United States Patent [19]

Smith

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[54] **SORTING DEVICE FOR CORE HANDLER**

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[52] **U.S. Cl.**.....**209/74,** 193/31 A

[51] **Int. Cl.**.....**B07c 5/00**

[58] **Field of Search**.....209/74, 81; 193/31 R, 31 A

[56] **References Cited**

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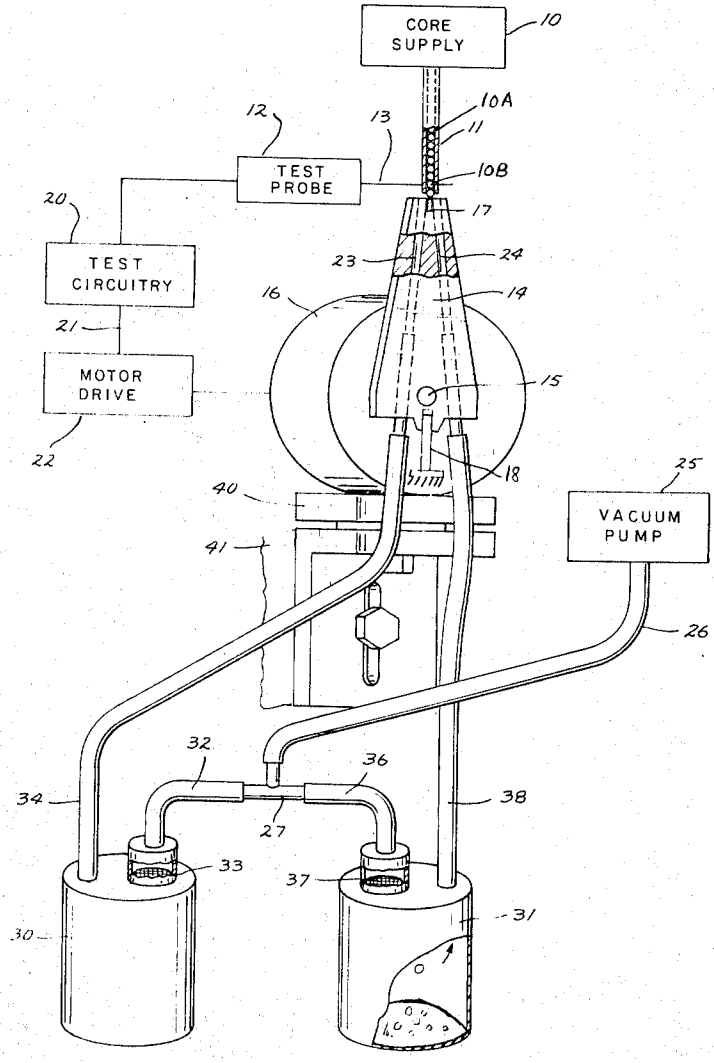
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[57] **ABSTRACT**

A sorting mechanism for magnetic core handlers utilizing a sort gate or block that is provided with tubular openings, and is directly attached to the output shaft of a conventional stepper motor that has a shaft which can be rotated between a neutral position and at least one position from neutral. The gate is shifted directly by the movement of the motor shaft in response to a test signal for a core being tested, and suitable vacuum means can be supplied to the sorting chambers to exert a vacuum force to pull tested cores through the properly aligned opening in the sort block.

20 Claims, 3 Drawing Figures



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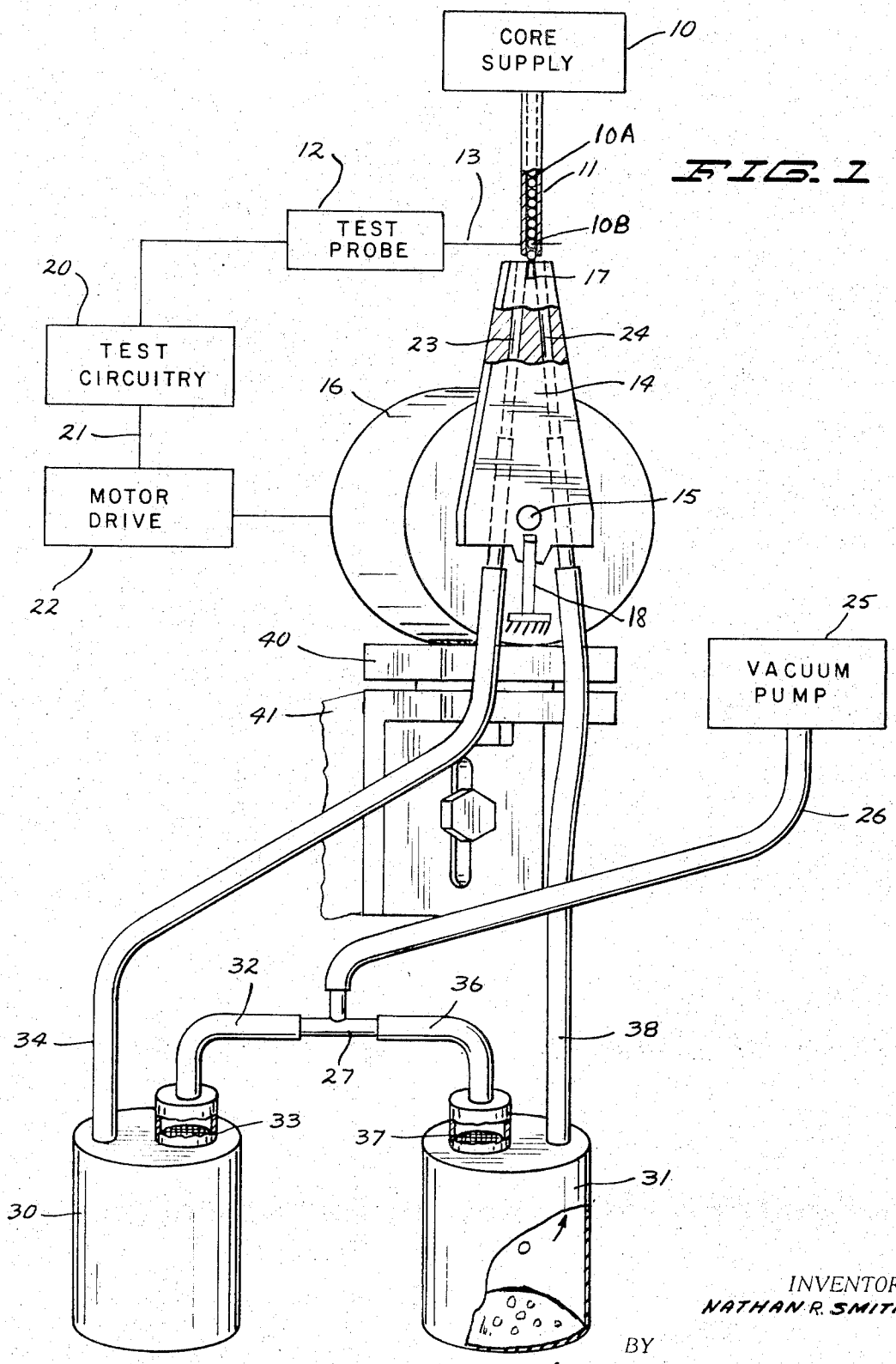


FIG. 1

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FIG. 2

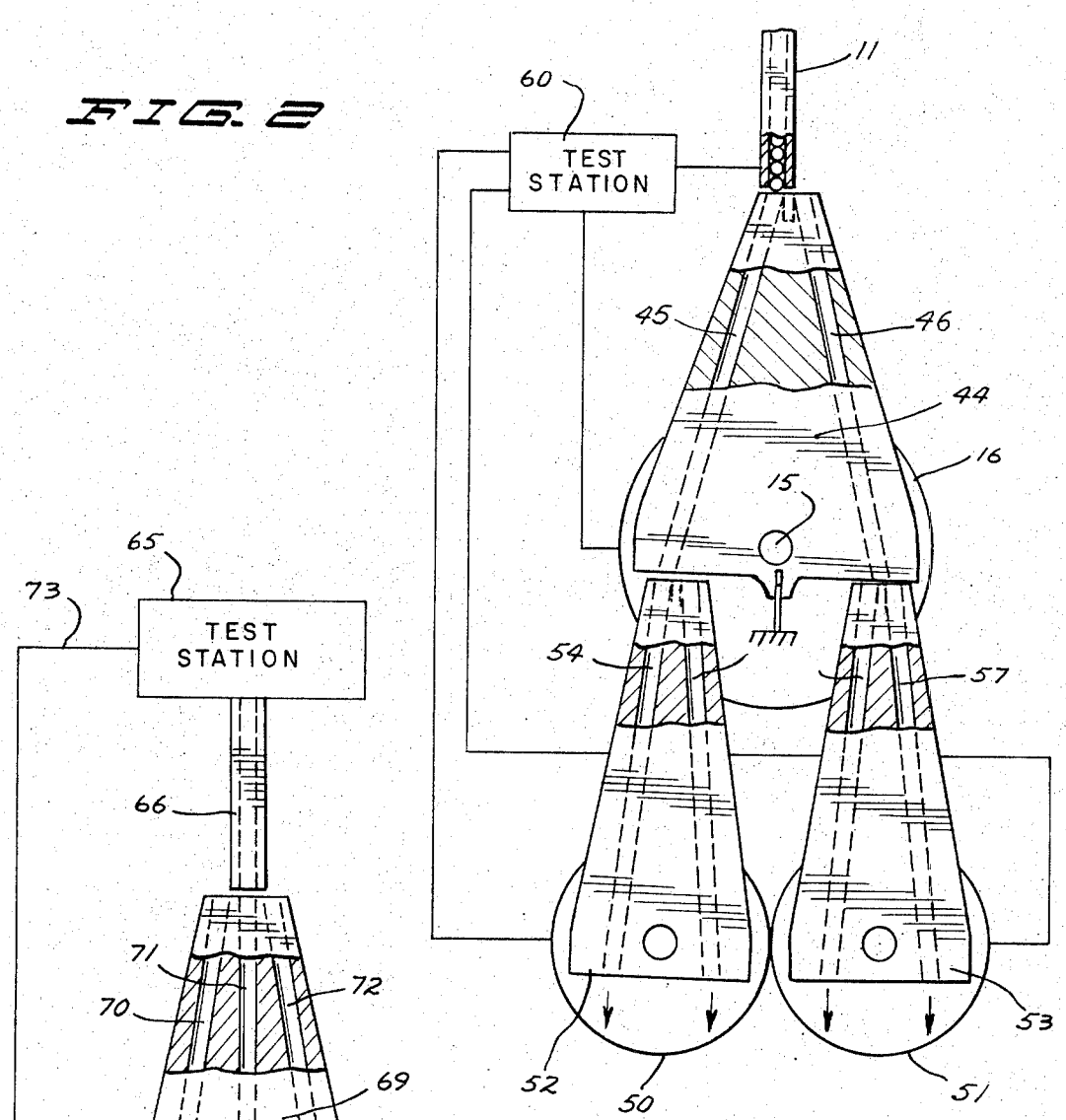


FIG. 3

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SORTING DEVICE FOR CORE HANDLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to sorting devices for core handlers.

2. Prior Art

In the prior art, there are generally three types of sorting devices used with automatic core handlers for magnetic cores. These include the mechanical type, the air aspirator type, and an air discharge type. The mechanical type is illustrated in U.S. Pat. No. 2,975,894 wherein a shaft is rocked under solenoid action to position a proper tube underneath the discharge chute for cores in response to a test signal. A similar device is shown in IBM Technical Disclosure Bulletin, Vol. 8, No. 12, May 1966 in an article by Danneberg et al. entitled "Sorting Mechanism For Magnetic Cores".

This type of mechanical device has variations wherein a sorter vane also can be operated. This use of a vane for sorting in combination with air and suction is shown in U.S. Pat. No. 2,858,018.

In addition, U.S. Pat. No. 3,298,782 shows an air aspirator type of a sorting mechanism. In this patent the cores are held by a ledge that moves out of the way after the test has been performed, and the sorting is done strictly by air.

Other sorting systems of the same general type use a blast of air to blow a core off a supporting ledge after the core has been tested, and to actually blow it into the proper receptacle, or to use a supporting ledge with an ejector that will move the tested core off the shelf or ledge into a sort position that can be air aspirated or mechanically operated.

However, several drawbacks of the prior art sort mechanisms occur. Usually critical alignment procedures are required. Sort vanes or tubes require extremely close machining tolerances and critical assembly and alignment procedures. Normally two separate drive mechanisms are required for the solenoid type of mechanical sort mechanism. Because of the critical alignment and manufacturing tolerances, the sort mechanism reliability is low and they require frequent maintenance. Because the core handling rate is high the time allowed to accomplish the sort function is very short. In practice the core must be accelerated from the test area into the sort bin rather than merely being allowed to fall by gravity because gravity movement is not fast enough. This acceleration is normally accomplished by an airstream that imparts a high velocity to the core. With the smaller core sizes now in production, typically 0.012 inch to 0.018 inch diameter, the cores are quite fragile, so that the present sort mechanisms can and do cause core damage.

SUMMARY OF THE INVENTION

The basic form of the present invention provides a sorting block which also will support the core in testing position, and is shifted to the proper sort position in response to a test signal. The sort gate is mounted onto a shaft of a stepper motor. In the first form of the invention the sort block has two tubular openings extending through it and the openings are connected to flexible tubing which can connect to storage bins. The bins are held under vacuum so that the openings in the sort block are also under vacuum for core acceleration.

Between the two spaced tubular openings in the sort block, there is a carbide core support ledge mounted which supports the core stack in the guide during the insertion of the test probe. When the probe is in place, in the core second from the bottom, the sort block is moved either left or right by the stepper motor acting in response to a test signal and the bottom, previously tested core is pulled by the vacuum induced air flow into the selected sort opening and deposited in the storage bin.

The device is simple to adjust, can easily be molded, and does not require close tolerances of fits with other parts. The reliability is high because only one moving part is used. The vacuum is maintained along the entire path of travel of the core during its movement to its sorting bin, and because of the positioning of the vacuum inlet in the bins, the core tends to change direction when it has entered the bin before being dropped by the airstream, this allows the sorted core to drop gently to the bottom of the bin without being accelerated downwardly.

Modified forms of the device can be utilized to provide a three sort position, where the core is independently supported on a ledge or movable arm for testing, or the sort gates or blocks can be mounted in series in the path of core movement after test so that the sorting of the cores can be graded across a substantial range of acceptability.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of a sorting system made according to the present invention;

FIG. 2 is a modified form of a sorting system of the present invention; and

FIG. 3 is a further modified form of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a schematic showing of a sorting system that can be used with various types of magnetic core handling devices, for example the device shown in U.S. Pat. No. 3,415,368 issued to Vosika. The general construction of the core handler can be of any desired form, and in the core handler, there is shown schematically a core supply **10** that delivers the cores **10A** one at a time to a core chute **11** so that they are vertically aligned in the chute. A test probe **12** is mounted on a machine, and has a needle **13** which is inserted into the center of a toroidal magnetic core, for testing, and suitable contacts (not shown) which are used for completing a test circuit through the probe to test the magnetic core electrically in a known manner. Each core in the stack held by chute **11** is sequentially tested and is delivered by gravity to test position. The needle **13** actually enters through the opening in the core **10B** which is a second from the bottom of the stack of cores in the chute. The cores are sequentially delivered through the chute **11**. The sorting, and also the stack support device illustrated generally at **14** comprises a sorting block or gate drivably mounted with a key or set screw onto an output shaft **15** of an electrical stepper motor **16** of usual design. The motor shaft will be rotated in selected direction one step at a time upon energization of a proper coil in the motor. The block **14**

has a narrow upper end, with an insert **17** made of carbide steel or other hard material mounted therein and exposed to the upper end surface of the block, and centered in the block. The block **14** is spring loaded with a flexure or leaf spring **18**, shown schematically, toward a center position, which is the position as shown in FIG. **1**. The spring **18** normally centers block **14** so that the insert **17** is directly below the center of the chute **11** for the magnetic cores.

When the probe needle **13** is withdrawn from the cores the stack drops and the core tested will rest upon the carbide insert **17**. The stack is held in place until the test probe is again inserted through the second core in the stack and the test circuit repeated. The tested bottom core will then be sorted.

Once the test circuit is completed, in the known manner, the circuitry illustrated generally at **20**, delivers a signal along the line **21** to a motor drive **22**. The signal delivered will be delayed so that the probe will be reinserted in the next core (now the second core) before the sorting action occurs. The tested core is thus resting on the sort block. The test signal is a pulse to drive the motor **16** one step in either one of the two directions of rotation of the shaft **15** depending on whether the bottom core was accepted or rejected. The pulse from the motor drive then will shift the shaft **15** one step, which is a sufficient angular distance to move the block **14** so that the carbide insert **17** is no longer underneath the stack of cores, but one or the other of a pair of sorting passageways in the block **13** will be positioned underneath the chute **11**. For example, there is a reject passageway **23**, and an accept passageway **24**. When the signal from the test circuitry indicates that the core is to be rejected, the signal along line **21** to the motor drive will operate the motor drive circuit to rotate the shaft **15** clockwise, as shown in FIG. **1**, and shift the passageway **23** to position underneath the chute **11**. The probe needle **13** will remain through the second from the bottom core during this shifting of the block **14**, to support the stack of cores in chute **11** and once the block has been shifted, the bottom core in the stack, which was tested, is pulled through the port or opening at the top of the block **14** and passes through the passageway **23**. Needle **13** continues to support the core stack until the pulse for motor **16** is over, and the test on the second to the bottom core is performed during this time. Then the spring **18** centers block **14** again and the probe can be withdrawn. The core stack then drops down on the insert.

It should be noted that both the passageway **23** and passageway **24** are subjected to a vacuum at all times. This is provided from a vacuum pump **25** that is connected with a hose **26** to a Y connection **27**. Then there are hoses that extend to a reject bin **30**, and an accept storage bin **31**. One side of the Y connection **27** is connected through a hose **32** to a small manifold or housing member **33**. The housing member **33** has an open bottom that opens through a screen member into the interior of the bin **30**, so that the vacuum source provides a vacuum on the interior of the reject storage bin. The bin is sealed so that vacuum is then carried through a tube **34** to the passageway **23**. A small junction tube is used to connect the tube **34** to the passageway. A second tube **36** leads from the other side of Y connection **27** into a manifold **37** on the accept storage bin **31**, and vacuum is introduced into the interior of the accept storage bin through a screen member. This accept storage bin **31** is also sealed, and vacuum is then carried through a flexible tubing **38** which leads to and is open to the passageway **24**. Air flows from the sort blocks toward the vacuum pump. Thus the vacuum will quickly accelerate the cores dropped into the accept or reject passageways.

If the test circuitry **20** indicates that a tested core should be accepted after the probe has been withdrawn, and the tested core is resting on insert **17**, the probe is reinserted in the second from the bottom core immediately and the test signal is delivered along the line **21**. The motor drive **22** sends out a pulse to rotate the motor shaft **15** one step in direction to position the opening or port leading to the passageway **24** underneath the chute **11**. The bottom core will be sucked into the passageway **24** and moved to the accept storage bin while the probe again supports the core stack and tests the next core. The probe is again withdrawn after the motor has been relaxed and the block **14** has centered, so that the tested core will drop into the carbide insert **17**, then the probe is inserted into the next to the bottom core, and the sorting action takes place again in response to the test signal.

It should be noted that the manifolds **33** and **37** are at the top side of the accept or reject storage bins, respectively, so that the air flow toward the vacuum pump changes direction when it flows from the inlet tubes **34** and **38**, to the air outlet in the bins. This means that the pull of vacuum will tend to pull the cores back up toward the top of the respective bins, and gravity will be acting downwardly on the cores. This will create an opposing action, which will gently drop the cores into the bottom of the bins. The flow of air will not be sufficient to carry the cores up into the vacuum pump and the screens provided insure that this will not happen.

The motor **16** has an adjustable mounting bracket **40**, that mounts it to the frame **41** of the core handler. The bracket is two piece and permits adjustment up and down, and fore and aft to properly position the sorting block. The frame **41** of course is also used to mount the guide chute **11**, and the adjustment of the motor mounting is all the adjustment that is necessary for properly positioning the outer end portions of the block **14** adjacent the chute **11** to get proper holding of the cores. Note the screw directly under the motor which slides in a horizontal slot in bracket **40**.

The stack of cores is held by the probe needle when the sorting operation takes place just as it is in U.S. Pat. No. 3,415,368. In the present device the insert **17** on block **14** is the support for the cores instead of the ledge member **60** in U.S. Pat. No. 3,415,368.

The block **14** can be molded out of a suitable plastic, and the passageway can be drilled or otherwise formed. The tubes **34** and **38** can be flexible plastic tubing which is cheap, and easy to install. The carbide insert **17** is provided to prevent wear on the plastic block **14** when it is used to support the tested core prior to sorting.

The operation can be quite fast. The vacuum is always on, so there isn't any need for switching valves, or operating solenoids, but only a conventional stepper motor **16** that may be held in three shaft positions under electrical power.

FIG. 2 shows a modified form of the invention wherein the stepper motor **16** has a sort gate or block **44** which has a pair of passageways **45** and **46**, respectively. The shaft **15** is drivably mounted on the block **44**, and is positioned below the chute **11** as previously explained. Also, the cores will come in from the chute after being tested, and the tested core will rest upon an insert between the passageways **45** and **46**. In this particular form of the invention, there are also separate stepper motors **50** and **51**, respectively, which are mounted with respect to the frame of the sorting device, and each motor **50** and **51** includes a separate sorting gate or block mounted thereon. For example, there is a sorting block **52** mounted on the output shaft of motor **51**. Each of the blocks **52** and **53** have passageways defined therein, for example passageways **54** and **55** in block **51**, and passageways **56** and **57** in block **53**. There could also be three passageways in the blocks **52** and **53** if desired. These passageways are positioned so that they may be selectively aligned with the lower ends of the passageways **45** and **46**, respectively. This gives a multiple number of sort gates, and you can have discharges shown by the arrows at the bottom of the block **52** and **53** going to four different bins, or six different bins if there are three passageways in the blocks **52** and **53**. The sort signal from the test station **60** can go along the respective lines to energize the respective motors. The stepper motor **16** would be actuated to one of its two sorting positions, and then either the stepper motor **51** or stepper motor **52** would be properly positioned to either of its positions. A center passageway could be installed in both of the blocks **52** and **53** so that there could be six different outlets for sorting the magnetic cores being tested into six different levels of desirability. The passageway also can carry vacuum. The clearance between the blocks is very small and vacuum can be carried right up through passageway **45** and **46**.

This utilizes the same concept of a stepper motor using a block mounted directly on the shaft, and of course the vacuum connections to the outlets from the passageways **54**, **55**, **56** and **57** can be through bins that would be connected as shown in FIG. **1** to the vacuum pump. The sorting blocks in FIG. **2** also may be spring centered as block **14** was spring centered. In FIG. **2**, the unit is shown shifted so that the bottom core will go through passageway **44** and passageway **54**.

In FIG. **3**, a stepper motor **67** is mounted in a modified core handling device. For example, the type of device shown in U.S. Pat. Application Ser. No. 815,960 filed Apr. 14, 1969 by Gunther Schaaf for ARTICLE TESTING DEVICE. In this particular instance the test station **65** has means for supporting the core independently during testing, and pushing the core off into a discharge chute **66** after the core has been tested. Thus the unit in this particular instance does not have to support the core stack before or after testing, but merely sorts the core. This device as shown in FIG. **3** could take the place of the sorting system shown in the aforementioned application of Gunther Schaaf Ser. No. 815,960, or any of the other sorting devices, for example that shown in U.S. Pat. No. 2,975,894.

The stepper motor **67** is mounted on the testing device, and has an output shaft **68** on which a sort gate or block **69** is mounted. The sort block **69**, as shown, has three passageways, namely passageway **70**, **71** and **72**. The stepper motor **67** is operated in the same manner as the stepper motor **16** as before described. The block **69** is normally held by a spring in its centered position and can be switched to either of two side angular positions by energization of proper motor coils. The upper end of the passageways **70**, **71**, and **72** are made so that they may selectively align with the discharge end of the chute **66**, depending on the position of the stepper motor. The outlet sides of the passageways **70**, **71**, and **72** are connected through tubes **70A**, **71A**, and **72A** to suitable storage bins. The tubes and passageways are subjected to vacuum as shown in connection with FIG. **1**.

In this instance, there can be three positions of sorting using just one block **69**. The test signal along the line **73** can control the stepper motor **67** into its proper position, so that the core coming from the chute **66** will be either made to drop through the center passageway **71**, (no signal when the core is to go to the center passageway) or either one of the side passageways **70** or **72** merely by energizing the stepper motor to its proper rotational position so that the shaft **68** rotates, moving the sort gate or block **69** to get the proper position. Here again, the device can be easily adjusted, is simple to make, does not require a large number of moving parts, and is low in cost. The sort gate or block can be molded, and clear plastic tubes can be used for the tubes that lead from the passageways in the support gate. Suitable tubular connections can be attached to the passageways to make the connections for the flexible tubes **70A**, **71A**, and **72A**.

The use of the stepper motor eliminates solenoid valves, solenoids for actuating mechanical blades, eliminates the need for precise adjustment of mechanical elements, other than the mere vertical adjustment of a motor, and is not subject to critical tolerances in manufacturing. The passageways are all held under vacuum and cores can be handled by vacuum, but are gently handled because of the use of the bins shown in FIG. **1** wherein the vacuum is applied to the bin itself, the vacuum tends to pull the core upwardly in the bin while gravity lets it settle gently to the bottom of the bin for storage.

The stepper motors used are made by Bulova Watch Company, their model VR–1510–15. The motor as purchased is equipped with damping means to prevent excessive vibration at high speeds. The motor employs reverse pulse braking, which imposes a restraining force that decelerates the rotor and load so that rotation stops just as the step position is reached. This retro torque principle permits optimum acceleration with minimum overshoot and settling time.

What is claimed is:

1. A sorter for magnetic core handling devices comprising means to deliver cores to said sorter, said sorter comprising a sorting block having first, second and third positions, said second position being between said first and third positions, said cores being transferred by said device from said block to a first location in said first block position, and to a second location in said third block position, a stepper motor having an output shaft, means mounting said stepper motor with respect to said means to deliver cores to said sorter, means to deliver a control signal to said stepper motor to cause

said stepper motor to rotate said shaft in one direction to position said sorting block in its said first position to receive a core from the means to deliver a core to said sorter and to transfer said core to said first location corresponding to said first block position and in an opposite direction to position said sorting block in its said third position to receive a core from the means to deliver a core to said sorter and to transfer said last-mentioned core to said second location corresponding to said third block position, and spring means to normally urge said block to said second position to provide a rest position, said block having means at said second or rest position for obstructively preventing movement of said cores from said means to deliver said cores.

2. The combination as specified in claim 1 and spring means to normally urge said block to said second position to provide a rest position wherein a portion of said block prevents movement of said cores from said means to deliver said cores.

3. The combination as specified in claim 1 wherein said preventing means includes an insert member aligned with the cores coming from said means to deliver said cores when said block is in its second or rest position.

4. The combination as specified in claim 1 wherein said passage means in said block comprises first, second and third separate passageways, and said stepper motor shaft is actuable to two positions to shift said block in said one direction to move said block into its said first position with said first passageway below said means to deliver said cores and in said opposite direction to shift said block in said opposite direction to move said block into its said third position with said third passageway below said means to deliver said cores, and means to center said block to normally hold said second passageway below said means to deliver said cores, said stepper motor shaft selectively moving said first and third passageways below said means to deliver cores when the stepper motor is actuated to either of its said two positions respectively.

5. A core sorting device comprising a core supply, a delivery means to deliver cores from said core supply, test means to test cores coming from said core supply, a sorting block member and at least a pair of passageways defined in said member, said pair of passageways having spaced entrances, a stepper motor having an output shaft, means to mount said block on the output shaft of said stepper motor, said stepper motor being movable in opposite directions between at least two positions to position one or the other of said entrances of the pair of passageways adjacent said delivery means to receive cores coming from said delivery means, means to normally center said block member substantially midway between said two positions, and a support rest on said block between said spaced entrances to support cores from said delivery means when said block is centered by said means to normally center said block.

6. The combination as specified in claim 5 and adjustable support means to position said stepper motor and said block member with respect to said delivery means.

7. The combination as specified in claim 5 and means to supply a vacuum to said passageways in said block, said means to supply vacuum comprising a vacuum pump, at least one core storage bin, said storage bin comprising a container having an interior chamber and a connection to said vacuum pump adjacent the top of said interior chamber, an outlet tube opening to said passageways and leading from said bin adjacent the top of the said interior chamber whereby a flow of air from said passageways to said vacuum pump changes direction inside said storage bin.

8. The combination as specified in claim 6 wherein said adjustable support means for said stepper motor permits movement of said motor in at least two mutually perpendicular directions.

9. The combination as specified in claim 5 wherein said sorting block is a molded block of material.

10. The combination as specified in claim 7 wherein each of said passageways is connected to a sorting bin, and said vacuum pump carries a flow of air through both of said sorting bins.

11. A sorter for magnetic core handling devices comprising a core supply, a generally vertical chute connected at its upper end to said core supply and open at its lower end for discharging the lowermost of a stack of cores received in said chute from said core supply, an angularly shiftable sorting block having a pair of passageways extending downwardly therethrough from laterally spaced ports or entrances in its upper end, said upper end supporting the lowermost core in said stack when said sorting block is angularly positioned so that said ports or entrances are to either side of said lowermost core, means for testing the core next above the lowermost core in said stack while said block is supporting said lowermost core, and means responsive to said testing means for shifting said block so as to align one or the other of said ports or entrances with the lower end of said chute in response to a control signal derived from said test means as a result of having tested said lowermost core when it was previously the core next above, the lowermost core in each instance supporting the core next above during its said test.

12. The combination as specified in claim 11 including a hardened insert located between the ports or entrances of said passageways, said hardened insert engaging and supporting the lowermost core in said stack until said block is angularly shifted to locate the port or entrance of either of said passageways beneath said chute.

13. The combination as specified in claim 11 including a leaf spring connected at its upper end with said block and having its lower end fixedly mounted so that said leaf spring normally positions said block so that said ports or entrances are to either side of the lower end of said chute.

14. A sorter for magnetic core handling devices comprising a core supply, a chute extending downwardly from said core supply having an open lower end for discharging cores, a sorting block, a shaft supporting said sorting block for angular movement, a leaf spring connected to said block subjacent said shaft for normally maintaining said block in a vertical position, said block having a pair of spaced passageways extending downwardly through said block from spaced ports or entrances in the upper end of said block, said block having its upper end centrally located beneath said chute when said block is held vertical by said leaf spring to support on a central portion of said block

between said ports or entrances the lowermost of a stack of cores contained within said chute, test means for testing the particular core in said stack of cores immediately above the lowermost core, and a stepper motor responsive to said test means for shifting said block in the proper angular direction to move the appropriate port or entrance beneath said lowermost core in response to a control signal derived previously from said test means when said lowermost core was then the particular core immediately thereabove.

15. A core sorting device comprising a generally vertical chute for containing a stack of cylindrical cores and gravitationally discharging said cores via its lower end, a block shiftable angularly about a horizontal axis having a portion of its upper end disposed below the lower end of said chute at a distance therebeneath less than the diameter of said cylindrical cores so as to support the lowermost core in said stack of cores and to prevent discharge thereof, said block having a pair of passageways extending downwardly therethrough from entrances to either side of said core supporting portion, and means for angularly shifting said block to selectively bring one of said entrances into registry with the lower end of said chute, whereby the lowermost core then drops into the passageway having its entrance in registry with the lower end of said chute.

16. The combination as specified in claim **15** in which said block is of plastic and said support portion contains a hardened insert.

17. The combination as specified in claim **15** including means for testing the core next above the lowermost core to provide a control signal for subsequently causing said shifting means to move said block in the appropriate direction from a position in which said supporting portion is directly under the lower end of said chute to effect registry of the proper entrance with the lower end of said chute in accordance with the test results determined when the lowermost core was the one next above.

18. The combination as specified in claim **17** including spring means for normally positioning said supporting portion beneath the lower end of said chute.

19. The combination specified in claim **18** in which said spring means constitutes a leaf spring fixedly mounted at its lower end and extending upwardly into the lower end of said block.

20. A sorter for magnetic core handling device comprising means to deliver cores to said sorter, said sorter comprising a sorting block having first, second and third positions, said second position being between said first and third positions, said cores being transferred by said device from said block to a first location in said first block position, and to a second location in said third block position, a stepper motor having an output shaft, means mounting said stepper motor with respect to said means to deliver cores to said sorter, means to deliver a control signal to said stepper motor to cause said stepper motor to rotate said shaft in one direction to position said sorting block in its said first position to receive a core from the means to deliver a core to said sorter and to transfer said core to said first location corresponding to said first block position and in an opposite direction to position said sorting block in its said third position to receive a core from the means to deliver a core to said sorter and to transfer said last-mentioned core to said second location corresponding to said third block position, a second sorting block, said first and second blocks being arranged in series to receive cores coming from said means to deliver said cores, and said first block being selectively movable to one of its first or third positions in response to the control signal, a second stepper motor having an output shaft, said second block being mounted on said output shaft of said second stepper motor and movable to first, second and third positions independently of said first block, said second block being arranged to receive cores coming from said first block when said second block is in only its said first position.

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