

Feb. 20, 1940.

D. C. COX

2,190,935

SORTING MACHINE

Original Filed April 5, 1937

2 Sheets-Sheet 1

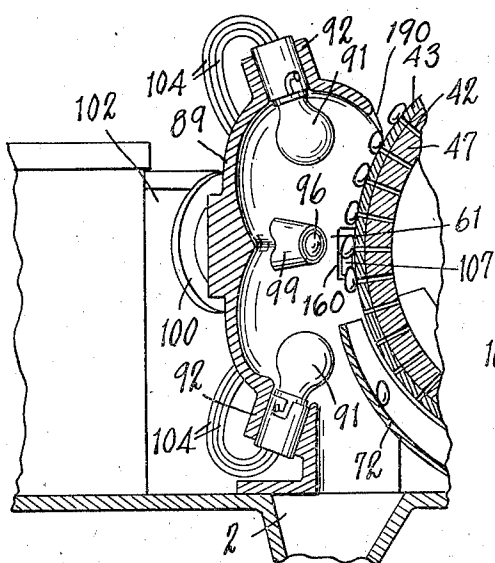


Fig. 1

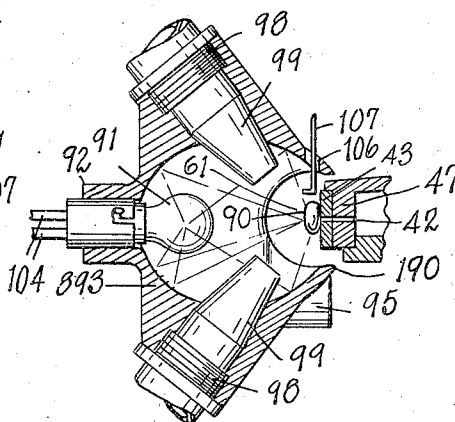


Fig. 7

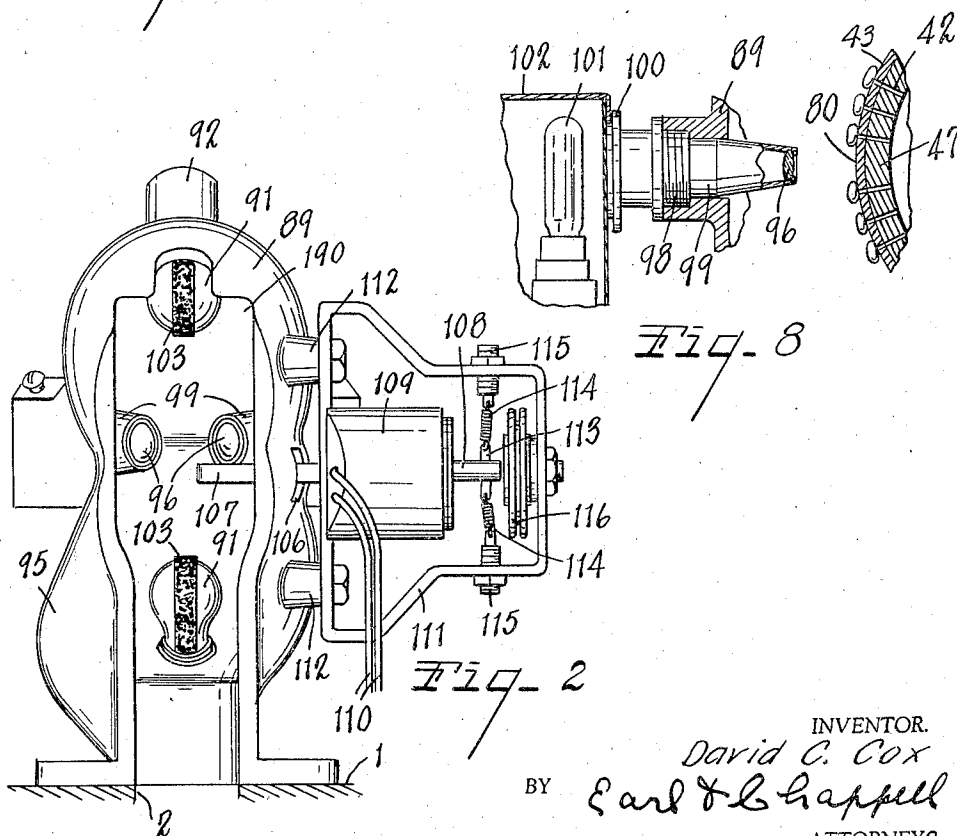


Fig. 2

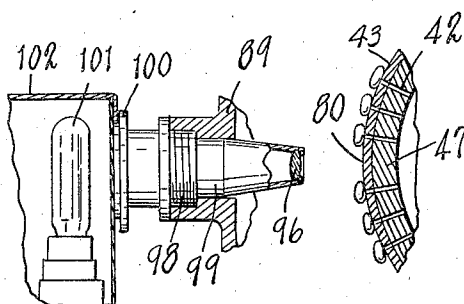


Fig. 8

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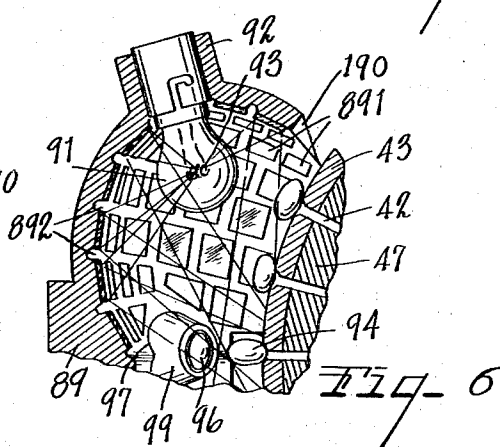
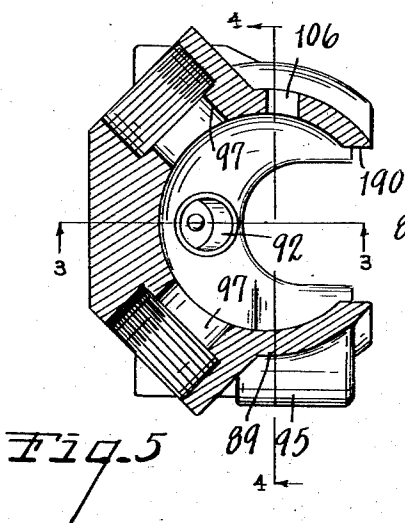
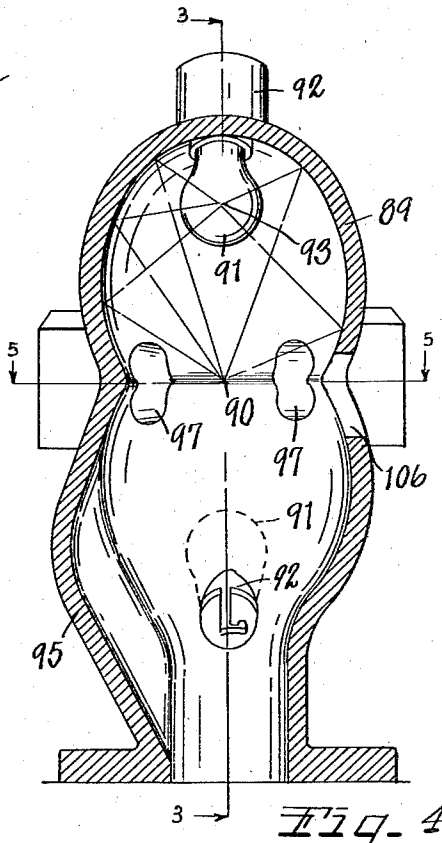
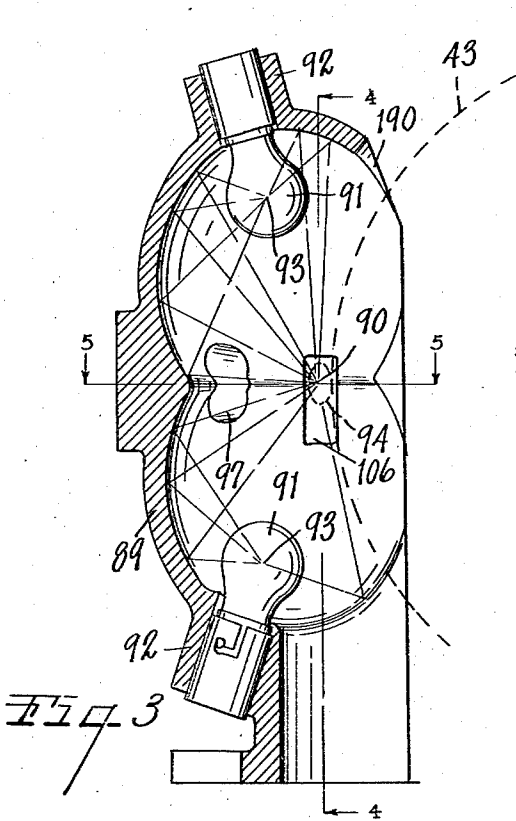
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SORTING MACHINE

Original Filed April 5, 1937

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,190,935

SORTING MACHINE

David C. Cox, Grand Rapids, Mich., assignor to
Electric Sorting Machine Company, Grand
Rapids, Mich.

Original application April 5, 1937, Serial No.
135,012. Divided and this application No-
vember 5, 1937, Serial No. 172,912

10 Claims. (Cl. 88-14)

This invention relates to improvements in elec-
tric sorting machines of the type disclosed in the
patent to Hanson No. 2,054,319, of September 15,
1936, and in my pending applications Serial No.
711,374, filed February 15, 1934, and Serial No.
49,727, filed November 14, 1935, and is a division
of my copending application Serial No. 135,012,
filed April 5, 1937.

The invention herein disclosed and claimed re-
lates particularly to the provisions for more per-
fectly illuminating a viewing field wherein a
photoelectric viewing means is mounted.

The main objects of this invention are:

First, to provide illuminating and photoelectric
viewing means for a sorting machine by which
the energization or failure of energization of a
photoelectric viewing means due to imperfect
lighting effects is entirely eliminated.

Second, to provide an improved housing for
lighting and photoelectric viewing means in a
machine of the type described, which is theo-
retically perfect in its results.

Third, to provide a lamp housing for illuminat-
ing a viewing field of improved construction.

Fourth, to provide a lamp housing of the type
described in combination with a conveyor where-
on articles are supported and brought within the
said lamp housing.

Fifth, to provide a housing in which illuminat-
ing means and photoelectric viewing means are
mounted, said housing being of theoretically per-
fect design, in combination with a conveyor
adapted to transport articles through said hous-
ing and into operative relation to said illuminat-
ing and viewing means.

Objects relating to details and economies of
the invention will appear from the description to
follow. The invention is defined in the claims.

Preferred embodiments of the invention are
illustrated in the accompanying drawings, in
which:

Fig. 1 is a fragmentary view partially broken
away and in vertical section, illustrating a ro-
tary conveyor associated with a lamp housing
and illuminating and photoelectric viewing means
therein in accordance with my invention.

Fig. 2 is an enlarged view in front elevation
of the lamp housing illustrating the illuminating
lamps and photoelectric viewing means in their
operative relation.

Fig. 3 is a view of my improved lamp housing
in transverse vertical section on line 3-3 of Figs.
4 and 5, the position of the illuminating con-
veyor and objects carried thereby being indicated
in dotted lines.

Fig. 4 is a view of the lamp housing in section
on line 4-4 of Figs. 3 and 5.

Fig. 5 is a view of the housing in horizontal
section on line 5-5 of Figs. 3 and 4.

Fig. 6 is a fragmentary view of a modified form
of lamp housing in section corresponding to that
of Fig. 3.

Fig. 7 is a view in horizontal section illustrat-
ing a still further modified form of lamp housing
embodying the principles of my invention.

Fig. 8 is a side elevation partially in section,
illustrating details of the conveyor and its rela-
tion to the photoelectric viewing means.

An important consideration in the successful
operation of sorting devices of the type disclosed
in the patent to Hanson and my copending appli-
cations referred to above is the proper illumina-
tion of the articles at the time when they are
supported on a conveyor in the viewing line of
the photoelectric viewing means. Thus, if a
perfect article is imperfectly illuminated, shadows
formed because of the imperfect illumination are
likely to cause energization of the photoelectric
cell with the resulting ejecting action. Similarly,
an imperfect article discolored only in part, in-
correctly illuminated, may be permitted to pass
into the outlet receiving perfect articles, due to
the fact that the incorrect lighting thereof has
not rendered the discoloration to be sufficiently
distinguished from the reference background on
the conveyor rim. The same result may be caused
when the article is improperly positioned on the
conveyor. This invention eliminates entirely
failure of operation of the ejector due to the ef-
fects of imperfect lighting as noted, because of
the fact that it utilizes illuminating lamps sup-
ported in an illuminating and viewing housing
of theoretically perfect construction, which acts
to focus the rays of the illuminating source di-
rectly on each of the succeeding articles brought
into the viewing field of the judging means. The
rays are focused on the article from all sides
thereof, with the result that there is no possi-
bility of shadows occurring to cause the photo-
electric viewing means to be energized nor of
discolored articles passing the viewing means
without energizing the same, due to the failure of
the illumination to cause the discoloration to
be discerned by the viewing means.

Further details of improvements characterizing
the invention will appear in the specification.

Referring to Fig. 1, the reference numeral 47
indicates generally a conveyor drum of the rotary
type rotatable in counterclockwise direction, the
said drum being characterized by provisions il-

illustrated and claimed in my copending application, Serial No. 135,012 above identified, to pick up articles from a bin or hopper (not shown) and transport the same individually in spaced relation, the articles being held to the periphery of the drum by suction through radial perforations 42 formed in the wall of the conveyor drum.

The rim 43 of drum 47 is suitably tinted on its outer periphery to provide a reference background of the proper color, as described in my copending application, Serial No. 49,727, filed November 14, 1935, and likewise carries a pair of normalizing spaces 80 enabling the amplifying circuit of the machine to be given a setting appropriate to the effective lighting, as described in that application. The number of such blank spaces may be varied as desired.

I will now describe my improved structure for illuminating and viewing objects at the illuminating and viewing station which is indicated by the reference numeral 61.

The lamp housing, generally indicated by the reference numeral 89, is preferably mounted on a support 1 provided with an article receiving opening 2, the housing being on the side of the conveyor drum 47 opposite the hopper (not shown), although this position may, of course, be altered at will. The housing overlaps the drum on either side, having upper and lower recesses 190 receiving the drum. The housing is formed internally in the shape of a pair of intersecting ellipsoids with the imaginary plane of intersection passing through one of the foci of each of the ellipsoids. In other words, the ellipsoids have one common focus and are so positioned relative to the path of travel of an article on the conveyor rim 43 that the article passes through the theoretical common focus which is indicated by the reference numeral 90 in Figs. 3 and 4. Illuminating lamps 91 are placed in socket-like holders 92 formed in the double ellipsoidal housing 89 so that the theoretical point of radiation of each of the lamps lies on a focus indicated by the reference numeral 93 of each of the ellipses. The result is that the light rays, as shown in Figs. 3 and 4, converge on the article 94 on the conveyor rim from all directions, the rays being indicated by broken lines in Figs. 3 and 4.

The slight bulge or enlargement 95 formed at one side in the housing, as shown in Fig. 4, is provided to allow more room for ejected articles to pass to a point of discharge after they are ejected from the conveyor by means to be described and to prevent their accidental glancing or rebounding into the collector or chute 72.

A pair of lenses 96 are mounted in openings 97 in the housing on the line of intersection of the ellipsoids and on either side of the common focus, as illustrated in Fig. 4, the mounting being made by a sleeve 98 threadedly engaging in the opening in the lamp housing and carrying a lens support 99 which is adjustable by the knurled disk 100 whereby the focusing of the lenses is accomplished (see Figs. 1 and 8). Aligned with each lens is a photoelectric tube 101, or other suitable light-responsive viewing means, carried in light-sealed mounting 102.

Each of the lamps 91 is provided with a relatively light-impervious area or zone 103 to the end that direct glare of the light rays on the articles being viewed is prevented, the entire illumination thereof being as a result of rays reflected uniformly thereon. The lamps are energized by feed wires 104 and the photoelectric

cells 101 are likewise suitably connected to the amplifying circuit.

A modified form of lamp housing is illustrated in Fig. 6, which embodiment relies for its effectiveness on the principle of directing parallel means rather than converging rays of light on the article at the viewing station with the effect of illuminating the same through overlapping areas of light rather than through an infinite number of converging points of light. I have found that this principle of lighting is very effective in the elimination of false effects due to shadows etc. In carrying the idea into practice, I employ a large number of mirrors or other planar reflecting surfaces 891 suitably secured to the housing 89 in a manner not to interrupt the reflecting area of each surface. Channels 892 separate the mirrors and are deep enough to eliminate any reflecting tendency of the housing itself. The rays of light emanating from the lamps 91 and the limits of the beams reflected from the mirrors 891 are indicated in broken lines in Fig. 6, and it will be seen that an article at the viewing station 61 is completely bathed in uniform light. The article being viewed in Fig. 6 is illustrated as being in an up-ended position to clarify the effect of the individual mirror system of illumination. The article is illuminated throughout substantially its entire area. There is no point which is relatively intensively lighted and the resulting tendency to mask the effect of a discolored portion of the article is not possible, as might be the case were the light rays focused by use of a perfect ellipsoidal reflecting surface.

In Fig. 7, I illustrate a lamp housing 893 suitable for illuminating articles on the conveyor, the said housing being internally in the form of a single ellipsoid or approximately so, articles on the conveyor rim 43 being transported through one focus thereof while lamp 91 is set at the other focus thereof, and the lens mountings 99 are placed in the side walls, the major axis of the ellipsoid extending at right angles to the conveyor periphery as distinguished from the previously described housing having double ellipsoidal surfaces wherein the major axes are obliquely disposed to the conveyor periphery. The housing illustrated in Fig. 7 is a simplified adaptation of the principle of my invention. However, I find it provides very satisfactory illumination of articles for the purpose of my invention. My invention also broadly contemplates forming the inner elliptical surfaces of the housing 893 of a plurality of separate mirrors such as those indicated by the reference numeral 891 of Fig. 6.

The improved ejector mechanism of the invention will now be described. Referring to Figs. 2 and 3, an aperture 106 is provided in the lamp housing on one side thereof and at a point slightly below the viewing station and the lenses 96. The ejector blade or tappet 107 operates centrally of the aperture 106, extending transversely of the rim of the conveyor 43. The blade is preferably formed of aluminum so as to be quite light and readily actuated by an iron armature or core 108 connected to the rear end thereof. The armature slides in an electromagnet, generally indicated by numeral 109, which is energized by lead 110 as determined by impulses originating in the photoelectric viewing means, suitably amplified, and suitably controlled by means described in my copending application, Serial No. 135,012. The magnet is carried by a bracket 111

rigidly mounted to the lamp housing on bosses 112.

For the purpose of retracting the ejector after its inward ejecting stroke rapidly and smoothly and at the same time without imposing a serious starting load on the ejector, a retractor mechanism is employed consisting of a pin 113 having a free sliding fit in a diametral hole drilled through armature 108, the pin having coil springs 114 at the ends thereof attached to anchor screws 115 which threadedly and adjustably engage the bracket 111. A resilient bumper 116 is carried by the rear end of the bracket to absorb the impact of the armature on its return stroke.

By the above construction, it will be seen that since the springs 114 are substantially aligned with the pin 113 in normal position, they impose no resistance to starting movement of the armature and will act as a buffer at the end of the inward or ejecting stroke of the ejector blade. They will also return the armature at the same speed at which it was initially projected. A further important feature of the ejecting structure just described lies in the fact that the pin centralizes the reaction of the springs 114 by virtue of the loose fit of the pin in the armature. Accordingly, there will be no binding action if the anchor screws 115 should be screwed in the bracket at different distances.

From the foregoing, the operation of the machine as well as the refinements made possible in the operation should be clear. Articles to be sorted are picked up from the hopper by substantial suction effective through openings 42 and are carried on the rim to viewing station 61 where they are completely and uniformly illuminated so that shadows will not produce an improper energization of the photoelectric tube, or, on the other hand, fail to energize the tube when a cull is present. Of course, the photoelectric cell views the article in comparison with the reference background provided by the rim 43. Periodical normalizing action to make an appropriate adjustment or setting according to the effective brightness of the illuminations is provided by the blank spaces 80 on the conveyor rim whereby the machine is rendered invulnerable to variations in illumination caused by variations in lamps 91, outside influences, etc., in accordance with the description in my copending application, Serial No. 49,727.

I have shown preferred embodiments of my invention, but further adaptations and modifications will be apparent to those skilled in the art, and I desire to claim the same specifically as well as broadly as pointed out in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In combination, a conveyor for moving a series of articles in spaced relation, and illuminating and viewing means disposed adjacent said conveyor, said means comprising a housing having an opening through which said articles are transported by said conveyor, the internal surface of said housing being in the form of a pair of intersecting ellipsoids having a common focus, viewing means disposed in said housing substantially at the intersection of said ellipsoids, said housing and conveyor being so associated that the articles on the conveyor pass through and are viewed by said viewing means at said common focus, and illuminating means at the other foci of said ellipsoids, the arrangement being such

that the articles are uniformly bathed with light while being viewed.

2. In combination, a conveyor for moving a series of articles in spaced relation, and illuminating means disposed adjacent said conveyor, said means comprising a housing having an opening through which said articles are transported by said conveyor, the internal surface of said housing being in the form of a pair of intersecting ellipsoids having a common focus, said housing and conveyor being so associated that the articles on the conveyor pass through said common focus, and illuminating means at the other foci of said ellipsoids, the arrangement being such that the articles are uniformly bathed with light at the common focus.

3. In combination, a rotary conveyor adapted to pick up articles at one point and transport the articles in circumferentially spaced relation past a viewing point, a housing adjacent said conveyor, said housing being internally in the shape of a pair of intersecting ellipsoids having a common focus at the viewing point, illuminating means at the other foci of said ellipsoids, and viewing means disposed in said housing to view articles at said common focus.

4. In combination with a conveyor adapted to transport articles in spaced relation past a viewing point, a lamp housing disposed adjacent said conveyor, said lamp housing having an internal surface of substantially elliptical form with a focus thereof substantially at said viewing point, said housing having illuminating means substantially at another focus thereof, and means in the housing for viewing articles on said conveyor at the viewing point.

5. An illuminating housing for a sorting machine provided with an internal surface substantially in the form of a pair of intersecting ellipsoids having a common focus, viewing means disposed in said housing to view articles transported through said common focus, and illuminating means in said housing disposed substantially at the other foci of said surface, said surface being in the form of a plurality of planar reflecting elements separated from one another by non-reflecting areas whereby parallel beams of light are reflected from said illuminating means towards the viewing point.

6. An illuminating housing for a sorting machine provided with an internal surface substantially in the form of a pair of intersecting ellipsoids having a common focus, viewing means disposed in said housing to view articles at said common focus, and illuminating means in said housing disposed substantially at the other foci of said surface, said surface being in the form of a plurality of planar reflecting elements.

7. An illuminating housing for a sorting machine provided with an internal surface substantially in the form of a pair of intersecting ellipsoids having a common focus, viewing means disposed in said housing to view articles at said common focus, and illuminating means in said housing disposed substantially at the other foci of said surface.

8. An illuminating housing for a sorting machine provided with an internal substantially elliptical surface, photosensitive viewing means connected to said housing and communicating with the interior thereof to view articles at a focus of said housing, and illuminating means in said housing disposed substantially at the other focus of said surface, said surface being in the form of a plurality of reflecting elements

having substantially planar reflecting surfaces whereby beams of light of substantial width are reflected from said illuminating means towards the viewing point.

- 5 9. An illuminating housing for a sorting machine provided with an internal substantially elliptical surface, and illuminating means in said housing disposed substantially at a focus of said surface, said surface being in the form of a plu-
10 rality of substantially planar reflecting elements separated from one another by areas ineffective to reflect light from said illuminating means whereby beams of light of substantial width are reflected from said illuminating means towards a
15 viewing point at the other focus, said housing having means for viewing articles at said point.

10. In an automatic sorting machine having means for transporting articles, an illuminating housing disposed in the path of travel of the articles for illuminating the same during the
5 sorting operation, said housing having an opening receiving said articles in their travel and being provided with an internal substantially elliptical surface positioned in relation to said transporting means for passage of the articles
10 through a focus thereof, photo-sensitive viewing means connected to said housing and communicating with the interior thereof to view articles at said focus, and means disposed in said housing to illuminate said articles from another focus
15 of said surface.

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