April 18, 1950 D. R. DE TAR 2,504,505

AUTOMATIC CALIPERING AND SORTING MECHANISM

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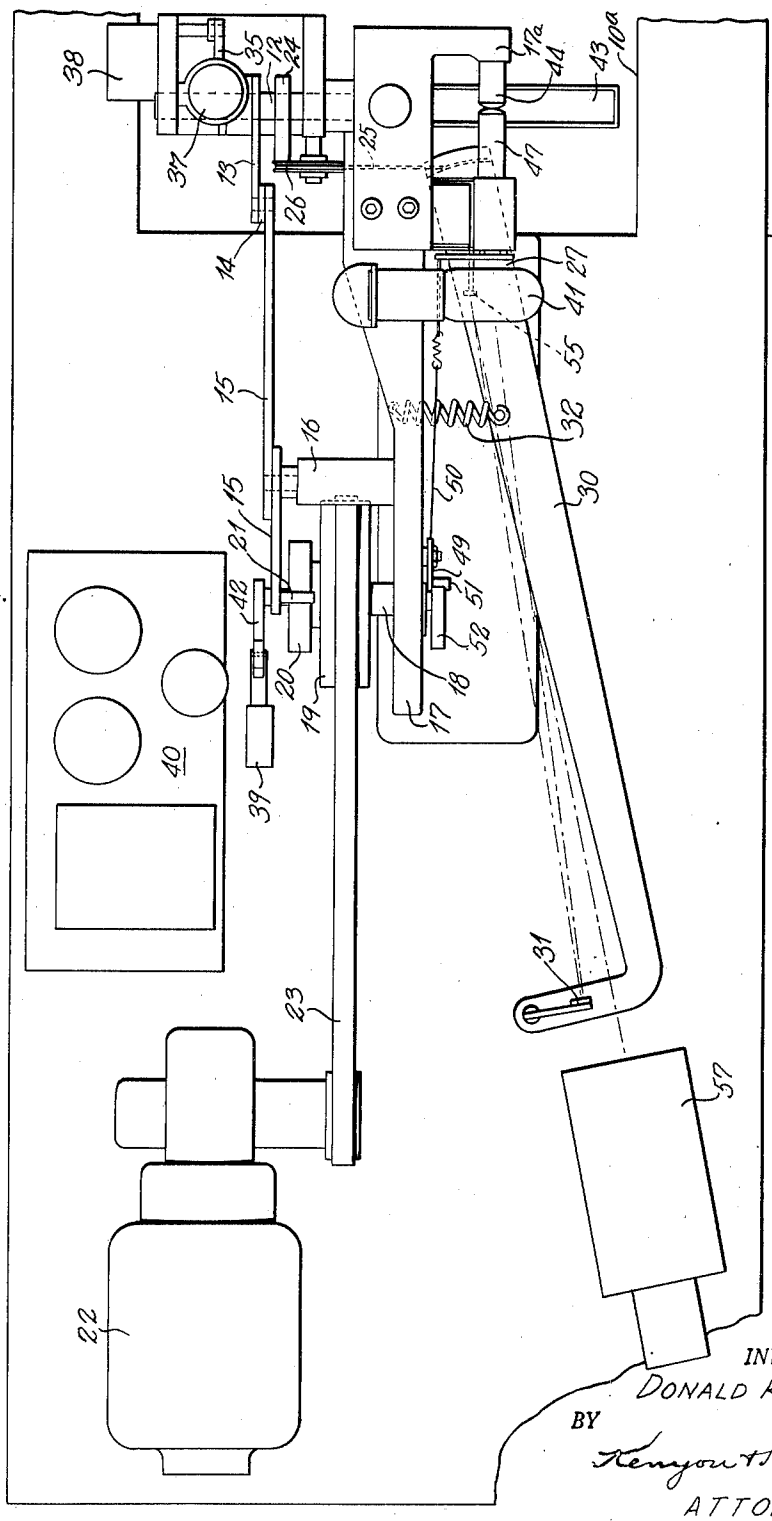


Fig. 1.

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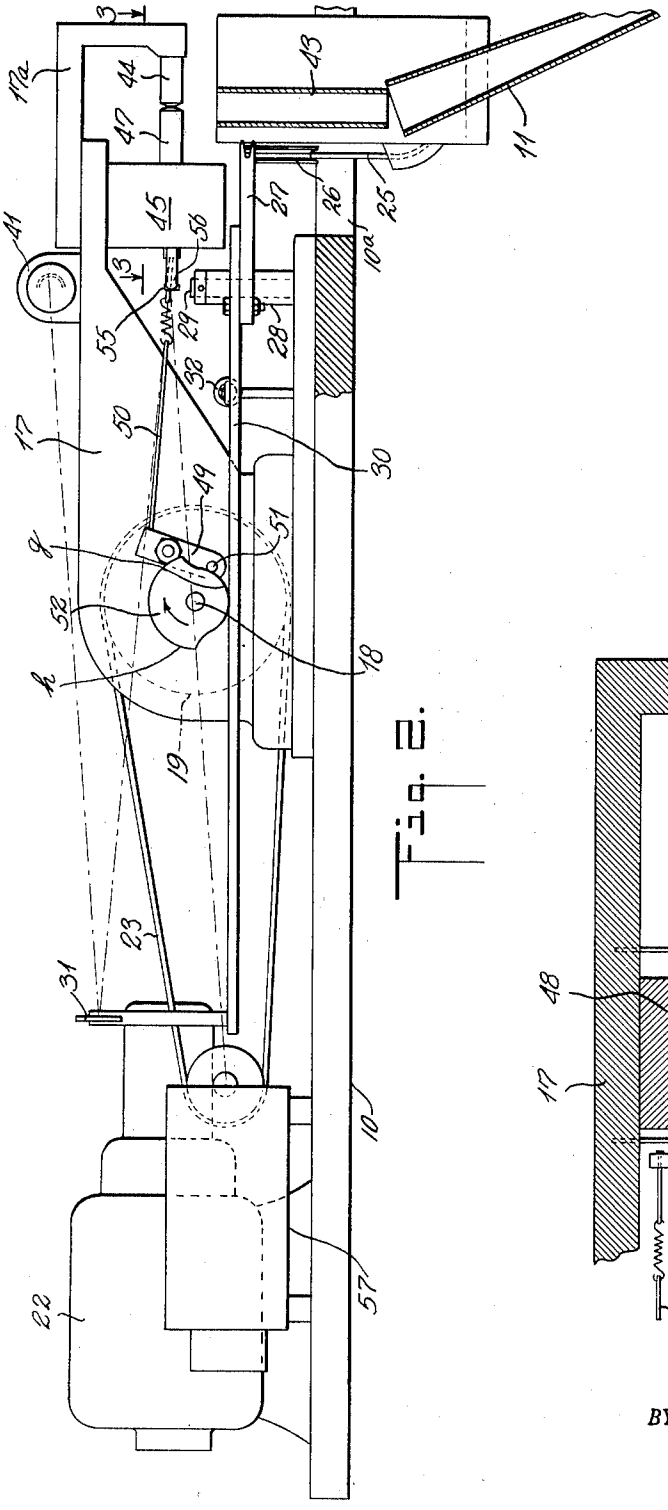
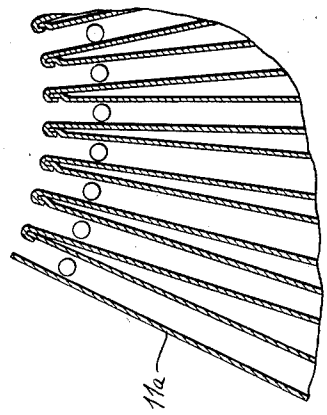


Fig. 2.



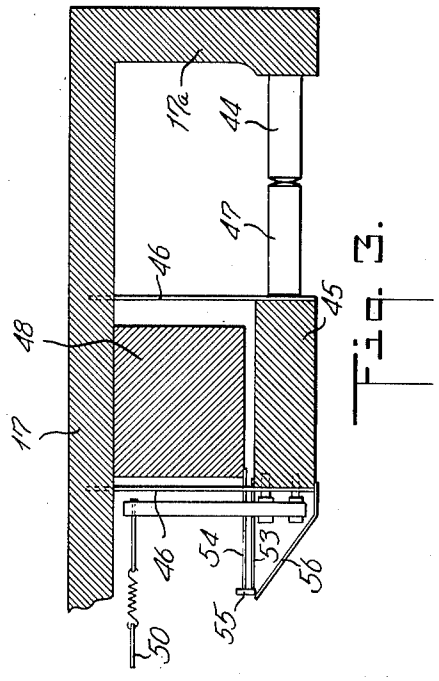


Fig. 3.

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AUTOMATIC CALIPERING AND SORTING MECHANISM

Filed Feb. 15, 1947 3 Sheets-Sheet 3

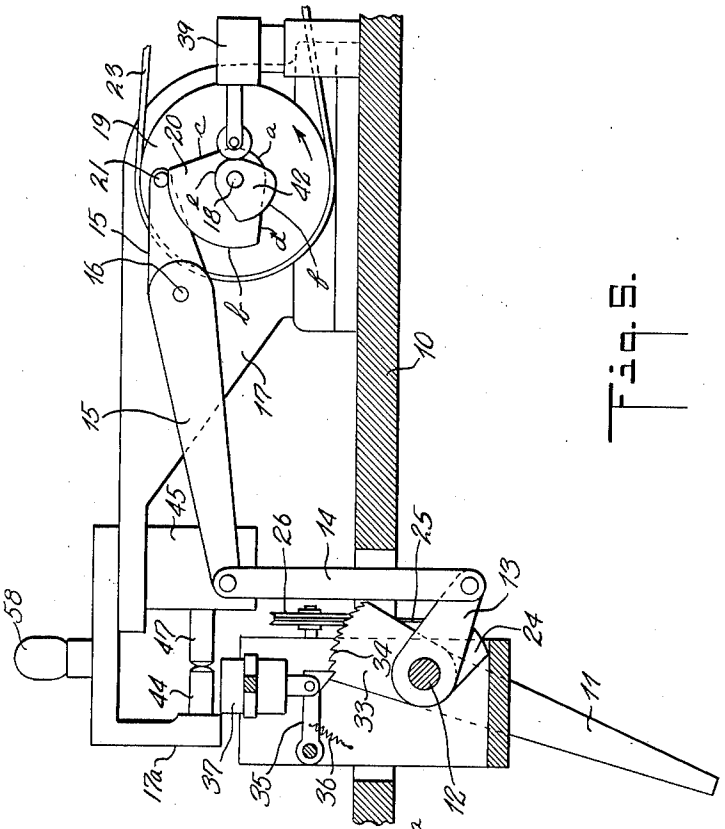


Fig. 5.

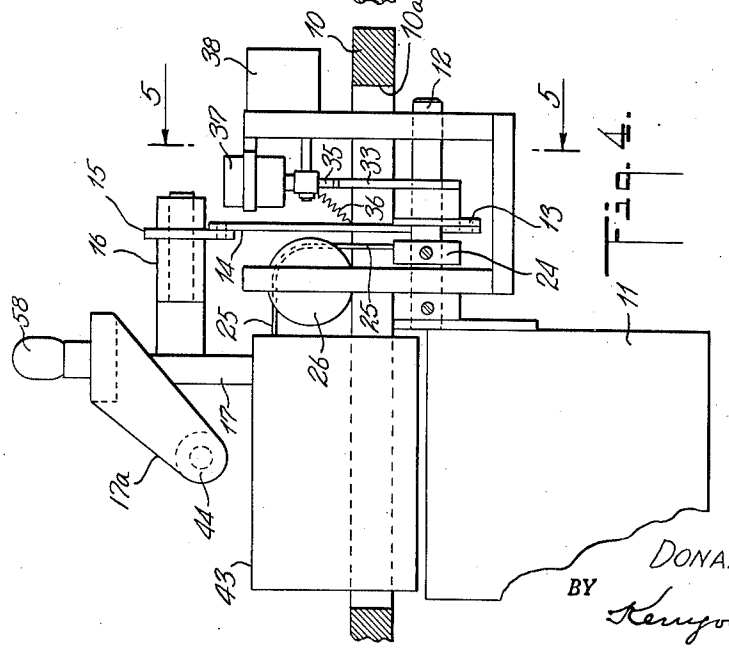


Fig. 4.

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Patented Apr. 18, 1950 2,504,505

UNITED STATES PATENT OFFICE

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AUTOMATIC CALIPERING AND SORTING MECHANISM

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Application February 15, 1947, Serial No. 728,773

29 Claims. (Cl. 209—88)

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This invention relates to automatic sorting mechanisms.

An object of this invention is a relatively simple, highly efficient and comparatively inexpensive mechanism which will accurately gage units with respect to a characteristic thereof and deposit the gaged units in different bins according to the variation of the unit characteristic from a predetermined standard.

A machine embodying the invention utilizes the principle of the optical lever, a device well-known in the art. It also uses photoelectric means for determining the position of the emergent beam of light and an oscillating hopper, communicating selectively with a plurality of stationary bins, for properly disposing of the gaged units. These elements are combined together and with additional elements, namely, a scanning mirror moved in synchronism with the oscillating hopper and arranged to scan all possible positions of the emergent beam and reflect it when intercepted back to a common photocell, and magnetically operated stopping means for arresting the motion of the oscillating hopper when the emergent beam is intercepted by the scanning mirror.

The specific embodiment of the invention herein disclosed is designed specifically to sort parts according to a linear dimension. Such a device is of particular utility in connection with the gaging and sorting of thin mica sheets. Nevertheless, the invention is equally applicable to the gaging and sorting of units according to other physical properties such as weight, color, hardness, etc.

Other objects, novel features and advantages of this invention will become apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a plan view of one embodiment of the invention;

Fig. 2 is a side elevation partially broken away of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is an end view from the right of Fig. 2, and

Fig. 5 is a section on the line 5—5 of Fig. 4.

A table top 10 is provided with an opening 10*a* in which is arranged a chute 11 together with a rotatable horizontal shaft 12 to which the chute is fixed. Below the chute is a series of sorting chutes 11*a* having their upper ends defining an arc concentric with the shaft 12 and extending substantially radially of the shaft axis. An arm 13 carried by the shaft 12 has its free end con-

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nected by a link 14 to one end of a lever 15 pivoted on a pin 16 supported by a bracket 17 mounted on the table top 10. In the bracket 17 is journalled a shaft 18 to which is attached a drive pulley 19 and a cam 20, the surface of which is arranged to co-operate with a follower 21 located at the remaining end of the lever 15. The pulley 19 is driven from a motor 22 through a belt 23. The cam 20 is formed with a short radius arc *a* and a long radius arc *b*, both concentric with the shaft 18 and interconnected by surfaces *c* and *d*.

An arm 24 shaped as a segment of a pulley fixed to the shaft 12 has one end of a cable 25 attached to its free end. The cable 25 passes around an idler pulley 26 located above the shaft 12 and has its remaining end attached to the free end of an arm 27 likewise shaped as a segment of a pulley fixed to a sleeve 28 rotatably mounted on a vertical stud 29 supported by the table top 10. An arm 30 supported by the sleeve 28 and adjustably attached to the arm 27 carries a mirror 31 at its free end. A spring 32 biases the arm 30 clockwise (Fig. 1) and through the cable connection between the arm 30 and the arm 24 also biases the shaft 12 counterclockwise (Fig. 5).

An arm 33 fixed to the shaft 12 is provided at its outer end with a series of ratchet teeth 34. A pivotally supported pawl 35 is provided for cooperation with the ratchet teeth 34 and a spring 36 biases the pawl toward the teeth. A suitably supported solenoid 37 has its plunger connected to the pawl 35 for moving the pawl away from the teeth 34 upon energization of the solenoid. The arrangement of the pawl 34 and ratchet teeth 35 is such as to oppose counterclockwise movement of the shaft (Fig. 5) while at all times permitting clockwise movement of said shaft.

The energizing circuit for the solenoid 37 includes a suitable source of electrical energy (not shown) and the contacts of an electromagnetic relay 38, the coil of which, together with a microswitch 39, is included in the output circuit of a thyratron type electronic relay 40. The relay 38 is so designed that when it is de-energized the solenoid energizing circuit is closed. A photoelectric cell 41 controls the input circuit of the electronic relay 40. The switch 39 is of the self-closing type and has its operating member engaging a cam 42 fixed to the shaft 18 and having two different radius arcuate surfaces *e* and *f* concentric with the shaft. With this arrangement, the switch 39 is closed when its operating member engages the small radius surface *e* and open when said member engages the large radius surface *f*. The electronic relay 40 is so designed that

except when the photoelectric cell 41 is excited, the output of the relay is insufficient to energize the electromagnetic relay 38. Because of the characteristics of the thyratron, the electronic relay after energization remains energized despite de-excitation of the photo-electric cell 41 until the switch 39 is opened.

A stationary chute 43 is located above the upper end of the chute 11 and above the upper end of the chute 43 is arranged a stationary anvil 44 supported by the arm 17a of the bracket 17. A metal block 45 supported from the bracket 17 for movement relative to the anvil 44 by horizontal resilient plates 46 is provided with an extension 47 projecting toward the anvil 44. A metal block 48 is fixed to the bracket 17 in close proximity to the block 45. A lever 49 pivotally supported by the bracket 17 has one end connected by an expansible link 50 to the block 45 and is provided at its other end with a pin 51 which engages a cam 52 fixed to the shaft 18 and having two different diameter concentric arcuate surfaces *g* and *h*. Two thin parallel flexible members 53 and 54 are fixed respectively to the movable block 45 and the fixed block 48 and have their free ends fixed to the rear of a vertical mirror 55. Movement of the block 45 and its extension 47 relative to the anvil 44 causes swinging movement of the mirror 55 to an extent dependent upon the extent of linear movement of the block 45. A third resilient member 56 has one end fixed to the block 45 and its remaining end bearing against the rim of the mirror 55. The arrangement of the surfaces *g* and *h* of the cam 52 is such that with the pin 51 engaging the smaller radius surface *g* the block 45 and projection 47 are at the right end of their path of movement and with the pin 51 engaging the larger radius surface *h* are pulled to the left end of their path (Fig. 2).

A light source 57 projects to the mirror 55 a collimated beam of light which is reflected by the mirror 55 into the path of the mirror 31. The mirror 31 is properly arranged on the arm 30 to reflect to the photoelectric cell 41 the beam of light directed to it by the mirror 55. The location of the arm 30 at which the mirror 31 reflects the beam of light to the photoelectric cell 41 depends upon the angular position of the mirror 55 which in turn depends upon the space relation existing between the ends of the stationary anvil 44 and the projection 47 of the movable member 45.

For the purpose of tracing the cycle of operation of the machine, assume that the arm 30 is in the position shown in Fig. 1 and the chute 11 is in the position shown in Fig. 5 in register with the extreme right chute 11a (Fig. 2). The pin 21 contacts the surface *b* of the cam 20 at the rear end of said surface. The projection 47 is in its extreme rightward position with the pin 51 engaging the lagging end of the surface *g* of the cam 52 and the mirrors 55 and 31 are in position to direct the beam of light from the light source 57 to the photoelectric cell 41 thereby exciting the latter. The switch 39 is closed by engagement of its operating member with the leading end of the surface *e* of the cam 42 and the electronic relay 40 is energized so that the electromagnetic relay 38 is energized, thereby opening the energizing circuit of the solenoid 37. The pawl 35 is biased by the spring 36 into engagement with the extreme left ratchet tooth 34 (Fig. 5). The operation of the machine is such that the pin 21 at times may be prevented from

engaging the surface *a* of the cam 20 except at the trailing end thereof. However, for the purpose of clarifying the sequence of movement of the various parts of the machine, the period of rotation of the cam 20 during which its surface *a* would be engaged by the pin 21, if not prevented, will hereinafter be termed the low dwell period of the cam 20. As the shaft 18 rotates, the surface *b* of the cam 20 moves out from under the pin 21, but the lever 15 remains in the position shown in Fig. 5 by reason of the engagement of the pawl 35 with the extreme left ratchet tooth 34. After sufficient rotation of the shaft 18 for the cam 20 to begin its low dwell period, the surface *h* of the cam 52 engages the pin 51, thereby rocking the lever 49 and through the medium of the link 50 pulling the block 45 to the left and holding it in such position with maximum spacing between the projection 47 and the anvil 44. Further rotation of the shaft 18 brings the surface *f* of the cam 42 into engagement with the operating member of the switch 39 and near the end of the low dwell period of the cam 20 to open the switch thereby de-energizing the electromagnetic relay 38 and effecting energization of the solenoid 37 to lift the pawl 35 away from the ratchet teeth 34. Thereupon, the arm 30 swings clockwise (Fig. 1) and the chute 11 swings counterclockwise (Fig. 5) under the influence of the spring 32 with concomitant clockwise rotation of the lever 15 until the pin 21 engages the surface *d* of the cam 20. Engagement of the pin 21 with the cam surface *d* results in counterclockwise rotation of the lever 15 to return the chute 11 and arm 30 together with the mirror 31 to their original positions, such return being accomplished when the surface *b* of the cam 20 again underlies the pin 21. As the surface *b* progresses along under the pin 21, the surface *e* of the cam 42 engages the operating member of the switch 39 to close the relay 38 energizing circuit which, however, is not energized until the mirrors 55 and 31 are again in such position that the photoelectric cell 41 again is excited, such condition being dependent upon the position of the block 45. Slightly prior to or simultaneously with the opening of the switch 39, the surface *g* of the cam 52 engages the pin 51 to permit rightward movement of the block 45 and projection 47. Assume, however, that before release of the block 45, a piece of mica has been interposed between the projection 47 and the anvil 44. The mirror 55 will now assume a different position from its original position dependent upon the thickness of the mica sheet and a position in which the mirror 31 will not intercept the beam of light reflected by the mirror 55, with the arm 30 in its most counterclockwise position. Consequently, the electronic relay 40 will remain de-energized and the solenoid 37 will remain energized to keep the pawl 35 out of engagement with the ratchet teeth 34. When the surface *b* of the cam 20 again moves out from under the pin 21, the pin will follow the surface *c* of the cam 20 and the lever 15 will rotate clockwise and the chute 11 will rotate counterclockwise under the influence of the spring 32 until the mirror 31 intercepts the beam of light reflected by the mirror 55 and directs the reflected beam to the photo-electric cell 41. The photo-electric cell, upon excitation, causes energization of the electronic relay 40 as previously described to release the pawl 35 which is then drawn by the spring 36 into engagement with the ratchet teeth 34 to prevent further movement

of the chute 11 and the arm 30. The arm 30 and chute 11 are then stopped with the chute 11 in register with one of the chutes 11*a*. The chute 11 and arm 30 are held in this position until the switch 39 is again actuated to energize the solenoid 37 and lift the pawl 35. However, previous to actuation of the switch 39, the block 45 is moved to the left as previously described, thereby releasing the piece of mica and allowing it to drop through the chute 11 into the registering sorting chute 11*a*.

A suitably mounted signal lamp 58 is connected to ground across the switch 39 in such manner that the lamp is lighted when the switch is closed. The lamp, therefore, is out during the period that the projection 47 is in its retracted position. In feeding mica to the machine, the operator places the mica sheet between the projection 47 and anvil 44 during the lightout period and holds it in place until the block 45 is released and the mica sheet is clamped between the projection and the anvil. If the operator drops the mica before it is gripped or the mica is too thin to be gripped, it is delivered by the chute 11 to the extreme right chute 11*a*. If the mica sheet is thick enough to be gripped by the projection 47 and anvil 44, it is eventually dropped into the chute 11*a* with which the chute 11 is brought to rest as above described.

It is of course understood that various modifications may be made in the structure above described, without in any way departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A gaging and sorting device comprising a fixed first member, a second member movable relative to and biased toward said fixed member and adapted to be spaced therefrom in accordance with a dimension of an object being gaged, a swinging chute in alinement with the space between said members, an oscillatable first mirror, a second mirror, a pivoted arm supporting said second mirror for movement along an arcuate path, a light-sensitive element, means for projecting a beam of light to said first mirror, said two mirrors being arranged to direct said beam of light to said light-sensitive element in different relative positions of said mirrors, interconnecting means between said movable member and said first mirror for varying the angular position of said first mirror in response to linear movement of said movable member, means for swinging said arm and chute, and means controlled by said light-sensitive element for interrupting the swinging movement of said arm and chute.

2. A device according to claim 1 characterized by means operated in timed relation to said arm and chute-swinging means for rendering inoperative said interrupting means.

3. A device according to claim 1 characterized by means operated in timed relation to said arm and chute-swinging means for temporarily moving said second member away from said first member.

4. A device according to claim 1 characterized by means operated in timed relation to said arm and chute-swinging means for rendering inoperative said interrupting means, and means operated in timed relation to said arm and chute-swinging means for temporarily moving said second member away from said first member.

5. A gaging and sorting device comprising a fixed first member, a second member movable relative to and biased toward said fixed member and adapted to be spaced therefrom in accordance with a dimension of an object being gaged, a swinging chute in alinement with the space between said members, an oscillatable first mirror, a second mirror, a pivoted arm supporting said second mirror for movement along an arcuate path, a light-sensitive element, means for projecting a beam of light to said first mirror, said two mirrors being arranged to direct said beam of light to said light-sensitive element in different relative positions of said mirrors, interconnecting means between said movable member and said first mirror for varying the angular position of said first mirror in response to linear movement of said movable member, means including a cam and a spring for oscillating said chute and arm, means for operating said cam, and means responsive to said light-sensitive element for locking said arm and chute in any one of several positions against movement by said spring.

6. A device according to claim 5 characterized by means operated in timed relation with said cam for rendering said locking means inoperative.

7. A device according to claim 5 characterized by means operated in timed relation with said cam for temporarily moving said second member away from said first member.

8. A device according to claim 5 characterized by means operated in timed relation with said cam for rendering said locking means inoperative, and means operated in timed relation with said cam for temporarily moving said second member away from said first member.

9. A gaging and sorting device comprising a fixed first member, a second member movable relative to and biased toward said fixed member and adapted to be spaced therefrom in accordance with a dimension of an object being gaged, a swinging chute in alinement with the space between said members, an oscillatable first mirror, a second mirror, a pivoted arm supporting said second mirror for movement along an arcuate path, a light-sensitive element, means for projecting a beam of light to said first mirror, said two mirrors being arranged to direct said beam of light to said light-sensitive element in different relative positions of said mirrors, interconnecting means between said movable member and said first mirror for varying the angular position of said first mirror in response to linear movement of said movable member, means including a cam and a spring for oscillating said chute and arm, means for operating said cam, a biased latch member for locking said arm and chute in any one of several positions against movement of said spring, and a solenoid controlled by said light-sensitive element for rendering said latch inoperative.

10. A device according to claim 9 characterized by means operated in timed relation with said cam for controlling the energization of said solenoid.

11. A device according to claim 9 characterized by means operated in timed relation with said cam for temporarily moving said second member away from said first member.

12. A device according to claim 9 characterized by means operated in timed relation with said cam for controlling the energization of said solenoid, and means operated in timed relation with said cam for temporarily moving said second member away from said first member.

13. A gaging and sorting device comprising an oscillatable first mirror, a second mirror, a pivoted arm supporting said second mirror for movement along an arcuate path, a light-sensitive element, means for projecting a beam of light to said first mirror, said two mirrors being arranged to direct said beam of light to said light-sensitive element in different relative positions of said mirrors, gaging means including means for varying the angular position of said first mirror in response to a characteristic of the unit being gaged, an arm and chute and means for swinging said arm and chute, and means controlled by said light-sensitive element for interrupting the swinging movement of said arm and chute.

14. A device according to claim 13 characterized by means operated in timed relation to said arm and chute-swinging means for rendering inoperative said interrupting means.

15. A device according to claim 13 characterized by means operated in timed relation to said arm and chute-swinging means for temporarily moving said second member away from said first member.

16. A device according to claim 13 characterized by means operated in timed relation to said arm and chute-swinging means for rendering inoperative said interrupting means, and means operated in timed relation to said arm and chute-swinging means for temporarily moving said second member away from said first member.

17. A device as in claim 5 in which said means responsive to said light sensitive element comprises an electromagnetic relay adapted upon energization of said light sensitive element to lock said arm and chute.

18. A device for gaging and sorting objects according to a selected property thereof comprising object-gaging means including a first member and a movable member adapted to be spaced from said first member by a degree of spacing indicative of said property of a given object to be gaged, a sorting device adapted to direct said given object after gaging by said gaging means to an assortment point corresponding to said degree of spacing and second means for moving said sorting device throughout a plurality of positions corresponding to a plurality of such assortment points, a first mirror and means connecting said movable member to said first mirror for varying the position thereof to correspond to the position of said movable member, means for projecting a beam of light to said first mirror, a second mirror, and third means movable in synchronism with said second means for moving said second mirror throughout a scanning path including substantially all possible positions of the reflection of said beam from said first mirror, a light-sensitive element, said mirrors being arranged to reflect said beam to said light-sensitive element when said sorting means is at an assortment point corresponding to said degree of spacing, and means controlled by said light-sensitive element for arresting the motion of and fixing the position of said sorting means at the latter assortment point when said beam impinges on said light-sensitive element.

19. A device as in claim 18 including means operated in timed relation to the means moving said sorting device and second mirror for rendering said last-mentioned means inoperative to arrest motion of said sorting means at predetermined positions thereof.

20. A device as in claim 19 including cyclically operable means for causing said movable member and said sorting device to move cyclically throughout a plurality of positions corresponding to said property of different such objects, said cyclically operable means including elements operable in timed relation to render said means controlled by said light sensitive element operative and inoperative to arrest motion of said sorting device as aforesaid.

21. A device for gaging and sorting objects according to a selected dimension thereof comprising means for gaging said dimension including a first member and a second member so movable with respect to said first member that said members are adapted to engage therebetween a given object at opposite ends of said dimension, a sorting device adapted to direct said given object after gaging by said gaging means to an assortment point corresponding to the said dimension thereof and second means for moving said sorting device throughout a plurality of positions corresponding to a plurality of such assortment points, a first mirror and means connecting said movable second member to said first mirror for varying the position thereof to correspond to the position of said movable member, means for projecting a beam of light to said first mirror, a second mirror, and third means movable in synchronism with said sorting device for moving said second mirror throughout a scanning path including substantially all possible positions of the reflection of said beam from said first mirror, a light-sensitive element, said mirrors being arranged to reflect said beam to said light-sensitive element when said sorting means is at an assortment point corresponding to said dimension of said given object, and means controlled by said light-sensitive element for arresting the motion of and fixing the position of said sorting means at the latter assortment point when said beam impinges on said light-sensitive element.

22. A device as in claim 21 including means operated in timed relation to the means moving said sorting device and second mirror for rendering said last-mentioned means inoperative to arrest motion of said sorting means at predetermined positions thereof.

23. A device as in claim 22 including cyclically operable means for causing said second movable member and said sorting device to move in timed relation cyclically throughout a plurality of positions corresponding to said dimension of different such objects, said cyclically operable means including elements operable in timed relation to render said means controlled by said light-sensitive element operative and inoperative to arrest motion of said sorting device as aforesaid.

24. A device for gaging and sorting objects according to a selected dimension thereof comprising means for gaging said dimension including a first member and a second member so movable with respect to said first member that said members are adapted to engage therebetween a given object at opposite ends of said dimension, a sorting device adapted to direct said given object after gaging by said gaging means to an assortment point corresponding to the said dimension thereof, a cyclically operable mechanism for periodically withdrawing said second member from said first member whereby said given object may be placed therebetween for gaging, a cyclically operable mechanism for periodically driving said sorting device throughout a plurality of positions corresponding to a plurality of assortment points corresponding to

said dimension of different such objects, a first mirror and means connecting said movable second member to said first mirror for varying the position thereof to correspond to the position of said movable member, means for projecting a beam of light to said first mirror, a second mirror and means movable in synchronism with said sorting device for moving the same throughout a scanning path including substantially all possible positions of the reflection of said beam from said first mirror, a light-sensitive element, said mirrors being arranged to reflect said beam to said light-sensitive element when during the cycle of said mechanisms said sorting means is at an assortment point corresponding to said dimension of said given object, and means controlled by said light-sensitive element for arresting the motion of and fixing the position of said sorting means at the latter assortment point when said beam impinges on said light-sensitive element, said cyclically operable mechanisms being so operable in timed relation to each other that said arresting and fixing occurs after said gaging.

25. A device as in claim 24 including cyclically operable means operated in timed relation to said cyclically operable mechanism for periodically rendering said last-mentioned means inoperative to arrest motion of said sorting means.

26. A device as in claim 25 in which said means controlled by said light-sensitive element comprises a thyratron type relay energized when said light-sensitive element receives said beam and means actuatable by said relay when energized for arresting and fixing as aforesaid, and said cyclically operable means comprises a cyclically operable switch for cyclically deenergizing said relay.

27. A device for gaging and sorting objects according to a selected dimension thereof comprising means for gaging said dimension including a first member and a second member so movable with respect to said first member that said members are adapted to engage therebetween a given object at opposite ends of said dimension, a sorting chute adapted to receive and direct said given object after gaging by said gaging means to an assortment point corresponding to the said dimension thereof, a cyclically rotatable member having thereon a plurality of cams including a first such cam for periodically withdrawing said second member from said first member whereby said given object may be placed therebetween for gaging and a second cam for periodically driving said chute

throughout a plurality of positions corresponding to a plurality of assortment points corresponding to said dimension of different such objects, a first mirror, and means connecting said movable second member to said first mirror for varying the position thereof to correspond to the position of said movable member, means for projecting a beam of light to said first mirror, a second mirror and means movable in synchronism with said chute for moving the same throughout a scanning path including substantially all possible positions of the reflection of said beam from said first mirror, a light-sensitive element, said mirrors being arranged to reflect said beam to said light-sensitive element when during the cycle of said rotatable member said chute is at an assortment point corresponding to said dimension of said given object, and means controlled by said light-sensitive element for arresting the motion of and fixing the position of said chute at the latter assortment point when said beam impinges on said light-sensitive element, said cams being arranged such that said arresting and fixing occurs after said gaging.

28. A device as in claim 27 including a third cam on said rotatable member and a switch in the circuit of said last mentioned means, said third cam being arranged to actuate said switch periodically for periodically rendering said last-mentioned means inoperative to arrest motion of said sorting means.

29. A device as in claim 28 in which said means controlled by said light-sensitive element comprises a thyratron type relay energized when said light sensitive element receives said beam and means actuatable by said relay when energized for arresting and fixing as aforesaid, and in which said switch is in the input circuit of said relay whereby said relay is periodically deenergized by said switch.

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