Sept. 25, 1945. E. E. GARLITS, JR 2,385,700

SORTING DEVICE

Filed July 14, 1942 3 Sheets-Sheet 1

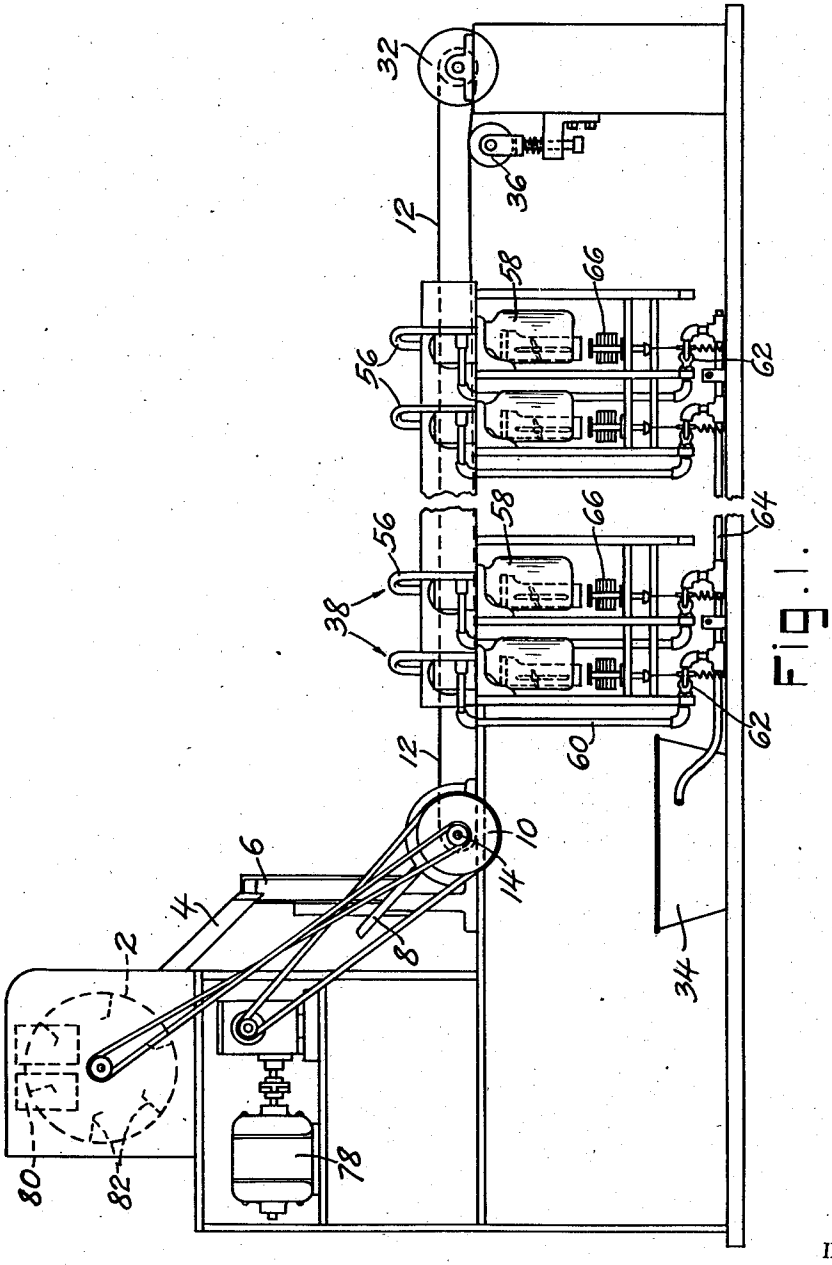


Fig. 1.

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Filed July 14, 1942 3 Sheets-Sheet 2

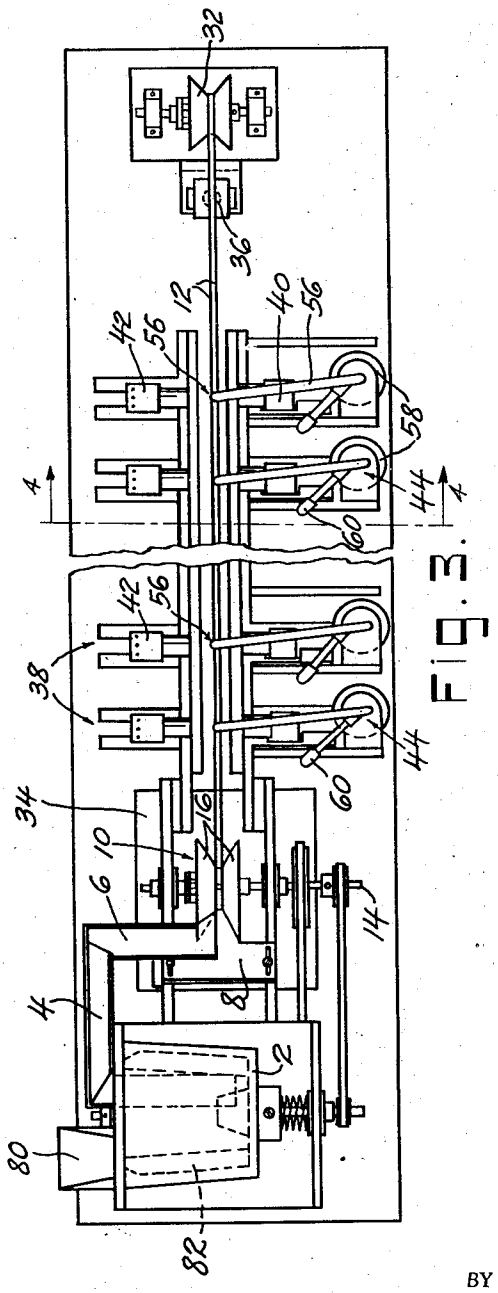


Fig. 3.

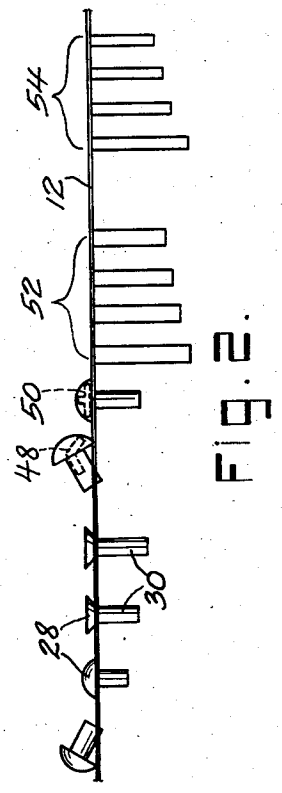


Fig. 2.

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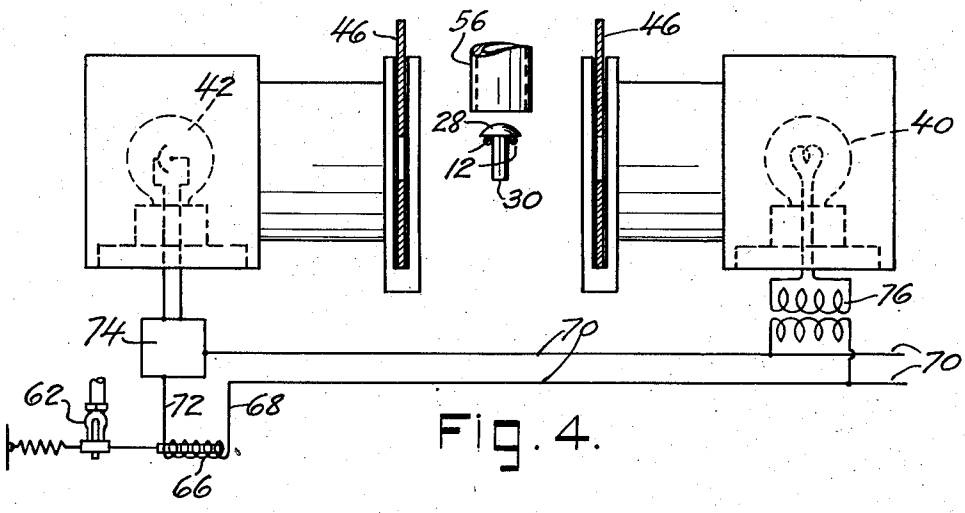


Fig. 4.

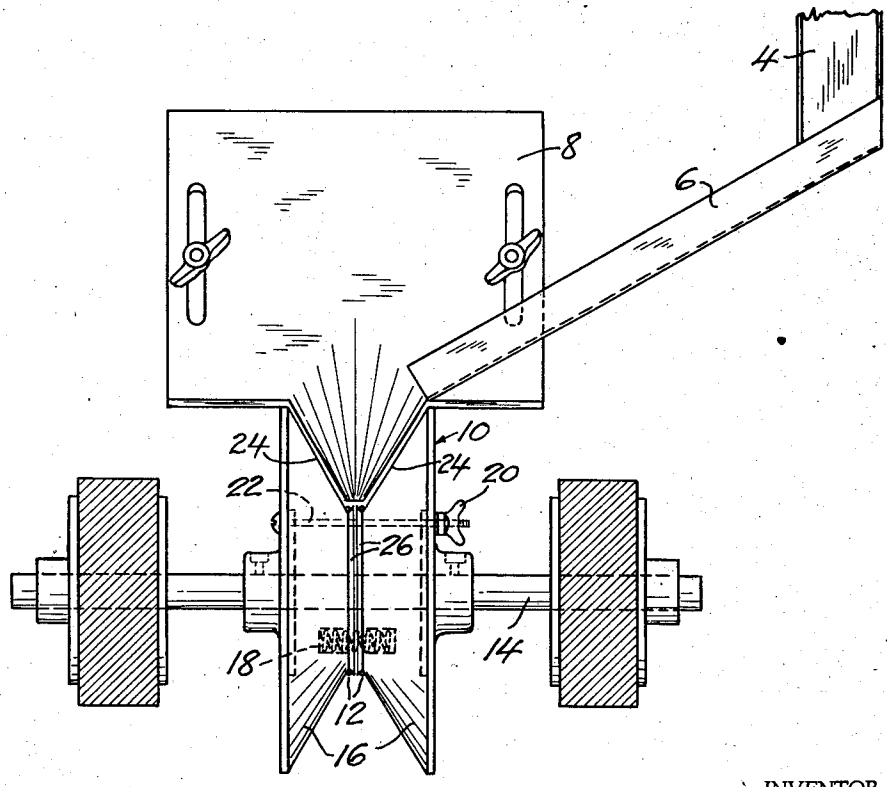


Fig. 5.

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UNITED STATES PATENT OFFICE

2,385,700

SORTING DEVICE

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Application July 14, 1942, Serial No. 450,929

12 Claims. (Cl. 209—82)

My invention relates to sorting devices and although the principle of construction and numerous features thereof are of general application and may be embodied in devices for sorting objects, the invention is particularly designed and hereinafter described for use in sorting mixed accumulations of rivets of the type used in the manufacture of aircraft.

Many thousands of rivets are used in each aircraft produced and these vary in length, diameter, head size, head type and in other respects. Moreover, they are small and difficult to handle so that the operators drop or spill hundreds of rivets every day. Because of the present shortage of aluminum and the relatively high cost of the rivets they are carefully swept up for re-use. However, the accumulation of rivets thus obtained include rivets of all different sizes, shapes and types and it is necessary to sort them out before they can be re-used. This is a very tedious and expensive operation when done by hand but no very satisfactory machine for performing this operation has previously been developed.

In accordance with my invention the sorting of rivets, or other objects, is effected rapidly and accurately by providing means for conveying the rivets one after another past a series of units each embodying identifying means capable of distinguishing between rivets having different types of heads, or shanks of different length or different diameter. Further, the device embodies mechanism controlled by the identifying means for extracting rivets of a predetermined type from the conveyor at different points along the path of travel of the conveying means. Each unit is formed or adjusted to remove a single type or size of rivet and by using a suitable number of units or by passing the rivets repeatedly through the device with proper adjustment thereof each type or size of rivet may be extracted from the accumulations and collected in a separate receptacle.

While various types of extracting means may be used I have found in practice that a suction device for lifting rivets from the conveyor is very satisfactory. Similarly, I may use different or alternative types of conveying means but prefer to deposit the rivets on traveling members arranged in parallel relation and spaced apart so that the heads of the rivets rest on the members while the shanks of the rivets extend downward between the members. These members may be threads, wires, tapes or any other preferred means.

Any suitable type of identifying means may be used but I prefer to employ a photo electric cell for controlling the operation of the extractor. Suitable masks or screens can then be placed between the light source and photoelectric cell so that when a rivet of predetermined type, size or shape passes between the light source and the cell it will be automatically identified or classified by the mask and if it is of such size or shape that it cuts off all or substantially all the light passing from the light source to the photoelectric cell the extractor will be actuated to remove the rivet from the conveyor. If the rivet is not of the size or type for which the first unit is adjusted it will pass on to the next unit where it will again be graded and thus continue on until extracted by the proper unit or discharged at the end of the device. A photoelectric cell and characteristic masks are preferred for identifying those rivets of different type, size or shape since it is possible by the use of such means to effect the selection and sorting of the rivets without direct physical contact between the rivets and identifying means and the rivets are not displaced or disturbed by the classifying operation. However, it will be apparent that any preferred type of classifying means may be used in the practice of my invention.

The principal object of my invention is to provide a novel type of sorting device which is simple in construction and automatic in its operation.

A particular object of my invention is to provide a novel rivet sorter with means for selectively extracting each of a plurality of different sizes, shapes and types of rivets from an accumulation thereof.

Another object of my invention is to provide a rivet sorter with novel identifying means capable of distinguishing between rivets of different types and rivets of different size for selectively controlling the removal of rivets from the device.

A further object of my invention is to sort rivets into groups of different size, shape and type, continuously and automatically with a high degree of accuracy and in a rapid and economical manner.

These and other objects and features of my invention will appear from the following description thereof in which reference is made to the figures of the accompanying drawings, in which

Fig. 1 is a side elevation of a preferred form of rivet sorting device embodying my invention,

Fig. 2 is a diagrammatic illustration of certain of the elements embodied in the construction shown in Fig. 1,

Fig. 3 is a plan view of that form of device illustrated in Fig. 1,

Fig. 4 is an enlarged sectional view of a portion of the device taken on line 4—4 of Fig. 3, and

Fig. 5 is a sectional view through a preferred form of the drive and feed drum shown in Figs. 1 and 3.

In that form of device chosen to indicate the nature of my invention and illustrated in the drawings the rivets to be sorted are supplied to a rotatable hopper 2 which serves to agitate the rivets and discharge them through 4, 6 and 8 by which they are passed to conveying means which as shown include a drive and feed drum 10 about which pass a pair of spaced parallel threads, wires, tapes or other movable members 12 for carrying the rivets to be sorted.

As shown in Fig. 5 the drum 10 is mounted on a shaft 14 and is composed of opposite sections 16 which are urged apart by springs 18 and adjustable toward and away from each other by wing nuts 20 on bolts 22 which pass through both sections of the drum. Each section of the drum presents an inwardly facing conical surface 24 which is provided with a bead or flange 26 for receiving and positioning the threads 12.

With this construction the conical surfaces of the sections of the drum direct and guide the rivets onto the threads 12 whereas the spacing of the threads is variable to receive and hold rivets of predetermined size with the heads 28 of the rivets resting on the threads and the shanks 30 of the rivets extending downward below the threads. Adjustment of the threads also may be made to cause the largest rivets to ride in an inclined position on the threads while the smaller rivets are suspended in vertical positions.

It is found in practice that if the drum 10 is formed of non-metallic material such as wood, or is suitably roughened the rivets are caused to move with the drum in such a manner that they are distributed substantially uniformly along the threads as they travel from the drum toward the idler 32 at the opposite end of the machine. A tray 34 is located below the drum 10 to catch any rivets which fall from the drum or threads so that they may be returned to the hopper 2. It is also found, particularly on long machines, that some sag preventing means such as auxiliary drums or tensioning members of the type illustrated at 36 in Fig. 1 should be used to retain the threads 12 in predetermined horizontal positions for accurate sorting of the rivets.

The threads or other conveying means by which the rivets to be sorted are carried, move the rivets past a series of units 38, each of which includes identifying means and an extractor. The identifying means shown are of the light sensitive type and embody a light source 40, a photo electric cell 42 and a mask 46, whereas the extractor 44 is of a type which may be controlled electrically to respond to operation of the photo electric cell.

Masks 46 are located between the light source and cell and it is found in practice that greater accuracy is attained if similar masks are positioned adjacent both the light source and the cell and on opposite sides of the parallel threads 12. The masks for each unit are formed with apertures of characteristic shape corresponding to the particular type, size or shape of the rivets to be removed by that unit. Thus, as shown in Fig. 2, the units may be arranged in series and the masks may be formed with apertures formed to cause the large rivets supported in inclined positions on the threads to obstruct all or a sufficient portion of the light passing through the aperture 48 to insure operation of the extracting means. The next aperture 50 is formed to cause all of the round headed rivets to be removed from the conveying means and as a result only flat headed rivets will be carried by the conveyor after it passes the second unit. Thereafter, the masks 52 of successive units are arranged to cause the rivets of greatest shank diameter to be extracted one after another, the longest ones first and each shorter size of rivet in turn until all of largest diameter rivets are removed. Subsequently, the rivets of next smaller diameter are removed by the use of masks 54 of another series of units. Any suitable number of units or series of units may be provided to extract each size of rivet separately and the rivets having the smallest shank diameter and shortest in length may be collected as they pass over the idler 32 at the end of the device. By removing the larger and heavier rivets prior to removal of the smaller rivets the weight of the rivets carried by the conveyor is reduced and sagging and displacement thereof is reduced.

After the flat headed rivets have been sorted the round headed rivets may be passed again through the device or through another device and the unit associated with the aperture 50 eliminated or rendered inoperative. The device will then sort the round headed rivets according to diameter and length. Finally the drive and feed drum 10 may be adjusted to space the threads 12 farther apart so that the larger rivets which previously rode in inclined positions and were extracted as they reached the aperture 48 may be suspended from the threads in vertical position and then sorted according to head type, diameter and length.

The type of extractor preferred utilizes suction for removing rivets from the conveyor. This device includes a suction tube 56 arranged so that the end thereof is located above the threads 12 and substantally in alignment with the beam of light passing to the photo electric cell. In this way the end of the tube is positioned directly above the rivet when the rivet is in position to break the light beam and cause the unit to be actuated. The tube leads to a receptacle 58 in which the sorted rivets are collected and a tube 60 having a valve 62 therein leads to a common line 64 extending to a vacuum pump (not shown). When the valve 62 is opened suction is applied to the receptacle 58 and tube 56 whereby the rivet beneath the end of the tube is sucked up into the pipe 56 and delivered to the receptacle. The size of the tube used in each unit may be varied to avoid clogging of the tube by a rivet in passing therethrough and a screen may be located over the end of the tube 60 to prevent any rivets from passing into the tube 60.

The valve 62 is actuated by a solenoid 66 under the control of the photo electric cell 42. For this purpose the solenoid is arranged with one end thereof connected by conductor 68 to a source of power such as the 110 volt line 70 while the other end of the solenoid is connected to the conductor 72 which extends to the relay 74. The relay may be of any suitable type and in practice I have used a General Electric photo-electric relay #CR 7505-K 100 which also is connected to the photo-electric cell to create the required potential difference between the elements there-

in. The incandescent lamp 40 receives power from the line 70 through a transformer 76 and the motor 78 by which the hopper 2 and drum 10 are driven also may be connected to the power line by conductors not shown. Incidentally, I have found it to be preferable to mount the units separately from the thread supporting and driving means and on rubber blocks to prevent the action of the solenoids from jarring the threads and displacing the rivets or inadvertently actuating the units.

In the operation of the device described the positions of the apertures 48 and 50 in the masks associated with the first two units are adjusted so that they are located slightly above the threads 12 while the positions of the remaining apertures 52 and 54 are adjusted so that they are located slightly below the threads 12. The spacing of the threads 12 is also adjusted to allow the rivets to be selected to hang in vertical positions therefrom. The motor 78 is then started to rotate the hopper 2 and drive the drive and feed drums 10. The lamps 40 in the units are also lighted.

The rivets to be sorted are charged into the hopper 2 by a chute 80 and are agitated and raised by inwardly projecting cups or fins 82 so as to be discharged a few at a time to the chute 4. They then pass down the chutes 6 and 8 to the drum 10 where they are caused to pass onto the threads 12. As the threads travel lengthwise of the machine the larger rivets which are supported in inclined positions on the threads intercept the beam of light passing from the light source to the photo-electric cell through the aperture 48 in the mask 46 of the first unit. When the beam of light is broken the relay 74 causes the solenoid 66 to be energized whereby the valve 62 is opened to apply a vacuum to the receptacle 58 and tube 56. The larger rivets are thus raised from the threads and drawn into the receptacle 58 where they are collected for use in a further sorting operation.

Those rivets which are small enough to be suspended vertically between the threads pass the first unit without actuating it. They are then presented to the second unit and if they are of the round headed type they will break the beam of light passing through the aperture 50 in the mask for the second unit whereupon the second unit will be actuated to suck up all of the round headed rivets for further sorting.

The flat headed rivets remaining on the threads are moved past each of the following units in succession until they reach a unit having a mask with an aperture therein of such size and shape that the rivet will obstruct all or substantially all of the light passing to the photo-electric cell. The unit is then actuated to extract the rivet and in this way the masks serve to measure or classify each rivet in turn so that it will be deposited in the receptacle which receives other rivets of the same size or same type.

When all of the flat headed rivets have been sorted for length and diameter the round headed rivets may be sorted in the same manner by rendering the first and second unit inoperative and thereafter the larger rivets extracted by the first unit of the device may be sorted by suitable adjustment of the drive and feed drum 10 to space the threads 12 farther apart.

In this way the rivets may be quickly and accurately sorted according to type, size and shape so that they are ready for re-use with a minimum delay and at a great saving in the cost of sorting.

It will be readily understood that many changes may be made in the form, construction and arrangements of the various elements used in the device. Thus other types of hoppers and feeders may be used to supply the rivets to the conveying means employed. Similarly, other types of conveying means may be employed although the construction of the conveyor should be such that most of the headed articles to be sorted, such as rivets, bolts, screws, nails, etc. will be supported on the conveyor in vertical positions. Various types of identifying means and extractors may be employed and the units may be arranged in auy suitable number and order to sort either a great variety or a limited number of types and sizes of rivets with each device. Any number of separate devices may be used for sorting a mixed accumulation of rivets and they may be treated prior to sorting to remove paper, dirt, iron objects or the like.

These and other changes and substitutions may be made in accordance with the principle of my invention and therefore it should be understood that the particular embodiment thereof shown in the drawings and herein described is intended to be illustrative of my invention and is not intended to limit the scope of the following claims.

I claim:

1. A sorting device for separating and collecting each of a plurality of different kinds of headed articles such as rivets, bolts, screws, nails and the like from mixed accumulations thereof, comprising a conveyor, means for arranging articles to be sorted on said conveyor with the head portions thereof in contact with the conveyor and the shank portions thereof projecting from the conveyor, identifying means located adjacent said conveyor in position to gauge one of said portions and responsive to movement of such portion of a predetermined kind of article into position adjacent thereto, a suction device positioned to remove from the conveyor the article located adjacent the identifying means, and means controlled by said identifying means for actuating said suction device.

2. A sorting device for separating and collecting each of a plurality of different kinds of headed articles such as rivets, bolts, screws, nails and the like from mixed accumulations thereof, comprising a conveyor, means for arranging the articles to be sorted on said conveyor with the heads upward and shanks downward, light sensitive means located below said conveyor in position to respond to movement of the shank of a predetermined kind of article into position adjacent thereto, a suction device positioned above said conveyor in position to raise from the conveyor the article located adjacent said light sensitive means, and means controlled by said light sensitive means for actuating said suction device.

3. A sorting device for separating and collecting each of a plurality of different kinds of headed articles such as rivets, bolts, screws, nails and the like from mixed accumulations thereof, comprising parallel conveyors, constructed to hold said articles in vertical position thereon with the heads of the articles projecting above the conveyors and the shanks of the articles extending downward between the conveyors, means for supplying round headed articles and flat headed articles of different size to the conveyors, mechanism located adjacent the conveyors, and including control means positioned at a

level above the conveyors for selectively actuating said mechanism to move articles having a predetermined type of head upward from between the conveyors, and other mechanism located adjacent said conveyors but beyond the first mechanism and including control means located below the conveyors for selectively actuating the second mechanism to move articles having shanks of predetermined size upward from between the conveyors.

4. A rivet sorting device comprising a conveyor including a pair of parallel members spaced sufficiently to support rivets thereon in vertical positions with the heads of the rivets resting on said members and the shanks thereof extending downward between and below the members, a plurality of units located along the path of movement of said conveyor and each including a light sensitive element and a source of light located on opposite sides of said conveyor and below said members in such positions that the shanks of rivets carried by the conveyor will intercept a beam of light passing from the light source to the light sensitive element, said units each having a mask between the light source and element and formed with an identifying aperture therein corresponding to a different kind of rivet, and means associated with each unit and including mechanism controlled by the light sensitive element for moving upward from the conveyor rivets identified by that unit.

5. A rivet sorting device of the type defined in claim 4 in which the mechanism controlled by the light sensitive element is a suction device.

6. A rivet sorting device of the type defined in claim 4 in which the mechanism controlled by the light sensitive element includes a receptacle, a tube extending from the receptacle to a point above the conveyor and adjacent a rivet being identified, and means controlled by the light sensitive element for applying suction to said tube to raise the rivet from the conveyor and deliver it to said receptacle.

7. A rivet sorting device of the type defined in claim 4 in which the members of the conveyor are in the form of threads.

8. Rivet sorting mechanism comprising parallel conveyors, means for arranging rivets on said conveyors with the heads of the rivets resting on the conveyors and with the shanks of the rivets extending downward between the conveyors, and a plurality of extracting devices located along the path of movement of the conveyors and each including an element vertically disposed with respect to the space between the conveyors to raise rivets upward from between the conveyors, said devices each being adjusted to remove rivets of a predetermined size from said conveyors.

9. Rivet sorting mechanism comprising parallel conveyors, means for arranging rivets on said conveyors with the heads of the rivets resting on the conveyors and the shanks of the rivets extending downward between the conveyors, and a plurality of extracting devices located along the path of movement of the conveyors and arranged to raise rivets upward from between the conveyors, said devices each including means located below the conveyors selectively adjusted to cause rivets of predetermined length to be extracted by said devices.

10. Rivet sorting mechanism comprising parallel conveyors, means for arranging rivets on said conveyors with the heads of the rivets resting on the conveyors and the shanks of the rivets extending downward between the conveyors, and a plurality of extracting devices located along the path of movement of the conveyors and arranged to raise rivets from the conveyors, said devices each including means located above the conveyors and vertically disposed with respect to the space between the conveyors for directing the rivets extracted to a separate receptacle and means located below the conveyors selectively adjusted to cause rivets of predetermined length to be extracted by said devices and moved in a direction upwardly from between the conveyors.

11. Rivet sorting mechanism comprising parallel conveyors, means for arranging rivets on said conveyors with the heads of the rivets resting on the conveyors and with the shanks of the rivets extending downward between the conveyors, and a plurality of suction devices located above the conveyors and over the space between the same, and means associated with each of said suction devices for actuating the same to raise rivets of predetermined size from the conveyors when such rivets reach a position beneath said suction device.

12. Apparatus for sorting mixed accumulations of headed articles such as rivets or the like which are characterized by having shanks of different lengths comprising parallel supporting means, means for arranging rivets on said supporting means with the heads of the rivets resting on the supporting means and the shanks of the rivets extending downward between said supporting means, means for successively moving the rivets while so arranged on the supporting means past each of a plurality of stations, and extracting means located at each of said stations including an element disposed vertically with respect to the space between the supporting means each of said extracting means being differently adjusted and operable to raise rivets having a predetermined length of shank upward from between the supporting means.

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