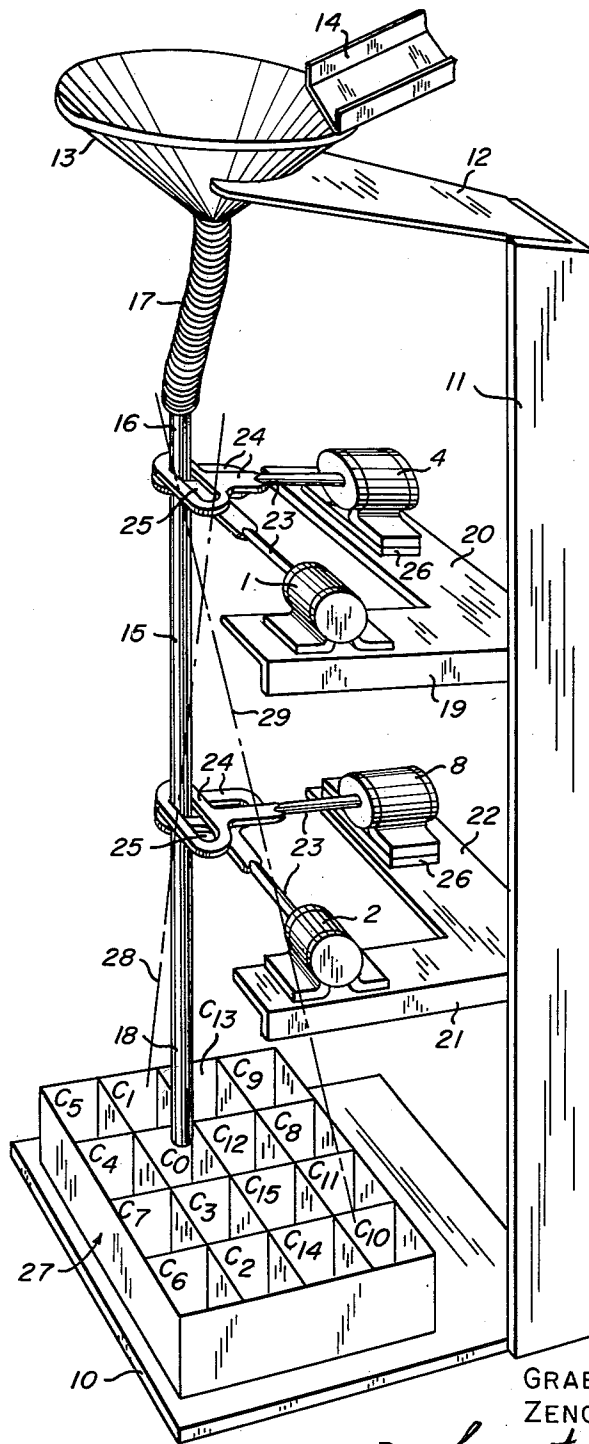


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SORTING APPARATUS

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SORTING APPARATUS

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This invention relates to sorting apparatus for sorting objects into a plurality of receptacles.

According to this invention, a sorting apparatus having a sorting tube freely movable over the receptacles into which the objects are to be sorted and guide means for guiding the objects to one end of the tube, is provided with four shifting members which are operable singly and in combination to shift the other end of the tube to obtain the desired sorting of the objects into the receptacles. The shifting members, each of which has a reciprocable element engageable with the sorting tube, are arranged in two pairs adapted to act on the tube at two locations spaced longitudinally thereof and spaced from said other end. They are further arranged so that the reciprocable elements in one pair of shifting members are disposed radially of the tube at right angles to each other with each of the reciprocable elements in one pair lying in the same plane as a reciprocable element of the other pair.

A sorting apparatus according to the invention utilizes only simple and readily available components requiring very little in the way of special adaptation and yet provides an accurate means by which objects can be sorted into a plurality of receptacles. Because of the simple components, this apparatus is less expensive to construct and maintain than previously known sorting devices employing a single movable sorting tube. A surprising feature of the invention, which also illustrates its simplicity, is that, in one embodiment, the apparatus can sort objects into as many as sixteen receptacles by utilizing only four standard solenoids as the shifting members. These solenoids may be connected directly to a sensing device, such as described in Z. A. Kular's Canadian Patent No. 631,465, dated November 21, 1961, and the corresponding United States Patent No. 3,029,941, dated April 17, 1962, so that the sorting is done automatically in accordance with characteristics of the objects to be sorted as sensed by the sensing device.

A preferred embodiment of the invention is described below with reference to the attached drawing.

In this embodiment, a sorting apparatus comprises a square base plate 10 at one corner of which is mounted a vertical column 11 having at its upper end a horizontal arm 12 rigidly supporting a funnel 13 over approximately the centre of the base plate and under a chute 14 which delivers the objects to be sorted to the funnel. A rigid sorting tube 15 is suspended at its upper end 16 from the lower small-diameter portion of funnel 13 by a flexible tube 17 so that its lower end 18 is spaced above the base plate 10.

The column 11 also supports two vertically spaced pairs of horizontal arms 19, 20 and 21, 22 on which are respectively mounted solenoids 1, 4, 2 and 8, each of which has a reciprocable plunger 23. Arms 19 and 20 are disposed at right angles to each other and parallel to the sides of base plate 10 adjacent the corner at which column 11 is mounted, and the solenoids 1 and 4 are mounted at the free ends thereof with their respective plungers 23 extending at right angles to each other and radially toward a location on tube 15 adjacent its upper end 16. Arms 21 and 22 and solenoids 2 and 8 are similarly arranged with these latter solenoids lying directly beneath solenoids 1 and 4, respectively, with their plungers extending toward a location on tube 15 midway between

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the lower end 18 and the aforesaid location adjacent upper end 16.

Each plunger 23 is reciprocable from a normal extended position, shown in the drawing, to a retracted position when its solenoid is energized and has a stroke between these two positions which is the same for each of the other plungers. The plungers 23 are connected to the tube 15 at the aforesaid locations, each by a separate plate member 24 attached to the outer free end of the plunger and having an elongated closed slot 25 slidably embracing the tube 15. The slot 25 extends at right angles to its plunger 23 and has a length at least equal to the stroke of the other plunger 23 of the particular pair of solenoids plus the diameter of the tube 15. To compensate for the thickness of the members 24, solenoids 4 and 8 are mounted on spacers 26.

A container 27 having sixteen receptacles or compartments C_0 to C_{15} into which the objects are to be sorted is placed on base plate 10 with compartment C_0 directly beneath the lower end 18 of the sorting tube 15 when the solenoids are de-energized and their plungers 23 are extended as shown. Because of the particular arrangement of the solenoids in this preferred embodiment of the invention, the compartments are arranged in a square form with adjacent compartments having centre-to-centre distances equal to the common stroke length of the plungers 23.

The solenoids may be energized singly and in combination to sort the objects into any of the compartments of container 27. The compartment designations C_0 to C_{15} indicate the particular solenoid or combination of solenoids which must be energized to shift the lower end 18 of the tube 15 to any particular compartment. When no solenoids are energized, the lower end 18 of tube 15 overlies compartment C_0 and an object delivered to the funnel 13 by the chute 14 passes freely through the flexible tube 17 and the sorting tube 15 into that compartment. If, however, an object is to be deposited into compartment C_1 , solenoid 1 is energized to retract its plunger 23 which, by its connection 24, pulls the upper end 16 of tube 15 toward that solenoid. The tube 15 slides in slot 25 of the connection 24 of solenoid 4 and pivots about its connection with solenoids 2 and 8 to assume the position shown at 28 wherein the lower end 18 is shifted to overlie compartment C_1 . The upper end 16 remains connected to the funnel 13 by the flexible tube 17 which permits this displacement and ensures that the object will pass freely through the apparatus to compartment C_1 .

Compartment C_{10} may be reached in a similar manner by energizing solenoids 2 and 8 ($2+8=10$). Tube 15 is pulled toward both solenoids at its midpoint and pivots about its connection with solenoids 1 and 4 to assume the position shown at 29 in which the lower end 18 overlies compartment C_{10} . The remaining compartments may likewise be reached by energizing those solenoids having reference numerals which, when added together, give the subscript number of the desired compartment. Thus, solenoids 2, 4 and 8 select compartment C_{14} , solenoids 1, 2 and 4 select compartment C_7 , etc.

Energizing of the solenoids can be accomplished in any suitable manner. If the objects are being sorted according to characteristics determined by an operator, push buttons or the like may be provided which can be operated manually to energize the solenoids as required. It is generally preferred, however, that the characteristics of the objects be sensed automatically by a sensing device, such as described in the aforementioned Canadian Patent No. 631,465 and United States Patent No. 3,029,941, in which case the solenoids may be connected for direct actuation by the device in accordance with the sensed characteristics of the objects.

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What we claim as our invention is:

1. Sorting apparatus for sorting objects into a plurality of receptacles, comprising a sorting tube freely movable over said receptacles, guide means for guiding the objects to one end of said tube, and four shifting members operable singly and in combination for shifting the other end of said tube to obtain the desired sorting of the objects into said receptacles, said members being arranged in two pairs adapted to act on said tube at two locations spaced longitudinally thereof and spaced from said other end, each shifting member having a reciprocable element engageable with said tube, the reciprocable elements of a pair of shifting members being disposed radially of said tube and at right angles to each other and each of said elements of a pair of shifting members lying in the same plane as a reciprocable element of the other pair.

2. Sorting apparatus as claimed in claim 1 wherein each reciprocable element is operable between two positions whereby said other end of the sorting tube is shiftable to sort the objects into sixteen receptacles.

3. Sorting apparatus as claimed in claim 2 wherein one of said locations is twice the distance of the other location from said other end of said tube and the reciprocable elements have equal strokes between their respective two positions whereby said sixteen receptacles are arranged to form a square in which adjacent receptacles have centre-to-centre distances equal to the common displacement of said elements.

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4. Sorting apparatus as claimed in claim 2 wherein each of the reciprocable elements is a solenoid.

5. Sorting apparatus as claimed in claim 1 wherein each reciprocable element is provided with connecting means for connecting it to said tube, the connecting means comprising a plate member rigidly attached to the reciprocable element and having a slot therein slidably embracing said tube, said slot being elongated at right angles to its reciprocable element and being of a length at least equal to the stroke of the other reciprocable element of the particular pair of shifting members plus the diameter of said tube.

6. Sorting apparatus as claimed in claim 1 wherein said guide means comprises a flexible tube rigidly supported at one end and connected at the other end to said one end of the sorting tube.

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