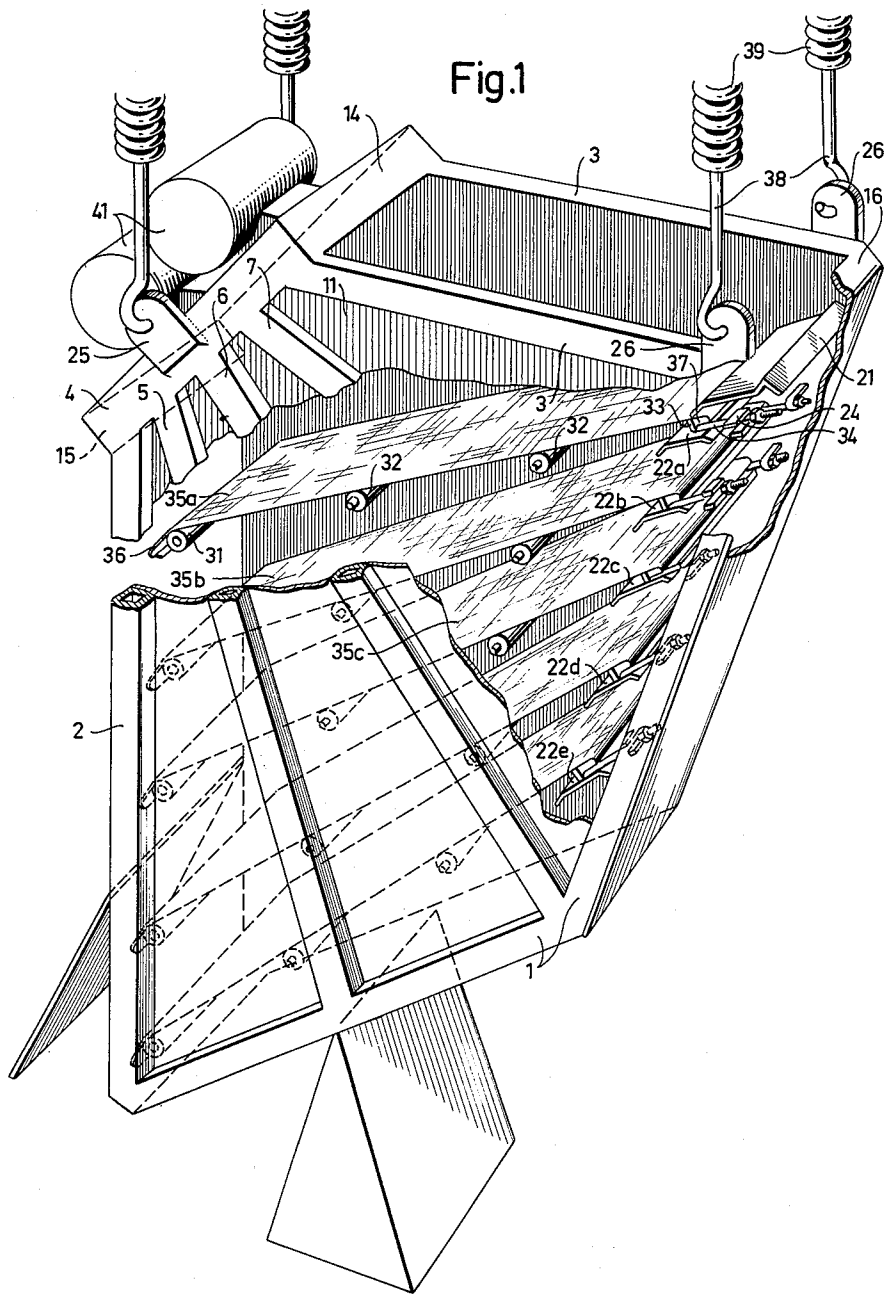
June 7, 1966 F. K. MOGENSEN 3,254,765

SCREEN CLASSIFIERS

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Fig.1



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Fig.2

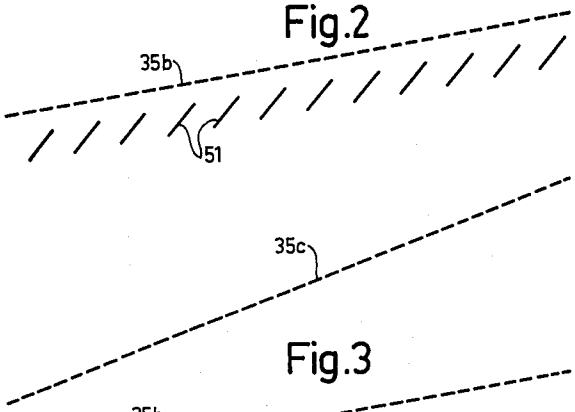


Fig.3

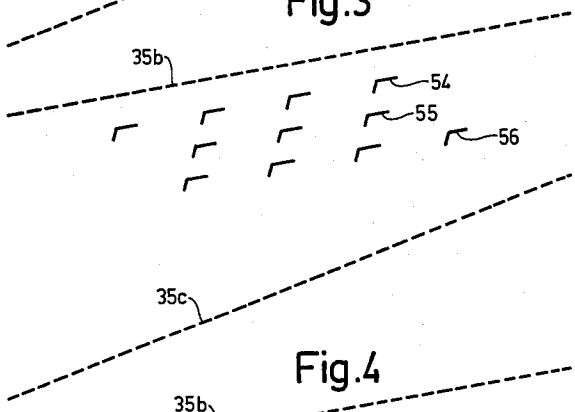


Fig.4

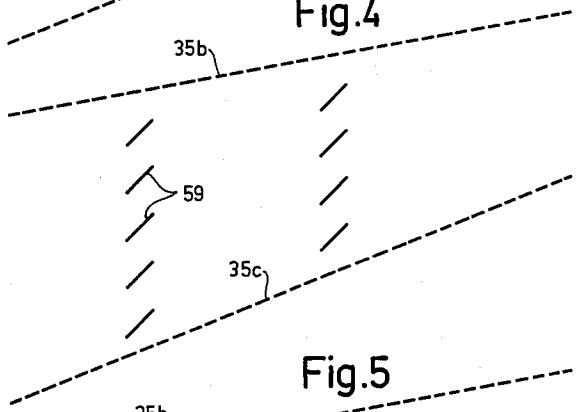
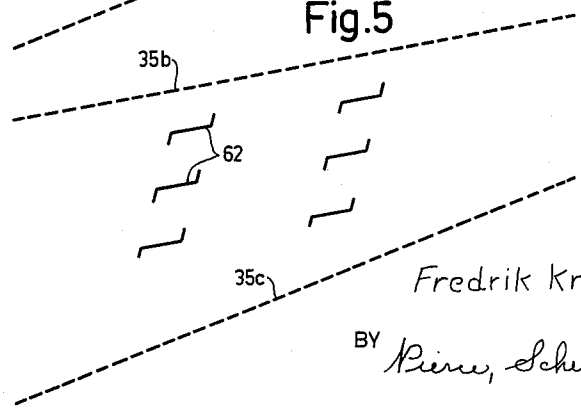


Fig.5



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SCREEN CLASSIFIERS

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11 Claims. (Cl. 209—316)

This application is a continuation-in-part of my copending application Serial No. 125,525, now abandoned, filed July 20, 1961.

This invention relates to an improvement in classifying an assembly of particles as to grain size by the aid of a maze of obstacles, as in the form of a screen classifier, in which the separating effect depends upon the probability of collision between the individual particles and the obstacles. Such a classifier is hereinbelow and usually called a sizer. A sizer differs from the common type of classifiers which consists of a series of stacked screens of different mesh size in which each screen retains particles greater than the mesh size and lets through only grains smaller than the mesh size.

In a sizer the apertures of a given screen are essentially greater than the size of any particle fed to the screen and the separating effect depends upon the degree of probability for particles of a given grain size falling against the screen to pass through or to collide with the obstacle formed by the screen. Thus, in a sizer all screens may have the same mesh size, or different screens or groups of screens may have different mesh sizes. A sizer of this kind having sloping, mutually parallel screens is shown in U.S. specification 2,572,177, and a more advanced type of sizer in which the screens of the set of screens also slope is described in U.S. specification 2,853,191 disclosing a sizer where the slope of the screens, however, increases from the top to the bottom of the set. In a set of a sufficient number of screens sloping in one direction and forming a maze of obstacles which is subjected to vibrations, preferably in said direction, the assembly or mixture of heterogeneous particles successively fed to the inlet of the maze, i.e. to the uppermost end of the top screen will be diffused into a cloud of individually spaced particles passing through the maze and as it passes through that maze it will be split up into fractions according to grain size. The smallest particles, for which the probability of impingement is low, will fall through the maze more or less vertically whereas the larger particles, which have a tendency to impinge against the screens more frequently than the small ones, will at each impingement be reflected and, due to the slope and vibrations of the screen, with preference be thrown to a portion at a lower level of the same screen, where the particle may pass through the screen or be reflected again and so on. The larger the particle, the more impingements and the further displacement towards the lower ends of the screens. Thus, at the outlet of the maze, i.e. at the lower ends of the screens and the space below the lowermost screen, the mixture of particles will come out distributed according to grain size. One or more fractions of the thus classified product may be taken out for use.

From the foregoing description it will be understood that the stream of particles when passing through the maze of obstacles will be split up in and by the maze into more or less well defined streams according to grain size, not unlike the splitting of a light beam by a prism into a spectrum of light beams according to wave length, or colour. The stream, or fraction, of the finest particles will pass almost vertically through the maze, while the stream, or fraction, of the coarsest particles will follow a path more or less inclined with regard to the vertical, and streams, or fractions, of intermediate grain sizes will pass

the maze at intermediate angles according to grain size. These streams are thus distributed in the maze in a fan-like pattern from the inlet upper corner of the maze to the wide range of outlets at the opposite end of the maze.

By adequately placing the screens at differently increasing angles to the vertical, the angle being dependent to a great extent of the mesh size of each individual screen, it is possible to carry out the classification with a high degree of accuracy. In practice the inclination of the screens is measured relative to the horizontal and assuming that the uppermost screen has an inclination of 20° the lowermost screen in a sizer of the said advanced type may have an inclination of 45° or even more, but usually not more than 60°. In order that the sizer shall not be too deep, i.e. be too extended in the vertical direction, the upper ends of the individual screens have to be placed rather close to each other.

Although such a sizer is capable of separating an assembly of differently sized particles very sharply, it has been found that the fraction or fractions of the finest particles in many cases become polluted with greater, and even very great particles. It has been found, moreover, that such pollution to some extent may take place also in coarser fractions.

It is the object of the invention to provide means for eliminating the pollution of one or more particular fractions, and especially of the finest fractions, with coarser material than would rightly belong to the particular fraction. As a consequence it is an object of the invention to improve upon the efficiency of the classifying so as to obtain desired fractions extremely free from particles of a coarser fraction.

A subsidiary object of the invention is to make feasible in a sizer with fan-like distribution of the particle streams to use screens of equal length without losing the classifying capacity of the screens in the lower sections of the sizer even if the standard length of the screens is but moderate.

The present inventor has now discovered that some particles, by colliding with other particles or the solid material (such as wires) of the screens, are reflected in a backward direction, i.e. towards the upper portion of a sloping screen, instead of being reflected towards the lower end of the screen as explained above. The reflection in false direction, in addition to pure probability reasons, may depend on the shape of the particle and the state of rotation, spin motion, thereof. These quite few particles being reflected in false directions may be of very great importance and in some cases a single odd particle may quite spoil a given fraction. A particle which on account of one of these phenomena has obtained a backward direction of movement will most probably be reflected in correct direction again by collision further on with an obstacle in the maze, particularly if it has an opportunity to collide with the obstacles a plurality of times, which may very well take place in the central portions of the maze of obstacles where the particle will thus have a good chance to be brought back in correct direction. But if the particle obtains the backward direction by a collision occuring in the peripheral portions of the maze of obstacles, the particle will easily leave the maze with the wrong direction. This is particularly the case in sizers where the screens have a considerable inclination relative to the horizontal. The screens expose there a relatively great mesh opening perpendicularly to the path of a particle rushing in a backward direction, which increases the probability of the particle passing through the opening insead of impinging the screen and thus be reflected forwards. Moreover, in order to moderate or reduce the height of the sizer the screens are preferably

placed with short mutual distance, particularly at the upper ends. This only makes matters worse, because the short distance between adjacent screens, which is particularly pronounced at the upper region of the screens, gives the particle but little chance to attain, by the influence of gravity, a more vertical path before arriving at the next screen, so that the probability for the backward-rushing particle to pass through more than one screen in the backward direction will increase, so that it will easily get out of the peripheral border of the maze.

With these discoveries in mind and for the purpose of obtaining the above objects of the invention the present invention suggests to provide in the maze of obstacles, e.g. between adjacent screens, and in the regular stream or path through the maze of a given grain size fraction of particles, a system of bodies such as baffle or shield means, impervious to particles coarser than said given grain size. The obstacle may be pervious to particles of said given grain size, and may thus consist of a wire netting, but it is usually advantageous that it consists of an imperforate plate. The baffle means could with advantage be placed with its flat surfaces at an angle to the horizontal greater, preferably substantially greater than that of the screen nearest above the baffle. Thereby the regular stream of particles of the given grain size will not be hindered too much. According to a preferred embodiment of general applicability the baffle means consists of a plurality of baffles of relatively small width arranged so as to expose their upper flat surfaces to the particles thrown backwards and at the same time leave a space between themselves free to the regular flow of the particles of the given grain size. The baffle means may take the form of a sash-blind. It is often advantageous that the surface of the baffle exposed to the impingements of backward passing particles is smooth and even. This will in practice improve the separating effect, because the coarser particles will have a greater tendency than the finer ones to rebound after impinging the surface; the finer particles will rather slide along the surface and drop vertically at the edge thereof.

In order to obtain the above objects especially with regard to the finest fractions it may be provided a body, such as a plate or sheet, impervious to greater particles at the upper end of at least one of the screens arranged to receive particles thrown backward and the goods that has passed through the uppermost portion of the correlated screen immediately above the screen at the upper end of which said impervious body is arranged. In a sizer of this kind the impervious body may replace the uppermost portions of the screen at which it is arranged, and the screen may thus be displaced a corresponding piece of length in the length direction relative to adjacent upper screen, thereby extending the effective classifying part of the screen downwardly and forwardly which will make it possible to use screens of equal length without jeopardizing the proper development of the fan-like distribution of the streams of the different grain size fractions.

The invention will now be described with reference to embodiments thereof illustrated in the accompanying drawings in which:

FIG. 1 gives a perspective view of a sizer equipped and arranged according to the invention with impervious baffles at the upper ends of the screens, and

FIGS. 2–5 are diagrammatic sectional side views of different arrangements with baffle means provided in the central part of the sizer.

The fundamental elements of the sizer, the screens and the baffle means, in the illustrated example consisting of impervious plates, are mounted in a framework built up from two frame halves each consisting of a bent rear bar **1**, a front bar **2**, a top bar **3** and a connecting bar **4** secured to each other, as by riveting or welding, ends to ends so that top bar **3** will connect the upper ends of the rear bar **1** and the connecting bar **4** and the front bar **2** will connect the lower ends of rear bar **1** and connecting

bar **4**. Intermediary bars **5**, **6** and **7** connect the rear bar **1** with the connecting bar **4** in places between the front bar **2** and the top bar **3**. Secured to one side of the frame formed of these bars is a side plate **11**, only a part of which is shown in the drawing. The two frame halves, being mirror images of each other, are fitted together so that the side plates **11** will be at the inner sides of the space formed by the frame halves. They are held together at the front top end by transversal connecting bars, bar **14** at the top end and bar **15** at the lower end of the connecting bar **4** and bar **16** at the junctions of bars **1** and **3**. At their rear portions the frame halves are fitted to each other by the aid of a feeder plate **21** at the top end of the rear bar **1** and the series of impervious plates **22***a*, **22***b*, **22***c*, **22***d*, and **22***e* near the rear bar **1** at successively lower levels, all these plates being secured at their opposite ends respectively to the side plates **11**, as by welding. Thus plates **22***a* to **22***e* extend across the full widths of the screens **35** between the opposite sides thereof. The frame halves are furthermore secured to each other by a lot of transversal bars, rods or tubes fixed to plates **11** at appropriate places for supporting the screens, namely a front bar **31** and two intermediate bars **32** for each screen **35**, which, in addition, is secured at its rear end to a stretch bar **33** carried by slide bolts **34** longitudinally movable in sleeves **24**. The screen netting is stretched between a nose rib **36** on the front bar **31** and a rib **37** on the rear transversal stretch bar **33** in conventional manner as by being clamped between folded sheets.

Secured to the connecting bars **4** are lugs **25** and near the joint of rear bar **1** and top bar **3** is another lug **26** on each frame half, the lugs having holes for hooks **38** or the like for suspending springs **39**, chains, bars or the like in which the sizer is suspended from a support in a way which is self-explanatory and need therefore not be illustrated.

As illustrated the screen nettings **35** have equal length and each screen is positioned with its stretch bar **33** somewhat in front of that of the screen above it. Similarly the impervious plates **22** beneath each of the screens is fitted so as to reach somewhat further towards the front of the sizer than the plate for the screen next thereabove so that the entirety of plates **22***a*–**22***e* are in successively displaced position.

A vibrator device **41** of conventional type is fitted on the unity formed by connecting bar **4** and the transversal connecting bars **14** and **15** so as to induce vibrations.

In operation the assembly of particles of different grain size is fed to the feeder plate **21** while the sizer is suspended in lugs **25** and **26** and the vibrator is actuated. The assembly of particles will spread out on the uppermost screen and practically all particles pass through the screen with a tendency for the coarser particles to pass later than the smaller particles. The particles passing through the uppermost portion of the screen are collected by the impervious plate **22***a* and are fed from the lower end thereof onto the next screen **35***b* at the top end thereof and a considerable quantity of the particles having passed the first screen **35***a* will fall directly therefrom on to screen **35***b* downstream of the end of plate **22***a*. On screen **35***b* there will be a better distribution of the particles according to size than on the first screen and all particles passing screen **35***b* above impervious plate **22***b* will be collected by the latter and be fed from the end thereof on to next screen **35***c*, whereas, particles having passed screen **35***b* downstream of plate **22***b* will fall directly on to screen **35***c* and so on and be classified in the usual way.

As a matter of principle, the degree of ingress of the impervious body below the screen, or, in other words, the degree of overlapping of the impervious bodies, depends on the mesh size and inclination of the screens. This is easily understood if consideration is paid to the fact that sizers are made for the most different particle

sizes so that the mesh sizes can vary between 1 millimeter or even fractions thereof, up to the order of 1 decimeter. From a practical point of view the uppermost portion of a screen pertaining to the impervious body therebelow comprises with advantage ⅓ to 1/10 of the length of the screen.

In the embodiment just described in detail, the baffle plates **22** are arranged only at the upper ends of the screens. There the baffles may have a relatively large extension in the longitudinal direction of the screens without jeopardizing the efficacy of the screening area of the screens because the latter can be displaced downwards, as is seen in FIG. 1, so that the baffles will not shade off any essential portion of the underlying screen. In the case of preventing oversized particles passing in a backward direction in the more central portions of the maze of screens, however, the extension of the baffles, as a rule, has to be relatively short in the longitudinal direction of the screens, in order that passage shall be left for the regularly sized particles to pass their regular way.

Modes of arranging the baffles in the central portions are illustrated in FIGS. 2 to 5, it being understood, however, that similar arrangements can be applied also to the upper ends of the screens, i.e. to the more peripheral portions of the device. These figures are highly diagrammatic and may be considered to illustrate central, fractional portions of a sizer as illustrated in FIG. 1 modified with regard to the baffles.

Thus FIG. 2 shows the intermediate fraction of a screen such as screen part **35***b*. Below screen **35***b* there are a series of baffle plates **51** arranged one after the other in spaced relationship along and quite near the screen, each baffle plate being inclined about 45° to the horizontal. It will be easily understood that particles falling in an about 45° forward direction and a great proportion of those falling more vertically will pass more or less unobstructed through the baffle arrangement. Particles falling through the screens in a backward direction will impinge the baffles and rebound in the forward direction or at least be caught by the plate and slide downward along it.

The inclination of the baffle plates **51** may be different from about 45° and any angle between the slope of the screen above the baffle and the vertical may be used, although an angle between 45° and 90° with the horizontal is usually preferred; the angle, of course, being to some extent dependent on the length of the baffle. Usually the baffle plate may be the shorter the smaller the angle with the horizontal is. Particles having passed screen **35***b* and baffle plates **51** fall onto the next below screen **35***c*, just as in the case of FIG. 1.

An alternative embodiment with relatively short baffles is illustrated in FIG. 3 below the screen **35***b*. In this case a plurality of series of baffle plates **54, 55, 56** are provided one below the other in order that "backrunners" passing between baffles in an upper series shall be caught by baffles in a following series. The baffles as illustrated have about the same inclination as the screen above them but they may have another inclination. At the front end the baffles have a portion of quite greater inclination, which not only offers an effective shield against "backrunners" of more horizontal direction but also renders a more stable structure. The individual baffles of one series may be placed right below a corresponding baffle of one or more of the above series, or they may be placed in a more or less staggered relationship.

In FIG. 4 a central, fractional screen **35***b* is illustrated. and below which the baffle plates **59** are fitted at vertically spaced relationship in one or more vertically disposed series. The horizontal distance between the series depends partly on the length of the individual baffles, in the longitudinal direction of the screens, and partly on the minimum size of oversized particles to be hindered from passing backwards.

The baffles may with advantage have a more or less curved cross section, so that the front surface of the baffle will become convex or concave, or both in the latter case being S-shaped, it being understood that in all cases the entire surface shall face forward. In addition to rendering a structure more stable against vibrations the curvature will provide a hindering effect over a broader range of backward directions of the "back-runners." An embodiment including S-shaped baffles is illustrated in FIG. 5 below screen **35***b* by baffles **62**.

I claim:

1. Apparatus for classifying a mixture of particles of different sizes into size fractions which comprises a plurality of superposed downwardly inclined and vertically spaced wire mesh screens, the apertures in each screen being larger than the largest particle in the particle mixture fed thereto, means for simultaneously vibrating said screens, said particles when introduced to said screens from the top passing through the apertures of some of said screens while colliding with the wire mesh of other screens whereby individual particles will in most cases be progressively deflected by the collisions forwardly along the screens in the direction of their inclination, the number of collisions increasing with the particle size such that the larger particles are deflected a greater total distance forwardly along the screens than are the smaller particles, baffle means comprising at least one baffle element located between adjacent screens and extending laterally for the full width of said screens between the opposite sides thereof and in the regular path through the screens of a given particle size fraction, the over all length of said baffle means in the direction of screen inclination not exceeding a comparatively small portion of the length of said screens as measured in that same direction, said baffle means being impervious to particles coarser than said given particle size fraction thereby to intercept such of said coarser particles as are deflected thereagainst in a backwards direction from the screen next-above said baffle means and to redirect said coarser particles in said forward direction to the screen next-below said baffle means, and means for collecting said particles according to their various size fractions.

2. Classifying apparatus as defined in claim **1** wherein said baffle means located between adjacent screens have the general configuration of a sash blind.

3. Classifying apparatus as defined in claim **1** wherein said baffle means are located between adjacent screens in the vicinity of the upper end portions of the screens.

4. Classifying apparatus as defined in claim **3** wherein adjacent screens have equal length and the lower screen is displaced in the downward direction relative to the upper screen, the horizontal component of the displacement being not greater than the horizontal component of the length of the upper screen shaded off by the baffle means between the screens.

5. Classifying apparatus as defined in claim **1** wherein at least a substantial portion of said baffle means are arranged at an angle greater than the inclination of the screen next-above.

6. Classifying apparatus as defined in claim **1** wherein said baffle means are constituted by a series of inclined baffle elements having their upper surfaces exposed to such of said coarser particles as are thrown backwards through the screen next-above, said baffle elements also being spaced longitudinally from each other in the direction of inclination of said screens to permit regular flow of particles of said given particle size fraction passing through the screen next-above without colliding therewith to the screen next-below.

7. Classifying apparatus as defined in claim **6** wherein said inclined baffle elements are arranged generally parallel to the screen next-above.

8. Classifying apparatus as defined in claim **6** wherein said inclined baffle elements are arranged generally parallel

to the screen next-above but with their forward end portions inclined downward at an angle to the screen next-above.

9. Classifying apparatus as defined in claim **6** wherein said inclined baffle elements are arranged generally parallel to the screen next-above but with their forward and rear end portions inclined downward and upward respectively at an angle to the screen next-above.

10. Classifying apparatus as defined in claim **6** wherein said inclined baffle elements are arranged at an angle steeper than the inclination of the screen next-above.

11. Classifying apparatus which includes a plurality of vertically spaced series of inclined baffle elements each as defined in claim **6** between adjacent screens.

References Cited by the Examiner

UNITED STATES PATENTS

347,391	8/1886	Smith	209—316 X
752,145	2/1904	Cornwall	209—37
1,095,592	5/1914	Owens	209—316 X
1,096,707	5/1914	Froslid	209—316
1,098,079	5/1914	Barnwell	209—316 X
1,145,316	7/1915	Kelly	209—316
2,572,177	10/1951	Mogensen	209—315
2,853,191	9/1958	Mogensen	209—315

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