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2,392,856

GAGING DEVICE

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3 Sheets-Sheet 1

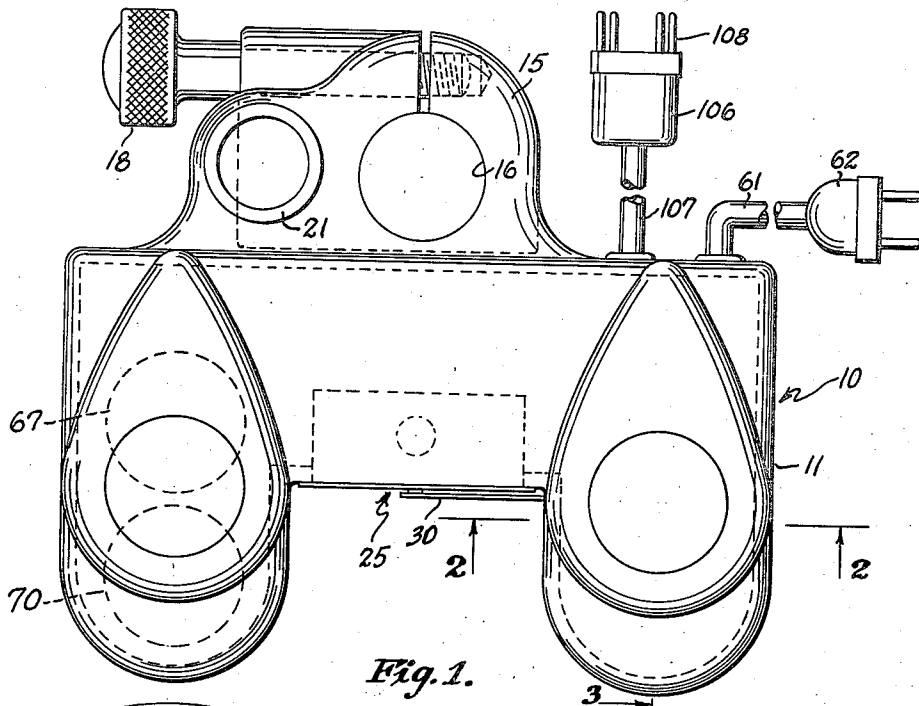


Fig. 1.

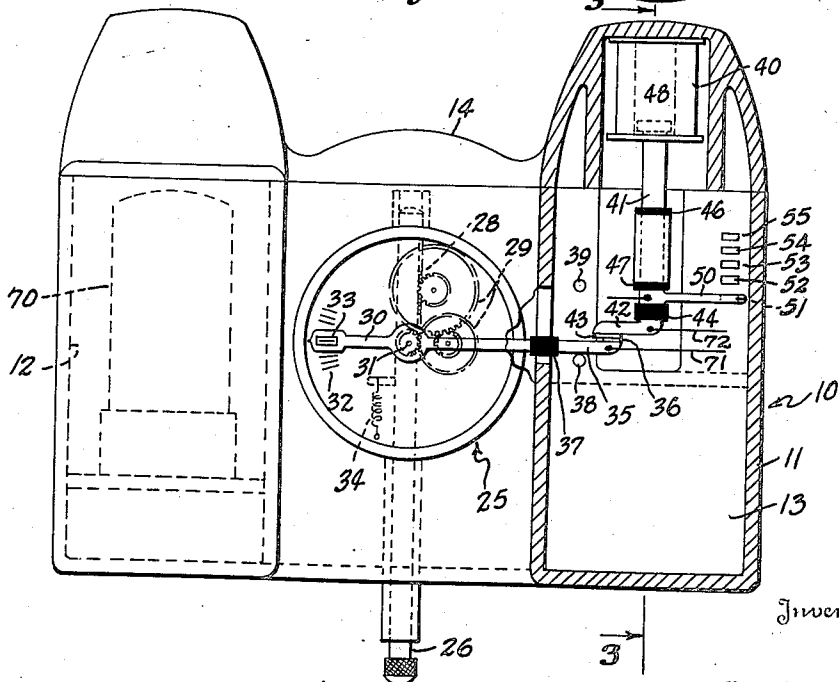


Fig. 2.

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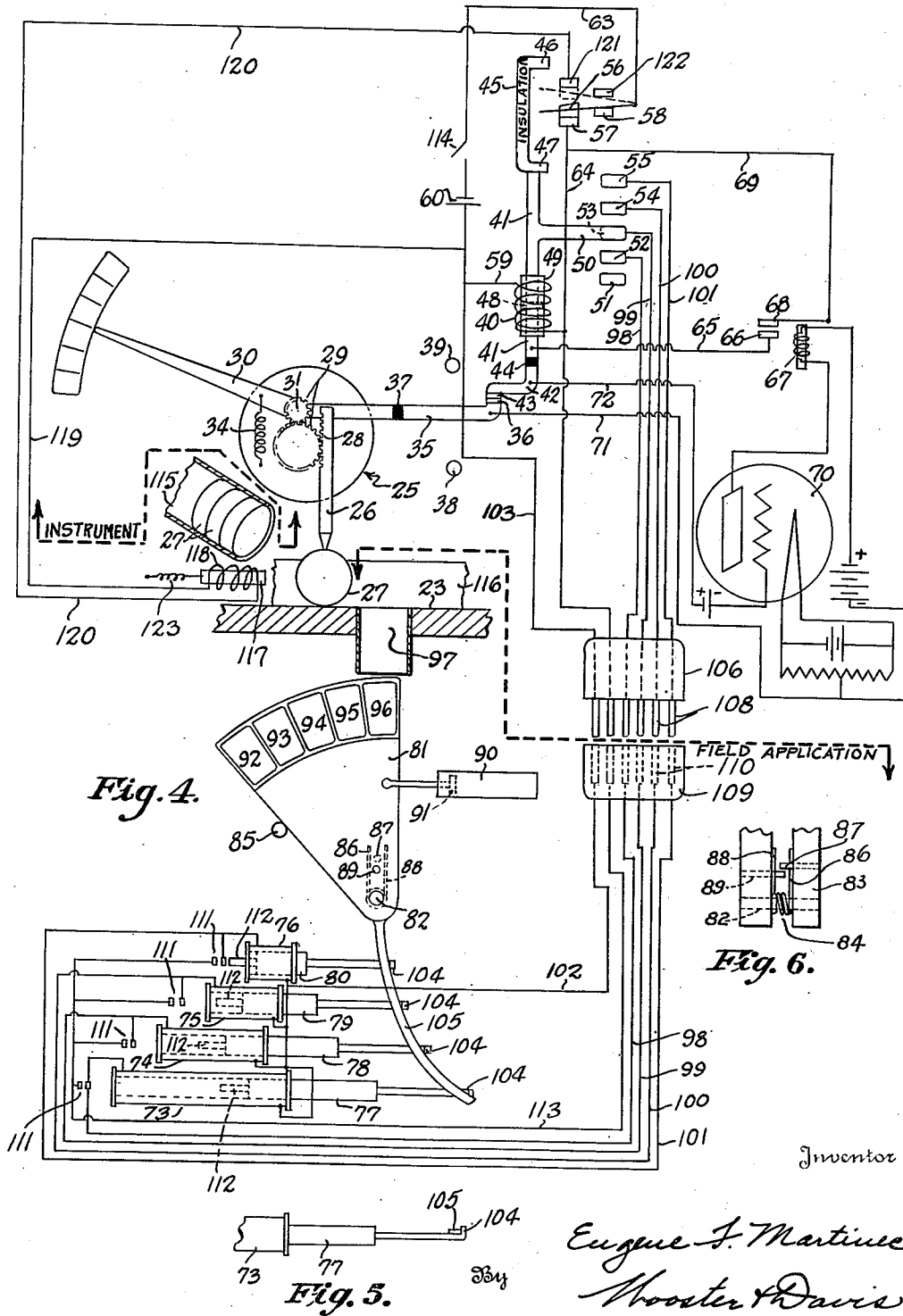
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GAUGING DEVICE

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UNITED STATES PATENT OFFICE

2,392,856

GAUGING DEVICE

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Application March 15, 1943, Serial No. 479,242

17 Claims. (Cl. 209—88)

This invention relates to gauging instruments and has for an object to provide a simple and effective device for accurately gauging various parts or elements and one which may be employed to operate an indicating means either visible, audible, element sorting or separating and the like.

In this device a gauging element operates through control of the grid circuit of a vacuum tube, particularly by breaking this circuit under given conditions, to produce a signal or other manifestation or cause operation of some device or apparatus.

It is also an object to provide a device of this character which will insure sufficient time in the gauging operation for low-price high inertia translating equipment controlled by said gauging operation to function accurately and positively.

It is another object to provide such a device which may be constructed and assembled as a small unit and one which may be assembled and adjusted independently of its application and may be mounted as a unit on an application locating support in position for gauging desired parts or elements involved, and at the same time may be used in connection with the device with which it is so located to control operation of such device on the elements to be gauged to control them within predetermined small limits.

A particular object is to provide a construction and arrangement which utilizes the breaking of contacts in the grid circuit of a vacuum tube to produce a signal or put into operation any type of electrical or electrically controlled manifestation desired, such for example as automatically sorting parts being gauged, or automatically performing any operation desired, said desired operation depending on the size of the part being gauged.

With the foregoing and other objects in view I have devised the construction and arrangement illustrated in the accompanying drawings forming a part of this specification. It is, however, to be understood the invention is not limited to the specific construction and arrangement shown but may employ various changes and modifications within the scope of the invention. These drawings are somewhat diagrammatical but show the device in sufficient detail that the principles of construction and operation may be readily understood.

In these drawings:

Fig. 1 is a top plan view of the assembled unit of the device;

Fig. 2 is a partial front elevation and partial

section, the section being substantially on line 2—2 of Fig. 1;

Fig. 3 is a partial vertical section and partial side elevation looking from the left of Fig. 1, the section being substantially on line 3—3 of Fig. 2;

Fig. 4 is a wiring diagram showing the electrical connections and also showing diagrammatically certain elements of the device;

Fig. 5 is a side elevation of a portion of the operating means for the selector, and

Fig. 6 is a detail elevation of the mounting for the selector.

This invention was developed for the purpose of filling a definite need on the part of industry for gauging equipment capable of not only automatically gauging parts or elements to within .0001 inch or less, but which also could be used to automatically grade them and sort them into bins or receptacles according to size. Gauges now largely employed are dependent upon the human element to correctly read the gauge, and then depend on the operator to sort the articles according to such readings in the correct receptacle. The ordinary dial type of gauge is rather difficult to read and becomes extremely tiresome to the operator where a large number of pieces are handled, resulting in liability to error, which tendency increases as the number of pieces handled is increased. In an attempt to remedy this condition several so-called electro-limit gauges and other types of electric gauges have been developed which spread the indication of size over a much larger dial area so as to make them easier for the operator to read. All the electric gauges are extremely critical devices and require considerable setting and maintaining of adjustment, and in addition are quite expensive and complicated. In spite of the larger dial area for any given tolerance provided by these electric type gauges, they are still subject to the human element in correctly reading and sorting the pieces.

To overcome these difficulties and problems I have devised the present construction which will not only automatically register extremely small tolerances, but may also be employed to sort the measured piece into its correct receptacle. In this invention the extremely simple gear type dial gauge, which over a good many years has proved to be extremely durable and accurate, is employed, and there is built around it and assembled therewith in a complete unit, means of translating the reading given by the dial gauge into any amount of energy necessary for correctly indicating the reading or doing any type of feeding,

grading, sorting, feed or adjustment control and the like. This has been accomplished without in any way affecting the accuracy, life or simplicity of the dial gauge.

This device makes use of an indicator arm or pointer of a dial gauge associated with the device for breaking the grid circuit of a vacuum tube at a time depending on the size of the part being gauged to operate devices such as relays, to produce a signal or put into operation any type of electrical or electrically controlled manifestation desired, such for example as automatically sorting the parts being gauged or automatically performing any operations desired, so that such manifestations or operations will depend on the size of the article to be gauged. No special equipment in the form of special vacuum tubes, relays or other similar equipment is necessary, as standard devices readily available on the market may be employed. All vacuum tubes and relays used may be of standard types produced in large quantities for other purposes and therefore may be readily secured on the market.

The device illustrated comprises a housing 10 made of suitable material, preferably a suitable molded plastic material or die casting, and may for convenience and simplicity of molding comprise two or more sections secured together, as for example in the present case a body portion 11 having suitable chambers 12 and 13 in which may be mounted various elements of the device and which may be open through one side of the body portion of the housing, as for example a top thereof, to facilitate mounting the elements in these chambers and gaining access thereto, and which chambers may be closed by any suitable top or closure section 14.

The housing also includes a split lateral extension or frame 15 having an opening 16 therethrough to receive and embrace an application locating post or support 17 on which it is adjustable to permit location of the housing in a desired position with relation to other elements and to position the indicating arm or pointer of a gauging element at zero or any other point, as determined by a master part, and on which post or support the housing may be clamped in adjusted position by clamping screw 18. This post or support may be mounted on an automatic machine, machine tool or other device with which the gauging device is to be used, and is also provided with a locking collar 19 also embracing the post 17 and split so that it may be clamped in the desired position on this post or support by a clamping screw 20. The frame portion 15 is connected to this collar by a micrometer adjusting screw 21, mounted for turning movement in the collar 19, as indicated at 22, and held therein against longitudinal movement, and having threaded connection with the housing frame 15. This may be a single or double micrometer screw as desired and is designed for close micrometer adjustments of the housing with respect to the collar to properly locate the housing and the gauging means carried thereby with respect to the gauging table or support indicated diagrammatically at 23 and permit locating of the device with the indicating arm or pointer of the gauging element at the zero position or any other position with respect to the master or standard part or element 24 with which the elements to be gauged are to be compared, as will be more fully described later. The collar 19 may be clamped in the desired position on the post or support 17, and after loosening the clamping

screw 18, the housing may be raised or lowered by the micrometer screw 21 to the desired position and then clamped in this position by again tightening or setting the screw 20.

Mounted in the housing is a gauging element 25, and although for this purpose various types of gauging or measuring mechanism may be used, I prefer a typical gear type dial gauge which has over a good many years of use proved to be extremely durable and accurate. A satisfactory type of this mechanical gauging element is illustrated somewhat diagrammatically and comprises a movable gauging stem 26 guided for vertical sliding movement and projecting from the housing in position to engage the element to be gauged, such as a master gauge block 24 (shown in Fig. 2) for setting the device, and the element to be gauged and compared with this master block, such for example as the circular element 27 shown in the gauging position in Fig. 4. It is to be understood that this stem need not directly engage the element being gauged, but could engage an intervening member whose position is determined by the element so that the position of the stem is determined by this element. An example of such an arrangement is disclosed in my pending application filed of even date herewith, Serial No. 479,243, and indicated as Case F. This movable stem 26 is connected by a rack 28 and suitable gearing 29 with an indicating arm or pointer 30 pivoted at 31 the gearing being such as to step up or amplify the movement of the stem 26 to give a much larger movement of the indicating arm. This arm or pointer may move over a suitable indicating dial 32, and has a zero setting slot 33 or other indicating means to indicate when it is in zero or any other position over the dial. A spring 34 tends to shift the stem 26 downwardly to engage the article being gauged.

The indicator arm 30 is extended on the opposite side of the pivot 31 where it is provided with a tail portion 35 carrying a contact 36. This tail portion is electrically insulated from the indicating arm by an insulating barrier 37. Lower or downward movement of this portion is limited by a stop pin 38 and upward movement is limited by a similar stop pin 39. In use the housing and the dial gauge are so mounted or located in respect to the gauge bed 23 that the pointer or indicating arm 30 and with it the tailpiece 35 will assume some position in respect to the dial 32, depending on the size of the part being gauged. It will be seen from the gearing indicated that the larger the part 27 being gauged, the higher on the dial will be the position of the pointer 30. It is, however, shown in its highest position in Fig. 2 with the tailpiece 35 at its lowest position against the stop 38. The ratio of the gearing in this dial gauge may be any value desired and by means of compound gearing can be several hundred to one. In both Figs. 2 and 4 this gearing is shown diagrammatically, and although it is indicated somewhat differently in Fig. 4 for simplicity, it still operates in the same manner as that in Fig. 2.

Mounted in the housing, for example in the upper part of chamber 13, is a slow-acting solenoid 40, which has a vertically moving plunger 41 forming a control member which carries at its lower end a mounting 42 for a contact 43 adapted to cooperate with the contact 36, the mounting 42 being electrically insulated from the plunger by the barrier 44. At its upper end the plunger 41 carries an insulating yoke 45, having

upper and lower spaced fingers 46 and 47. Normally the tailpiece 35 is held downwardly against the stop 38 as shown in Fig. 2, by the weight of the solenoid plunger 41. This plunger is provided with a head 48 operating in a dashpot 49 so that the plunger will move with a relatively slow uniform movement. The plunger 41 also carries a contact arm 50 adapted to move over and engage a series of spaced stationary contacts 51, 52, 53, 54 and 55. Associated with the yoke 45 is a movable spring contact 56 adapted to engage a stationary contact 57 and it may be held in this position by a permanent magnet 58. The spring action of the contact 56, however, tends to move it away from the contact 57. The solenoid 40 is connected by suitable wiring 59 with one side of a source of electric current 60 which may be a battery or the usual wiring system of a building, and connections may be made from the parts in the housing 10 to such wiring such as by a flexible cable 61 (Fig. 1) and a plug-in cap 62 which may be plugged into any suitable outlet receptacle. The other side of the power source 60 may be connected by wiring 63 with the spring contact 56. The stationary contact 57 is connected by wiring 64 with the other side of the solenoid 40. The plunger 41 and contact arm 50 are electrically connected by a wire 65 to a contact 66 of a relay 67 having a spring contact 68 adapted to engage the contact 66, but because of spring action is normally separated from the contact 66. The spring contact 68 is connected by a wire 69 with the wire 64. The operating solenoid of the relay 67 is connected to the plate or output circuit of the amplifier or vacuum tube 70. The tailpiece 35 and mounting piece 42 are connected by wiring 71 and 72 respectively to the grid circuit of the tube 70 so that this circuit is controlled by the contacts 36 and 43.

The indicating device, in this case a selector for sorting the parts being gauged, is shown somewhat diagrammatically at the lower part of Fig. 4. It comprises a series of solenoids 73, 74, 75 and 76 of different lengths so that their plungers 77 to 80 respectively will have different lengths of travel, and each plunger is operatively connected with a selector 81. In this case the selector is in the form of a sector pivoted at 82 to a suitable support 83 and a spring 84 tends to hold it in the retracted position against a suitable limit stop 85. One arm 86 of the spring engages a suitable pin or abutment 87 on the support 83 while the other arm 88 engages a similar pin or abutment 89 on the selector sector. Too rapid movement of the sector 81 is prevented and a uniform relatively slow movement thereof effected by a dashpot 90 whose plunger 91 is connected to the sector 81. The sector is provided with a series of openings 92, 93, 94, 95 and 96 forming the entrances to a series of chutes (not shown) leading to a series of separate compartments or bins (also not shown). These openings are so arranged that when the sector 81 is in the normal or retracted position the opening 96 is under or in alignment with the discharge opening 97 in the gauging support or table 23 into which the piece 27 after being gauged is discharged when it is shifted from its position under the gauging stem 26, and the openings 92 to 95 are so arranged that when the sector 81 is shifted by the solenoids 73 to 76 these openings are respectively brought to position under or in alignment with the discharge opening 97. That is, when the sector 81 has been shifted by operation of the plunger 77 of the solenoid 73, opening 92 is under the opening

87; when it is shifted by the plunger 78 of the solenoid 74 opening 93 is brought under the opening 97, and so on.

Each of the stationary contacts 52, 53, 54 and 55 is connected respectively with one of the solenoids 73, 74, 75 and 76 by the lead wires 98, 99, 100 and 101, and the other end of each solenoid by the lead 102 to lead 103 from one side of the power source 60. Each solenoid is connected to the side of the power source 60 opposite that from the lead 63 which is connected to the spring contact 56 and is normally connected through this contact with the lead 69 to the spring contact 68, the cooperating contact 66 being connected through the lead 65 to the plunger 41 and the movable contact 50, which as previously described is movable over and cooperates with the contacts 51 to 55. The movable plungers of the solenoids 73 to 76 are each operatively connected with the sector 81 through a hook connection 104 operated by each solenoid and engaging a curved extension or tail 105 of the sector 81. By means of this arrangement this forms a one-way connection so that the tail 105 may be shifted to the left independently of each hook 104, and therefore this tail may be so shifted by each hook 104 and each solenoid independently of each of the other solenoids, and the sector 81 may be shifted by each solenoid independently of each of the other solenoids.

A sustaining circuit is provided for each of the solenoids 73 to 76 so that after any solenoid is energized by the control mechanism, as will presently be described, the circuit through this solenoid will be maintained until the result or effect of the operation of the solenoid has been completed. Thus associated with each solenoid is an auxiliary switch 111 the contacts of which are normally separated but are so located that the movable contact thereof is shifted by the respective solenoid plunger as this plunger reaches the end of its operative movement. For this purpose each solenoid plunger has an extension or tailpiece 112 arranged to engage the movable contact of each switch 111 as the plunger reaches the end of its movement to close the switch and maintain a sustaining circuit through the solenoid. The stationary contact of each switch 111 is connected by a lead 113 to the lead 64 so that the circuit is controlled by the switch 56, and the movable contact of each switch 111 is connected with the leads 98 to 101 respectively leading to the particular solenoid involved. The circuit from the source of power 60 may be controlled by a hand or other suitable switch 114.

The amplifier 70 and the relay 67 may be mounted in the housing 10 and connected with the various elements as indicated in the wiring diagram, the indication of these elements in the housing being shown diagrammatically. For easy and quick connection and disconnection of the assembled unit, represented by the housing and the parts assembled and mounted therein, and the indicating means or field application such for example as the sorting device illustrated, may be effected by a detachable connection such for example as an attachment plug cap 106 connected with the required elements within the unit by a flexible cable or connection 107 and suitable wiring, as indicated in Fig. 4, and having the required number of contact pins 108 each connected to the proper lead and adapted for insertion in a receptacle plug or connection 109 whose socket or receptacle contacts 110 are arranged to receive and engage the respective pin

contacts 108 and in turn are connected by the proper leads to the various elements to be operated or controlled, in this case the solenoids 73 to 76.

The operation is as follows: As previously described, the tail part 35 of the indicating arm is normally held down against a stop 38, as shown in Fig. 2, because of the weight of the solenoid plunger 41, which plunger carries the contact 43 and thus holds it in this position against the contact 36 on the tailpiece 35, also as shown in Fig. 2. In this position the yoke 45 which is made of insulating material is also in its lowest position and because of its upper finger 46 engaging the spring contact 56 has forced it into engagement with the contact 57. In this position the contact arm 50 is on the lowest contact 51. The action of forcing the tailpiece 35 downwardly to the stop 38 has, due to the gearing 29 in the gauge element 25, raised the gauging stem 26 upward so that the part 27 which is to be gauged can be easily positioned under this stem.

Now if the switch 114 is closed completing the circuit from the power supply 60 the solenoid 40 will be energized because the circuit through it is closed by the contacts 56 and 57 and the solenoid plunger 41 will begin to rise slowly because of the dashpot 49 or other slow-acting control means and the tailpiece 35 will rise with this plunger because of the biasing spring 34 in the gauge, keeping the contact 36 in engagement with the contact 43, thus keeping the grid circuit of the amplifier closed. Upward movement of the tailpiece 35 and downward movement of the indicator pointer 30 will be limited by the stop 39 unless their movements are previously arrested by a part 27 to be gauged under the gauging stem 26. This part 27 is of sufficient size that as the tailpiece 35 rises the stem 26 moves downwardly until it comes in contact with the part 27 being gauged at which time any further movement of the tail 35 upward is prevented. At this instant further movement of the plunger 41 upwardly will separate the contacts 36 and 43, thus breaking the grid circuit of the vacuum tube amplifier 70. During the upward movement of the solenoid plunger 41 carrying with it the yoke 45 the spring contact 56 remains in engagement with the contact 57 as it is held in this position by the permanent magnet 58, thus maintaining the circuit through the solenoid 40. This circuit is not broken until the yoke 45 reaches its uppermost position at which time the bottom finger 47 of the yoke engages the spring contact 56 and forces it upwardly away from the contact 57.

As previously described, the output circuit of the amplifier 70 terminates in a relay winding 67 controlling the normally open contacts 66 and 68. The amplifier is so designed that sufficient current is caused to flow through the winding 67 to close the switch contacts 66, 68 when the grid circuit is broken by separation of the contacts 36 and 43.

It will now be seen that whichever contact 52, 53, 54 or 55 the movable contact arm 50 is on when the grid circuit is broken by separation of the contacts 36 and 43 and therefore the relay contacts 66 and 68 are closed, is the one that will have its circuit completed through this relay switch 66, 68 and the source of power 60. Therefore the corresponding solenoid of solenoids 73 to 76 will be energized to shift its

plunger and correspondingly shift the selector 81 to bring the corresponding opening 92 to 95 into a position under and in alignment with the discharge opening 97.

To set the device, a master part indicated diagrammatically at 24 (Fig. 2) of exactly the correct size desired is placed under the stem 26 and the gauge so adjusted by shifting the housing 10 through operation of micrometer screw 21 that the contacts 36 and 43 break when the contact arm 50 is on the upper contact 55. If the contacts 52 to 55 are spaced one measuring unit apart in respect to pointer calibration, then if a piece one unit over the master size is placed under the stem 26 the engagement of contacts 36 and 43 will be broken when the arm 50 is on contact 54. If the piece is two units over the master size then engagement of contacts 36 and 43 will be broken when the contact arm 50 is on the contact 53, and so on.

Referring now to the linkage or operative connections between the solenoids 73 to 76 and the selector 81, it will be noted that if for instance solenoid 74 is energized because the size of the part being gauged is such that contacts 36 and 43 separate when contact arm 50 is on contact 53, the solenoid 74 will be kept energized after the contacts 36 and 43 separate because the auxiliary contacts 111 were closed at the end of the movement of the plunger 78 and therefore maintain the circuit through the solenoid until it is broken by shifting of the spring contact 56 by the lower finger 47 of yoke 45 when the plunger 41 reaches the end of its upward movement. Even if solenoids 75 and 76 are later energized, they do not affect the position of the selector 81 because their plungers have a shorter stroke. Consequently, if on its way up the contact arm 50 is on the contact 53 when the contacts 36 and 43 separate, resulting in a signal to the special amplifier 70 which in turn closes the relay contacts 66 and 68, the selector 81 will assume a position governed by solenoid 74 and that position will not be changed if the solenoids 75 and 76 are subsequently energized, as the plunger 41 and the contact arm 50 complete their upward travel. In this way the proper compartment of selector 81 is brought into position under the discharge opening 97 in the gauging table 23. It will be noted that the lower contact 51 is not connected with a solenoid as its position represents the position of the selector in its normal position with its opening 96 in alignment with the opening 97 and therefore nothing needs to be energized to bring it to this position.

As yoke 45 reaches its upper limit of travel it shifts the contact 56 from the contact 57 and therefore not only breaks the circuit of the slow-acting solenoid 40, but also the holding circuit to any solenoid 73 to 76 which has been set up by closing of the auxiliary contacts 111 for that solenoid. The plunger 41 then drops by gravity, again contacting the tailpiece 35 and pushing it downward, thereby lifting the stem 26 and completing the cycle with this stem 26 pulled upwardly to its upper position ready for receiving another part 27 for a gauging operation. The operation of the plunger 41 in going up and down is entirely automatic so long as electric power is supplied to the solenoid 40.

The contacts 51 to 55 are so spaced as to correspond with movement of the plunger 41 and therefore movement of the indicating arm 30 corresponding to one measuring unit, and the con-

tact arm 50 is preferably made of a width so that in an intermediate position it will bridge two of the stationary contacts, and thus at no time is it out of contact with at least one of these contacts. Thus if a piece 27 to be gauged is one-half of a measuring unit over the size indicated by a given stationary contact, the movable contact 50 will engage this contact and the next higher contact. Thus if the piece 27 is of a size so that downward movement of the stem 26 is arrested when the arm 50 bridges the contacts 52 and 53 when the grid circuit through the amplifier is broken, then both solenoids 73 and 74 will be energized but, due to the one-way connection 104 to the tailpiece 105 of the selector, the selector will be shifted to correspond with the movement of the solenoid plunger having the longest stroke, in this case the solenoid 73, so that under these conditions the selector 81 will be shifted to bring the opening 92 under discharge opening 97 and a piece which is half a measuring unit over the given size will be placed with the parts of one full unit larger size.

It will be understood that there may be as many contacts 52 to 55 representing as many measuring units as desired, and that the selector 81 can be made with as many corresponding positions and discharge openings. It will also be understood that contacts 52 to 55 can be connected to and control any type of electrically energized equipment which may be desired, and by the addition of an automatic feeding and ejecting means for the parts being gauged complete automatic operation may be obtained. Such a feeding and ejecting means is indicated diagrammatically in Fig. 4 and comprises a feed chute 115 leading from any suitable feed hopper (not shown) and mounted to deliver pieces 27 to be gauged one at a time to gauging position under the stem 26. This may be accomplished by having the discharge end of the chute 115 spaced from an upright back wall 116 on the base support 23 spaced so as to allow only one piece 27 at a time to drop from the chute 115 into the gauging position. After the piece has been gauged, as described, an ejector plunger 117 will be operated to shift the piece just gauged from the gauging position to the discharge opening 97 through which it will drop into one of the openings 92 to 96 of the selector 81 depending upon where the selector has been positioned as a result of the gauging operation, and therefore the piece will be conducted to the proper compartment or bin. The ejector plunger 117 is operated automatically at the proper time by a solenoid 118 connected at one end by lead 119 to one side of the source of power 60 and at the other end by lead 120 to the contact 121 in position to be engaged by the contact 56 after it has been shifted from the contact 57. Thus just before the plunger 41 reaches the upper limit of its movement at the end of the gauging operation and the lower finger 47 of the yoke 45 engages the spring contact 56 to shift it from engagement with the contact 57, the contact 56 will snap into engagement with contact 120 and close the circuit through the ejector solenoid 118, thus operating the plunger 117 to shift the piece 27 just gauged from the gauging position to the discharge opening 97. Contact 56 will be held in this position by a permanent magnet 122 until it is shifted downwardly by the upper finger 46 of the yoke 45, when this yoke drops with the plunger 41 after the circuit through the solenoid 40 has been broken. This action will occur as the yoke approaches the limit of its downward movement at

which time the spring contact 56 is shifted from the contact 121 and snaps into engagement with the contact 57, thus completing the circuit through the solenoid 40 for the next gauging cycle. As the contact 56 is shifted from the contact 121 the circuit through the solenoid 118 is broken and the plunger 117 is withdrawn to its normal position by the spring 123.

The setup of the device shown is illustrated with a sorting device for sorting out the elements being gauged according to size and depositing elements of the same size or sizes within predetermined limits in the same receptacle. This is shown as one example of the way the device may be employed to control various devices, such for example as an indicating device, as either visible or audible indicating means, a suitable sorting or separating means for the elements being gauged as above disclosed, or any other desired means. The term "indicating means" is used in a broad sense as meaning any one of a number of different devices, such for example as a physical indicator, an audible signal, sorting means, adjusting means on a machine tool or other machine to be controlled, and so forth or any device affected or controlled by the circuit or circuits controlled through the cooperation of the indicator arm and its tailpiece 35 positioned by the gauging stem cooperating with the parts being gauged and the movement of the plunger 41.

Although this device has been illustrated and described in a set-up for gauging a series of round elements, it is to be understood that this set-up has been given merely as one example of the large number of applications for which the device is adapted. In other words, it is not limited to the application specifically described and illustrated but may be employed for a large number of different applications and controls. Examples of these are shown in Figs. 8 to 12 inclusive of my copending application Serial No. 479,239, filed of even date herewith and designated as Case A. These figures with their descriptions give examples of various different applications in which the device may be used for controlling various devices and effects, and their description and illustration are not included in this application in order to simplify and reduce the amount of disclosure in the present case and avoid unnecessary repetition.

I claim:

1. A gauging device comprising a housing, means for adjustably mounting the housing on an application locating support, a mechanical gauging element in the housing including a movable gauging stem adapted to engage an element being gauged and a movable member connected with said stem to be positioned thereby, means tending to move said stem toward an element to be gauged, an electrical contact carried by said movable member, a control member mounted in the housing for up and down movement, a contact connected with the control member and normally resting by the weight of the control member on the first contact and holding the movable member in a position with the stem raised, a plurality of selector circuits, a selecting means movable with the control member for controlling said circuits, means controlled by the respective circuits, an amplifier including a vacuum tube having its grid circuit connected to the said contacts to be controlled thereby, a switch controlled by said amplifier, said switch being connected with the selecting means to control said circuits, and means for shifting the control member to per-

mit the stem to drop against an article in the gauging position and to operate the selecting means.

2. A gauging device comprising a housing, means for adjustably mounting the housing on an application locating support, a mechanical gauging element in the housing including a movable gauging stem adapted to engage an element being gauged and a movable member connected with said stem to be positioned thereby, means tending to move said stem toward an element to be gauged, an electrical contact connected with the said movable member for movement therewith, a movable control member mounted in the housing, a contact connected with the control member, said control member tending to move to hold said latter contact normally in engagement with the first contact and to hold the stem spaced from the article to be gauged, a plurality of selector circuits, a selecting means movable with the control member for controlling said circuits, means controlled by the respective circuits, an amplifier including a vacuum tube having its grid circuit connected to the said contacts to be controlled thereby, a switch controlled by said amplifier, said switch being connected with the selecting means to control said circuits, and means for shifting the control member to move the second contact in a direction away from the first contact and permit the stem to move against the article in the gauging position.

3. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an amplifier including a vacuum tube having its grid circuit connected with said contacts to be controlled thereby, a plurality of selector circuits, a selecting means movable with the control member for controlling said circuits, means controlled by the amplifier for controlling the selecting means, and means to shift said control member to permit the gauging member to move into engagement with the element and arrest movement of the first contact and to then shift the second contact from the first to control said amplifier.

4. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, a plurality of spaced stationary contacts, a plurality of circuits connected with said contacts, a selecting contact connected with the control member and movable thereby over the stationary contacts, an amplifier controlled by the first contacts, means controlled by the amplifier connected with the selecting contact to control said circuits, and means to shift the control member to permit the gauging member to move into engagement with the element to be gauged and arrest movement of the

first contact and then to shift the second contact from the first to control said amplifier.

5. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable plunger, a contact connected with the plunger and movable therewith, said plunger tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, a plurality of selector circuits including a plurality of stationary spaced contacts connected one to each circuit, a selecting contact movable with the plunger to engage said stationary contacts in succession, an amplifier including a vacuum tube having its grid circuit connected with the first contacts to be controlled thereby, a switch controlled by said amplifier and connected to the selecting means to control said selector circuits, a solenoid for shifting the plunger to permit the gauging member to move into engagement with the element to be gauged and arrest movement of the first contact and then to separate the second contact from the first to control the amplifier, a switch for controlling the solenoid, and means operated by the plunger for controlling the latter switch.

6. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable plunger, a contact connected with the plunger and movable therewith, said plunger tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an electrical device connected with said contacts and controlled thereby, a solenoid for shifting the plunger to permit the gauging member to move into engagement with the element to be gauged and arrest movement of the first contact and to then separate the second contact from the first to control said electrical device, a switch for controlling the solenoid, and means movable with the plunger to control said switch.

7. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable plunger, a contact connected with the plunger and movable therewith, said plunger tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an amplifier including a vacuum tube having its grid circuit connected with said contacts to be controlled thereby, a plurality of selector circuits, a selecting means movable with the plunger for controlling said circuits, means controlled by the amplifier for controlling the selecting means, a slow acting solenoid for shifting the plunger to permit the gauging member to move into engagement with the element to be gauged and arrest movement of the first contact and then separate the second contact from the first to control said amplifier, a switch for controlling the solenoid, and means operated by the plunger to control said switch.

8. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected

with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an electrical device connected with said contacts and controlled thereby, a plurality of selector circuits, selecting means movable with the control member for controlling said circuits, means controlled by said electrical device for controlling the selecting means, a movable selector provided with a plurality of openings adapted to receive the article being gauged after leaving the gauging position and direct it to different compartments, means in each circuit for shifting the selector means and each arranged to shift said selector a different amount from each of the other circuits to position the respective openings, means for shifting the control member to permit the gauging member to engage the element to be gauged and then separate the first contacts to control said electrical device, and means for shifting the article from the gauging position to the selector.

9. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an amplifier including a vacuum tube having its grid circuit connected with said contacts to be controlled thereby, a plurality of spaced stationary contacts, a plurality of selector circuits connected with said contacts, a movable selector provided with a plurality of openings adapted to receive the article being gauged after leaving the gauging position and direct it to different compartments, a solenoid in each selector circuit including an armature connected with the selector and each having a different length of movement from each of the others to locate the respective openings in article receiving position, a selecting contact connected with the control member and movable thereby over the stationary contacts, a switch controlled by the amplifier and connected with said selecting contact to control the selector circuits, means for shifting the control member to permit the gauging member to move into engagement with the article to be gauged and arrest movement of the first contact and then to separate the second contact from the first to control the amplifier, and means to shift the gauged article from the gauging position to the selector.

10. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable plunger, a contact connected with the plunger and movable therewith, said plunger tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an amplifier including a vacuum tube having its grid circuit connected with said contacts to be controlled thereby, a plurality of spaced stationary contacts, a plurality of selector cir-

cuits connected one to each stationary contact, a selecting contact movable with the plunger to engage said stationary contacts in succession, a switch controlled by the amplifier and connected with the selecting contact to control said circuits, a movable selector provided with a plurality of openings adapted to receive the articles after they are shifted from the gauging position and direct them to different compartments, a solenoid in each selector circuit including an armature connected to the selector by a one-way connection so that each armature is adapted to shift the selector independently of each of the other armatures and each armature having a different length of movement from each of the other armatures to impart a different movement to the selector to locate the respective openings in article receiving position, a slow acting solenoid to shift the plunger to permit the gauging member to engage an article in the gauging position and arrest movement of the first contact and then separate the second contact from the first to control the grid circuit, a switch to control said latter solenoid, means operated by this solenoid to control said latter switch, and means for shifting the articles from the gauging position to the selector.

11. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, a movable member connected with said gauging member to be positioned thereby, means tending to move said gauging member toward the element to be gauged, an electrical contact connected with the movable member for movement therewith, a movable control member, a contact connected with the control member, said control member tending to move to hold said latter contact normally in engagement with the first contact and to hold the gauging member spaced from the element to be gauged, an amplifier including a vacuum tube having its grid circuit connected with said contacts to be controlled thereby, means controlled by the amplifier, and means for shifting the control member to move the second contact in a direction away from the first contact and permit the gauging member to move against an element in the gauging position.

12. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, a movable member connected with said gauging member to be positioned thereby, an electrical contact connected with said movable member for movement therewith, means tending to shift the gauging member into engagement with the element, a movable control member, a contact connected with said control member and movable therewith, said control member tending to move to normally hold said second contact in engagement with the first and to retain said gauging member spaced from the element, a plurality of selector circuits, a selecting means movable with the control member to control said circuits, an electrical means controlled by the contacts and controlling said selecting means, and means to shift the control member to permit the gauging member to engage the elements to be gauged and to then separate the contacts to control the selecting means.

13. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, a movable member connected with said gauging member to be positioned thereby, an electrical contact connected with said movable member for movement therewith, means

tending to shift the gauging member into engagement with the element, a movable control member, a contact connected with said control member and movable therewith, said control member tending to move to normally hold said second contact in engagement with the first and to retain said gauging member spaced from the element, an electrical device controlled by said contacts, and means to shift the control member to permit the gauging member to engage the element to be gauged and then separate the contacts to control said device.

14. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an amplifier including a vacuum tube having its grid circuit connected with said contacts to be controlled thereby, and means for shifting the control member to permit the gauging member to engage the element to be gauged and then separate the contacts to control said amplifier.

15. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an electrical device connected with said contacts and controlled thereby, and means to shift said control member to permit the gauging member to move into engagement with the element and arrest movement of the first contact and to then shift the second contact from the first to control said electrical device.

16. A gauging device comprising a movable gauging member adapted to engage an element

to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally retain the second contact in engagement with the first and to hold said gauging member spaced from the element, an electrical device connected with said contacts and controlled thereby, electrical means for shifting the control member to permit the gauging member to move into engagement with the element to be gauged and arrest movement of the first contact and to then separate the second contact from the first to control said electrical device, a switch for controlling the electrical means, and means movable with the control member to control said switch.

17. A gauging device comprising a movable gauging member adapted to engage an element to be gauged, an electrical contact connected with said member to be positioned thereby, means tending to shift the member into engagement with the element, a movable control member, a contact connected with the control member and movable therewith, said control member tending to move to normally hold the second contact in engagement with the first and to hold said member spaced from the element, an electrical device connected with said contacts and controlled thereby, a plurality of selector circuits, selecting means movable with the control member for controlling said circuits, means controlled by said electrical device for controlling the selecting means, a movable selector adapted to receive the article being gauged after leaving the gauging position and direct it to different compartments, means in each circuit for shifting the selector means and each arranged to shift said selector a different amount from each of the other circuits to position the selector, means for shifting the control member to permit the gauging member to engage the element to be gauged and then separate the first contacts to control said electrical device, and means for shifting the article from the gauging position to the selector.

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