

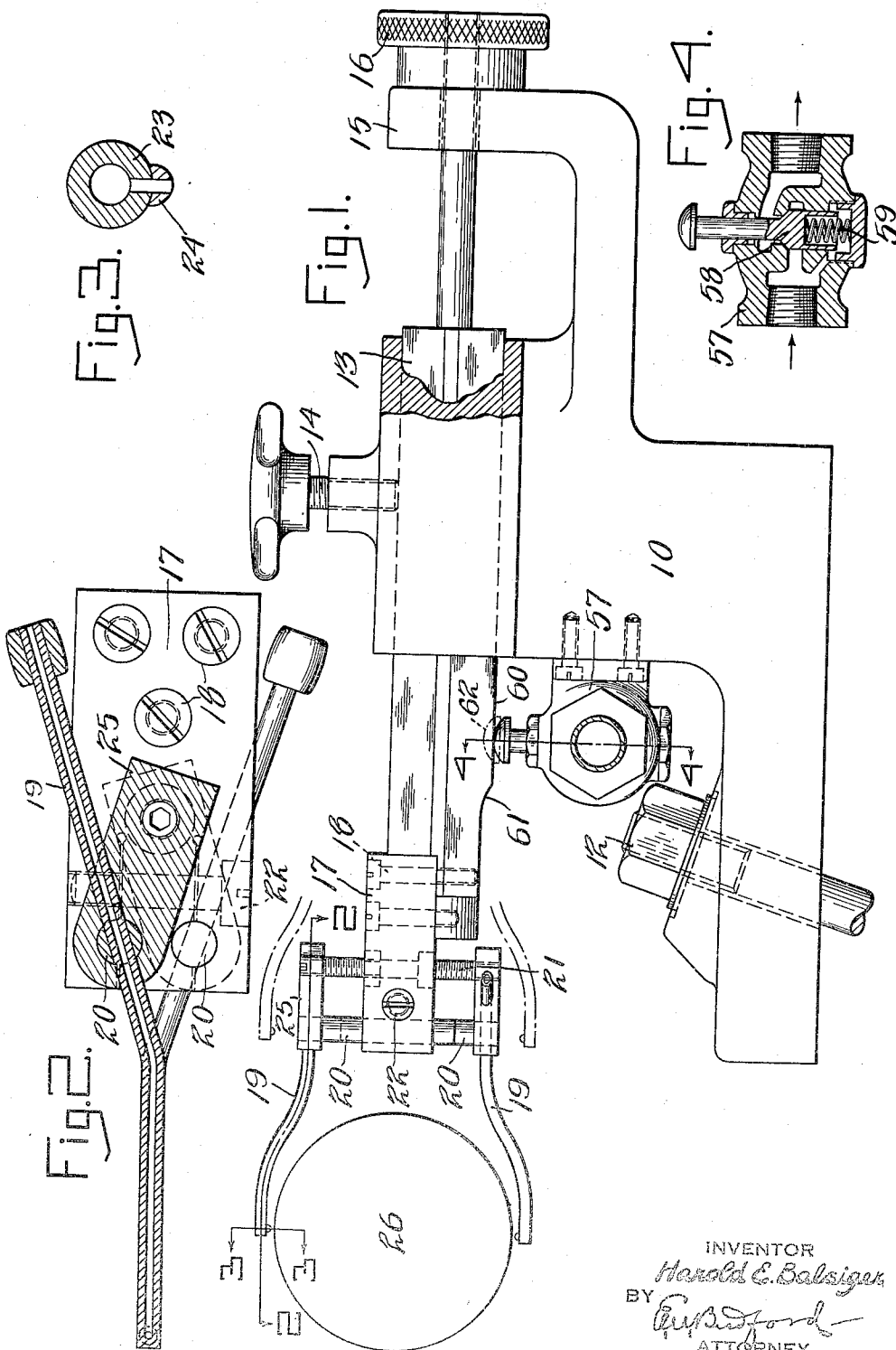
Oct. 29, 1935.

H. E. BALSIGER
AUTOMATIC SIZING DEVICE

2,019,066

Filed April 5, 1932

3 Sheets-Sheet 1



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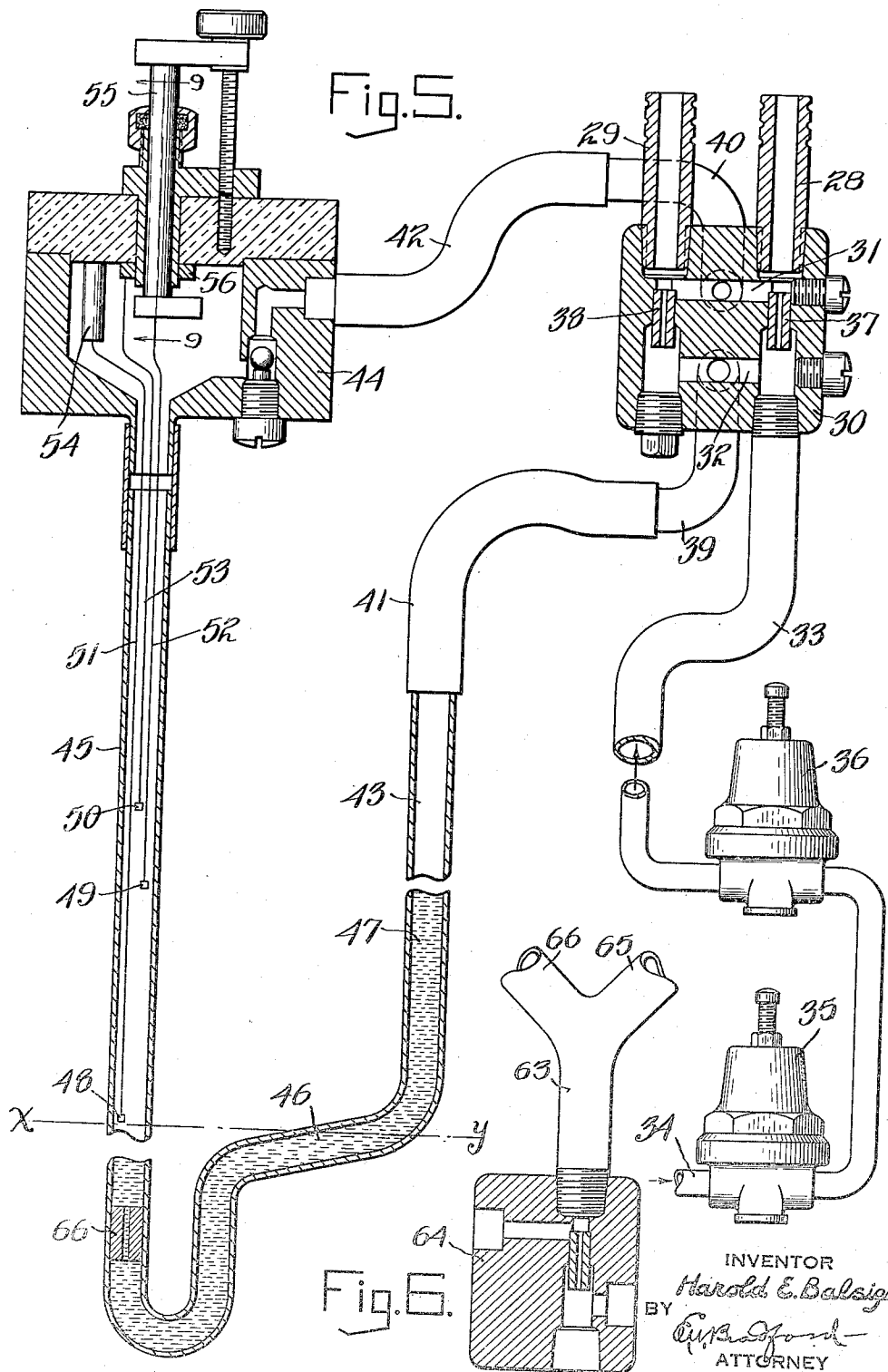
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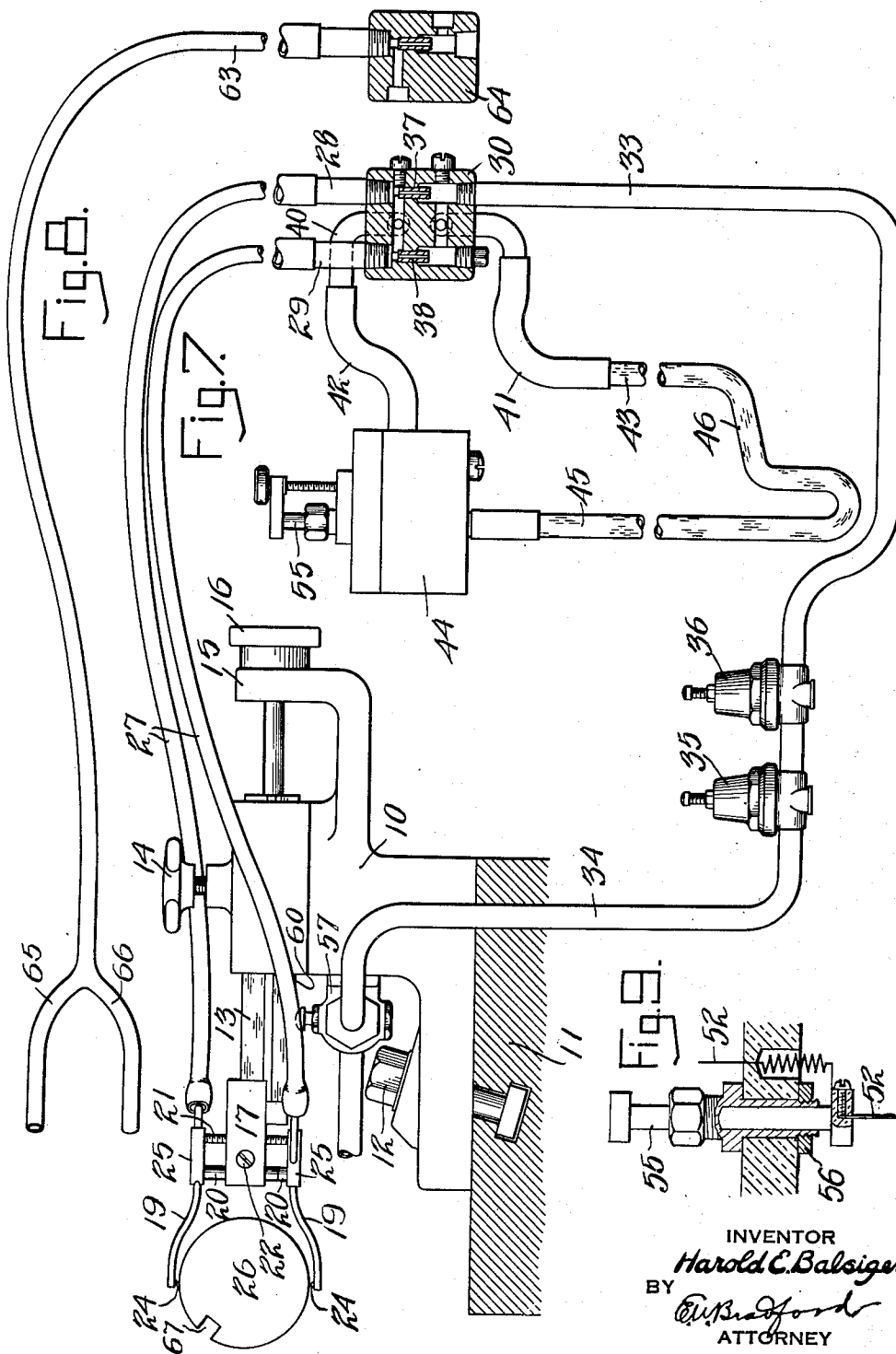
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UNITED STATES PATENT OFFICE

2,019,066

AUTOMATIC SIZING DEVICE

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poration of Pennsylvania

Application April 5, 1932, Serial No. 603,236

27 Claims. (Cl. 51—165)

This invention relates to automatic sizing devices and its object is to provide a device which will be highly sensitive to small changes in the size of the work being gaged and a further object is to improve generally devices of this character for measuring variations in the size of the work and for controlling mechanism for changing the size of the work.

Another object is to provide a device of such a character so that work pieces having keyways, splines, holes or depressions or projections can be effectively measured and sized while the work is revolving and also while work is being done on the work piece.

Another object is to provide a device whereby the measuring and sizing of the work is done without contact between the work and the measuring device.

Another object is to provide a device rigidly mounted to a base and unaffected by the pressure set up by the tool on the work and being of such a character that springing of the work by the tool will not affect sizing of the piece.

Another object is to provide a device of such a character that the piece being sized can be shifted toward or away from one of the recording members and the size measurement will be constant during said shifting of the piece.

Referring to the accompanying drawings, which are made a part hereof and on which similar reference characters indicate similar parts,

Figure 1 is a side elevation of a portion of the device,

Figure 2, a section on line 2—2 of Figure 1 and on an enlarged scale,

Figure 3, a section of the nozzle taken on line 3—3 of Figure 1,

Figure 4, a section of a cut-off valve taken on line 4—4 of Figure 1,

Figure 5, a section of a manometer tube forming a part of the invention,

Figure 6, an enlarged detail of the modified form shown in Figure 8,

Figure 7, a side elevation of the complete device mounted on the bed of a grinding machine or other machine for varying the diameter of work,

Figure 8, a detail of a modified form of a part of the device, and

Figure 9, a detail section on the dotted line 9—9 in Figure 5.

Numeral 10 indicates the support for the device which may be secured by bolts 12 to some element 11, which in some instances may be the work carriage of a grinding machine or other machine used in reducing the size of work. A

guide 13 may be slidably mounted in a bore in the support 10 and held in adjustable position by means of a screw 14. The support 10 may have an arm or standard 15 through which a portion of the guide 13 is slidably mounted in order to support the guide in rigid position. The guide may be axially movable by means of a knurled end 16. The forward end of the guide 13 carries a block 17 secured thereon by means of screws 18. The block 17 supports pipes or nozzles 19 carried on blocks 25 which are secured to studs or pins 20. The blocks 25 are adjusted toward and from the block 17 by means of screws 21 and locked in adjusted position by a screw 22 so that the nozzles will be held in a fixed predetermined position relative to the work during the grinding operation. The pipes 19 have radial passages 23 through which fluid under pressure may issue. Nozzle portions 24 having a bore registering with bore 23 are preferably secured to pipes 19. The outer surface of the element 24 is preferably rounded or spherical in order to give a better effect to the jet. The rounded outer surface of the nozzle 23 provides a stream line for air currents entrained by the escaping fluid, so that these currents serve to maintain the fluid jet in compact shape for a greater distance from the outlet of the nozzle than would be true if a flat nozzle were used. The rear ends of the pipes 19 are connected to fluid conduits 27. The other ends of these conduits 27 are connected to nipples 28 and 29 which nipples in turn are secured in bores in a block 30. The block 30 is provided with chambers 31 and 32 to the latter of which chambers is connected a pressure fluid conduit 33 for supplying fluid under pressure thereto. Pressure fluid is supplied to the conduit 33 from a pressure fluid line 34. Suitable pressure reducing valves 35 and 36 are provided in line 34 in order to reduce the pressure and to maintain a constant pressure in the line 33. Plugs 37 and 38 having restricted openings therethrough are provided between the chambers 31 and 32. The bores of these plugs are in alignment with the nipples 28 and 29. The bores in the plugs therefore have a Venturi effect. The pressure in the chamber 31 will be affected by the velocity of the fluid flowing through plugs 37 and 38. A pipe 39 is connected to chamber 32 and a similar pipe 40 is connected to chamber 31. Flexible or other fluid conduit 41 connects pipe 39 with the upper end of a leg 43 of a manometer tube and conduit 42 connects pipe 40 with a chamber in a block 44. The upper end of the leg 45 of the manometer tube communicates also with this chamber. The

leg 43 has an almost horizontal portion 46, the purpose of which will later be explained. The lower portion of the manometer tube is filled with a liquid 47 such as mercury or any other suitable liquid. Within the leg 45 are contact elements 48, 49 and 50 which are connected by wires 51, 52 and 53 with posts 54, 55 and 56. Leg 45 has a restriction 66.

The posts 54, 55 and 56 may be connected with suitable electrical circuits not shown which will be controlled as the contacts 48 and 49 are closed by the column of liquid 47 or by closing of contacts 49 and 50 when the column of liquid has reached the contact 50. The column of liquid 47 will be moved by a differential pressure in chambers 31 and 32 as will presently be explained. A valve 57 is positioned in the pressure fluid supply line 34. This valve consists of a plunger 58 which is urged to close off the line 34 by means of a spring 59. The upper end of the valve engages the lower side 60 of the guide 13. When in the position shown in Figure 1 the upper end of the valve resting on the lower side 60 will hold the valve open so that fluid under pressure may flow through the line 34. When the guide 13 is retracted the plunger may slide up on the cam surface 61 so that the end of the plunger will be in dotted line position 62 and the pipe 34 will be closed. This provides for cutting off pressure fluid whenever the device is withdrawn from the work.

In operation fluid from the source of supply from line 34 will be reduced in pressure through valves 35 and 36 and delivered to chamber 32. In this chamber fluid will be maintained at substantially constant pressure. Fluid connection 41 will supply pressure fluid to the top of the mercury column 47 in leg 43 so that the pressure on the mercury in this leg will be substantially the same pressure as exists in the chamber 32. If nipples 28 and 29 were closed so that a static pressure existed in chamber 31 then the same pressure would be maintained through the lines 40 and 42 to the top of the mercury column in the leg 45 of the manometer tube. In operation, however, fluid will escape through the space between nozzle 23 and the surface of the work 26. This will give a reduced pressure in the nipples 28 and 29 and consequently a reduced pressure in the chamber 31. Further reduction in pressure in chamber 31 will be created by the Venturi action of the fluid issuing through the restrictions in the plugs 37 and 38. The pressure in the tubes 27 will determine the velocity of the fluid through the restrictions and consequently will determine the pressure in the chamber 31. Of course the pressure in the chamber 31 will determine the pressure above the body of liquid in the leg 45. The nozzles 24 will be adjusted with respect to the surface of the work at the beginning of a machine or grinding operation and will remain in this fixed predetermined position relative to the work during the entire grinding operation. As the work is reduced in size fluid will be permitted to flow more freely through the nozzles 24 and consequently the pressure will be gradually reduced in the nipples 28 and 29. The reduction will be multiplied in the chamber 31 due to the increased velocity of the fluid through the restrictions in the plugs 37 and 38 so that a slight variation in the size of the work will be multiplied to create an appreciable difference in pressure between the chambers 31 and 32. This will create an appreciable pressure differential on the surface of the liquid in the legs 43 and 45.

As pressure is reduced on the liquid in the leg 45 the liquid in this leg will rise until contacts 48 and 49 are closed. The device will be so set that when these are closed any suitable mechanism on the grinding or other machine may be controlled, such as slowing down the feed of the grinding wheel or any other operations which should be put in action or which should be stopped at this time. When the work has been further reduced in size so that the pressure in lines 28 and 29 is further reduced a still greater pressure differential will be created between the legs 43 and 45 so that the liquid in the leg 45 will rise further and close contacts 49 and 50. These contacts will be closed when the work has been reduced to its final or finished size. Suitable mechanism may be set into motion for stopping operation of the grinding or other machine at this time. The means by which various operations of the machine will be controlled by closing contacts 48, 49 and 50 are more fully disclosed in my copending application Ser. No. 598,498, filed March 12, 1932.

The work is shown as having a key way 67. By reason of the restriction 66 this key way will not cause fluctuations in the column of liquid.

In the modified form shown in Figure 8 a single fluid line 63 is connected to the block 64 and this line separates into two tubes 65 and 66 which are connected to the fluid nozzles on the opposite sides of the work.

Due to the fact that the leg 43 has a relatively longitudinal portion 46, when the column of fluid in leg 43 has been lowered to the position indicated by the line $x-y$ the surface area of the column of liquid will be considerably increased. This further increases the rise of liquid in the leg 45 and decreases the fall in the leg 43 and will tend to move the column of liquid in the leg 45 to a greater elevation. This provides a further magnifying of the pressure differential in the chambers 31 and 32.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention and therefore I do not limit myself to what is shown in the drawings and described in the specification, but only as indicated by the appended claims.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a machine for reducing the size of work, the combination of a pair of nozzles positioned approximately at opposite sides of the work, a source of pressure fluid in communication with said nozzles, and means for registering variation in pressure of said fluid due to escape of fluid as the work is reduced in size, substantially as set forth.

2. In a machine for reducing the size of work, the combination of a pair of fluid nozzles positioned approximately at opposite sides of the work, said nozzles being in communication with a source of fluid under pressure, the fluid being permitted to escape between the nozzles and the surface of the work, and means controlled by variation in the pressure fluid due to variation in the space between the work and the nozzles in control of means for varying the size of the work, substantially as set forth.

3. The combination with a pressure gage of a plurality of fluid nozzles, said nozzles being positioned with their outlets adjacent the surface of work to be gaged, a source of fluid under pressure

in communication with said nozzles, variation in the size of the work creating a variation in the rate of flow of fluid through the nozzles, a manometer comprising a U-tube having each leg partially filled with liquid, the liquid in one leg being under a constant pressure and the liquid in the other leg being subject to varying pressures due to variation in the flow of the fluid through the nozzles, and means for multiplying variation in pressure of said fluid to multiply the result in the manometer tube, substantially as set forth.

4. A gaging device of the kind described comprising a source of fluid under pressure, means for permitting said fluid to escape adjacent the surface of work to be gaged, the rate of escape of said fluid being directly proportional to variation in the size of the work, and means controlled by the rate of escape of said fluid for controlling means for causing the variation in the size of the work and means for compensating irregularities in the shape of the work to prevent such irregularities from interfering with accurate gaging of the size of the work, substantially as set forth.

5. In a machine for reducing the size of work, the combination of a pair of fluid nozzles in communication with a supply of fluid under pressure, a block having a pair of chambers therein, a source of fluid under high pressure in communication with one of said chambers, the fluid nozzles being in communication with the other of said chambers, restricted passages between the chambers for increasing the velocity flow of fluid from one chamber to the other, said passages being disposed respectively relative to the connections of the fluid nozzles to said chamber so as to create a suction in the chamber to which said nozzles are connected, said suction being varied in response to variation in the speed with which fluid issues from the said nozzles due to a reduction in the size of the work, substantially as set forth.

6. In a gaging device of the kind described, a fluid nozzle having a hemi-spherical outer wall and a radial port therethrough, the outer wall serving to direct air currents into the path of an issuing jet to prevent breaking down of the jet until it has traveled a relatively great distance from the nozzle outlet, substantially as set forth.

7. In a gaging device of the kind described a manometer tube having two legs, a body of liquid in said tube and positioned so as to partially fill each leg, one of said legs having a bent portion adapted to extend approximately in a horizontal direction, a source of varying fluid pressure in communication with one of said legs, and a body of fluid under constant pressure in communication with the other of said legs, the fluid under constant pressure causing at times liquid to be moved until its surface lies within a horizontal plane passing through the horizontal portion of the leg, whereby a given increment of increase in pressure on this leg will lift the column of liquid in the other leg to a greater height, substantially as set forth.

8. In a gaging device of the kind described a manometer tube having two legs, a body of liquid in said tube and positioned so as to partially fill each leg, one of said legs having a bent portion adapted to extend approximately in a horizontal direction, a source of varying fluid pressure in communication with one of said legs, and a body of fluid under constant pressure in communication with the other of said legs, the fluid under constant pressure causing at times liquid to be moved until its surface lies within a horizontal plane

passing through the horizontal portion of the leg, whereby a given increment of increase in pressure on this leg will lift the column of liquid in the other leg to a greater height, and means for changing the pressure differential on the liquid in the two legs in response to variation in the size of work being gaged, substantially as set forth.

9. In a machine for reducing the diameter of cylindrical work, a gage for said work comprising a pair of nozzles through which fluid under pressure is caused to escape, said nozzles being positioned adjacent the surface of the work and spaced from each other circumferentially of the work whereby variation in the size of the work causes a variation in the escape of the fluid through said nozzles, and means controlled by variation in the freedom with which fluid issues from said nozzles in control of certain operations of said machine, substantially as set forth.

10. A device to control the operation of a machine from the size of the work piece comprising one or more nozzles positioned adjacent said work piece and adapted to direct a stream of fluid thereagainst, a gage responsive to changes in the rate of flow of fluid against the work as the work changes in size, and means to make said gage uniformly sensitive over a predetermined range corresponding to a given change in size of the work piece, substantially as set forth.

11. In a machine for changing the size of a work piece, a device actuated by said change in size and adapted to control the operation of the machine comprising one or more nozzles positioned adjacent said work piece and adapted to direct a stream of fluid thereagainst, a gage responsive to change in velocity of the fluid as the size of the work piece changes, and means to make said gage uniformly sensitive over a predetermined range corresponding to a given change in size of the work piece by stream lining said nozzles, substantially as set forth.

12. A device to control the operation of a machine from the size of the work piece comprising one or more nozzles positioned adjacent said work piece and adapted to direct a stream of fluid thereagainst, a gage responsive to changes in the rate of flow of fluid against the work as the work changes in size, means to make said gage uniformly sensitive over a predetermined range corresponding to a given change in size of the work piece, and additional means to further control the sensitivity of said gage, substantially as set forth.

13. In a grinding machine, a work sizing device comprising a nozzle having a body of fluid in communication therewith to issue therethrough, said nozzle being positioned during operation adjacent the surface of work to be gauged, the rate of escape of the fluid being determined by the distance between the nozzle and the surface of the work, the outer contour of the nozzle being stream-lined whereby the issuing jet of fluid will entrain a cone of fluid about the outside of the nozzle to assist in holding together the issuing jet of fluid as the space between the nozzle and the work increases.

14. A device of the kind described comprising a nozzle having a body of fluid in communication therewith to issue therethrough said nozzle being positioned so as to make said fluid responsive to a change in size of a work piece during machining, the outer contour of the nozzle being streamlined whereby the issuing jet of fluid will entrain a body of fluid about the outside of the nozzle to assist in holding together the issuing jet of fluid.

15. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, means for holding said nozzle in a fixed predetermined position relative to the work whereby the flow of fluid from the nozzle is caused to increase as the size of the work decreases, said conduit having a restricted passage for producing a velocity change in the flow of the fluid, said velocity change varying in response to a change in the flow of fluid from the nozzle, and means controlled by the velocity change at the restricted passage for controlling the action of the grinding machine.

16. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, a support for the nozzle movable toward and from the work for setting and maintaining said nozzle in a predetermined fixed position relative to the work whereby the flow from the nozzle is controlled by the work and caused to increase as the size of the work decreases, said conduit having a restricted passage for producing a velocity change in the flow of the fluid, said velocity change varying in response to a change in the flow of fluid from the nozzle, and means controlled by the velocity change at the restricted passage for controlling the action of the grinding machine.

17. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, a support for the nozzle movable toward and from the work for setting and maintaining said nozzle in a predetermined fixed position relative to the work whereby the flow from the nozzle is controlled by the work and caused to increase as the size of the work decreases, said conduit having a restricted passage for producing a velocity change in the flow of the fluid, said velocity change varying in response to a change in the flow of fluid from the nozzle, means controlled by the velocity change at the restricted passage for controlling the action of the grinding machine, and means whereby the flow of fluid from the nozzle is cut off when said support is retracted and automatically established when the support is moved to said set position.

18. A gaging device for a grinding machine comprising a fluid conduit, a pair of nozzles connected to said conduit for discharging fluid therefrom, means for supporting said nozzles in a fixed position relative to the work operated upon and at points spaced circumferentially thereof, whereby the flow of fluid from each nozzle is controlled by the work and is caused to increase as the size of the work decreases, said conduit having branches leading to the respective nozzles, means associated with each branch and providing a restricted passage for producing a velocity change in the flow of fluid into the respective branches, and means controlled by the velocity change at the restricted passages for controlling the action of the grinding machine.

19. A gaging device for a grinding machine comprising a fluid conduit, a pair of nozzles connected to said conduit for discharging fluid therefrom, means for supporting said nozzles in a fixed position relative to the work operated upon and at points spaced circumferentially thereof, whereby the flow of fluid from each nozzle is controlled by the work and is caused to increase as the size of the work decreases, said conduit having branches leading to the respective nozzles, means associated with each branch and providing a restricted passage for producing a velocity change in the flow of fluid into the respective branches,

and means controlled by the velocity change at the restricted passages for controlling the action of the grinding machine, said means for supporting the nozzles being movable toward and from the work, and means controlled thereby for cutting off the fluid supply from the nozzles when said support is retracted and for automatically establishing said flow of fluid from the nozzles when the nozzles are moved to a set position relative to the work.

20. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, means responsive to a change in the size of the work for varying the flow of fluid from the nozzle, said conduit having a restricted passage for producing a velocity change in the flow of the fluid in the conduit, a tube having a movable body therein, means connecting one end of said tube with said conduit between the restricted passage and the source of supply, and means for connecting the other end of the tube with the conduit adjacent the restricted passage so that the change in the velocity of the flow of the fluid produces a differential pressure on the movable body within the tube.

21. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, means responsive to a change in the size of the work for varying the flow of fluid from the nozzle, said conduit having a restricted passage for producing a velocity change in the flow of the fluid in the conduit, a tube having a movable body therein, means connecting one end of said tube with said conduit between the restricted passage and the source of supply, means for connecting the other end of the tube with the conduit adjacent the restricted passage so that the change in the velocity of the flow of the fluid produces a differential pressure on the movable body within the tube, electric contacts within said tube and spaced from each other, said body within the tube being of conductive material, and means controlled by the contacts for controlling the action of the grinding machine.

22. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, means responsive to a change in the size of the work for varying the flow of fluid from the nozzle, said conduit having a restricted passage for producing a velocity change in the flow of the fluid in the conduit, a tube having a movable body therein, means connecting one end of said tube with said conduit between the restricted passage and the source of supply, means for connecting the other end of the tube with the conduit adjacent the restricted passage so that the change in the velocity of the flow of the fluid produces a differential pressure on the movable body within the tube, said tube having a section thereof shaped so as to provide an approximately horizontal portion disposed so that the surface of the movable body in the tube subjected to the pressure from the conduit moving said body lies within said horizontal section, whereby the volume of liquid moved for a given increment of change in the differential pressure is increased.

23. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, means responsive to a change in the size of the work for varying the flow of fluid from the nozzle, said conduit having a restricted passage for producing a velocity change

in the flow of the fluid in the conduit, a tube having a movable body therein, means connecting one end of said tube with said conduit between the restricted passage and the source of supply, means for connecting the other end of the tube with the conduit adjacent the restricted passage so that the change in the velocity of the flow of the fluid produces a differential pressure on the movable body within the tube, electric contacts within said tube and spaced from each other, said body within the tube being of conductive material, and means controlled by the contacts for controlling the action of the grinding machine, said tube having a section thereof shaped so as to provide an approximately horizontal portion disposed so that the surface of the movable body in the tube subjected to the pressure from the conduit moving said body lies within said horizontal section, whereby the volume of liquid moved for a given increment of change in the differential pressure is increased.

24. A gaging device for a grinding machine comprising a fluid conduit, a nozzle for discharging the fluid therefrom, said fluid conduit having spaced chambers, one of which is connected to the fluid supply and the other of which is connected to said nozzle, a restricted fluid passage connecting said chambers and disposed so that a change in the velocity of the flow of fluid through the passage produces a variation in the pressure in the chamber connected to the nozzle, means whereby the flow of fluid from the nozzle is caused to change as the size of the work varies, a tube having a movable liquid body therein, one end of said tube being connected to one of said chambers and the other end of said tube being connected to the other chamber.

25. A gaging device for a grinding machine comprising a fluid conduit, a pair of nozzles for discharging the fluid from the conduit, said fluid conduit having spaced chambers, one of which is connected to the source of supply and the other of which is connected to said nozzles, means forming a restricted passage between the chambers, said restricted passage being disposed in alignment with the passages leading to the nozzles, a tube having a movable liquid body therein, one end of said tube being connected to one of said chambers and the other end of said tube being connected to the other chamber, and electric contacts within said tube spaced from each other and disposed so that the differential pressure created on said liquid will shift the same and cause a circuit to be established through said electric contacts, said contacts being adapted to control the action of the grinding machine.

26. A gaging device for grinding machines

comprising a fluid conduit, a pair of nozzles for discharging the fluid therefrom, means for supporting said nozzles, said means being movable so as to position and maintain said nozzles in a fixed set position relative to the work whereby the flow of fluid from the nozzles is controlled by the work and increases as the work diminishes in size, said conduit having spaced chambers, one of which is connected to the source of supply, nipples connected to the other chamber and to the respective nozzles, said conduit having a restricted passage for producing a velocity change in the flow of fluid from one chamber into the other and into the nipples, whereby the pressure on the chamber connected to the nozzles varies in response to the flow of fluid from the nozzles, a tube having a conductive liquid therein, one end of said tube being connected to one of said chambers and the other end of said tube being connected to the other chamber, and electric contacts disposed in said tube and spaced from each other whereby a differential pressure created on the fluid in the tube will establish circuits through said contacts and control the action of the grinding machine.

27. A gaging device for grinding machines comprising a fluid conduit, a pair of nozzles for discharging the fluid therefrom, means for supporting said nozzles, said means being movable so as to position and maintain said nozzles in a fixed set position relative to the work whereby the flow of fluid from the nozzles is controlled by the work and increases as the work diminishes in size, said conduit having spaced chambers, one of which is connected to the source of supply, nipples connected to the other chamber and to the respective nozzles, said conduit having a restricted passage for producing a velocity change in the flow of fluid from one chamber into the other and into the nipples whereby the pressure on the chamber connected to the nozzles varies in response to the flow of fluid from the nozzles, a tube having a conductive liquid therein, one end of said tube being connected to one of said chambers and the other end of said tube being connected to the other chamber, electric contacts disposed in said tube and spaced from each other whereby a differential pressure created on the fluid in the tube will establish circuits through said contacts and control the action of the grinding machine, and means whereby the fluid supply to the nozzles is cut off when said support is retracted and is automatically established when the support is moved to place the nozzles in a predetermined set position relative to the work.

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