

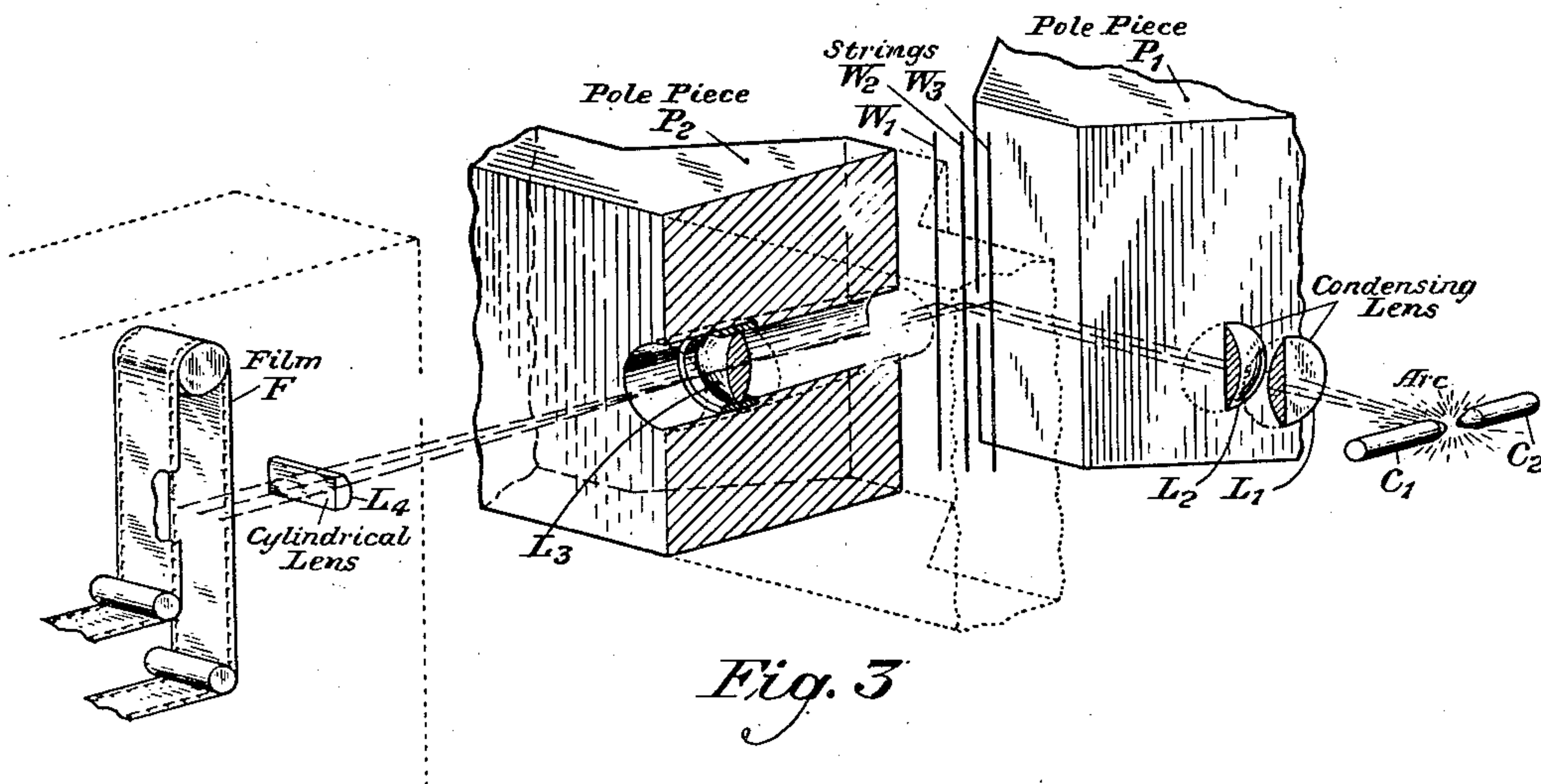
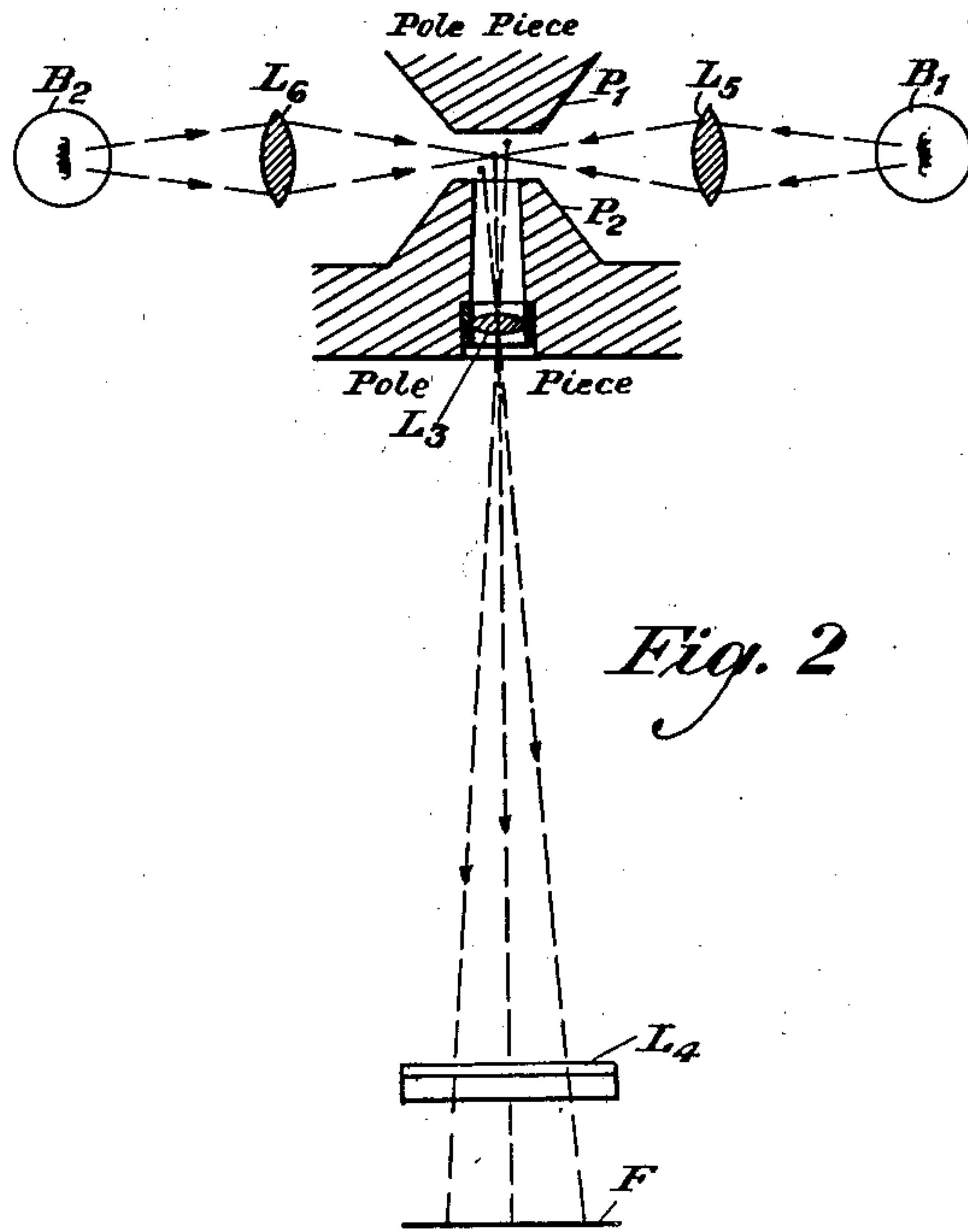
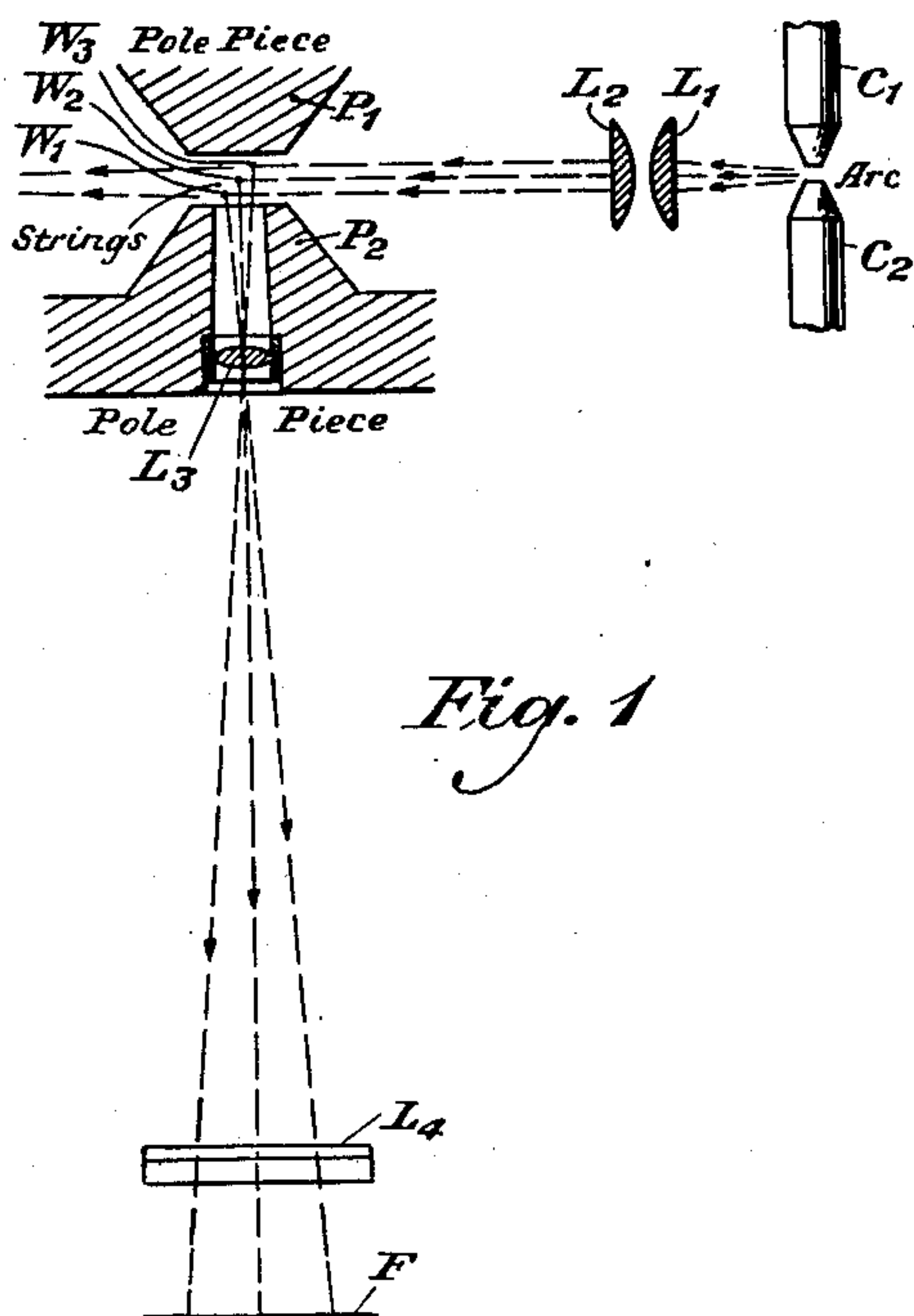
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OSCILLOGRAPHIC APPARATUS

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OSCILLOGRAPHIC APPARATUS

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13 Claims. (Cl. 234—61)

This invention relates to electrical measuring systems and apparatus. More particularly, this invention relates to oscillographic systems and apparatus for exhibiting the characteristics of electrical currents.

This invention discloses novel electrical apparatus suitable for obtaining a record of alternating current phenomena. The apparatus may also be used for recording so-called "envelope pictures" of the various currents obtained from a complex source. The properties required to make such records with the apparatus commercially sold as oscillographic instruments, have heretofore been obtainable only with great difficulty.

This invention will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing in which Figures 1 and 2 represent different embodiments of the invention, and Fig. 3 represents a perspective of the arrangement shown in Fig. 1.

Referring to Fig. 1 of the drawing, the reference characters W_1 , W_2 , and W_3 represent three strings or conductive wires which are placed between specially designed pole pieces P_1 and P_2 forming part of a powerful electromagnet, the windings of which (not shown) are supplied with direct current. The wires W_1 , W_2 , and W_3 are fastened at or near their ends so as to be quite taut, and moreover, they are spaced so as to be definitely insulated from each other. Furthermore, each of these wires may be used independently of the others, if desired, and these other wires will not interfere with the record to be taken. One form of apparatus employed successfully to effectively carry out the objects of this invention, used duralumin for the wires W_1 , W_2 , and W_3 . Each wire had a highly polished surface which was non-tarnishable and efficiently reflected light. In this apparatus each of the duralumin wires had a diameter of about .0008 of an inch.

Each of the wires W_1 , W_2 , and W_3 may be connected independently to an electrical circuit to be examined for its electrical characteristics. By virtue of the presence of the magnetic field produced by the electromagnet, any flow of current through each of the wires W_1 , W_2 , or W_3 will cause its mechanical vibration. Thus, if a sinusoidal current of some particular frequency, as, for example, 24 cycles or 60 cycles or any other frequency which is much higher in the frequency spectrum, is transmitted through one of these wires, it will vibrate at the frequency

of the transmitted current, and of course, any complex current will produce a corresponding complex mechanical vibration. The wires W_1 , W_2 , and W_3 will vibrate in planes almost parallel to each other which are uniformly spaced between the faces of the pole pieces P_1 and P_2 during their vibration. The paths traversed by these wires while in vibration will be sufficiently spaced between the pole pieces of the electromagnet so as not to strike each other or otherwise interfere with their respective vibrations. Thus, the paths traversed by the vibrating wires will be fairly well defined and the distance between any one of these wires and the face of either pole piece will remain practically constant throughout vibration.

The reference characters C_1 and C_2 represent a pair of carbons which, when supplied with proper potential, produce a continuously lighted arc of considerable luminosity. This light is passed through a pair of properly mounted semi-convex lenses L_1 and L_2 (their mountings not shown), the lenticular portions of which face each other. The light emerging from these lenses will be composed of parallel rays which continuously pass between the pole pieces P_1 and P_2 . These rays of light will strike the surface of all of the wires W_1 , W_2 , and W_3 and the incident light will be definitely reflected at all times throughout their vibration. The reflected rays of light will then pass through and emerge from a cylindrical opening or aperture formed in the pole piece P_2 in which a convex lens L_3 may be properly mounted. The lens L_3 will pass somewhat convergent, although almost parallel, rays of light. It will be apparent that if all three wires W_1 , W_2 , and W_3 are in continuous vibration, the three almost parallel pencils of rays will sometimes overlap and occasionally pass each other.

Those rays of light emerging from the lens L_3 strike a cylindrical lens L_4 . A section of this lens taken perpendicular to the plane of the paper and perpendicular to the various reflected rays, will be rectangular. Moreover, one portion of the lens when viewed from either side, will be a segment of a circle. Such a lens will resolve the almost parallel lines emerging from the lens L_3 into very small spots approximating points. These points will have definite boundaries and they will be free from "ghosts" or stray spots which occur wherever there is secondary reflection. These concentrated spots of light will be impressed upon a film F which may move at some predetermined speed. Thus, this arrange-

ment may be employed to exhibit either temporarily or permanently the properties of alternating currents on a slow moving film.

On the drawing, the rays of light which emerge from the lens L_3 are indicated as being almost parallel after passing through the lens L_4 . Actually the lens L_4 does not change the direction of the rays in the plane shown on the drawing; it causes them to converge in a plane perpendicular to that shown on the drawing.

It will be understood that a pair of carbons suitable to form an arc is not an indispensable lighting medium for carrying out the principles of this invention. Other light producing media, as, for example, an incandescent lamp, may easily be substituted therefor without departing from the spirit or scope of this invention.

Fig. 2 of the drawing shows another arrangement for utilizing reflected light in permanently recording the characteristics of electrical phenomena. A good economical and readily adjustable means of illumination is provided by two lamps B_1 and B_2 both of which project light between the pole pieces P_1 and P_2 upon the wires W_1 , W_2 , and W_3 from opposite directions, this light passing through the convex lenses L_3 and L_4 , respectively. The lamps B_1 and B_2 are preferably so situated that their filaments lie in planes perpendicular to the axis of lenses L_3 and L_4 .

The arrangement of lights and lenses shown in Fig. 2 illuminates with great intensity a small portion of each wire. The lines reflected by the various wires are projected through lens L_3 to the cylindrical lens L_4 which concentrates the reflected light into very bright images. By a proper choice of lenses and their spacing, each of the pencils of light impressed upon the cylindrical lens L_4 may be arranged to be less than one-half inch long. The lens L_4 will condense these small lines or pencils into tiny spots of considerable luminosity. Very little light is lost, and therefore the necessity for a high powered arc as shown in Fig. 1, is clearly obviated. The two lamps B_1 and B_2 have been found to give sufficient luminosity so as to permit "envelope pictures" to be taken properly.

Fig. 3 of the drawing shows a perspective of the apparatus forming the arrangement shown in Fig. 1. The lighted arc formed by applying suitable potential to the carbons C_1 and C_2 is converted by the semi-convex condensing lenses L_1 and L_2 into parallel rays. These parallel rays pass between the pole pieces P_1 and P_2 and continuously strike the wires or conductors W_1 , W_2 , and W_3 which are supplied with currents of unknown characteristics. The wires or conductors W_1 , W_2 , and W_3 are in simultaneous vibration and light reflected by them passes through a cylindrical aperture formed in the pole piece P_2 . A convex lens L_3 may, if desired, be placed in this aperture and the proportions of this lens will aid in determining the length of the pencils of rays reaching the cylindrical lens L_4 . The lens L_4 will concentrate the emergent pencils of light into highly concentrated spots which may be considered as points. These will be impressed upon the moving film F and thereby become properly recorded.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit

of the invention and the scope of the appended claims.

What is claimed is:

1. The combination of a light-reflecting conductor carrying current and vibrated in accordance with the frequency of that current, a source of light incident upon said conductor, and means for exhibiting only the light reflected by said conductor.
2. The combination of a plurality of closely spaced current-carrying conductors insulated from each other, means for independently vibrating said conductors in parallel paths, means for impressing light uniformly upon said conductors as emanated from a direction substantially coincident with the paths of said conductors, said conductors being positioned diagonally with respect to the light path, and means for exhibiting only the reflected light.
3. The combination of a source of light, a surface for receiving light impressions, a highly polished current-carrying vibratory conductor out of alinement with said source and said surface, and means for passing only the light of said source reflected by said conductor to the surface.
4. The combination of an electromagnet, a current-carrying vibratory wire having a highly polished surface placed between the pole pieces of the electromagnet, a source of light adjacent to said wire, and means for exhibiting only the light impressions reflected by the surface of said wire.
5. The combination of an electromagnet having two pole pieces one of which has an aperture, a plurality of closely spaced vibratory wires mounted so that each will remain uniformly spaced between said pole pieces during vibration, a source of light projected between said pole pieces so as to impinge equally upon all of said wires, said wires being positioned on a line diagonal to the rays of the light, and means for receiving only light reflected by said wires through said aperture.
6. Electrical apparatus comprising a bi-polar electromagnet, one pole piece of said electromagnet having an aperture, a wire having a highly polished surface mounted between the pole pieces of said electromagnet so as to be freely vibratory, a source of current to be examined which is connected to said wire, a source of light impressed upon said wire the reflection of which emerges from said aperture, and means for exhibiting the vibrations of said wire as determined only by the reflection of light incident upon said wire.
7. The combination of a light-reflecting vibratory member carrying current to vibrate said member and means for exhibiting only light reflected by said vibratory member.
8. The combination of a current-carrying conductor having a polished surface, means for vibrating said conductor in accordance with the current carried thereby, and means for manifesting and exhibiting only the light reflected by the surface of said conductor while in vibration.
9. Apparatus for recording the vibrations of a current-carrying conductor having a highly polished surface and located between the pole pieces of an electromagnet comprising means for continuously impressing light upon a portion of the vibrating conductor and means for exhibiting only the reflected light.
10. Apparatus for recording electrical variations with a highly polished conductor placed in a magnetic field comprising means for transmitting the electrical variations through the conductor

so as to cause its vibration, means for impressing light upon said conductor, and means for receiving only the reflected light.

5 11. Apparatus for recording the characteristics of an electrical source with a conductor having a highly polished surface and placed near a source of light including means for vibrating the conductor toward and away from the incident light, and means for exhibiting only the light reflected
10 by the conductor.

12. Apparatus for recording the current characteristics of a source including an elongated vi-

bratory member having a highly polished surface coupled to the source, means for impressing light upon said member, and means for exhibiting only the light reflected by the member.

13. Recording apparatus including a current-
5 carrying, light-reflecting conductor vibrating in accordance with the characteristics of an electrical source, and means for manifesting only the light positively reflected by the conductor to the
10 exclusion of all other light.

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