

Dec. 23, 1941.

W. O. BENNING

2,267,319

COLOR GRADING APPARATUS

Filed June 10, 1940

2 Sheets-Sheet 1

Fig. 1.

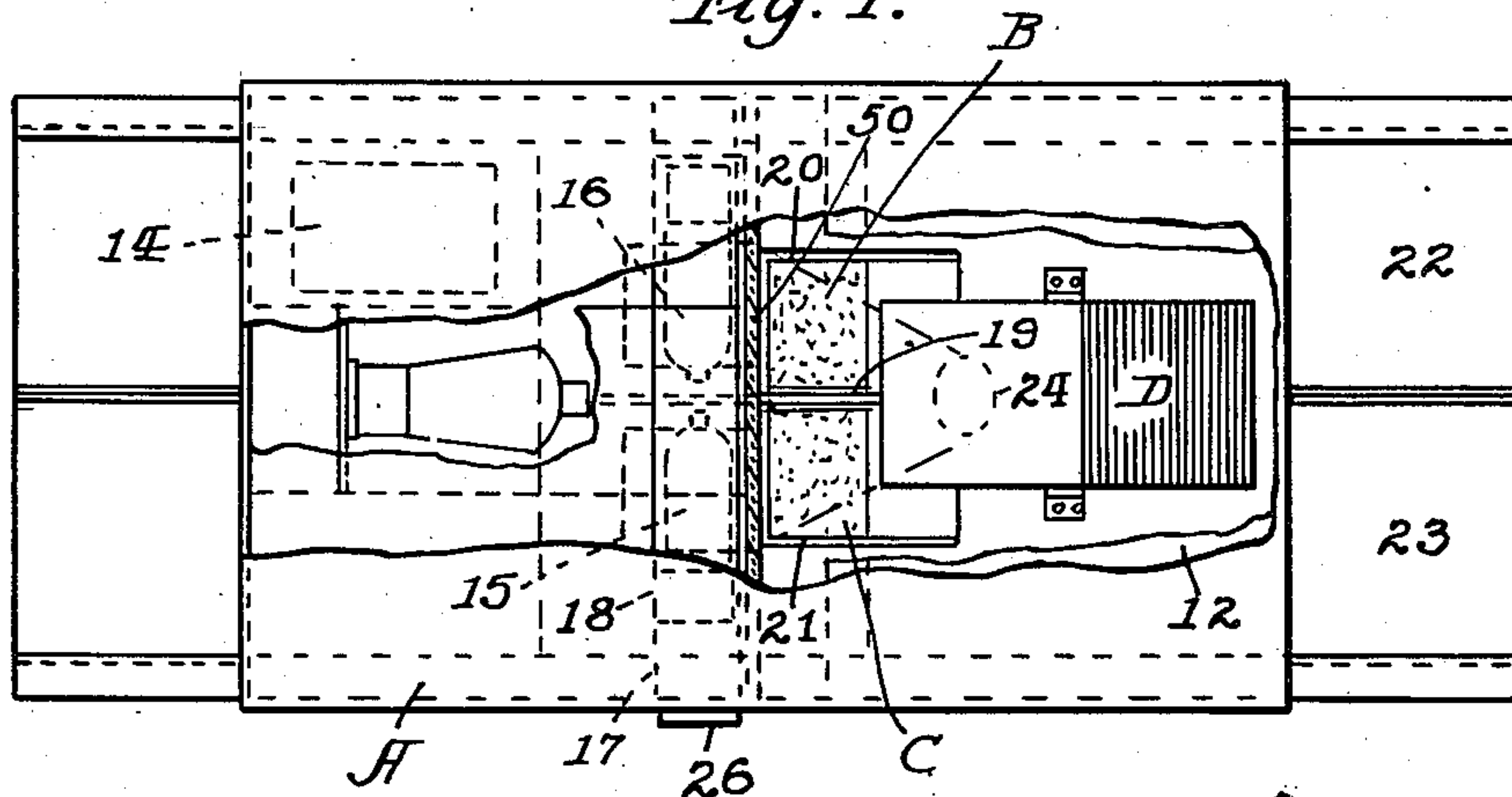


Fig. 2.

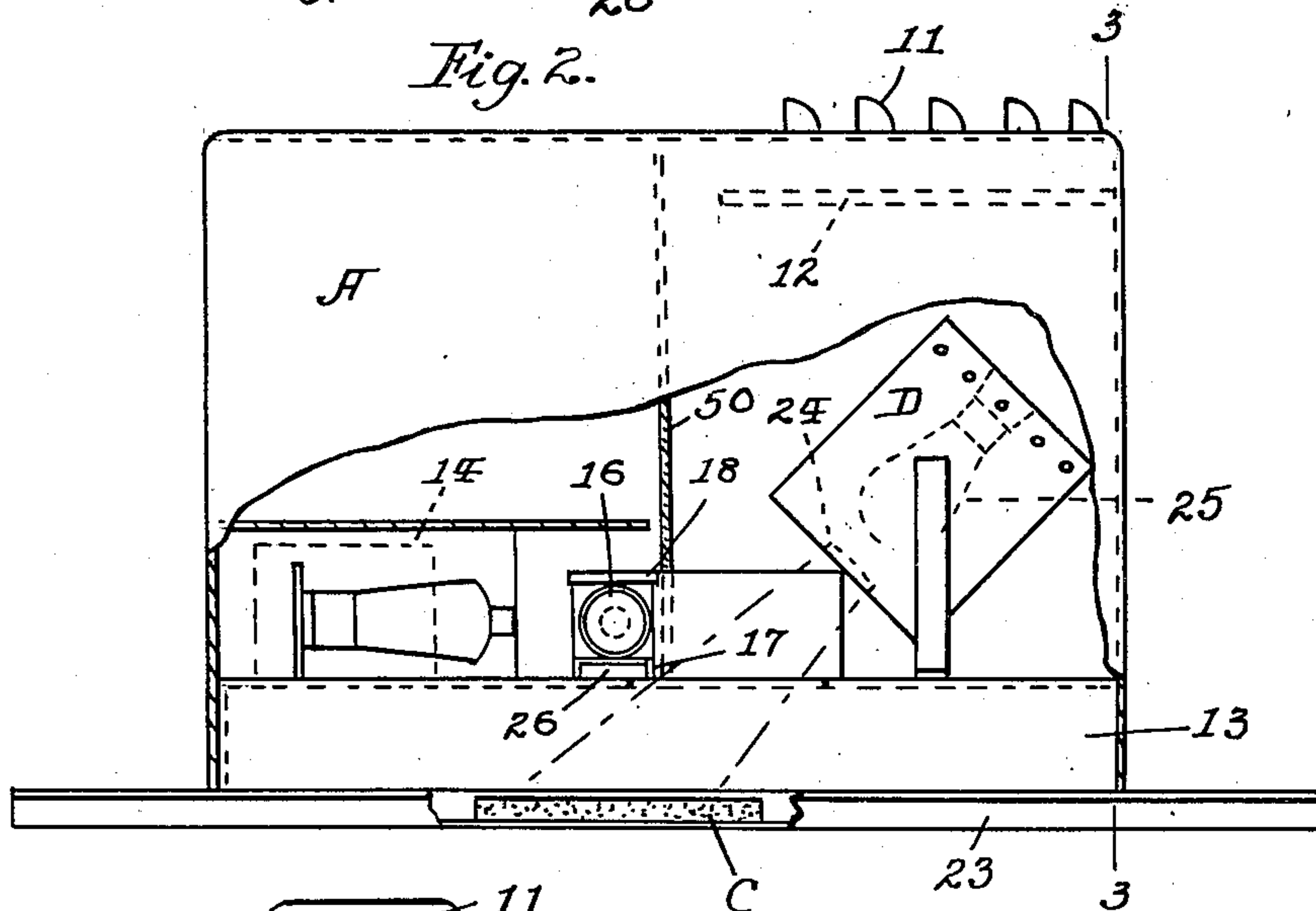
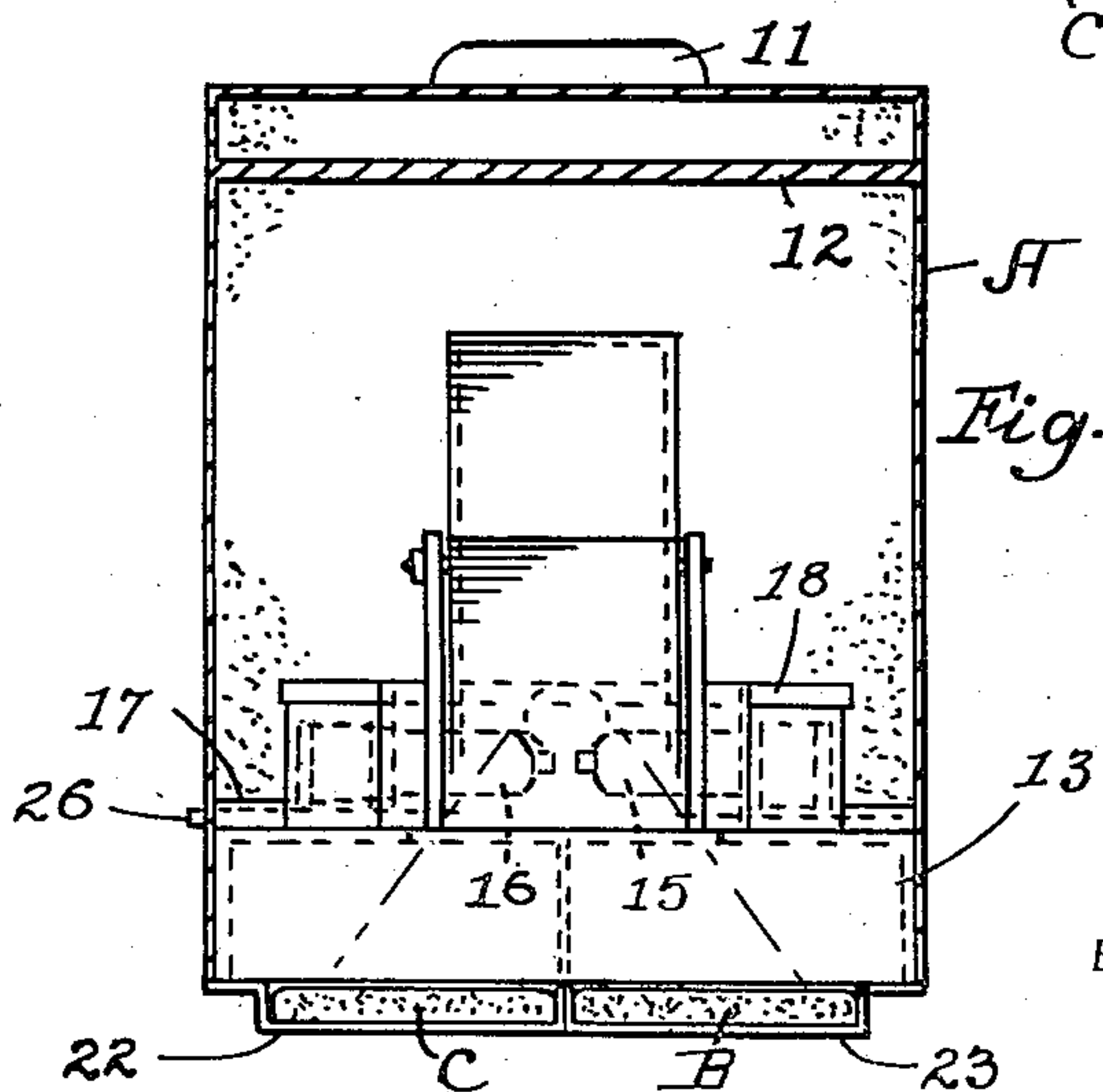


Fig. 3.



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Fig. 4.

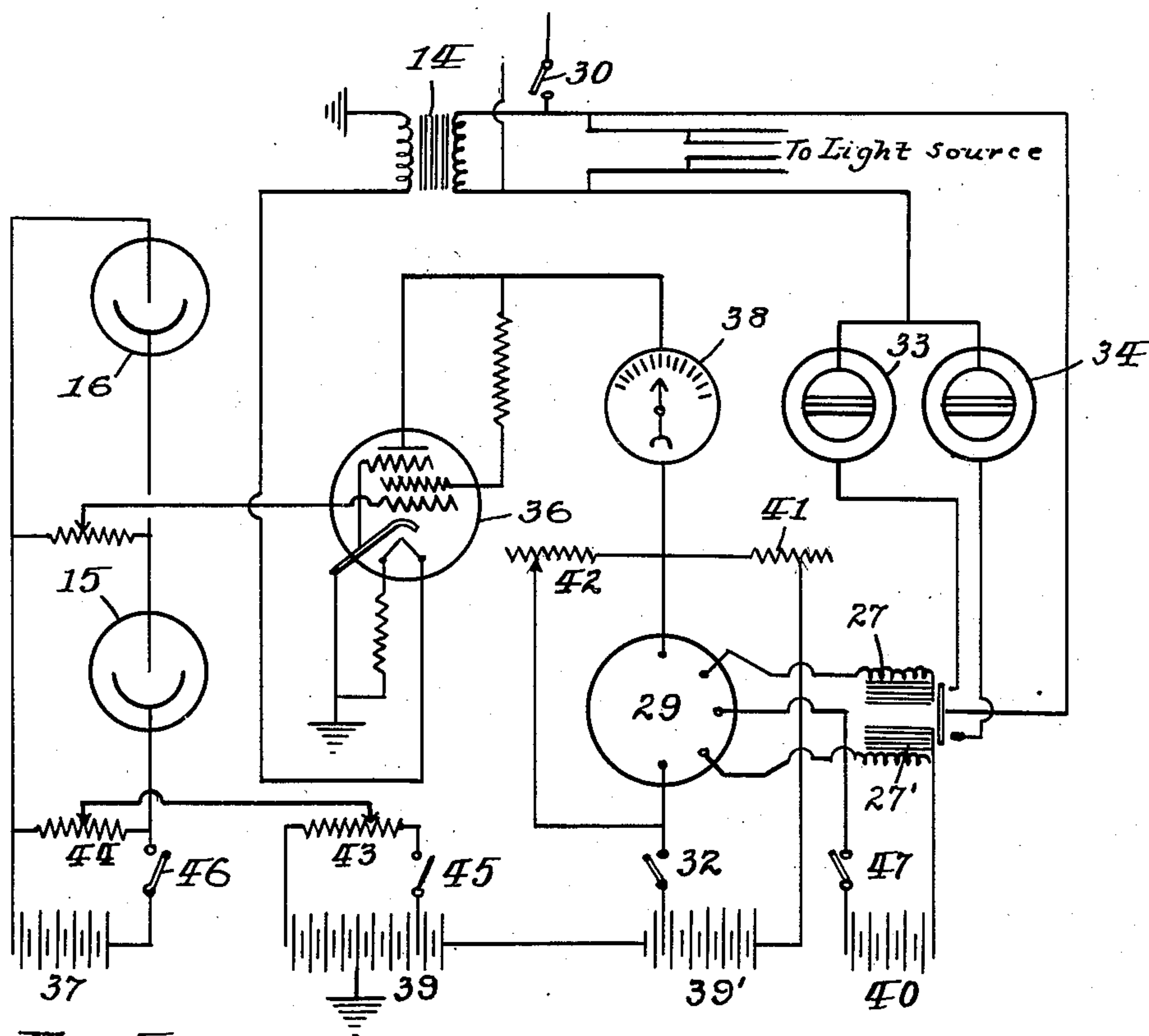
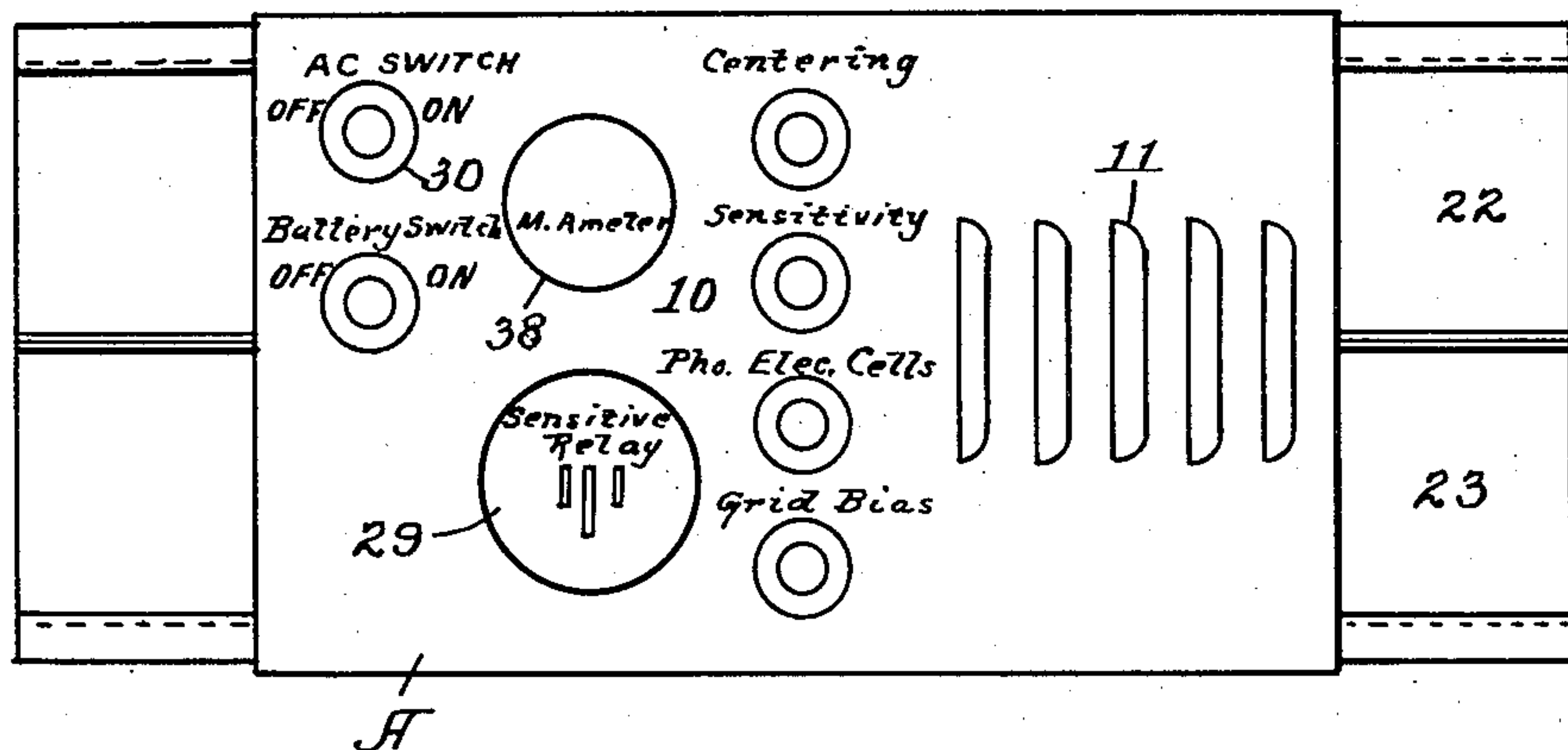


Fig. 5.

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UNITED STATES PATENT OFFICE

2,267,319

COLOR GRADING APPARATUS

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Application June 10, 1940, Serial No. 339,626

1 Claim. (Cl. 88—14)

My invention relates to improvements in color grading apparatus and more particularly to a light sensitive device for measuring, sorting or grading articles according to their differences in intensity of color or shade, where such articles are required to be of a uniformity of shade of a certain color, as compared with a standard. In the following disclosure of my invention I have shown and described my improvements as applied to tiles but it will be understood that it is equally applicable for measuring, sorting or grading other articles according to their differences in intensity of color or shade, within the spirit of the invention.

Among the objects of my invention is the production of an apparatus of its kind by which comparisons of shade can be made rapidly and in which adjustments can be easily made and are simple in construction. Another object is the production of apparatus by which persons entirely unskilled in the matching of colors or in handling or operating mechanical or electrical devices can easily and efficiently operate the device. Another object of this invention is greater simplicity of the component parts and the absence of optical systems, lenses, prisms and mirrors, as used between the initial light source and the tiles or other articles to be measured or compared. Another object is the housing of the light sensitive cells in such a way that no extraneous light can influence their action or balance, other than from the tiles or articles under measurement or comparison. Another object is the production of an apparatus for the grading of shades of color wherein the human element of error is entirely eliminated when once the allowable tolerance has been set. Another object is an apparatus in which the tiles or articles to be graded can be fed to their position below the opening or window below the light sensitive cells, manually or by slight modification, mechanically and automatically. Another object is to provide a simple, accurate and dependable color or shade matching device, wherein a single source of substantially white light is utilized whereby any fluctuation in line voltage will affect both light-sensitive cells equally. A still further object is to provide an apparatus which with slight modification is readily adaptable to comparison of oils or other liquids as to their clarity, or intensity of color, such as paints.

To these ends my invention comprises the features of construction and combinations of parts hereinafter described and claimed.

In the accompanying drawings forming part of

this specification, Fig. 1 is a top plan with a portion of the cover broken away; Fig. 2 is a side elevation with a portion of the cover and base broken away; Fig. 3 is a section taken on the line 3—3 of Fig. 2; Fig. 4 is a plan showing the arrangement of the instruments of the control panel; and Fig. 5 is a schematic diagram of one type of electric circuit employed.

In the following description it will be understood that changes can be made in the form, size, proportions and other details of construction, in order to adapt the invention to the individual requirements of the article or articles to be graded or sorted without sacrificing any of the advantages of the device.

In the drawings, A indicates the outside casing cover which is intended to contain the control panel 10 (see Fig. 4) and also the ventilating louvers 11 and a horizontal light baffle 12 below the louvers. The cover A telescopes over a base 13 which supports the step down transformer 14 and the pair of light sensitive cells 15 and 16 together with the transverse filter slide 17. These light sensitive cells are arranged transversely in horizontal alignment immediately above the filter slide. A suitable frame 18 mounted upon the base 13 serves to support the light cells. A longitudinal vertical fence or partition 19 is supported upon the base 13 between the lamp 25 and the light sensitive cells and divides the incident light from the lamp 25 (see Fig. 2) into two beams. The base 13 also contains two openings or windows 20 and 21 arranged side by side beneath one of which is placed a longitudinal and horizontal slide 22 and beneath the other the slide 23, said slides being adjacent to each other and parallel and being so shaped and adapted as to guide tiles such as B and C and any other articles of any suitable shape to be sorted and graded through the device, exposed to the influence of the light sensitive cells. These slides 22 and 23 in addition to guiding the tiles or articles longitudinally beneath the windows 20 and 21 exclude extraneous light.

Arranged in advance of the light sensitive cells and above the plane of the tiles in the slides is a ventilated lamp housing D, which contains a single lens 24 in its lower end and a single source of light which may be a single, concentrated filament prefocused incandescent lamp such as 25, arranged to direct its rays through the lens and on either side of the fence 19 down upon the surfaces of a pair of the tiles which are supported face upward in the guides or slides 22 and 23. A transverse partition 50 interposed between the

lamp housing D and the light sensitive cells 15 and 16 prevents direct light from impinging upon said cells from the lamp within said housing.

In using the device to determine whether one tile or article differs from another in shade or color, two articles or tiles of the same shade and color are used, one placed beneath each window, and the instrument or device balanced electrically. When once balanced, one tile or article after another may be run through one of the slides without any other adjustment being made, all other operations being automatic or semi-automatic. The other tile or article in the opposite slide remains permanently and is used as a "standard" with which the unknown tiles or articles must be balanced to determine even shade or color.

Suitable filters such as 26 may be placed in the filter slide 17, one beneath each light sensitive cell, to narrow the frequency band to substantially the same band as the articles to be sorted or graded. Two power relays 27 and 27' (see Fig. 5) are included in the photocell circuit and coupled with a sensitive galvanometer relay 29, the latter being placed on the service panel 10 of cover A within full view of the operator and by which the latter can determine the closeness with which the shade or color of each unknown tile or article matches the "standard" tile or article used in the apparatus. As the unknown tiles or articles pass under the corresponding window and are compared or measured, the power relay 27 or 27' immediately responds to influence the diversion of the article into its proper place according to its shade or grading, the diversion apparatus with which the power relay co-operates not being shown.

All parts within the casing are coated with non-reflecting black pigment, in order that any light rays that may be reflected on them will be absorbed and not reflected again, so as to impinge upon the light sensitive cells of the device.

Thus this device utilizes a plurality of light sensitive cells 15 and 16, a single light source represented by the lamp 25 to illuminate the tiles or articles to be graded or measured, a means of balancing the electric system according to the material or article to be graded or measured, and also a means of modifying the sensitivity to any degree of tolerance.

In this invention the measurement of direct reflection of light from surfaces of the tiles to be graded or measured is avoided, by allowing the light beams to fall on each tile at such an angle that the directly reflected light does not impinge upon the light sensitive cells but is reflected upon the black light absorbing walls of the interior of the case.

In general, to operate the apparatus, both the A. C. switch 30 and the battery switches 32, 45, 46 and 47 are turned on. Then identical samples or standards represented for illustration by similar tiles B and C are placed one beneath each of the windows 20 and 21 by sliding through the slides 22 and 23. The electric circuit is then balanced by the adjustment of the control 43, until the indicating arm on the sensitive galvanometer relay 29 is in the center or neutral position. The proper filter 26 for the particular shade of tile to be graded is next placed in the filter slide 17. Articles to be measured and sorted are then fed along the slide 23 and either compared or matched with the "standard" tile which is left stationary as a sample below window 20 above slide 22. The electrical circuit is cut by means

of a switch 32 until the tile or article is in proper position for measuring at which time the circuit is closed. Upon closing the circuit, the sample tile below window 21 is automatically measured.

Suitable sorting means may be cooperatively associated with the power relays or solenoids (not shown) for sorting according to the measurements already made. As shown indicating lamps 33 and 34 (see Fig. 5) are coupled into the circuit which is controlled by the relays 27 and 27' for aiding the operation by visual indication.

It is possible to utilize the scale on milliammeter 38 as a direct indicator of light intensities, or a specially designed or calibrated scale in which case the galvanometer is merely used to indicate when the circuit has reached a certain value, such as a balance or zero.

In Fig. 5, 30 indicates the main switch which disconnects the entire apparatus from the A. C. supply. 14 represents the step down transformer, the secondary winding of which supplies the proper filament voltage for the amplifier vacuum tube 36. Referring to the measuring, amplifying and indicating systems, 15 and 16 are the two light sensitive cells, which derive their potential from the battery indicated as 37, which latter is coupled to the input of vacuum tube 36, which is used as an amplifier, whose plate circuit feeds through an indicating device represented by 38; and also through a sensitive relay 29 which may operate suitable power relays represented by 27 and 27', from which any signal device or other actuating device may be operated. The grid bias and plate power for the amplifier tube 36 are supplied by batteries 39 and 39'. The solenoids of the power relays 27 and 27' are energized by battery 40. Variable resistance 41 acts as a balance for the sensitive relay 29. Variable resistance 42 acts as a sensitive control by shunting more or less current around relay 29. Variable resistance 43 regulates the grid bias of amplifier tube 36. Variable resistance 44 by varying the potential across the light sensitive tubes 15 and 16 sets the pointer of the indicating device 38 to a reference point. As varying intensities of light strike the light sensitive cells 15 and 16, the current varies, swinging the grid of tube 36 more or less negative, which in turn increases or decreases the plate current of tube 36, which plate current actuates relay 29, also indicating device 38, to the left or right, whichever variation is indicated, energizing one or the other of the solenoids of power relays 27 and 27'. Switches 32, 45, 46 and 47 control the current from the batteries leading to the several elements.

The manner of operating this invention is susceptible of wide variation, and while I have described a method of making measurements, it is to be understood that I am in nowise confined to this use alone or to the particular construction above described within the spirit of the invention and the scope of the claim following.

I claim:

A color and shade comparison apparatus, comprising, a cabinet having a base provided with a transverse pair of window openings, a pair of longitudinally disposed slides extending beyond the opposite ends of said cabinet to guide tiles in registration one below each window opening and having solid floors shielding the openings from extraneous light when tiles are removed, a source of light in the cabinet directed longitudinally down upon the tiles exposed through said window openings, a central longitudinal beam

splitting fence extending upwardly between said window openings, a pair of light sensitive cells disposed singly on opposite sides of said fence one being arranged above each of said window openings to receive reflected light from the surface of the respective tile exposed through said opening, said fence being arranged to prevent light which is reflected by the tile exposed through one window opening upon the companion light sensitive cell from impinging upon the op- 10

posite light sensitive cell, a frame shielding said light sensitive cells from extraneous light, and having filter receiving slides disposed beneath the cells and in the paths of the reflected light beams, and a differentiating bridge circuit connected with said cells containing means for indicating variations in electric current due to variations in the color of light impressed upon said cells.

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