINS

Dr. C. Francis Jenkins was born in the country near Dayton, Ohio in 1868. His parents were Quakers. He spent his boyhood on a farm near Richmond, Indiana where he attended the county grade and high schools. On graduation from high school he attended Earlham College from which he was graduated in 1887. After graduation he explored wheatfields and timber regions of the Northwest and cattle ranges and mining camps of the Southwest United States. He came to Washington, D.C. in 1890 as Secretary to Sumner I. Kimball of the United States Life Saving Service, the forerunner of the present United States Coast Guard. He resigned from the position in 1895 to take up inventing as a profession. To date he has been granted over four hundred patents most of which are on motion pictures, radio photographs, and radio movies. He is a member of the Franklin Institute, the American Association for the Advancement of Science, the National Aeronautical Association, and is founder of the Society of Motion Picture Engineers. He has been awarded the Elliott Cresson Gold Medal by the Franklin Institute and also the John Scott Medal by the City of Philadelphia for his motion picture machine. He has a commercial airplane pilots license and owns and operates his own plane.

In June 1929 he was awarded the honorary degree of Doctor of Science by Earlham College of Indiana.

Dr. Jenkins Home at 5502 Sixteenth St.,N.W.,
Washington,D.C.

Dr. Jenkins maintains a private laboratory at 1519 Connecticut Ave.,N.W.,Washington,D.C. where he employs seven assistants. He owns and operates radio station W3XK at Wheaton Md. where radio movies are broadcast on a regular schedule.

THE INVENTIONS OF DR. C. FRANCIS JENKINS

In his private laboratory on the second floor of 1519 Connecticut Ave.,Washington,D.C. Dr. Jenkins and his staff of assistants have produced some of the most remarkable inventions of this scientific age. It is due to the keen inventive brain of Dr. Jenkins that we have many of our present day luxuries and comforts.

PROTOTYPE MOTION PICTURE PROJECTOR

The most notable of his early works deal with photography and motion picture machines. He invented the first printers and developers used by the Eastman Kodak Co. of Rochester,N.Y. and it is due to these early discoveries that the motion picture machine was developed. Dr. Jenkins made the first long strip film motion picture mchine by fastening together rolls of Kodak film and cutting them in thin strips.The present type projector used the world over and which has made the modern motion picture possible is entirely due to him.

HIGH SPEED CAMERA

This camera was designed for the study of high velocities or high speed motions,such as the flight of a projectile. It has a normal rate of exposuresof from 1000 to 3000 pictures per second,and as high as 4000 pictures per second have been successfully obtained.

It uses standard super-speed motion picture negative film and is developed in the usual manner. The film is projected in the standard projecting machine which gives a reduction of 100 to 200 in the apparant speed of the photographed object, which makes its motion and reactions much easier to study.

The camera uses 48 Zeiss Tessar lenses, size F-3.5 and of 2" focus. The camera is operated by an ordinary automobile starting motor and a 12 volt storage battery. Sunshine or illumination equivalent to sunshine is sufficient for its operation.

The secret of this camera lies in its lens system as each lens may work as much as 150 per cent of the time, that is to say, the exposures overlap.

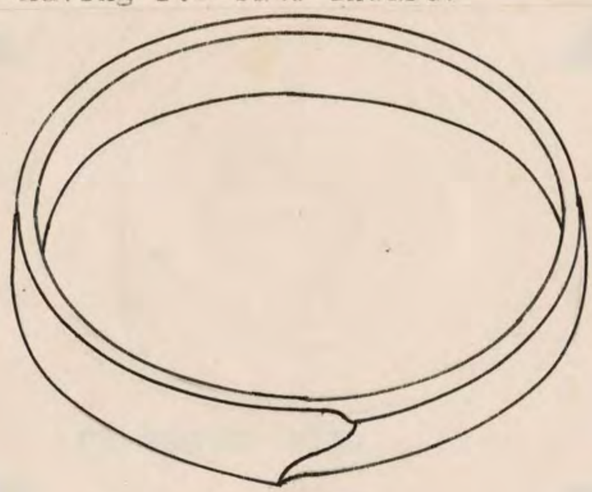
SPIRAL-WOUND PARAFFINED ALL PAPER CONTAINER

This is the familiar round paper container which is used in many confectionery stores as a container for ice cream or other liquids which require a cheap practical method of transporting liquids. From a monetary standpoint this was one of his most successful inventions.

RADIO PHOTOGRAPHS

Dr. Jenkins produced the first photographs ever sent by radio and produced the first apparatus for viewing distant scenes by radio. His first work on this subject began in 1913 and was continuously pursued until he was interrupted by the

World War to which he gave all his aid. After the termination of the War he developed a prismatic ring, a new contribution to the optical science. It is comparable to a solid glass prism which changes the angle between its sides,giving to a beam of light passing through an oscillating action on one side of the prism while holding a fixed axis of the beam on the other side of the prism. The prismatic ring section is ground into the face of a glass disc. From one end to a point half way around it has its base outward and from this point around to the other end having its base inward.



PRISMATIC RING

It was with the development of the prismatic ring that the first real success was obtained in the transmission of pictures and vision by radio,for it is by the use of these prismatic rings and a light sensitive cell at the sending station that the light values which make up the picture are converted into eletrical currents and broadcast This is accomplished by sweeping the picture across the light sensitive cell by means of these rotating prismatic rings. With each downward sweep the picture is moved one one-hundredth of an inch to the right until the whole picture has crossed the light sensitive cell which converts the light strength of the different parts of each slice into corresponding electrical currents. It is immaterial whether the current modulation is taken from a flat photograph, a solid object or an out-door scene at which the transmitter is directed.

At the distant receiving end it is only necessary to put these light values back again by reversing the process. This is accomplished by having a point of light to draw lines across the photographic place, which is done by the prismatic rings and by varying the strength of the different of the successive lines corresponding to the lights and shadows of the picture at the transmitter which is done by the varying strength of the incoming radio signal which causes corresponding changes in the intensity of the light.

The source of light is obtained from a filament lamp which consists of a single turn coil enclosed in an atmosphere of hydrogen. The variation of light is caused by impressing the incoming radio signals on this lamp after the filament has been brought to a dull red by a battery.

W.J. Bryan

J. S. Montgomery

PHOTOGRAPHS SENT AND RECEIVED BY APPARATUS
INVENTED BY DR. C. FRANCIS JENKINS. June, 15, 1924.

In order that the sending machine and receiving machine will run in exact synchronism a control fork was perfected. The control of the sending and receiving motors is maintained by the vibration of a rather heavy fork at each station and are adjusted to beat together, with a slight automatic conection by Radio as may be required to keep the folks in all of the receiving stations in synchronism with that of the transmitter. It is a simple and very dependable method.

Another method of keeping the motors in step is to have a small synchronous radio motor controlled by power radiated from the broadcasting station. It is rotated partly by this radiated power and partly by a local current just as a a loudspeaker is operated. These small motors regulate the rotation of a larger motor and thus keep them in step with the transmiting station.

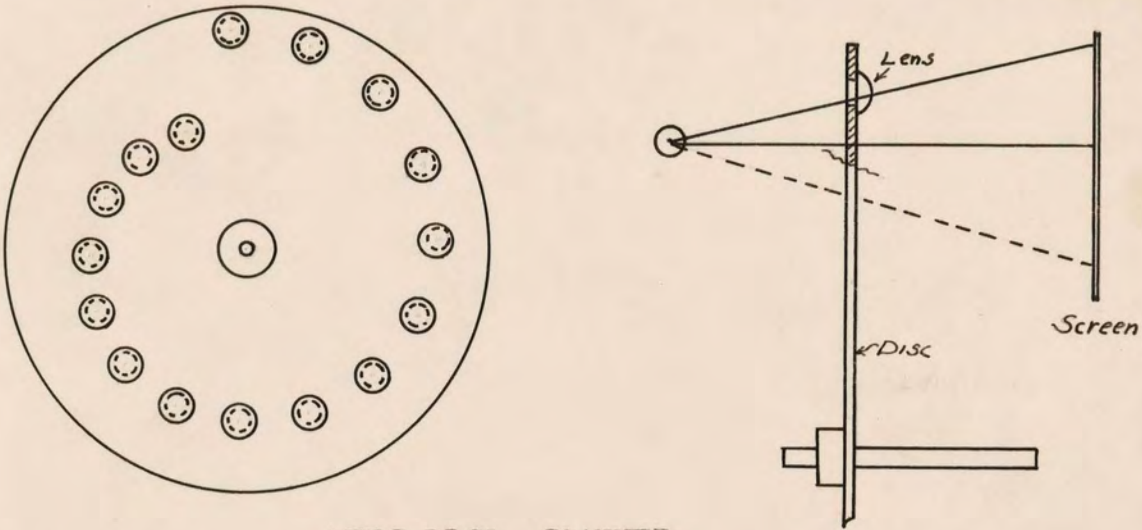
This method to the present time is the most practical and gives the best results in sending pictures by radio.

RADIO VISION AND MOVIES

After obtaining such wonderful results in radio photographs Dr. Jenkins immediately began to develop some practical means of transmitting pictures of moving objects and motion pictures.

When transmitted and received by the flat plate method radio vision is identical in principle to the method by which radio photographs are broadcast with the only difference being in the speed of transmission.

As in radio photographs the picture is formed by a small spot of light moving over the picture in successive parallel lines, with the light value controlled by the incoming radio signals. The whole picture is covered in one-sixteenth of a second and the persistence of vision of the human eye enables us to see the whole picture. In order to get this great increase in speed a lens disc is substituted for the pair of prismatic rings.



LENS DISC SCANNER

The rotation of the disc carrying the lenses arranged in a spiral causes the light to sweep across the screen. A speed of one-sixteenth of a second per revolution of the disc will give a motion picture screen effect.

The Radio Vision receiving set as designed by Dr. Jenkins is very simple and all the apparatus may be placed in a small box beside the radio set and one may see a distant football **game** or inaugural ceremony or **my** see a motion picture transmitted from a film.

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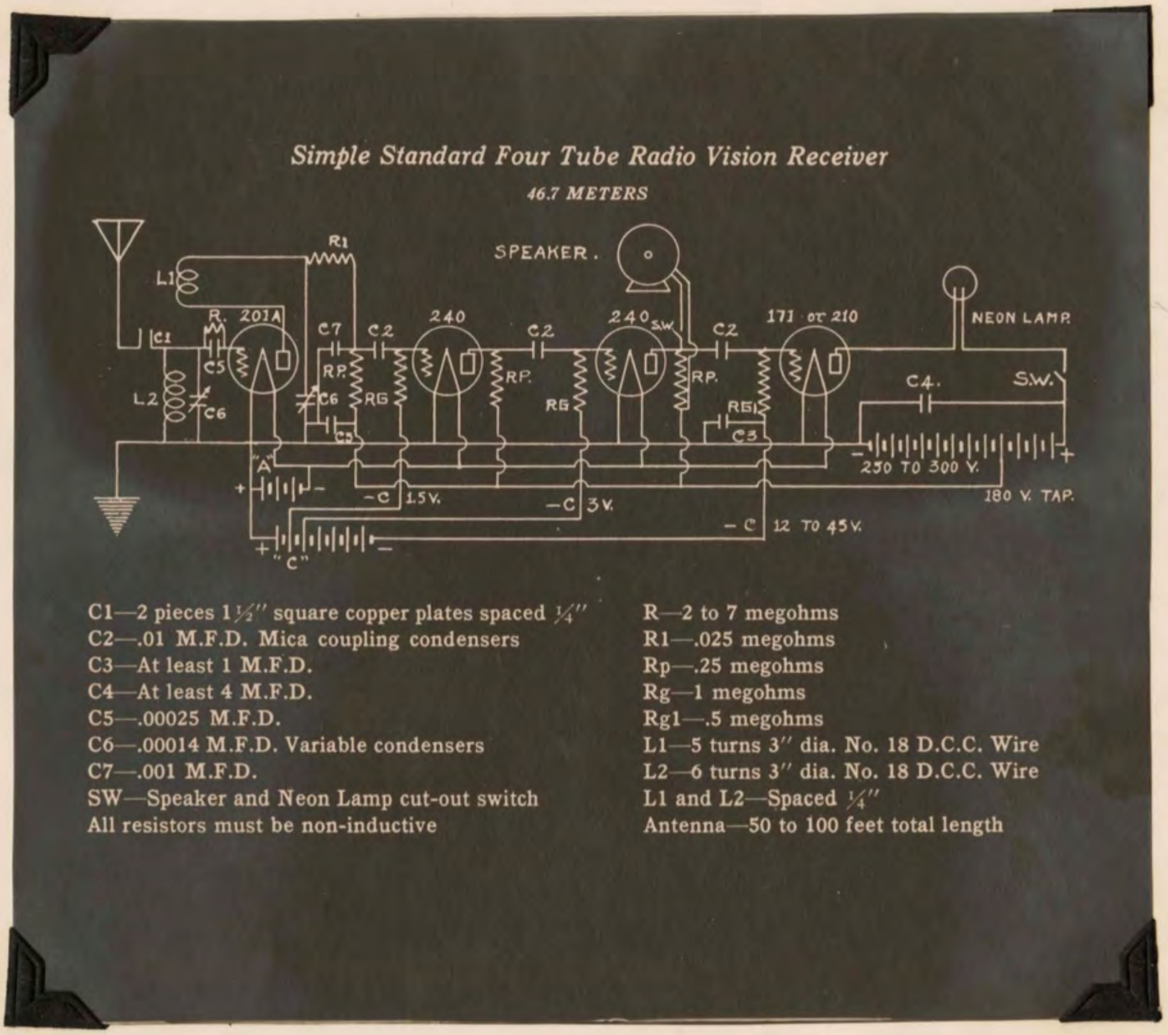


Dr. Jenkins made his first laboratory demonstration of Radio Vision and Radio Movies on June 14,1923 before a very distinguished gathering of guests(See visitors list).

VISITORS

Grace Coolidge
John Coolidge
Calvin Coolidge Jr.
Mrs. F. W. Stearns
Mary Vaux Walcott
Mary Roberts Rinehart
Mrs John Hays Hammond
C. D. Walcott
Cap'n J. P. Ault
Vernon Kellogg
Marlen E. Pew
J. McK. Cattell
Edwin E. Slosson

Orville Wright
James L. [illegible]
Paul Henderson
W. B. Mayo
Walter Hinton
R. R. [illegible]
W. G. McAdoo
Margaret Oliver Holmes
Burton Holmes
Wing Commander [illegible] Christie
Gelasio Caetani
Geo. H. [illegible] Jr.
Isaburo Yoshida

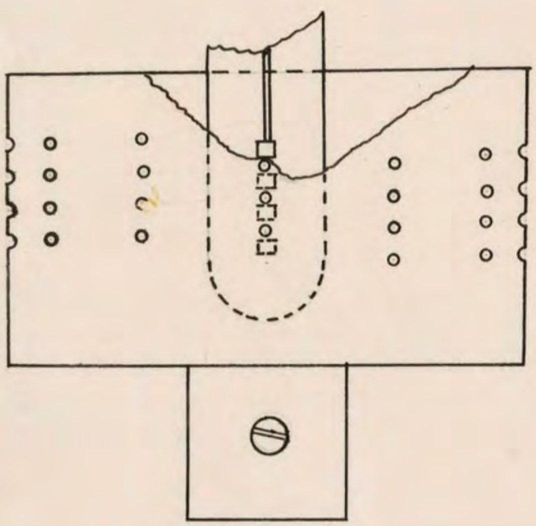
VISITORS

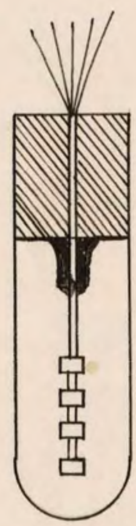
Geo. R. Robinson
O. H. Caldwell
Sam Pickard
Harold A. Lafount
D. B. Davis
W. D. Terrell
George Brown
H. M. Turner
Lee de Forest
Emile Berliner
Lloyd V. [illegible]
Mrs. Roger W. Babson
M. H. [illegible]

[illegible]
W. A. Moffett
J. J. Tompkins
D. W. Taylor
S. S. Robison
S. C. Hooper
H. J. Ziegemeier
A. Hoyt Taylor
Geo. O. Squier
Cmdr. Saltzman
Major J. O. Mauborgne
Général Ogata
Gabriel W. Ferrier

HELICAL DRUM SCANNER

With the disc scanner the minimum separation of the aperatures determines the width of the picture and as the picture is square the aperture separation also determines the off-set of the ends of the spiral. In order to have a picture 2 inches square a 36 inch diameter disc is required and 6 foot diameter disc for a 4 inch picture. In order to have a picture of reasonable size with apraratus of small dimensions he developed the Helical Drum Scanner.





FOUR TARGET CATHODE-GLOW NEON LAMP.

HELICAL DRUM SCANNER

In the peripheral wall of the drum 48 holes are drilled. There are four helical turns of 12 holes each. Each hole being spaced 2 inches apart circumferentially and the helical turns being ½ inch apart. In the middle of the drum there is placed a 4 target cathode-glow neon lamp. Between the lamp and the perphery of the drum are small quartz rods, each rod ending

its particular minute aperture in the peripheral wall. These quartz rods used as they have the property of conducting light through it with a very small loss. The cathode targets are placed one under each of the rows of quartz rods and are lighted in succession through a commutator, by the plate current of the power tube of the receiver. Each helical turn of the scanning apertures is lighted independently by its own particular glowing target, which results in a great economy of current required for lighting the entire picture.

A seven inch diameter drum of this type will give a picture 2" X 2" which may be magnified to 6" X 6" and from four to five people may watch it. A 10½ inch drum will give a picture four inches square which may be magnified to a picture 10 inches square. The photograph shows how the drum receiver may be used in the home.

Dr. Jenkins operates radio station W3XK at Wheaton, Md. which operates on a wavelength of 46.7 meters. He broadcasts radio movies from this station on a regular schedule.

JENKINS RADIO MOVIE TRANSMITTER W3XK, AT WHEATON, MD.

PLATE RECEIVER

The disc-scanning receiver, with 48 aperatures in the spiral on the disc, has a current-to-eye efficiency of less than one fifty thousanth of one percent. This low effiency is due to the fact that each elementary area light source should be as large as the whole picture and that persistence of vision of the eye is not depended upon for an assembly of the elementary areas of the picture.

Theoretically there should be no more light current than is needed to light a single elementary area at the time considered and a real picture should exist in the receiver whether there is a human eye to see it or not; that is, it should be possible to photograph the received picture with a snap shot camera which cannot be done with the lens disc scanner.

The plate receiver satisfies both of these conditions and consists of a picture plate divided into 2,304 elementary areas. This may be built by having 48 horizontal rows of flash light bulbs with 48 bulbs in each row. These lamps are divided, electrically into four groups and each lamp is individually wired to its particular contact of the switching gear. All the lamps in each group have a common return.

The switching gear consists of a commutator having four separate sections, one for each group of lamps. A 3,600 RPM ½H.P. synchronomous motor is used to drive the commutator

In operation, the incoming radio signals are distributed to the several lamps in succession and the lamps are lighted according to the intensity of the signals. The result is a picture 2 feet square made up in lights and halftone and shadows. The picture is made up of the glowing lamps which persist in light value for the appreciable time of about one tenth of a second. As the impulse to each lamp is every one-fifteenth of a second the lamp is glowing for the whole time the corresponding elementary area of the scene at the broadcasting station is alight. That is to say, persistence of light is used instead of persistence of vision as in the Lens-disc and drum receiver. Another advantage of the system is that the light color is white and not the pinkish color of a neon light.

As nearly all such systems are reversible, an excellent transmitter may be made by reversing the system, using light sensitive cells in place of the lamps.

BIBLIOGRAPHY

Vision by Radio, Radio Photographs and Radio Photograms. Published by Jenkins Laboratories, Inc. in 1925.

Radiomovies, Radiovision and Television. Published by Jenkins Laboratories, Inc., in Feb 1929.

Various short articles and sketches from time to time in the Electrical Engineer, Motion Picture News, Popular Radio, Radio News, Newspaper articles, etc., beginning in 1894.

DEPARTMENT OF COMMERCE
OFFICE OF THE SECRETARY
WASHINGTON

February 1,1924.

Mr.C.Francis Jenkins,
1519 Connecticut Avenue,
Washington,D.C.

Dear Mr.Jenkins:

I wish to express my appreciation for the photograph which you so kindly sent me. It represents a very startling development in radio and sometime when I have some leisure I would be interested in discussing the method with you.

Yours faithfully,

Herbert Hoover

WILLIAM JENNINGS BRYAN
VILLA SERENA
MIAMI, FLORIDA

July 29,1924.

Mr.C.Francis Jenkins,
1519 Connecticut Avenue,
Washington,D.C.

Dear Mr.Jenkins:

I thank you for the Radio Photograph--it is wonderful! What is there left to be discovered?

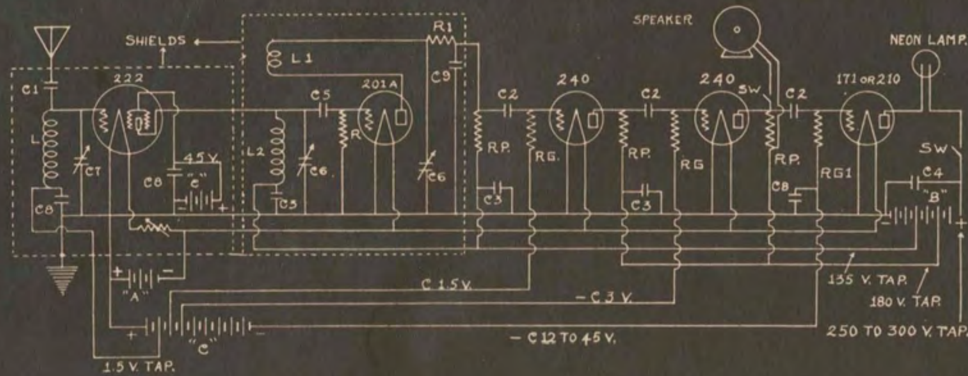
Appreciating your friendly interest, I am,

Very truly yours,

W. J. Bryan

Ideal Radio Vision Receiver Using Standard Parts

6420 K. C.



C1—2 pieces 1½″ square copper plates spaced ¼″
C2—.01 M.F.D. Mica coupling condensers
C3—At least 1 M.F.D.
C4—At least 4 M.F.D.
C5—.00025 M.F.D.
C6—.00014 M.F.D. Variable Condensers
C7—.00014 M.F.D. Variable Condensers
C8—At least .01 M.F.D.
C9—.001 M.F.D. Mica Condenser
Antenna—50 to 100 feet total length
SW—Speaker and Neon Lamp cut-out switch

"All resistors must be non-inductive"
R—2 to 7 megohms
R1—.025 megohms
Rp—.25 megohms
Rg—1 megohms
Rg1—.5 megohms
L —6 turns 3″ dia. No. 18 D.C.C.
L1—5 turns 3″ dia. No. 18 D.C.C.
L2—6 turns 3″ dia. No. 18 D.C.C.
L1—and L2—Spaced ¼″
UX-222—Requires only 3.3 volts on filament

July 31, 1928. | C. F. JENKINS | 1,679,086

SPIRAL MOUNTED LENS DISK

Filed Jan. 2, 1925

Fig 1

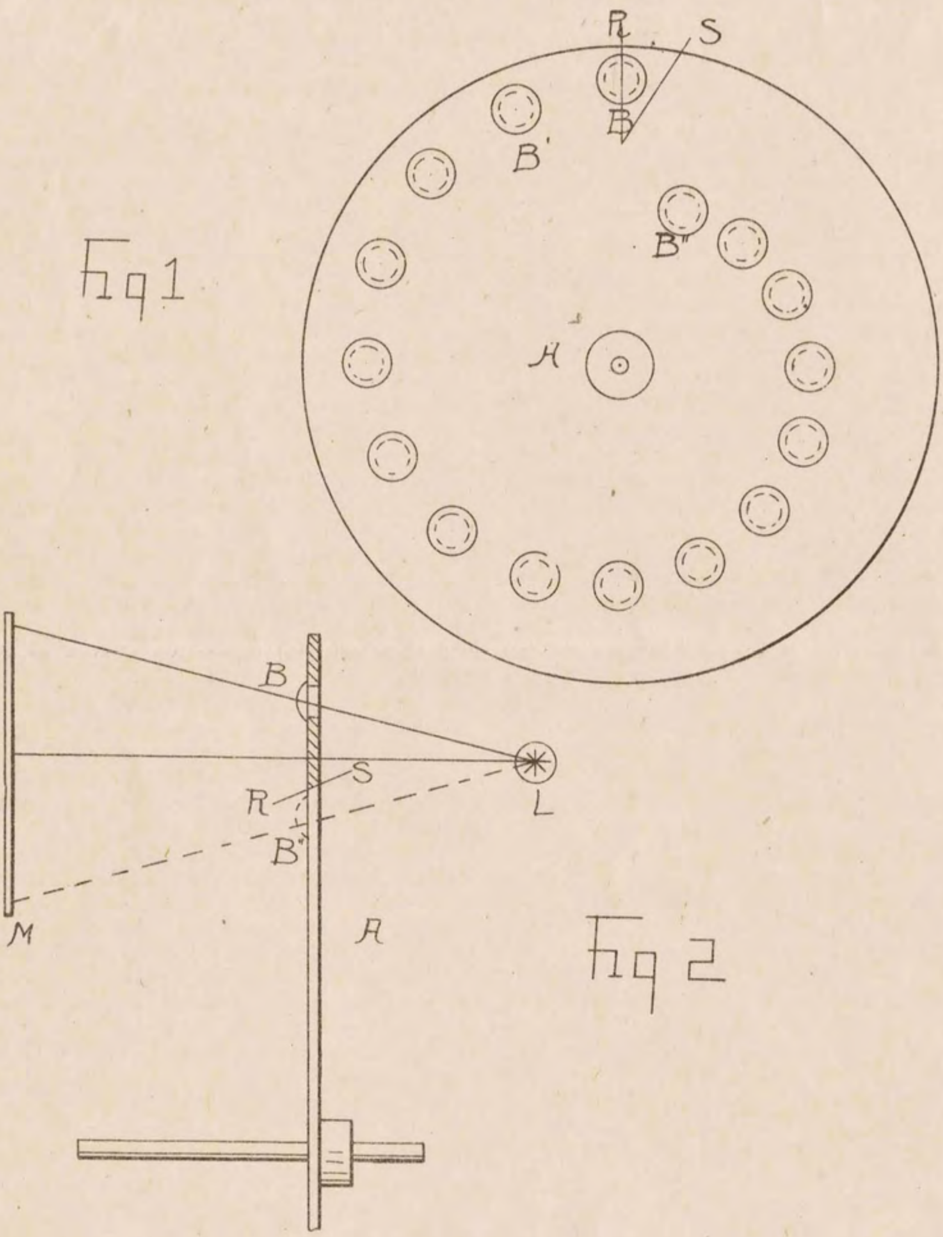


Fig 2

Inventor

C. Francis Jenkins.

Witness:

Sybil L. Almand.

Patented July 31, 1928. 1,679,086

UNITED STATES PATENT OFFICE.

CHARLES FRANCIS JENKINS, OF WASHINGTON, DISTRICT OF COLUMBIA.

SPIRAL-MOUNTED LENS DISK.

Application filed January 2, 1925. Serial No. 222.

This invention relates to apparatus for the transmission of pictures by radio, in which the picture is made up of lines across an approximately flat surface, said lines having varying values.

The principal object of this invention is the design of a simple device which permits of a speed which will cover the entire picture surface within the time of persistence of vision, say, one-twelfth or one-sixteenth of a second.

With these and other objects in view the invention consists of the novel details of construction and combination of parts more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawing forming a part of this specification, Figure 1 is a front view of the lens-carrier disk, and Figure 2 a schematic drawing showing how it is employed.

In the drawing A is a disk with a plurality of spirally arranged holes therein, over each of which a lens is mounted, as B, B′, B″, etc. The disk is intended to be rotated between a spot-source of light L, and a picture surface or screen M, shown edge on.

When the lens B is in front of the light the image of the source strikes the screen near the top, as shown in full line; when the lens B″ is in position to project, the image will appear on the picture surface near the bottom, as indicated by the dotted line; when other lenses come into position to project, the images fall in successively different positions between these extremes.

It will readily be understood that the rotation of the disk would cause the lenses to travel across the screen from side to side; while the location of the lenses at different radial distances from the axis makes the lateral trips of each lens at different levels, so that the whole picture surface is scanned.

It will also be understood that the disk-mounted lenses could just as well scan a picture surface to be sent as they scan a screen upon which the picture is put, without departing from the spirit of my invention.

What I claim, is—

1. In combination, a stationary picture surface, a stationary light translating element, a rotatable disk interposed between said surface and said element, said disk being provided with a plurality of apertures of large dimensions as compared with an elementary area of the picture surface, and a spherical lens mounted in each aperture for imaging the picture surface and the light translating element each upon the other, said apertures and lenses being so arranged that upon rotation of the disk the lenses pass successively between said surface and said element, and successive images of the light translating element traverse the picture surface by adjacent parallel paths.

2. In combination, a stationary light translating element, and a scanning device consisting of a rotatable disk interposed between the said element and a plane to be scanned, said disk being provided with a plurality of apertures of large dimensions as compared with an elementary area of the scanned plane, and a lens mounted in each aperture, said apertures and lenses being so arranged that upon rotation of the disk the lenses will pass between said plane and said element and successive images of the light translating element traverse the plane by adjacent parallel paths.

In testimony whereof I have affixed my signature.

CHARLES FRANCIS JENKINS.

Oct. 8, 1929. C. F. JENKINS 1,730,976

HELICAL DRUM SCANNER

Filed June 13, 1928

Fig 2

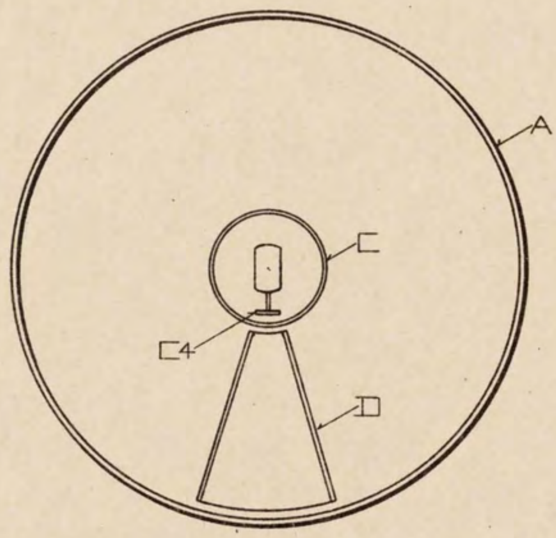


Fig 1

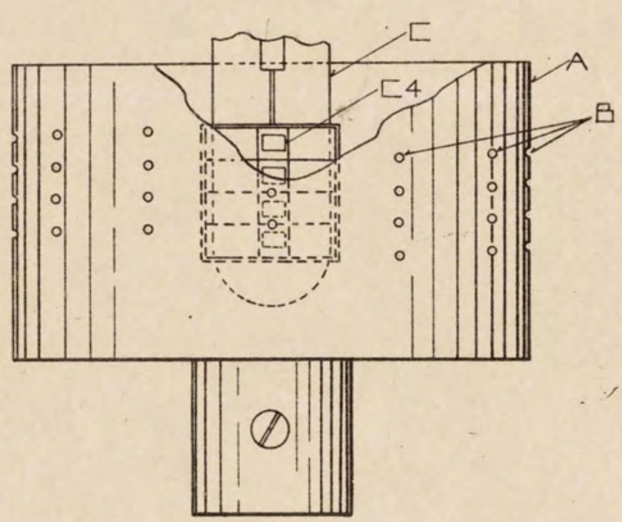
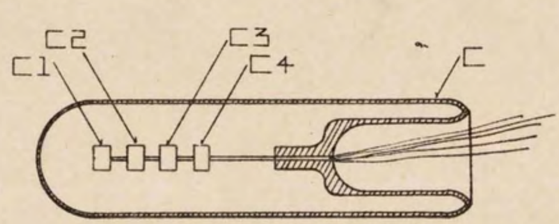


Fig 3



Inventor

Charles Francis Jenkins

Sybil L. Almand. By

Attorney

Patented Oct. 8, 1929 1,730,976

UNITED STATES PATENT OFFICE

CHARLES FRANCIS JENKINS, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO JENKINS LABORATORIES, OF WASHINGTON, DISTRICT OF COLUMBIA, A CORPORATION OF THE DISTRICT OF COLUMBIA

HELICAL DRUM SCANNER

Application filed June 13, 1928. Serial No. 285,015.

This invention relates to radiovisors, i. e., apparatus for the reception of motion pictures broadcast by radio, and has for its principal object simple, inexpensive apparatus of small size, and producing a relatively large picture of superior quality.

Heretofore the generally employed method for the reception of radio vision, radio movies, or television, has consisted of a large rotating disc with a plurality of scanning holes therein arranged in a spiral. Such a mechanism is limited by the dimensions of the apparatus itself, for example—

Assuming 48 lines to the picture, a scanning disc two feet in diameter produces a picture but one inch square. For a picture two inches square with the same number of lines per picture, requires a disc four feet in diameter, and an enormous increase in the power of the motor required to drive it at speed, an increase equal to the ninth power of the increase in speed. Reduced to merchandising terms, this means a device impractical for use in the average home.

A still further limitation of the disc method of scanning is that the whole picture area of the surface scanned is lighted simultaneously, and, therefore, requires a radio power amplifier (many times greater than a method which consists of but a small glow area). This power amplifier required still further limits the acceptability of the apparatus for the average home, for it cannot be attached to the usual two-stage amplifier radio set.

The employment of a drum as the scanning means, as provided in the present invention, is without the limitations cited above, for example, the picture may be increased by (1) an increase in the speed of rotation; and/or (2) an increase in the diameter of the drum; and/or (3) a lesser increase in both.

Among its further advantages, incident to the above, is that the scanning means is very light, with moderate peripheral speed, and, therefore, requires but a small motor.

The scanning apertures, in the drum method, are all equi-distant from each other, and, therefore, distortion due to varying spacing of apertures in the disc method, is entirely eliminated.

Also, with this drum method of scanning, each helical turn of the scanning apertures can be lighted independently by its own particular glowing target, which results in a great economy of current required for lighting the entire picture.

With this and other objects in view, the invention consists of the novel combination of elements herein described, illustrated in the drawings, and particularly pointed out in the claims.

In the drawings, Figure 1 is a top view of the drum; Figure 2 an end view thereof; and Figure 3 a sectional view of the lamp employed therewith.

In the figures, A is the scanning drum; B the scanning apertures therein arranged in a four-turn helix; C the lamp which encloses the glowing targets C^1, C^2, C^3, and C^4.

Between the lamp and the inner periphery of the drum lies a funnel structure D, divided by very thin partitions into four parts or sections. The small end of each section of this multiple funnel structure lies over its particular glowing light target.

The larger end has an opening in length equal to the circumferential separation of the scanning apertures, and a width equal to the helical separation of the holes beginning and ending the helical turn.

Therefore, the light from each target is confined to the illumination of but a single helical turn of the scanning apertures. Again, as the mouth of the funnel is only as wide as the circumferential separation between any two scanning apertures, the result is that but a single aperture is illuminated at any one moment.

As the generally accepted method of scanning in receiving instruments is so well known to those skilled in this art, a description of the operation in meticulous detail is not believed necessary.

In general, however, the method consists, first, in turning the scanning drum as many times per picture as there are helical turns of the circumferential line of scanning apertures; second, lighting the glow targets or light sources one at a time in synchronism with each rotation of the drum, for example

NOTE: The material used in this thesis was obtained from Dr. C. Francis Jenkins himself; his secretary, Sybil Almand Windridge and the Patent Offices of B. Singer. The writer greatly appreciates their kind help and assistance.
