

April 3, 1956

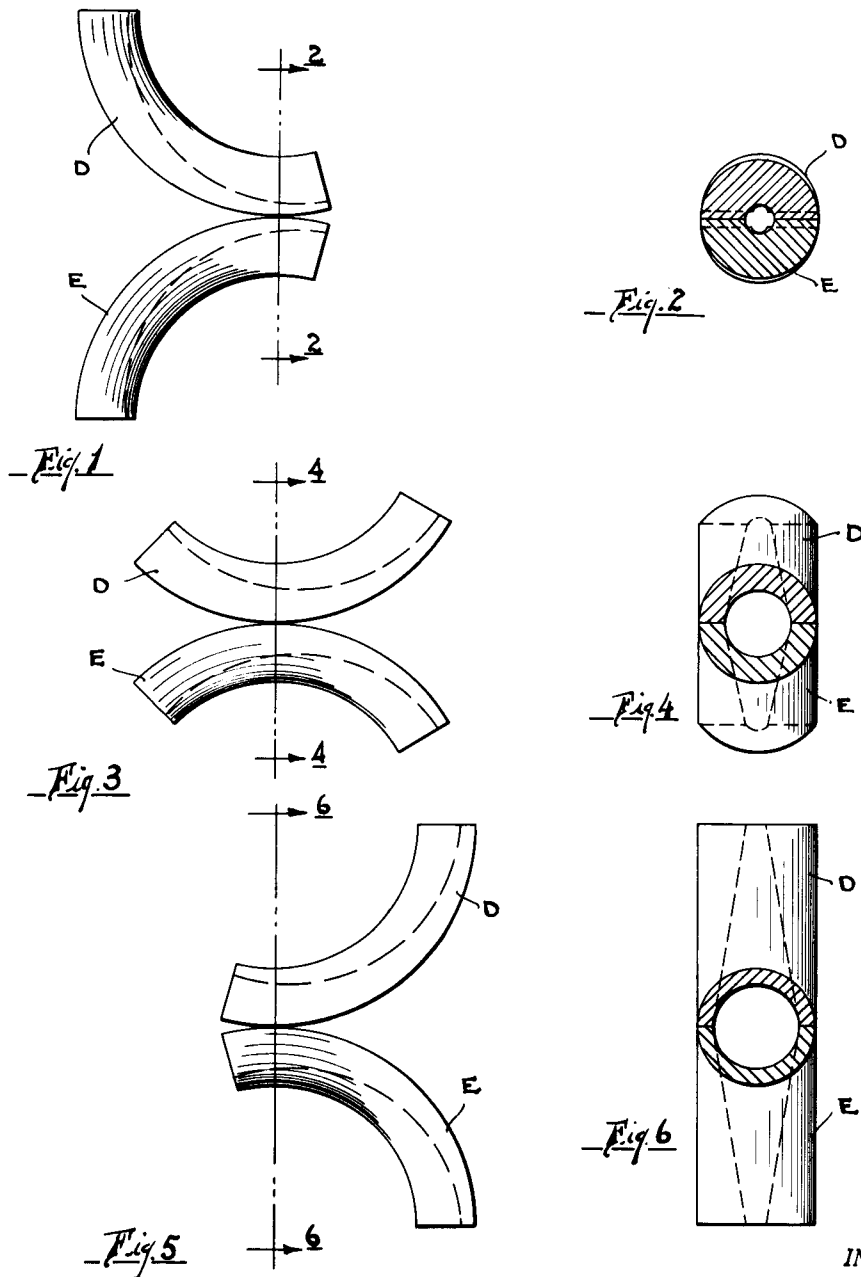
J. M. O'TOOLE

2,740,635

MEANS FOR PRODUCING VARIABLE SIZED APERTURES

Filed Dec. 8, 1952

8 Sheets-Sheet 1



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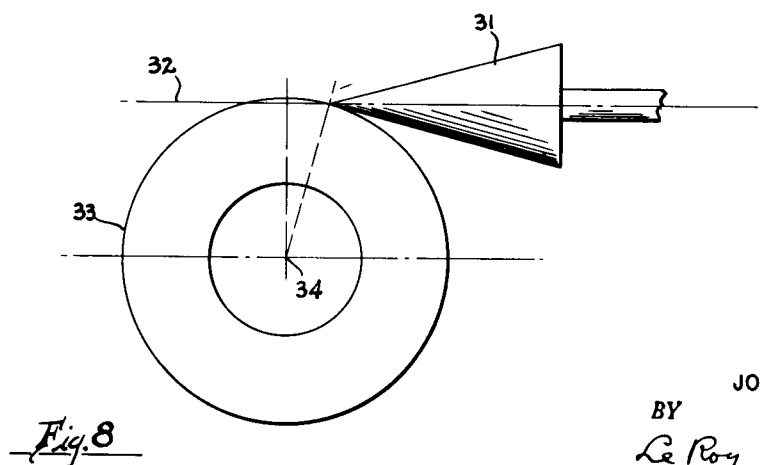
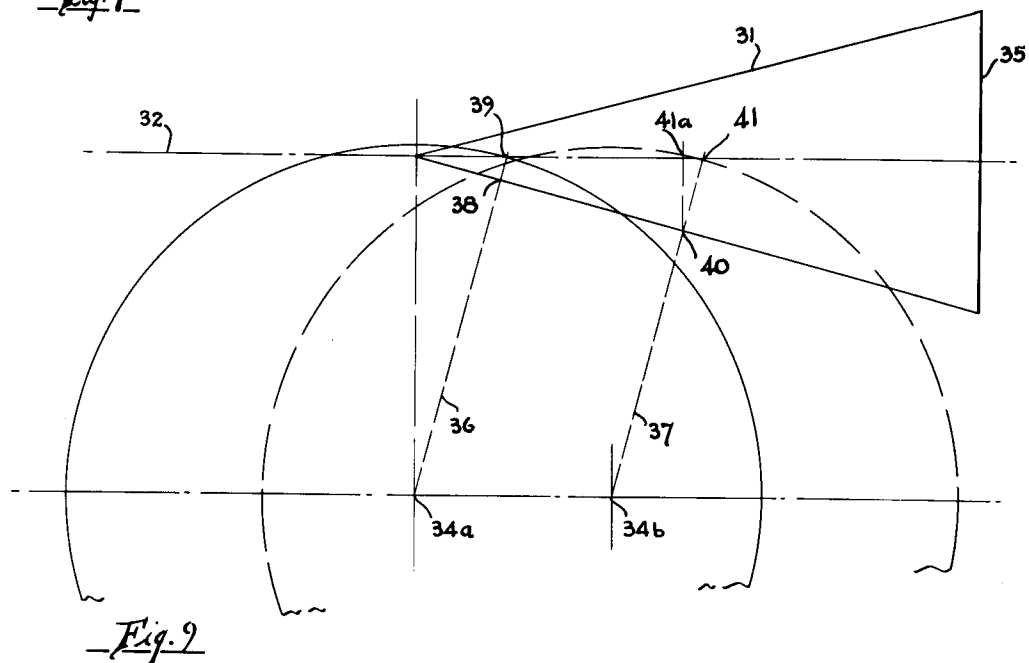
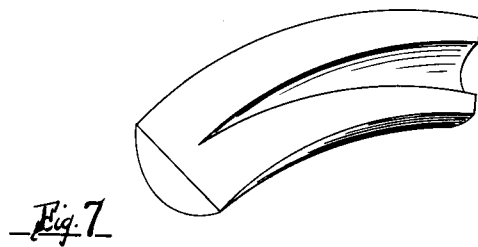
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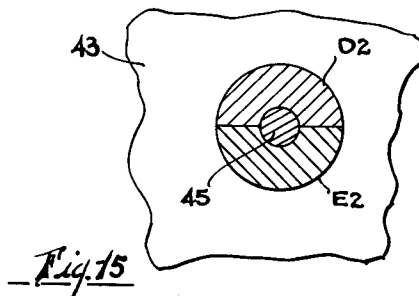
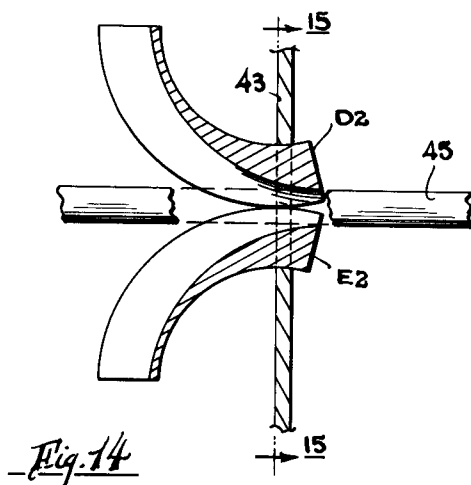
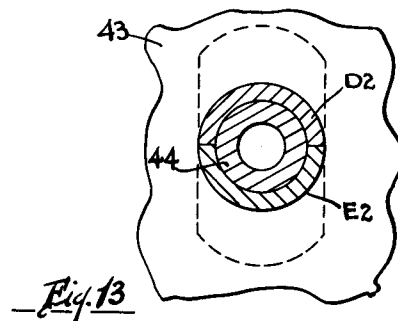
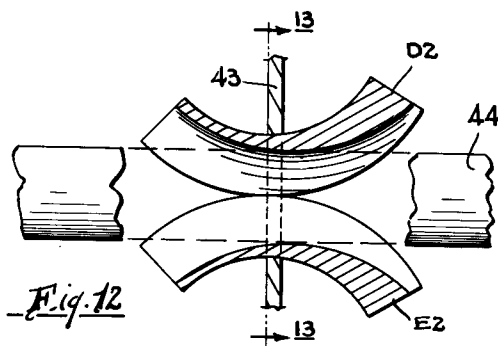
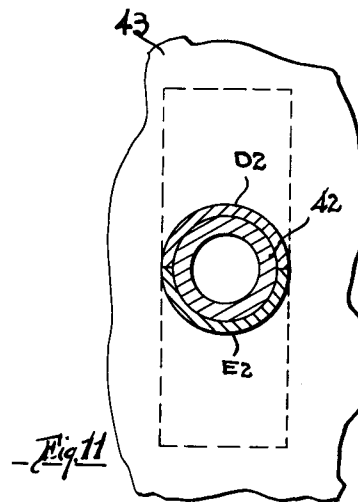
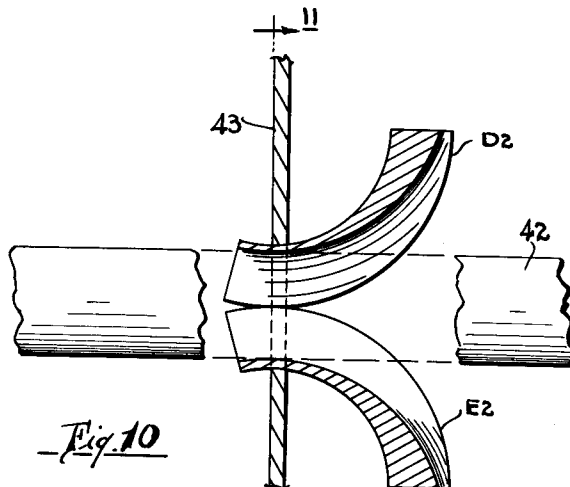
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8 Sheets-Sheet 3



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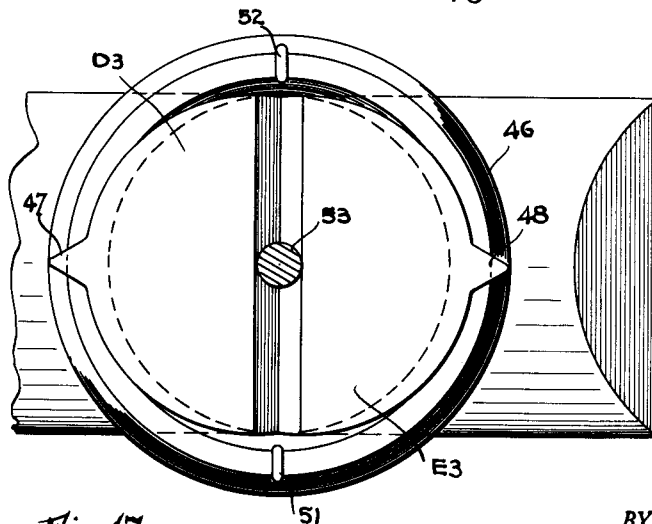
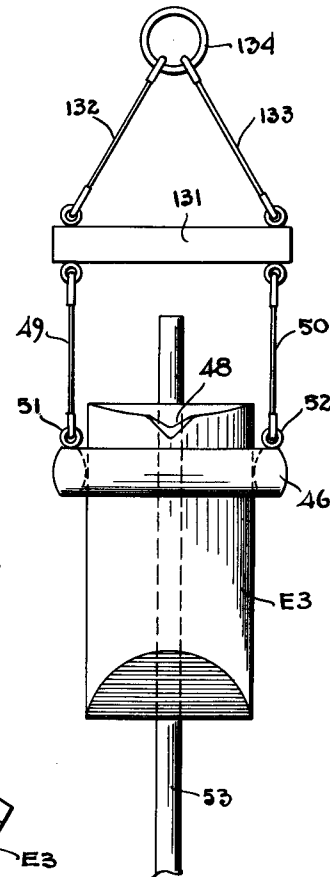
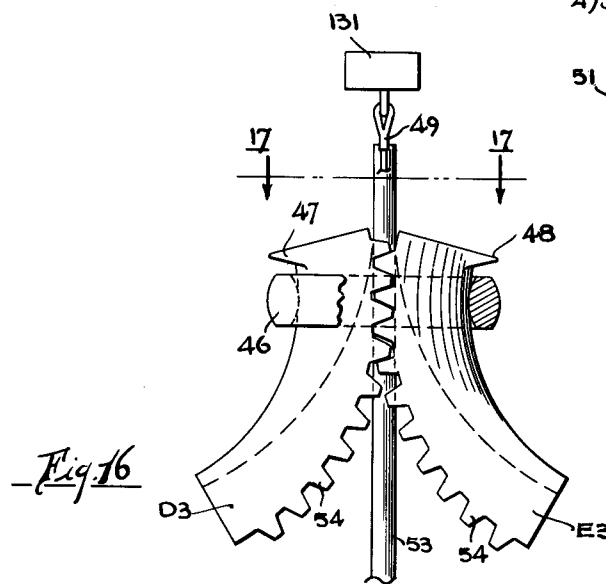
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8 Sheets-Sheet 4



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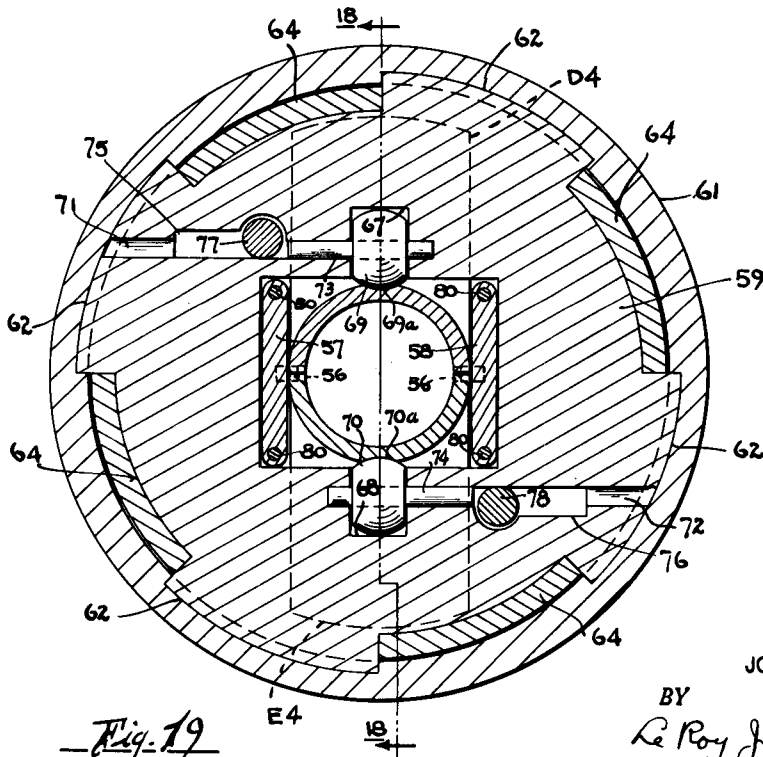
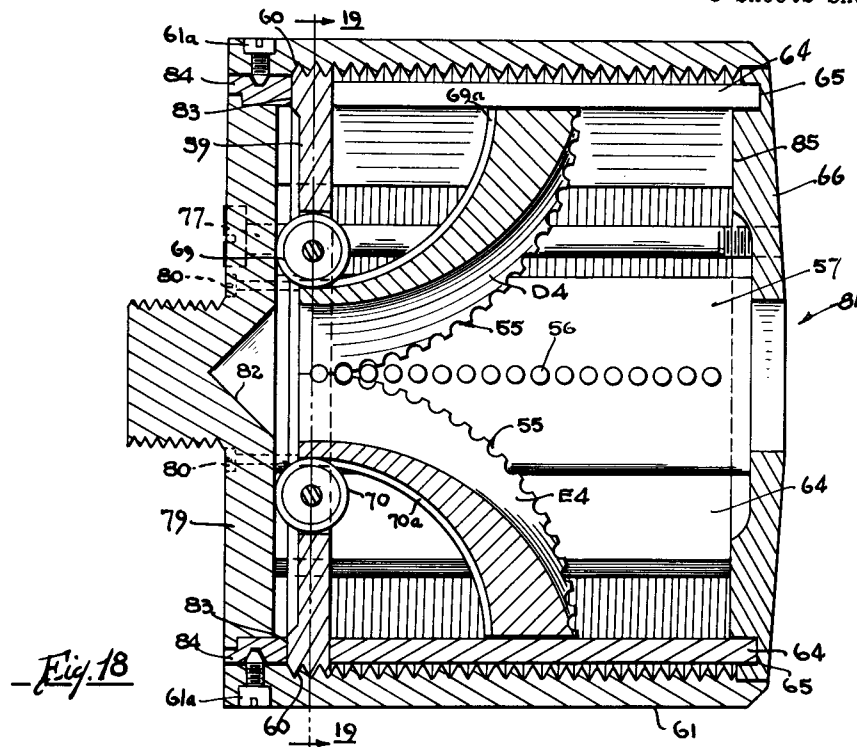
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8 Sheets-Sheet 5



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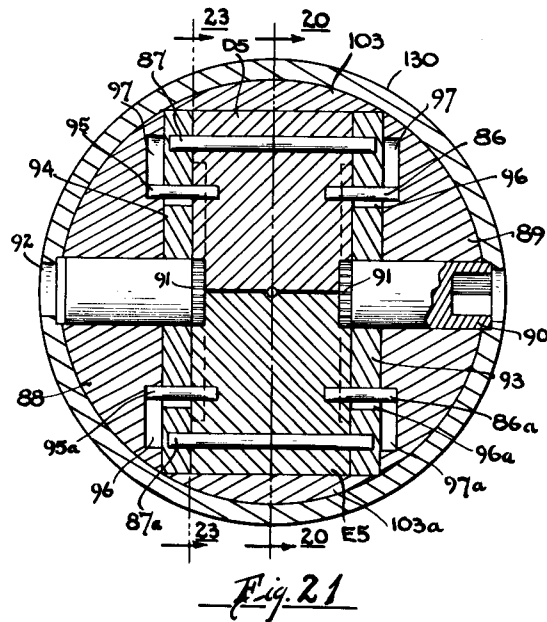
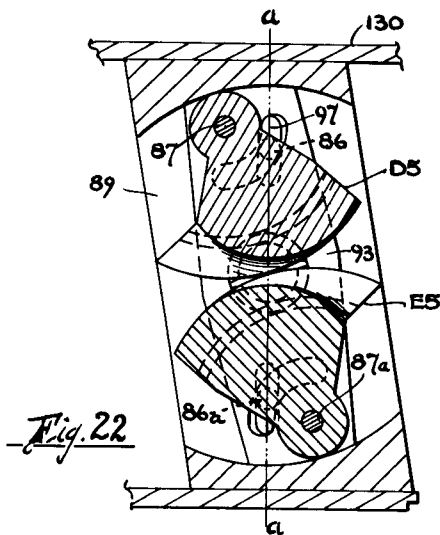
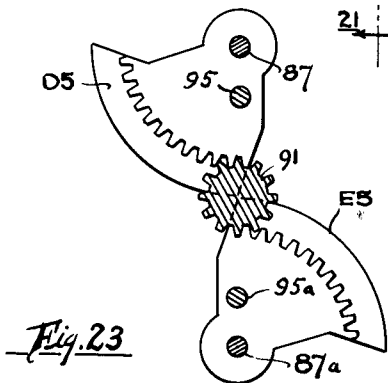
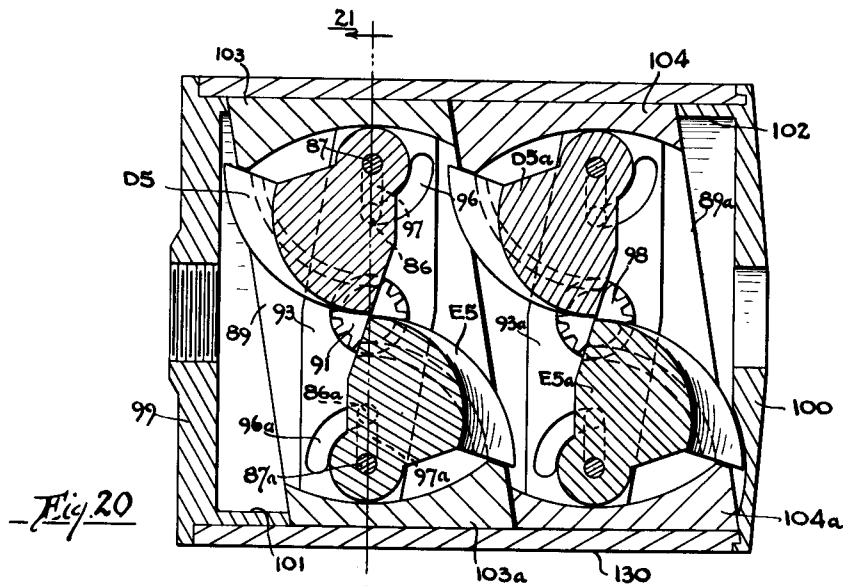
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8 Sheets-Sheet 6



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8 Sheets-Sheet 7

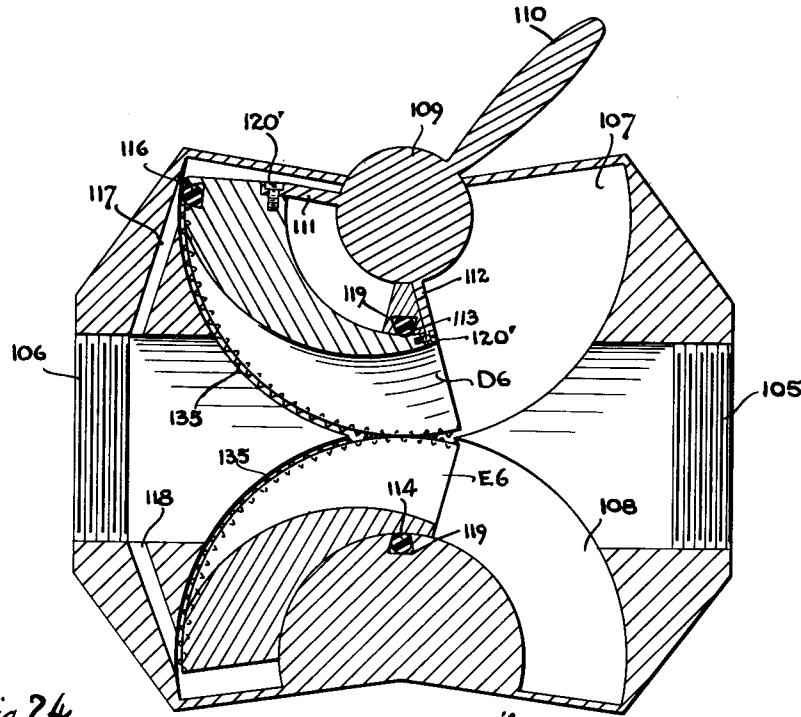


Fig. 24

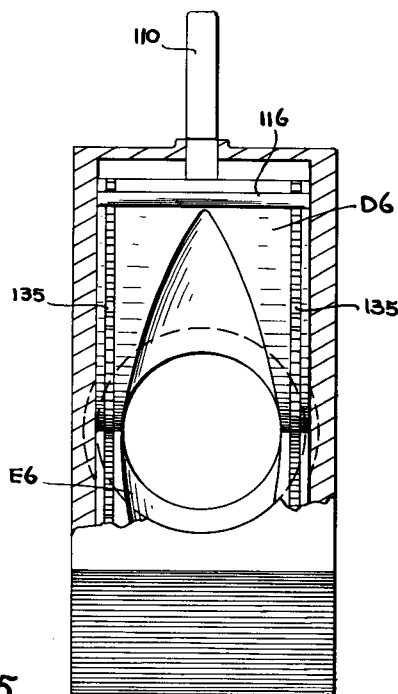


Fig. 25

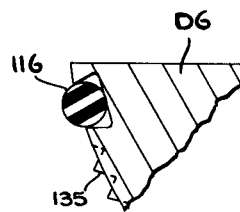


Fig. 26

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8 Sheets-Sheet 8

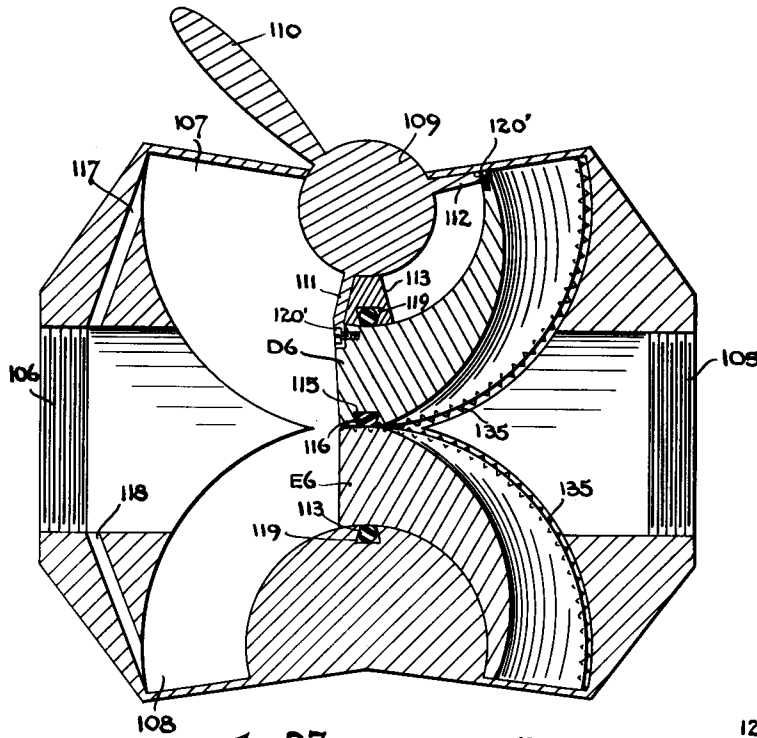


Fig. 27

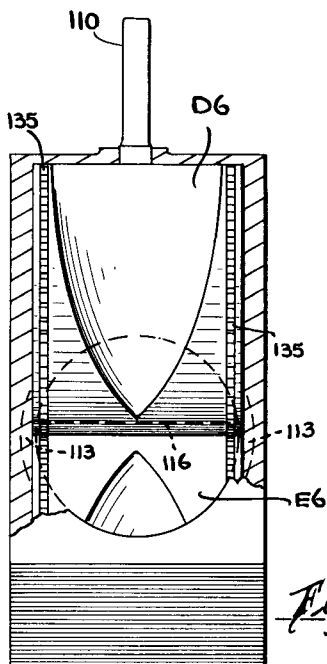


Fig. 28

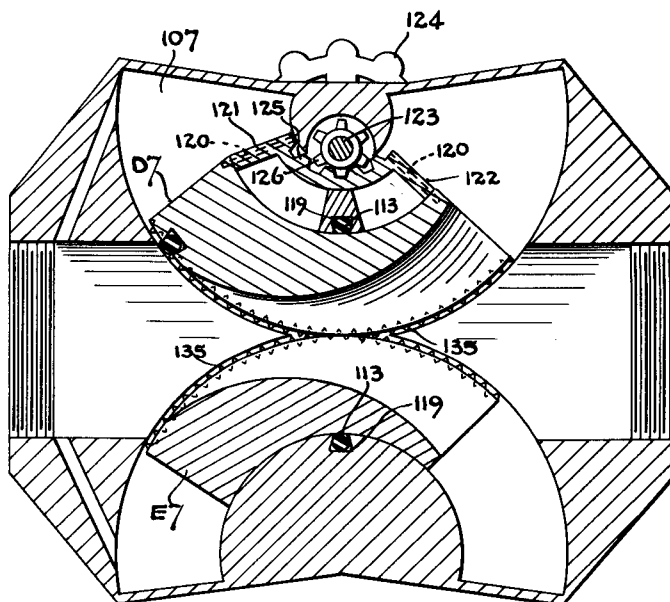


Fig. 29

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MEANS FOR PRODUCING VARIABLE SIZED APERTURES

John M. O'Toole, Culver City, Calif.

Application December 8, 1952, Serial No. 324,657

5 Claims. (Cl. 279-106)

The invention herein described pertains to improved means for producing an aperture of variable size, said means being useful in a wide variety of devices, such as a lifting device, chuck, valve, variable venturi, extrusion die, etc. The aperture may have a cross section of any desired configuration, such, for example, as circular, rectangular, triangular, hexagonal or star-shaped.

In apparatus heretofore available for producing an aperture of variable size, it has not been possible to secure a circular aperture of substantially perfect circular cross section. One of the objects of my invention is to afford means that will permit such an aperture to conform more nearly to a perfect circle.

Another object is to provide a method for shaping the more important contours of the components required in carrying out my invention.

Another object is to afford a variable aperture structure that may be used as a grommet that will provide a central opening of any desired size within a wide range.

A further object is to associate the basic elements of my invention with other components in order to produce a superior lifting or grappling device.

Another object is to produce a chuck utilizing the aforementioned components for producing a variable size aperture.

Still another object is to provide means in association with the basic elements of my invention for eliminating inaccuracies in the configuration of the aperture which they produce.

A further object is to produce a gas or fluid valve embodying the said elements.

Another object, in connection with said valve, is to eliminate the central obstructions that are characteristic of valves of conventional design.

Still another object in connection with the valve adaptations is to provide means for sealing the portions of the valve where leakage would otherwise occur.

Still another object, in connection with valves, is to provide a readily controlled venturi.

Other objects, not here enumerated, will appear as the specification proceeds.

In the drawings:

Figure 1 is a side elevation of the basic elements of my variable aperture combination.

Fig. 2 is a section taken on line 2-2 of Fig. 1.

Fig. 3 shows the same parts illustrated in Fig. 1, but respectively arranged in a position that provides a larger opening than is provided when the components are positioned as shown in Fig. 1.

Fig. 4 is a section taken on line 4-4 of Fig. 3.

Fig. 5 shows the same components illustrated in the preceding figures, but they are so arranged to produce an aperture of a size still larger than that indicated in the preceding figures.

Fig. 6 is a section taken on line 6-6 of Fig. 5.

Fig. 7 is a perspective view of either of the identical elements D and E shown in the preceding figures.

Fig. 8 is a diagrammatic representation of a method

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for producing the components shown in the previously described figures.

Fig. 9 is a mathematical diagram to indicate wherein the apertures formed with the components of previous figures will normally vary from a perfect circle.

Fig. 10 illustrates the use of basic components of my invention as a grommet, the grommet being shown in longitudinal section.

Fig. 11 is a section taken on line 11-11 of Fig. 10.

Fig. 12 illustrates the grommet combination shown in Fig. 10, but they are here positioned to form a smaller aperture than that provided in the position illustrated in Fig. 10.

Fig. 13 is a section taken on line 13-13 of Fig. 12.

Fig. 14 is another view of the same grommet components shown in Figs. 10 and 12, but they are here shown arranged for producing an aperture of still smaller size than that illustrated in Figs. 10 and 12.

Fig. 15 is a section taken on line 15-15 of Fig. 14.

Fig. 16 shows my invention adapted for use as a lifting device.

Fig. 16a is a right side view of the device of Fig. 16.

Fig. 17 is a view of the apparatus of Figs. 16 and 16a taken on line 17-17 of Fig. 16.

Fig. 18 is a longitudinal section through a chuck, in which the basic components of my device are associated with suitable operating mechanism.

Fig. 19 is a cross section of the complete chuck, taken on a line corresponding to line 19-19 of Fig. 18.

Fig. 20 is a longitudinal section through another form of chuck in which the basic components of my broad invention are associated with other mechanisms in order to produce an aperture of a more perfect configuration.

Fig. 21 is a cross section through the same chuck illustrated in Fig. 19.

Fig. 22 shows certain of the parts illustrated in Fig. 20 but they are here pictured in a different operative position in order to illustrate more clearly the means for producing an aperture of a more nearly perfect circular cross section than can be produced with the components illustrated in Figs. 1 to 19, inclusive.

Fig. 23 is a cross section through the chuck shown in Figs. 20, 21 and 22, the said section being taken on a line corresponding to line 23-23 of Fig. 21.

Fig. 24 is a longitudinal section through a valve in which the basic components of my invention are utilized for controlling the flow of a gas or liquid. This figure is a section taken on line 24-24 of Fig. 25 with various portions of the apparatus added in order to give a complete longitudinal cross section.

Fig. 25 is an end view, partly cut away, of the valve of Fig. 24, showing the aperture and the principal elements of the device at the time of full flow.

Fig. 26 is an enlarged detailed view of a portion of Fig. 23.

Fig. 27 is a cross section through the valve illustrated in Figs. 24 and 25, but operating parts are here shown in the position in which the flow of air or gas is completely shut off. This figure is a section taken along lines 27-27 of Fig. 28, but with certain portions added in order to form a complete longitudinal section.

Fig. 28 is a left end view of my valve when the flow is completely shut off—that is, when the various components are positioned as shown in Fig. 27.

Fig. 29 is a cross section through a modified form of my device in which the moving parts are driven by gears, in order to produce less angular movement of the flow-controlling components of the valve for a given angular movement of the control arm or knob than is possible in the previously described form.

The two complementary elements whereby I am able to produce an aperture of variable size are shown in one

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of their simplest forms in Figs. 1 to 7 inclusive. While my invention is capable of producing variable sized apertures having a cross section of any desired configuration, the embodiment used in these figures to illustrate my invention is confined to apertures having a substantially circular cross section, as shown in Figs. 2, 4, and 6.

The elements D and E are each arcuate in form and have an outer periphery that is a segment of a cylinder—that is, any point on the periphery is the same distance from the central axis of curvature as any other point on the periphery, regardless of the plane in which such points are located. An element of this type is indicated in perspective in Fig. 7. If elements D and E were straight members, rather than arcuate, they would combine to form the two halves of a perfect cylinder. If a perfect cylinder were centrally slit along its axis and the two halves thus formed were turned outwardly from such axis in order to form arcuate members, the resulting parts would be like those shown in Figs. 1, 3 and 5, excepting for the peripheral grooves now about to be described.

Centrally disposed around the outer periphery of elements D and E there is a substantially semi-circular groove or recess having a constant taper, as shown in Fig. 7. The nature of this recess may perhaps be better understood by referring to one suitable method whereby the tapering groove may be generated. This method is diagrammatically illustrated in Fig. 8, wherein the part designated by the numeral 31 is a conical cutter or grinder revolving on an axis 32. The part designated by the numeral 33 is a short cylinder disposed so that its axis 34 is transverse to the axis 32 of the cone, but displaced therefrom by a distance equal to the radius of the cylinder when the radius is normal to the near side of the cutting cone. The cutter or abrasive cone 31 removes material from the outer portions of the cylinder as the cylinder moves toward the base of the cone with its axis 34 always at a uniform distance from the axis of the cone. The cylinder must turn counterclockwise so that the portions of the groove already cut will move away from the cone. If the groove is to have a perfect taper, the angular rotation of the cylinder must be uniform for any given length of movement of the cylinder's axis 34 toward the base of the cone 32.

The elements D and E of Figs. 1 to 6 may be considered as corresponding and identical segments of two cylinders in which grooves have been generated in the manner just described. When the elements D and E are disposed as shown in Fig. 1, the apertures formed where the two elements come in contact will have substantially the cross section indicated in Fig. 2. If the elements are rotated to the position pictured in Fig. 3, larger semi-circular portions of the recesses will be superimposed, with the result that the central apertures will be substantially as shown in Fig. 4, which is a cross section on line 4—4 of Fig. 3. As the elements D and E are further rotated together so that still larger sections of the tapering grooves are in juxtaposition, the aperture thus formed will have the larger cross section indicated in Fig. 6.

When the grooves are generated in the manner hereinbefore described, the configuration of the aperture formed when corresponding parts of the elements D and E are in engagement, will have a cross section that varies slightly from a perfect circle and will be somewhat oval or elliptical in form. This fact is illustrated in Fig. 9. The cutting cone 31, when it is disposed with respect to the cylinder as previously described, is obviously tangent to the portion of the cylinder at the bottom of the groove being cut, and the cone therefore does not cut material from the cylinder 33 on a line that is parallel to the cone's base 35, but rather on a line which is a radius of the cylinder and which is at right angles to the cone at its point of engagement with the cylinder, as indicated in

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Fig. 9 by radii 36 and 37 which extend from the center of the cylinder along lines normal to the cone's adjacent edge. Two different positions of the cylinder axis are indicated by numerals 34a and 34b respectively. When point of contact 38 of the cone is in engagement with the cylinder, the cone will have cut a groove having a maximum depth represented by a line drawn between points 38 and 39 on the radius 36. Such a line is obviously not parallel to the base 35 of the cone and the edges of the groove will therefore not form a perfect arch of a circle. This is indicated in more marked degree if we consider a cross section taken in a plane extending through the radius 37 and the axis 34b. The maximum depth of the groove formed here is indicated by line 40—41. The depth of the cut will thus be greater than if it were represented by line 40—41a, which is parallel to base 35 of the cone, and which would be the radius of a perfect semi-circle. As a consequence, if two corresponding segments from circles in which grooves have thus been generated, were to be placed in engagement, the length of the elliptical cross section thus formed would vary from the diameter of a perfect circle by an amount represented by the secant of $\frac{1}{2}$ of the angle of the cutter. For example, if the angle of the cutter is 16 degrees, $\frac{1}{2}$ of the angle would be 8 degrees and the secant of this angle would be 1.0096, or substantially 1.01. The aperture in this case would thus be 1% wider in one direction than in the other. In most practical applications of my invention, this variation is of minor significance. It is, however, entirely compensated for in one of the embodiments described near the end of this specification.

One of the simplest uses of my invention is illustrated in Figs. 10 and 15, in which the arcuate members D2 and E2 form a grommet which is shown in longitudinal section in Figs. 10, 12 and 14, each of these figures showing the grommet arranged to produce a central aperture of different size. The rod or pipe 42 is broken in Fig. 10 in order to show the grommet more clearly, but it will be noted that the opening in the grommet is of a suitable size to accommodate this rod or pipe. The grommet formed by the complementary components D2 and E2 are shown extending through an opening in a panel or sheet 43. Fig. 11 shows the various elements of Fig. 10 in cross section taken on line 11—11 of Fig. 10.

In Figs. 12 and 14 the grommet is arranged in the angular positions required to produce apertures of smaller size, the aperture in Fig. 14 being even smaller than that shown in Fig. 13. In Figs. 12 and 14 the complementary halves of the grommet are indicated by the same reference characters as in Fig. 10 because these figures are intended to show that the same grommet may be used to produce whatever size aperture may be desired within the range of sizes of which the given grommet combination is capable. The pipes or tubes in Fig. 12 or 14 are indicated by numerals 44 and 45 respectively.

The excess portion of the grommet may, of course, be cut off. If the grommet members are made of rubber or other resilient material, they will remain in place. Should they be formed of non-resilient material, suitable transverse grooves may be provided around the elements at spaced intervals throughout their length to accommodate C washers or wrappings of wire to prevent the grommet from slipping out of the hole through which it passed.

Perhaps the next simplest embodiment of my invention is that shown in Figs. 16, 16a and 17 wherein the elements D3 and E3 are used as the gripping members in a lifting device. A cross section taken through these elements at the point of engagement of corresponding parts, will be the same for any engaged position of corresponding parts excepting for the tapered central apertures. The periphery of the combined complementary elements in a transverse plane through the point of engagement will thus always be the same, and the ele-

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ments may therefore move through an opening such as that provided by control ring 46. As illustrated in the embodiment shown in Figs. 16, 16a and 17, the periphery or girth of the complementary elements is circular and the ring is therefore of that configuration. The weight of elements D and E causes them to move downwardly; in fact, if nothing is inserted in the central aperture between these complementary elements they would fall of their own weight until the extensions 47 and 48 on members D3 and E3 respectively come in contact with the ring 46. The entire assembly is supported by chains or cables 49 and 50 attached respectively to the spacer 131, which is suspended from ring 134 by means of chains or cables 132 and 133.

When any article such as the rod 53 is to be lifted, the lifting device may be lowered over the top of such article, or such article may be pushed upward through the jaws. In either case, the jaws D3 and E3 will move upward through the ring. When upward force is removed from the article 53, gravity will cause both the jaws and the article or rod 53 to move downwardly until a position is reached in which the jaws D3 and E3 grip the article between them—because, as the jaws fall, the aperture will continue to get smaller until the intervening object 53 is firmly grasped. Pressure on the lower end of the jaws, or lowering of the control ring 46, will cause the jaws to move upwardly in relation to the ring, thus releasing the article previously held between them.

In order to keep corresponding portions of the jaws in contact, suitable teeth 54 or other equivalent means are provided on the contacting surfaces of these members on opposite sides of the tapering grooves, as indicated.

Figs. 18 and 19 illustrate a chuck to which the basic elements of my invention are ideally suited. Members D4 and E4 are provided with tapering apertures of the general type shown and described in connection with previous figures. The outer contacting edges of members D4 and E4 are provided with recesses or indentations 55, adapted to cooperate with a series of pins 56 in the side plates 57 and 58. A generally circular disc 59 is provided at its periphery with a series of projections 62 which are adapted to slidably fit in longitudinal guide openings between the solid portions 64 of a cylindrical housing. The unslotted left end of this cylinder forms a ring 84, of which a cross sectional portion may be seen in Fig. 18. The slotted opposite end of this cylinder is anchored in recesses 65 in the end plate 66.

The outer edges of projections 62 of disc 59 are provided with threads 60 adapted to cooperate with internal threads in the operating shell or thimble 61, which is restrained against longitudinal or axial movement by the screws 61a, whose inner ends extend into an annular groove around the left end of the cylindrical housing. Recesses 67 and 68 in disc 59 accommodate the balls or rollers 69 and 70 which fit respectively in the guide grooves 69a and 70a in members D4 and E4. Holes 71 and 72 in disc 59, drilled from the outer edges as shown in Fig. 19, permit the insertion of the pins or shafts 73 and 74 around which the rollers 69 and 70 respectively revolve. In order to facilitate the insertion of these pins during assembly, two recesses 75 and 76 are provided in the plate. The long screws 77 and 78, which extend through the left end plate 79, pass through disc 59 just beyond the end of the pins 73 and 74 respectively, thus serving to keep these pins from moving out of position. The opposite ends of screws 77 and 78 are threaded into the chuck's right end plate 66, as indicated in Fig. 18. The end pieces 66 and 79, held in position by means of these screws, clamp the slotted cylindrical housing between them and hold the entire assembly together. Screws 80, passing through end plate 79 and threaded into the side pieces 57 and 58, merely serve to make certain that these plates will come

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out of position during the disassembly of the chuck.

The drill or other member to be engaged by the chuck is inserted through the central opening 81 in end plate 66 and into the centering conical recess 82 in the opposite end plate 79. The outer shell 61 is then rotated, and inasmuch as the threads 60 on the periphery of the disc 59 are in engagement with the threads of the shell, member 59 will move axially of the chuck assembly. In the position shown in Fig. 18, the abutments 83 on the disc 59 engage the annular portion 84 of the cylindrical housing, or, in other words, these abutments contact the bottom of the slots; but upon clockwise rotation of the outer shell 61, the threads in the shell will push the disc 59 toward the opposite or front end plate 66 of the chuck. In the position of disc 59 shown in the figure, the rollers or balls 69 and 70, which are carried by this disc, are in their extreme left position at the left ends of jaws D4 and E4, and the position is such that either the engagement of the abutments 83 with the annular ring or the engagement of the rollers 69 and 70 with the rear end plate 79 will prevent the balls from rolling off the left end of the jaws. If the outer shell were rotated until the disc 59 moved to the extreme right position within the housing, the movement of the disc would finally be stopped by the contact of the right side of the disc with the inner side 85 of the front end plate 66. In such position the rollers 69 and 70 would still be in engagement with the jaws.

It will be clear that as the rollers 69 and 70 move toward the right, the jaws will close; and the resulting aperture between them will decrease from the maximum opening shown in Fig. 19 until a point is reached at which the opening is such that the jaws will firmly grip the drill or other member inserted through the central opening 81 and into the conical recesses 82 at the opposite end of the chuck.

The long screws 77 and 78 are so positioned that they not only serve to hold the entire assembly together but also help to prevent unwanted relative movement of the jaws with respect to the balance of the chuck, due to the inertia of the jaws whenever the chuck initially starts to rotate in a clockwise direction. It will be seen in Fig. 19 that the flared-out portions of the jaws shown in phantom are substantially in engagement with screws 77 and 78 and that contact by these screws with the jaws assures their immediate rotation with the entire assembly regardless of any tendency to become displaced when sudden torque is applied at the initial starting.

It was mentioned in the description of one means for generating the tapering grooves required for my invention, that an embodiment would later be described that would employ means to compensate for the slight variation from a perfect circular aperture that occurs when the grooves in the complementary D and E elements are generated in the manner described. The chuck illustrated in Figs. 20, 21, 22, and 23 embodies such means. This chuck contains two sets of jaws, these pairs being shown in section in Fig. 20 as pair D5 and E5 and pair D5a and E5a. Inasmuch as other associated parts in this chuck are also in duplicate, a description of jaws D5 and E5 and associated components will thus serve as a description of the other pair of jaws and the parts associated therewith.

Jaws D5 and E5 have two separate axes of rotation, the nature of which will later be described. These jaws are interposed between two side castings 88 and 89. Both of these castings are shown in Fig. 21, but Fig. 20 shows only the latter. A control shaft 90 extends through casting 89 and terminates in a sprocket gear 91. A similar shaft extends through hole 92 in the opposite side casting 88. A rocker 93 is rotatably mounted on shaft 91, and a corresponding rocker 94, shown only in Fig. 21, is rotatably mounted on the shaft that extends through hole 92 in the side casting 88. A pin 87 is journaled in one end of rockers 93 and 94, as shown in Fig. 21, and a corresponding pin 87a is journaled in the opposite end of these rockers. Pin 87 passes through jaw D5, which is rotatable

thereon, and pin 87a passes through jaw E5, which is rotatable on the latter pin.

The second axis of rotation of jaws D5 and E5 is provided respectively by pins 86 and 86a, which are integral with, or tightly pressed into, the respective jaws with which they are associated. Corresponding pins 95 and 95a are provided for the opposite side of the jaws, as shown only in Fig. 21. Pin 86 extends through a clearance slot 96 in rocker 93 and thence into a more closely fitting slot or recess 97 in the side casting 89. Pin 86a likewise extends through a clearance slot 96a at the opposite end of rocker 93 and thence into a recess 97a in the casting 89, this latter recess corresponding with the previously described recess 97 for pin 86 in jaw D5. Rocker 94 is provided with clearance slots for pins 95 and 95a, these slots corresponding with the clearance slots already described for pins 86 and 86a respectively, and pins 95 and 95a likewise each extend into a suitable recess in the side casting 88, these recesses corresponding with the pin-receiving recesses in the opposite casting 89.

The right side of jaw D5, as shown in Fig. 21, is recessed at the lower end and provided with gear teeth as shown in full lines in Fig. 23 and in phantom in Figs. 20 and 22. Jaw E5 is likewise provided with correspondingly arranged gear teeth. The side gear teeth on jaws D5 and E5 mesh with the pinion gear teeth on the control shaft 90. Corresponding gear teeth, not shown, on the opposite sides of jaws D5 and E5 likewise mesh with the pinion gear on the end of the shaft that extends through the hole 92 in the casting 88.

The movement of these jaws, in response to rotation of the control shaft 90, is as follows: When shaft 90 and pinion gear 91 rotate clockwise, jaw E5 is caused to rotate counterclockwise. Jaw E5 likewise rotates counterclockwise due to the meshing of its gear teeth with those on the same pinion gear 91, which, as already mentioned, is at this time rotating clockwise. The counterclockwise rotation of these jaws moves shaft 87 to the left, as viewed in Fig. 20, while shaft 87a is caused to move to the right. This action is brought about by the fact that shaft or pin 86, which extends through the clearance slot 96 in rocker 93, is restrained against movement in either lateral direction by the sides of recess 97 in casting 89. As a consequence, pin 86 moves upward in slot 97, as seen in Fig. 22, and pin 87, journaled in the rotatable rocker 93, is forced to move to the left, carrying the rocker toward the angular position shown in Fig. 22. A corresponding action takes place with respect to the corresponding parts associated with jaw E5. It will be observed in Fig. 22 that the counterclockwise movement of the jaws and rocker 93 has caused the jaws to open—that is, larger cross-sectional portions of the grooves in these jaws have come into juxtaposition.

In the description of Fig. 9 it was shown that the depth of the groove in the basic elements of my device, when the groove is generated as illustrated in Fig. 8, is always a little greater than required to form a perfect circle when corresponding portions of such grooves are placed in juxtaposition, and it was mentioned that an embodiment which would later be described would include means for compensating for this slight deviation. The mechanism of this chuck provides such compensating means. The axis through pin 87 is the axis of generation for the groove cut in element D5, and the axis through pin 87a is that used for the generation of the tapered slot in element E5. The tapered groove in element D5 is thus cut on a line that would extend from the center of shaft 87 to the axis of the pinion gear at the center of the rocker, and for the reasons demonstrated in connection with the description of Fig. 9, the groove is slightly deeper, when measured on this line, than half its width. The tilting action effected in the axes of the two elements D5 and E5, as demonstrated in Fig. 22, causes the effective depth of these grooves to be lessened, as any shaft or drill inserted into this chuck would engage the bottoms of these

jaws at points along line *a*—*a*, which passes through the centers of pins 86 and 86a rather than along the line of generation which extends through the axes of shafts 87 and 87a. The angle of the tilt is arranged so that it exactly compensates for what would otherwise be a slight variation from a perfect circular contour.

The two sets of jaws and associated operating components make it possible to engage a rod or drill on opposite sides thereof at two different positions along its length. Each set of jaws is independently tightened against the shaft, as jaws D5a and E5a are actuated by an independent key in the opposite end of the shaft associated with pinion gear 98, shown only in Fig. 20.

The castings 88 and 89 and the corresponding castings associated with the jaws shown at the left in Fig. 20, are held in place by the shell or housing 130 and end members 99 and 100, which have appropriately shaped inwardly extending rings 101 and 102, shown in section in Fig. 20. The castings 103, 103a, 104 and 104a, serve as additional guides for the rockers but are not essential elements of this structure and may therefore be omitted from the assembly without seriously affecting the operation of the device.

The remaining figures of this invention illustrate the use of the basic elements of my invention for controlling the flow of a gas or fluid. Fig. 24 is a longitudinal section through the valve showing the control segments in full open position, while Fig. 27 is a corresponding longitudinal section with the valve in the completely closed position. The housing or main casting has a central bore providing an inlet 105 and an outlet 106 and it also has suitable intercommunicating recesses 107 and 108 to accommodate the groove elements or segments D6 and E6 respectively. Segment D6 is connected to hub 109 and the operating handle or lever 110 by the webs 111 and 112 which are integral with the hub and joined to the segment by screws 120'. Gear teeth or other suitable projections and corresponding recesses 135 are provided on the periphery of the segments between the groove and the outer edges of the segments, as indicated in Figs. 24 and 25, in order to cause the segment E6 to rotate with segment D6.

An O ring 113, or other suitable sealing element, encircles the segments D6 and E6 and surrounds the position where they engage, as shown in Figs. 24, 25, 27, 28 and 29. This resilient ring is retained in an annular recess 119 in the casting.

Figs. 24 and 25 show the valve in full open position, while Fig. 27 shows the valve in a completely closed position. It will be noted that a recess 115 is provided in the periphery of segment D6 just beyond the extreme small end of the tapered groove and that part of an O ring or other suitable sealing member is positioned in this recess. Fig. 26 shows an enlarged view of this arrangement. When the valve is in the completely closed position shown in Fig. 27, the ring or compression seal 116 is compressed against the periphery of segment E6, thus effectively closing the valve.

Relief ports or ducts 117 and 118 extend through the casting from the recesses in which the grooved segments turn to one of the valve ports in order to permit the escape of fluid or gas trapped in the channels 107 and 108 during the operation of the valve. Fig. 28 is a right end view, partly broken away, of the valve in a completely closed position, showing that the grooves have moved beyond central position and that the segments D6 and E6 are sealed by the intervening compression element 116, whose upper edge shows in broken lines in the figure.

Fig. 29 is a cross section through my valve, showing the segments in a position that provides an intermediate flow, and a modified manual control is here illustrated. In Fig. 29 segment D7 is connected to an internal gear segment 125 by the webs 121 and 122, and screws 120. Internal gear 125 meshes with an external gear or pinion 126, which is mounted on, or is integral with, the control

shaft 123 upon which is rigidly mounted the operating handle or wheel 124.

It will be obvious that this valve arrangement may be also employed as a variable venturi.

In several of the embodiments of my invention hereinbefore described, a casing surrounds the segmental members that circumscribe the variable sized opening. In the chucks, it is of course necessary that such casing have an opening in one end for the insertion of whatever article is to be engaged by the chuck, and this end opening must therefore be properly aligned with the variable opening between the segmental members. In the valve, there are two opposite end openings to permit the ingress and egress of the liquid or gas for which such valve is used. For the proper operation of the chucks and valve, these end openings should be symmetrically arranged with respect to the segmental members. Examination of the figures illustrating each chuck will reveal that the axis of symmetry extends midway between the jaws and is concentric with the end opening, and in the valves it will be observed that the axis of symmetry extends midway through the two end openings as well as through the central opening whose varying size controls the flow.

The various embodiments of my invention hereinbefore described do not of course illustrate all of the ways in which my broad invention may be employed. It has been my intention merely to show a series of widely diversified forms in order to illustrate the broad nature and wide possible applications of my invention. It is not necessary that a cross section through the curved basic elements of the various embodiments, when corresponding portions of these elements are in contact, be circular in exterior configuration. When guide or sealing rings are used, as shown respectively in the drawings of the lifting device and the valve, any desired exterior configuration may be used so long as the exterior configuration of each element remains the same throughout the useable length of such elements and so long as the inside of the embracing ring is made to conform. The grooves in the aperture forming elements have been shown as semi-circular in cross section in the various illustrative embodiments that have been described, but it will be understood that other cross sectional forms may be used in order to produce variable sized apertures of non-circular shape. Numerous other modifications may be made from each of the structures shown, and it will be obvious to those skilled in the art that many of the parts may be replaced by substitute parts which perform the same functions without departing from the broad spirit of my invention as set forth in the appended claims.

My claims are:

1. A combination including: a pair of parallel spaced supporting elements each having a series of spaced projections on the side facing the other element, said projections disposed in a straight line parallel to the corresponding series of projections on the other element; a pair of substantially identical longitudinally curved members disposed between said elements with their convex sides adjoining, each of said members having an elongated and continuously tapering groove longitudinally extending and centrally formed on its convex side and positioned with respect to the groove in the other member so that corresponding portions of the two grooves are opposite each other, each of said members having two series of spaced recesses therein, each of said series of recesses extending along one edge of the convex side of the member, said recesses so spaced and formed that each recess will fit over a portion of one of the projections on the adjoining element as the two members are rolled along the two series of projections; and an encompassing structure encircling said elements and said members, said structure having means associated therewith for engaging said members and holding the encircled portions thereof in engagement with said projections; said structure acting, upon movement over and along said members, to

bring different corresponding portions of the grooves in said members into juxtaposition thereby varying the size of the aperture encompassed by said members.

2. A combination including: a pair of parallel spaced supporting elements each having a series of spaced projections on the side facing the other element, said projections disposed in a straight line parallel to the corresponding series of projections on the other element; a pair of substantially identical longitudinally curved members disposed between said elements with their convex sides adjoining, each of said members having an elongated and continuously tapering groove longitudinally extending and centrally formed on its convex side and positioned with respect to the groove in the other member so that corresponding portions of the two grooves are opposite each other, each of said members having two series of spaced recesses therein, each of said series of recesses extending along one edge of the convex side of the member, said recesses so spaced and formed that each recess will fit over a portion of one of the projections on the adjoining element as the two members are rolled along the two series of projections; each of said members also having a concave side opposite and parallel to its convex side, said concave side having a longitudinally disposed channel formed therein; and an encompassing structure encircling said elements and said members, said structure comprising two rollers each shaped and arranged to be received in one of said channels for holding the encircled parts of said members in engagement with a portion of each of the two series of projections; said structure acting, upon movement over and along said members to bring different corresponding portions of the grooves in said members into juxtaposition thereby varying the size of the aperture encompassed by said members.

3. A combination including: a pair of parallel spaced supporting elements each having a series of spaced projections on the side facing the other element, said projections disposed in a straight line parallel to the corresponding series of projections on the other element; a pair of substantially identical longitudinally curved members disposed between said elements with their convex sides adjoining, each of said members having an elongated and continuously tapering groove longitudinally extending and centrally formed on its convex side and positioned with respect to the groove in the other member so that corresponding portions of the two grooves are opposite each other, each of said members having two series of spaced recesses therein, each of said series of recesses extending along one edge of the convex side of the member, said recesses so spaced and formed that each recess will fit over a portion of one of the projections on the adjoining element as the two members are rolled along the two series of projections; each of said members also having a concave side opposite and parallel to its convex side, said concave side having a longitudinally disposed channel formed therein; a cylinder surrounding said elements and members, said cylinder having a series of parallel longitudinal slots therein extending from one end thereof toward the other end; a centrally apertured disc having a series of peripheral flanges formed and spaced to slidably fit within the slots in said cylinder, said disc positioned so that its central aperture encircles said elements and members; a pair of rollers rotatably mounted on said disc, each of said rollers shaped and arranged to be received in one of said channels for holding the encircled parts of said members in engagement with a portion of each of the two series of projections; said rollers acting, upon movement along said members to bring different corresponding portions of the grooves in said members into juxtaposition thereby varying the size of the aperture encompassed by said members.

4. In a chuck, a combination including: a first plate having a conical recess in one surface; a pair of spaced parallel supporting elements extending perpendicularly from said first plate and symmetrically disposed on op-

posite sides of said conical recess, each of said supporting elements having a series of spaced projections on the side facing the other element, said projections disposed in a straight line parallel to the corresponding series of projections on the other element; a pair of substantially identical longitudinally curved members disposed between said elements with their convex sides adjoining, each of said members having an elongated and continuously tapering groove longitudinally and centrally formed on its convex side and positioned with respect to the groove in the other member so that corresponding portions of the two grooves are opposite each other, each of said members having two series of spaced indentations therein, each of said series of indentations extending along one edge of the convex side of the member, said indentations so spaced and formed that each indentation will fit over a portion of one of the projections on the adjoining element; each of said members also having a concave side having a longitudinally disposed channel formed therein; a first cylinder surrounding said elements and members, said first cylinder having a series of parallel longitudinal slots therein extending from one end thereof toward the other end; a centrally apertured disc having a series of externally threaded peripheral flanges formed and spaced to fit within the slots in said first cylinder, said disc positioned so that its central aperture encircles said elements and members; a pair of rollers rotatably mounted on said disc, each of said rollers shaped and arranged to be received in one of said channels for holding the encircled parts of said members in engagement with a portion of each of the two series of projections; a second cylinder surrounding said disc and first cylinder, said second cylinder having internal threads in screw threaded engagement with the threads on the flanges of said disc; a second plate disposed parallel to said first plate, said second plate having a central opening therein axially aligned with the conical recess in said first plate; means for tightly holding said plates against opposite ends of said first cylinder; and means for preventing said second cylinder from moving axially with respect to said first cylinder; said second cylinder acting, upon rotation thereof, to move said disc and its associated rollers along said members to bring different corresponding portions of the grooves in said members into juxtaposition thereby varying the size of the aperture encompassed by said members.

5. In a chuck, a combination including: a pair of substantially identical longitudinally curved members disposed with their convex sides adjoining, each of said

members having an elongated and continuously tapering groove longitudinally and centrally formed on its convex side and so positioned with respect to the groove in the other member that corresponding portions of the two grooves are opposite each other, each of said members also having a concave side with a longitudinally disposed channel formed therein; a first cylinder surrounding said members, said first cylinder having a series of parallel longitudinal slots therein extending from one end thereof toward the other end; a centrally apertured disc having a series of externally threaded peripheral flanges formed and spaced to fit within the slots in said first cylinder, said disc positioned so that its central aperture encircles said members; a pair of rollers rotatably mounted on said disc, each of said rollers shaped and arranged to be received in one of said channels for holding the encircled parts of said members together; a second cylinder surrounding said disc and first cylinder, said second cylinder having internal threads in screw threaded engagement with the threads on the flanges of said disc; a first plate adjoining one end of said cylinder, said first plate having a conical recess on the side facing said members; a second plate adjoining the opposite end of said first cylinder, said second plate having a central opening therein axially aligned with the conical recess in said first plate; means for tightly holding said plates against opposite ends of said first cylinder; means associated with said members for assuring their positive rotation together; and means for preventing said second cylinder from moving axially with respect to said first cylinder; said second cylinder acting, upon rotation thereof, to move said disc and its associated rollers along said members to bring different corresponding portions of the grooves in said members into juxtaposition thereby varying the size of the aperture encompassed by said members.

References Cited in the file of this patent

UNITED STATES PATENTS

206,113	Ingalls	July 16, 1878
321,740	Mead	July 7, 1885
747,746	Metcalf	Dec. 22, 1903
1,140,567	Boring	May 25, 1915
1,413,869	O'Connor	Apr. 25, 1922
2,577,941	Windus	Dec. 11, 1951
2,581,449	See	Jan. 8, 1952
2,593,811	Swinehart	Apr. 22, 1952

FOREIGN PATENTS

181,813	Great Britain	June 19, 1922
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