July 28, 1953 H. FRANKEL 2,646,880

PHOTOELECTRIC SORTING OF SMALL ARTICLES

Filed June 7, 1949

Fig. 1.

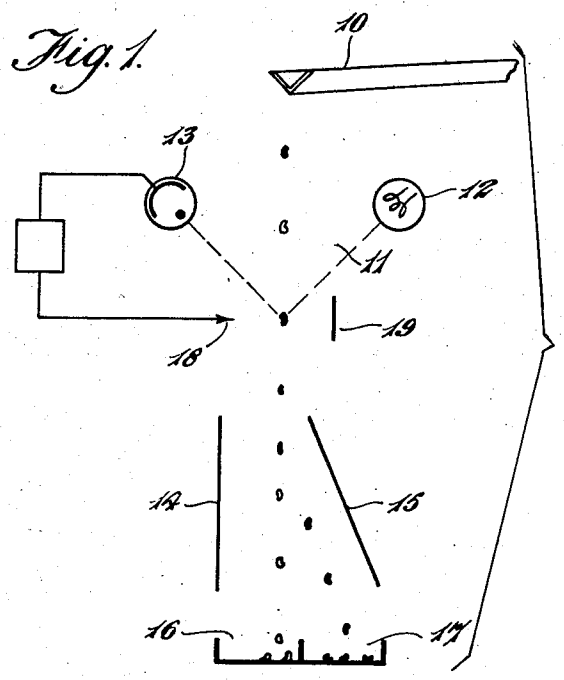
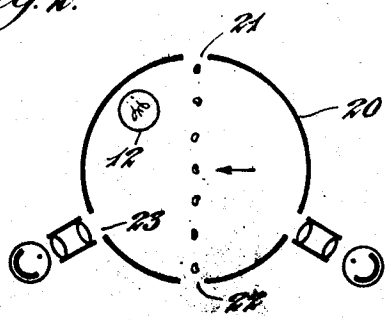


Fig. 2.



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PHOTOELECTRIC SORTING OF SMALL ARTICLES

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1 Claim. (Cl. 209—111)

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This invention relates to apparatus for sorting small articles according to their different colours and/or light reflecting properties. For the sake of simplicity it will be assumed in the following description that it is desired to sort light articles from dark articles i. e. to separate those articles the surfaces of which reflect more light from those articles whose surfaces reflect less light, but it will be appreciated that this distinction is to be taken in its broadest sense since, by the use of suitable colour filters and/or selective colour-responsive devices, conditions may easily be established whereby the sorting of the light articles from the dark articles becomes, in fact, the separation of articles of one colour from articles of other colours. All that is necessary is to establish conditions in which those articles which it is desired to separate from the other articles mixed therewith have different light reflecting qualities.

In Patent No. 2,536,693 of record, there is described and claimed a method of sorting small articles such as beans, peas and similar vegetable seeds the surfaces of which vary in their light reflecting properties which comprises selectively charging the articles electrically according to the amount, or kind, of light which they reflect and passing the charged articles through a steady electric field whereby they are selectively deflected according to their charge. Such a method of sorting mixed small articles will be hereinafter referred to, more particularly in the appended claim, as "a method of sorting mixed small articles of the kind specified."

In the preferred method of separating small articles from their admixture with other small articles described in the said Patent No. 2,536,693 one set of articles is electrically charged and the other is not, and the charged and uncharged articles are passed through a steady electrostatic field whereby the charged articles are deflected and separated from the uncharged articles.

The chief object of the present invention is to provide an improved method of charging those articles, such for example, as seeds, which are to be charged prior to their passage between the deflector plates employed to provide the steady electrostatic field.

According to the present invention, instead of being charged by reason of their contact with a charging electrode as in the arrangement described in Patent No. 2,536,693 mentioned above, the articles are charged by means of a corona discharge, preferably in mid-air.

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In order that this invention may be the more clearly understood and readily carried into effect, reference may be made to the accompanying drawings in which:

Figure 1 illustrates diagrammatically the manner of carrying out the present invention, and

Figure 2 illustrates somewhat diagrammatically the preferred form of chamber in which the articles are viewed.

As stated above, the present invention is concerned with providing an improved means of charging the articles for a method of sorting mixed small articles of the kind specified. Any detailed description of the means for feeding the articles, or of ensuring that they are selectively charged according to the amount, or kind, of light which they reflect is deemed to be unnecessary in the present application, since such details may be obtained from the specification of the Patent No. 2,536,693 above referred to. It may, however, be briefly stated and referring to the accompanying drawing that the mixed small articles to be sorted are fed from a feeding device 10 to a viewing area 11 where they are illuminated by light from a lamp 12, light reflected from the article in question being picked up by one or more photoelectrical cells 13, the output from which is used to control the charge applied to the article. After passing the viewing and charging area 11, the articles fall between deflector plates 14 and 15 across which a high voltage electrostatic field is set up and then fall into receptacle 16 or receptacle 17 according to whether they have been charged or not.

In carrying out the present invention, instead of applying the charging potential obtained as a result of the response of the photoelectric cell 13 to the tip of a chute or groove down which the articles pass as was the case with the apparatus described in the Patent No. 2,536,693 above referred to, the charging potential is caused by setting up a corona discharge between a point 18 and an associated electrode 19, the article falling freely between the point and the electrode and being viewed by one or more photoelectric cells at a point just prior to its passing between the point and the electrode.

The viewing of the articles and the charging of the same, where necessary, thus takes place in mid-air and a more efficient and effective charging will be obtained. For example, charging the articles in mid-air by means of the corona discharge according to the present invention enables one to overcome the difficulty, sometimes experienced with the previous apparatus, of the

charge on the article leaking away if the article were not the same shade or colour all over, and also prevents incorrect operation, as would be possible with the construction according to the above-mentioned Patent No. 2,536,693, if a second article of a different colour, i. e. a light article instead of a dark article, moves into the viewing field before the first article left the contact electrode.

So far it has been assumed that in order to sort what may, for the sake of brevity, be termed the "good" articles from the "bad" articles in a mixture of "good" and "bad" articles, one kind of articles, say the "good" articles, is charged by the corona discharge whilst the "bad" articles are not charged, the response from the photoelectric cells to the "good" articles initiating the discharge, whereas the response from a "bad" article does not initiate the discharge. Whilst this is a very convenient method, the present invention is not limited thereto. It is possible, for example, to vary the degree of charge according to whether the article viewed by the photoelectric cells is "good" or "bad." Separation will still be effected as the articles pass between the deflector plates, since the amount by which an article is deflected is a function of the charge on the same.

In addition to the above mentioned advantages the method of charging the articles according to the present invention has the additional advantage that it enables a vastly increased range of articles to be sorted. One can, for example, sort objects which themselves are very bad conductors, or even insulators, since the corona discharge closely envelopes the articles and applies the charge, by reason of the ionised air, over the whole of the surface of the article at once. This enables the sorting of articles to be speeded up very considerably since one of the limiting factors where the article is charged by reason of its physical contact with a charging electrode is the time that it takes for the charge to spread over the whole surface of the article.

Furthermore, whilst a contact charging device necessarily covers at least one side of the article from the illuminating light, a charging needle such as is used to produce the corona discharge according to the present invention is located away from the article and leaves the whole surface open to the light.

It is convenient in carrying out the present invention to employ an optical system adapted to illuminate the articles from practically all directions. Thus, for example, the light source 12 may be arranged in a substantially enclosed, internally reflecting sphere 20 with comparatively small entrance and exit holes 21 and 22 for the articles. The apparatus may also be provided with open gaps 23 for the emission of light reflected by the articles in combination with illumination from the background and photoelectrical cells 13 to receive the combined light coming from both the articles and the background, the reflected light from the background preferably being of such an intensity as to match the limit of reflectivity set for the articles to be accepted or rejected.

Any suitable means may be provided for feeding the articles one at a time to the viewing and charging spot in mid-air but in choosing the feeding means due consideration should be paid to the size, shape and surface properties of the articles in question. Preferably, however, the articles are fed to the viewing area in such a manner that they have no substantial lateral component in their velocity but fall substantially vertically.

In an alternative method the articles to be sorted may be fed on to a pair of inclined conveyor belts, the articles travelling along the contacting edges of the belts and being lined up to fall off the ends of the belts, one by one, in any suitable way. This method of feeding the articles is particularly suitable where the articles are of small size.

Any alternative method of feeding the articles, apparatus such as that used for packing tablets into bottles may be used, the articles falling into a gripping point established between the peripheries of two contact rollers and thus being delivered from the gripping point to the viewing and charging area one by one in a substantial vertical direction with a minimum lateral component in their velocity.

I claim :

The method of sorting small articles which vary in their ability to reflect light in accordance with their individual light reflecting properties, which comprises selectively charging said articles electrically in accordance with their individual light reflecting properties by passing said articles through a corona discharge from which said articles receive an electrical charge depending on their light reflecting properties, and then deflecting said articles in proportion to the electrical charge carried by each, thereby effecting a separation based on the individual light reflecting properties of said small articles and wherein said small articles are illuminated, and are viewed by a photoelectric cell as said articles are in mid-air, just prior to their entering said corona discharge, the response of said photoelectric cell to light reflected from each individual article determining whether said article is charged by said corona discharge and, if so, the amount of electrical charge placed thereon.

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