

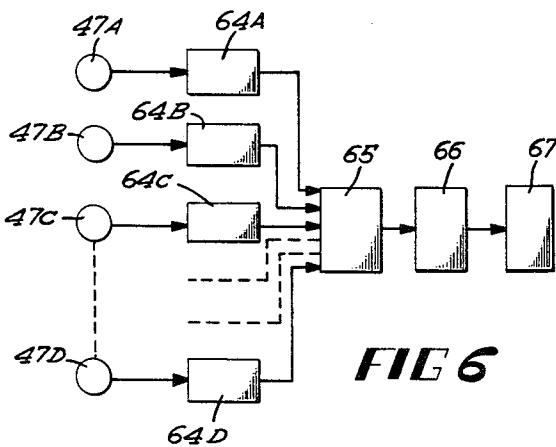
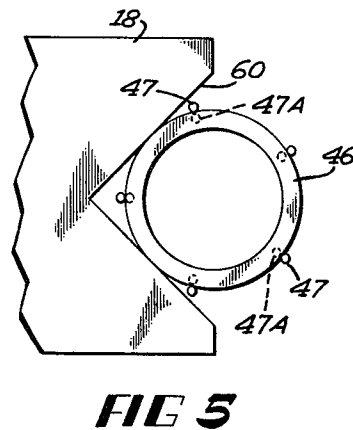
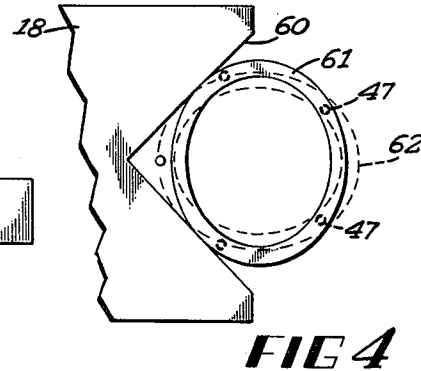
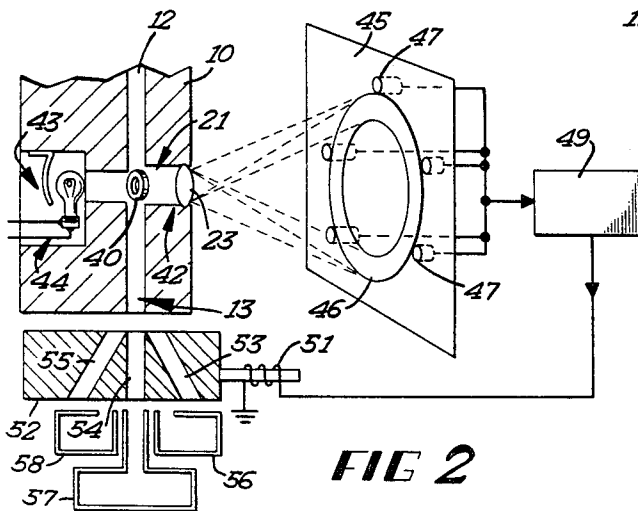
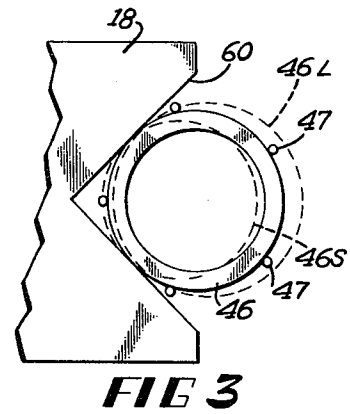
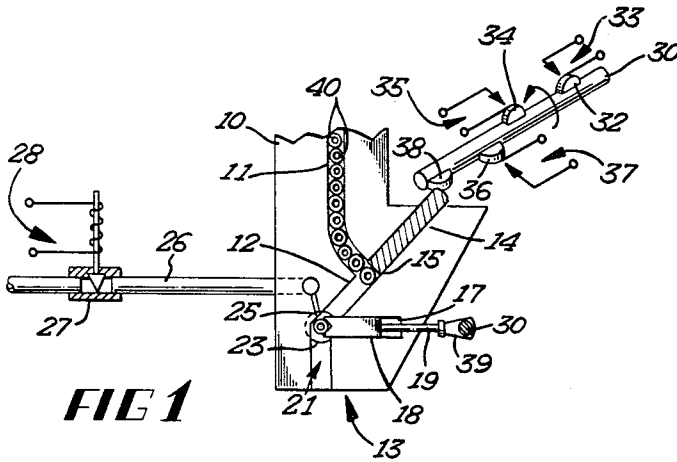
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COMPONENT SIZING APPARATUS

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COMPONENT SIZING APPARATUS

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ABSTRACT OF THE DISCLOSURE

Sizing apparatus for magnetic elements comprising a body having a pair of intersecting bores. Elements are put into the body through an egress in the first bore to fall by gravity to the point of intersection of the bores. A reciprocating plunger with a magnetic tip is mounted in the second bore such that it will hold an element which reaches the intersection, and will carry that element through the second bore to a point of inspection, while at the same time blocking the fall of any other elements from the point of intersection. At the inspection station a V-shaped calibration member grasps the element from the magnetic tip and holds it at the inspection station while the plunger reciprocates to pick up another element. While held in the V-shaped member, the element is inspected by photoelectric means which in turn determine the placement of the element after ejection from the body. Following the inspection, a pneumatic jet is provided to knock the element from grasp of the V-shaped member for ejection from the body.

This invention is concerned with component sizing apparatus, and more particularly with apparatus for the checking of linear dimensions of components.

Modern production techniques call for the handling of an immense number of assorted components. A constant effort is being made by those skilled in the art to create improved methods of handling these components. Preferably, such methods are automatic to avoid the element of human error. The apparatus of this invention provides automatic handling apparatus for the sorting of components by size. An example of the type of component which can be sorted with the apparatus of this invention is the well known toroidal magnetic core. Millions of these cores may be used in the memory of a single computer. Before the cores can be connected into a memory array, they must be sorted and properly placed. Apparatus for the placement of such cores has been described in a copending application by the inventor of the apparatus of this invention, entitled Component Placement Apparatus, Ser. No. 496,048, filed Oct. 14, 1965. The apparatus of this invention is primarily concerned with the automatic sizing of components such as magnetic cores, and uses a portion of the apparatus described in the copending application.

Briefly described, the apparatus of this invention comprises a body having therein at least first and second intersecting bores. A plurality of components are serially fed into the first bore. A plunger having a grasping tip is reciprocally mounted in the second bore, such that in a first position the tip grasps components from the first bore at the intersection between the two bores. Apparatus is provided to reciprocate the plunger to move a grasped component to an inspection station within the second bore. Mounted contiguous with the inspection station and in the body is a reciprocally mounted holder. The holder grasps the component from the plunger to hold it at the inspection station for sizing. Projection members are provided at the inspection station to cast an image of the component onto a screen member. Placed in a predetermined pattern on the screen member are a plurality of light-responsive devices. The pattern of the light-

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responsive devices is such that an image of predetermined size and shape will cause a predetermined response from the members. The response from the light-responsive members is felt by electrical circuitry which provides signals to a movable component direction block mounted adjacent the body. Thus, if the image is misshapen or normal, a separate signal is sent via the light-responsive devices and the electrical circuitry to move the component direction block beneath the body, so that when the sized component is ejected from the body, it can be directed through a proper channel in the block to a proper storage area, depending on its size. Ejection of a sized component is accomplished by providing a fluid blast through a jet port contiguous with the inspection station, which blast knocks a sized component from the holder and out of the body.

It will be apparent from the ensuing discussion that the steps in sizing of a particular component, that is, carrying the component to the inspection station, holding the component, sizing the component, and ejecting the component, for example, must be properly timed, and that a variety of devices can be used to accomplish the actions and the timing of the actions. In the ensuing discussion a cam shaft and cams will be described as the actuating and timing devices. However, it will be apparent that many other devices could serve as well.

In the drawings:

FIG. 1 is a plan view of an embodiment of the apparatus of this invention showing a section through a body incorporating the apparatus of this invention, and representatively showing mechanical actuating and timing means;

FIG. 2 is a sectional view of a portion of the apparatus of FIG. 1, also showing additional apparatus of this invention used for the sizing of components;

FIG. 3 is a view of a portion of the apparatus of this invention representatively showing how sizing of components such as magnetic cores is accomplished;

FIG. 4 is a view similar to that of FIG. 3, showing how sizing of oblong magnetic cores is accomplished;

FIG. 5 is another view similar to that of FIGS. 3 and 4, showing a second or alternate method of sizing components such as magnetic cores; and

FIG. 6 is a block schematic diagram of electrical circuitry exemplary of that used with the apparatus of this invention.

Description of figures

Referring first to FIG. 1 there is disclosed a sectional view of a body 10. Body 10 can be similar to the core gun of the copending application cited above. Within body 10 there are formed two intersecting bores 11 and 12. Bore 11 provides an egress through which a plurality of components 40 are serially fed from component feeding apparatus (not shown) such as that described in the copending application. In this preferred embodiment components 40 are shown as toroidal magnetic cores. Bore 12 provides an exit 13 from body 10 for sized components or cores 40. Within bore 12 there is mounted carrying means including a plunger 14 having a carrying tip 15. For magnetizable components 40, such as magnetic cores, tip 15 can be magnetic to grasp components 40. Plunger 14 and tip 15 are reciprocally mounted within bore 12. Plunger 14 is shown in its retracted position, and it will be understood that plunger 14 is extended through bore 12 to provide a component 40 to an inspection station 21 shown within bore 12.

Also shown in FIG. 1 is a cavity 17 in which there is reciprocally mounted a holder 18 connected to a cam follower 19. Holder 18 is reciprocated from a withdrawn position within cavity 17 to a position within inspection station 21 where it holds a component 40.

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Also shown in FIG. 1 is a projection lens 23, the positioning of which is best described in the following description of FIG. 2. Opening into bore 12 at inspection station 21 is a jet port 25. Port 25 is connected by a tubular member 26 to a source of fluid energy (not shown), such as air pressure. Disposed within tubular member 26 is a valve 27, here shown controllable by a solenoid 28.

Also shown in FIG. 1, in representative form as being operably connected to the above described apparatus, is a cam shaft 30 including a plurality of cams 32, 34, 36, 38, and 39. As cam shaft 30 is rotated it provides actuation and timing of the various functions of the apparatus of this invention. For example, cam 32 can actuate switch 33 which can be connected to delivery apparatus such as that described below. Cam 34 can actuate, in proper sequence, a switch 35 for energizing electrical circuitry such as that described below. Cam 36, in turn, can actuate a switch 37 for energizing solenoid 28. Cam 38 can provide actuation of the reciprocal motion of plunger 14. And cam 39 can provide the reciprocating motion of holder 18 as connected to cam follower 19. It should be understood that shaft 30 and its associated cams are intended merely to be representative of any one of a number of mechanical or electrical actuating and timing devices which can be used with the inventive apparatus described herein.

Referring now to FIG. 2, there is again shown a portion of body 10, including bore 12, exit 13, and inspection station 21. One of components or cores 40 is shown at inspection station 21. For purposes of clarity, holder 18 which holds component 40 at station 21 is deleted from the drawing of FIG. 2.

Contiguous with inspection station 21 in bore 12 there are shown a pair of cavities 42 and 43. Here it can clearly be seen that projection lens 23 is mounted within cavity 42, while within cavity 43 there is mounted a light source 44. Source 44 and lens 23 are in spaced relation on opposite sides of station 21 to provide an image 46 of component 40 on a screen member 45. Mounted in a predetermined pattern on screen member 45 are a plurality of light-responsive devices 47, here shown as photo-cells. Photo-cells 47 are electrically connected to electrical selection circuitry 49. Circuitry 49 is electrically connected to provide an actuation signal to a solenoid 51 which in turn is connected to a movable delivery block 52. Within block 52 are a plurality of delivery channels 53, 54, and 55. Block 52 is shown to be movably mounted adjacent exit 13 from body 10, such that movement of block 52 places the selected egress of channel 53, 54 or 55 below exit 13 for receiving sized components 40. Mounted adjacent block 52 there are shown a plurality of storage members, here shown as storage bins 56, 57 and 58. Bins 56, 57 and 58 are placed such that components delivered by channel 53 enter bin 56, components delivered by channel 54 enter bin 57, and components delivered by channel 55 enter bin 58.

Referring now to FIG. 3 there is shown a portion of holder 18. It is apparent that holder 18 includes a calibrated V-shaped groove 60. Groove 60 is calibrated such that each of the legs of the V will touch a core or component 40 of predetermined size at precisely two tangential points, and hold the core 40 at a predetermined position within projection station 21, such that image 46 of a core 40 will fall at a predetermined position on screen member 45.

In FIG. 3 it is shown that the pattern of light-responsive devices 47 is such that when a core 40 of predetermined dimensions is held by groove 60 in holder 18, image 46 will not cover any of light-responsive devices 47. Dotted line 46L in FIG. 3 indicates the image of the outer circumference of a core 40 which is larger than the predetermined size. It is apparent that the two legs of V-groove 60 will touch core 46L at two different points, thus causing image 46L to fall on one or more of light-responsive devices 47. Dotted line 46S shown in FIG. 3

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indicates that a small core will be held at still different points by groove 60 in holder 18, thus causing image 46S to fall on other of light-responsive devices 47.

In FIG. 4 there is again shown a portion of holder 18 including V-groove 60. Here again, light-responsive devices 47 are indicated as being in a similar pattern as in FIG. 3. In FIG. 4 there is shown for exemplary purposes an oblong or elliptically shaped core. There is shown an elliptical core in solid lines having its major axis in a vertical position, and designated for purposes of discussion 61. In dotted lines there is shown an elliptical core having its major axis in the horizontal direction, and designated 62. It is apparent that the image of each of cores 61 and 62 falls on one or more of light-responsive devices 47, thus giving a signal that the core is not circular.

Referring now to FIG. 5 there is again shown a portion of holder 18 including V-groove 60. There is also shown a core 40 which would provide a representative image 46 on screen member 45, image 46 being of the predetermined size. In FIG. 5 there is again shown the same predetermined pattern of light-responsive devices 47, but there is an additional set of light-responsive devices 47A, each shown paired with one of light-responsive devices 47. The apparatus of FIG. 5 provides an alternate embodiment for sizing of cores, as will be more fully described below.

In FIG. 6 there is shown a block diagram schematic of an embodiment of electrical circuitry which can be used with the apparatus of this invention. Here a plurality of light-responsive devices 47a, 47b, 47c and 47d are each shown connected to a trigger circuit, designated respectively, 64a, 64b, 64c, 64d. Each of trigger circuits 64a-64d have an output connected to a logic gate 65. Logic gate 65 is in turn shown connected to an amplifier circuit 66, the output of which can be used to actuate a device here designated generally as 67.

Operation

The operation of the apparatus of this invention will now be described with reference to all the figures of the drawings. A plurality of components or cores 40 are serially fed through bore 11 to the intersection of bores 11 and 12. Assuming plunger 14 to be in its retracted position, such that tip 15 is adjacent the intersection, tip 15 will grasp a component 40 at the intersection and hold it there. The construction of bores 11 and 12 is such that no further of components 40 enter channel 12 when one component 40 is being held at the intersection by tip 15.

As cam shaft 30 rotates, cam 38 interacts to push plunger 14 down through bore 12 to its extended position such that tip 15 carries a core 40 to inspection station 21. The timing of the apparatus is such that as tip 15 reaches inspection station 21, cam 39 acts on cam follower 19 to cause holder 18 to move from its retracted position within cavity 17 to its extended position to transfer core 40 from tip 15 and grasp it in V-groove 60. Tip 15 holds core 40 lightly enough so the transfer to holder 18 is easily made. Note that for magnetizable components such as toroidal magnetic cores holder 18 can also be magnetic.

As core 40 is held at station 21, light source 44 in conjunction with projection lens 23 will cause image 46 of component 40 to impinge on screen member 45. Assuming first that core 40 is of a predetermined desired size, image 46 will not impinge upon any of light-responsive devices 47, as is best seen in FIG. 3. Thus a first electrical signal will be derived from devices 47 which will, for example, when cam 34 actuates switch 35, be sensed by electrical circuitry 49, which will in turn send a signal to solenoid 51 to move delivery block 52.

Depending on the signal from circuitry 49, block 52 will be moved to place the proper of delivery channels 53, 54 or 55 beneath exit 13 of body 10. In the above described case of a component 40 of desired size, block 52 will be moved to place the egress of channel 54 adjacent exit 13.

As shaft 30 continues to rotate, cam 36 will actuate switch 37, to in turn actuate solenoid 28 to open valve 27. A fluid blast will then pass through tubular member 26 to enter chamber 21 through jet port 25. The fluid blast will knock component 40 from the grasp of holder 18, and out exit 13 to be delivered through channel 54 to a proper storage area such as bin 57.

Assuming now that the core 40 at inspection station 21 is of a larger than desired dimension, it will be apparent from FIG. 3 that certain of devices 47 will be covered by the image 46L of the large core 40. Thus the signal from devices 47 to circuitry 49, when switch 35 is actuated by cam 34, will be different than that described above for a core 40 of desired size. In this case, block 52 will move to position the egress of channel 55 below exit 13. Now when cam 36 causes switch 37 to close, thus actuating valve 27, the fluid blast will cause the core to fall through channel 55 and into a proper storage area for large components, such as bin 58.

Assuming now that the core 40 at inspection station 21 is smaller than the desired size, image 46S in FIG. 3 will cover different ones of devices 47 than did image 46L. When electrical circuitry 49 is actuated, a still different signal will be sent to solenoid 51 for the movement of block 52. In this case, the egress of channel 53 will be placed adjacent exit 13, so that ejection of the small component 40 will cause the small component to fall through channel 53 to a proper storage area, such as bin 56.

If the core 40 is oblong it will be ejected through either of channels 53 or 55, but never through channel 54.

In FIG. 4 it will be apparent how similar operation of the apparatus of this invention will detect deformed or oblong components. Oblong component 61, which has its major axis in the vertical position, will cover certain of light-responsive devices 47, causing another signal for actuation of block 52. Oblong component 62, which has its major axis in a horizontal position, will cover other of light-responsive devices 47 to provide yet another signal to block 52.

At this point it is important to note that the apparatus of this invention can also be operated as a "go-no-go" sizer. That is, cores of a desired size could be sent through a first channel in block 52 to a desired storage area, while all unacceptable cores, that is, cores other than the desired size, could be sent through a single second channel to a reject storage area, without the sizing as to being too large or too small, as is described above. It will also be apparent that other forms of delivery devices than block 52 will serve as well.

FIG. 5 indicates an alternate inspection apparatus which can be used with the apparatus of this invention. In this case, each of light-responsive devices 47 is paired with another light-responsive device 47A. For purposes of clarity a core having a desired image 46 is shown in FIG. 5. Here it is seen that all of light-responsive devices 47A will be covered by image 46, while all of light-responsive devices 47 will be uncovered. It will be apparent that this gives another form of signal to electrical circuitry, such as circuitry 49, for the selection of a storage area. It will also be apparent that components or cores 40 which are larger or smaller than the component which caused the image 46 of FIG. 5 will uncover certain of light-responsive devices 47A, while covering other of light-responsive devices 47. It will be apparent that this is just another way to derive a signal for proper actuation of the storage selection apparatus here comprising electrical circuitry 49, and block 52.

The block diagram of FIG. 6 is offered as one form of electrical circuitry 49 which can be used with the apparatus of this invention. In this case, each of light-responsive devices 47, here shown as devices 47A, 47B, 47C and 47D, has an input to a corresponding trigger circuit, such as the well known Schmitt Trigger. The output of trigger circuits 64A-64D are connected to a logic circuit 65. Circuit 65 performs logic on the signals from light-responsive devices 47A-47D to provide one of many

signals to, for example, an amplifier 66. Amplifier 66 in turn provides the actuation signal to the device that it is desired to actuate, here designated 67. Device 67 could be a solenoid such as solenoid 51, or one of many other devices which would cause proper selection of a storage area.

It will be apparent that the above described apparatus provides a unique automatic device for the sizing of components, such as toroidal magnetic cores. As has been mentioned throughout the above description of both the figures and operation of the apparatus, various portions of the apparatus could assume different forms without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Component sizing apparatus comprising:
 - a body;
 - at least a pair of intersecting bores in said body;
 - means for providing components to be sized;
 - a first of said bores providing an egress to receive components into said body from said means for providing components;
 - a second of said bores providing an exit for sized components from said body;
 - a plunger reciprocally mounted in said second bore and having means for grasping the components; and
 - means for reciprocating said plunger to carry components from the intersection of said bores to an inspection station in said second bore.
2. The apparatus of claim 1 in which said means for grasping the components comprises a magnetic tip.
3. The apparatus of claim 1 including:
 - a first cavity formed in said body contiguous with said inspection station in said second bore;
 - holding means reciprocally mounted in said first cavity;
 - means for reciprocating said holding means to grasp components from said carrying means and hold the components at said inspection station for sizing.
4. The apparatus of claim 3 in which said holding means comprises:
 - a V-shaped member calibrated to contact a component of predetermined size at selected points on the component.
5. The apparatus of claim 4 in which said V-shaped member is magnetic.
6. The apparatus of claim 3 in which said inspection means comprises:
 - first and second cavities formed in said body in spaced relation and on opposite sides of said inspection station;
 - a source of light mounted in said first cavity;
 - a projection lens mounted in said second cavity; and
 - said source of light and said projection lens cooperating to project an image of a component at said inspection station.
7. The apparatus of claim 6 in which said means responsive to said inspection means comprises:
 - screen means for receiving the projected image of components;
 - a plurality of photo-sensitive means mounted on said screen means in a predetermined pattern;
 - electrical circuitry means connected to said photo-sensitive means for deriving a signal therefrom dependent on the relative positions on said screen means of the image and said photo-sensitive means; and
 - storage direction means responsive to signals from said electrical circuitry means for directing sized components to proper storage areas after the components leave said body at the exit.
8. The apparatus of claim 7 in which said storage detection apparatus comprises:
 - a block movably mounted adjacent the exit of said body;
 - said block including a plurality of channels each having a separate channel egress and channel exit; and

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means connecting said block to said electrical circuitry means for movement of said block in response to signals from said circuitry means, the movement adapted to place a selected one of said channel egresses adjacent the exit from said body for receiving sized components and directing the components through said selected channel to a proper storage area.

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9. The apparatus of claim 6 including component ejection means comprising:

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jet port means in said body and contiguous with said second bore and said inspection station; and

fluid pressure means connected to said jet port for providing a fluid jet into said inspection station for

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dislodging a component from said holding means and ejecting the component from said body through the exit.

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