Dec. 23, 1952 G. HUMES 2,622,616

HYDRAULICALLY BALANCED TRACER WITH ECCENTRICALLY MOUNTED TRACER ARM

Filed June 9, 1949 3 Sheets-Sheet 1

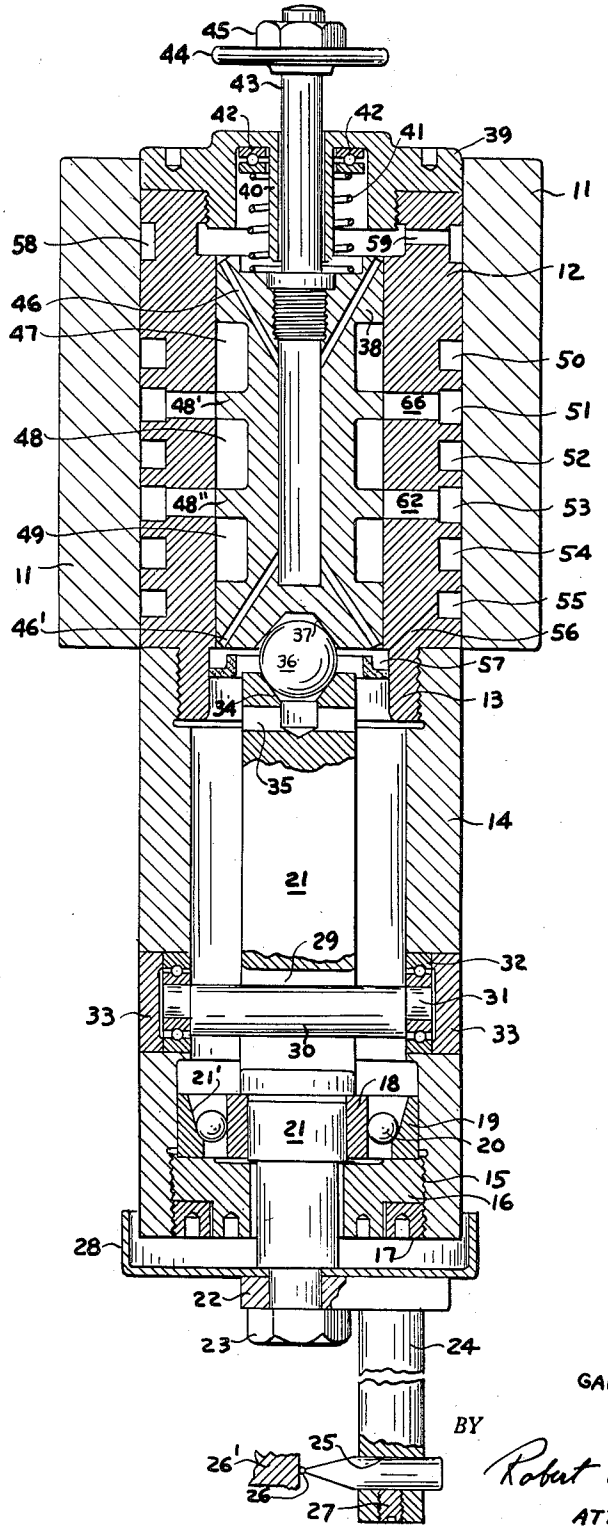


Fig. 1

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HYDRAULICALLY BALANCED TRACER WITH ECCENTRICALLY MOUNTED TRACER ARM

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Fig. 2

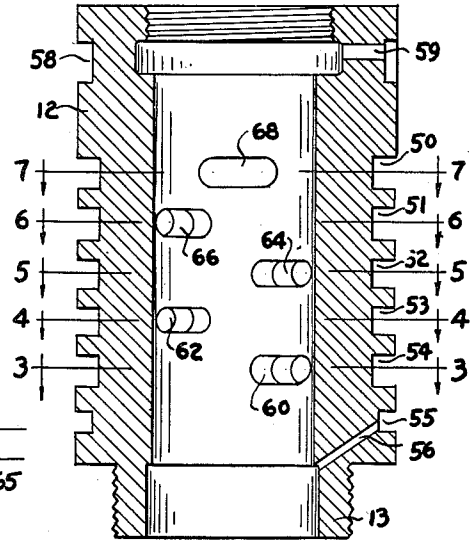


Fig. 5

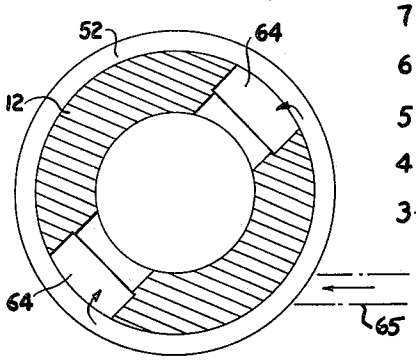
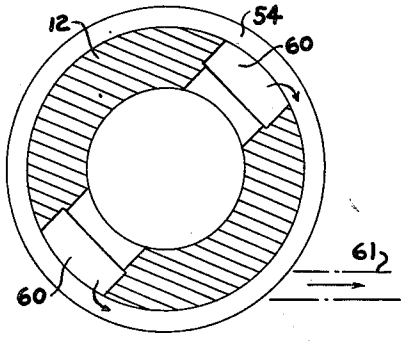


Fig. 3



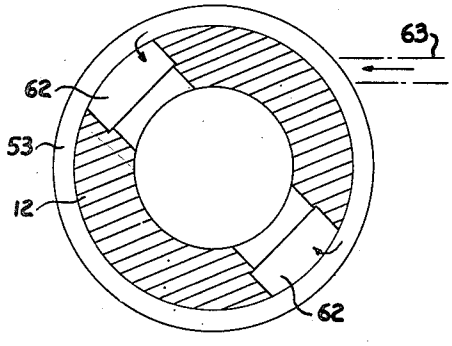


Fig. 4

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HYDRAULICALLY BALANCED TRACER WITH ECCENTRICALLY MOUNTED TRACER ARM

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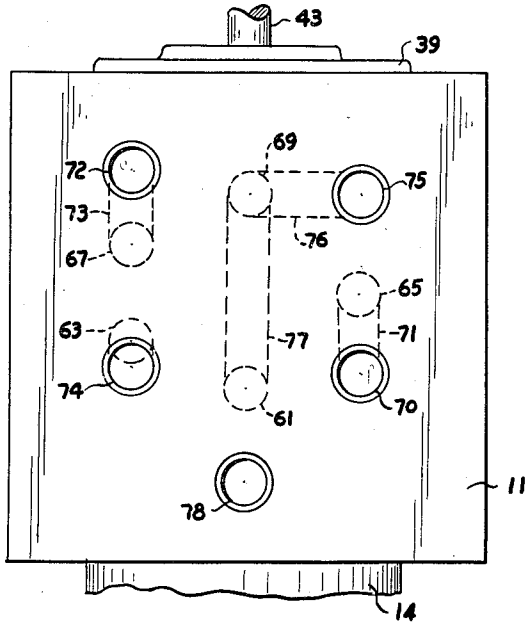


Fig. 10

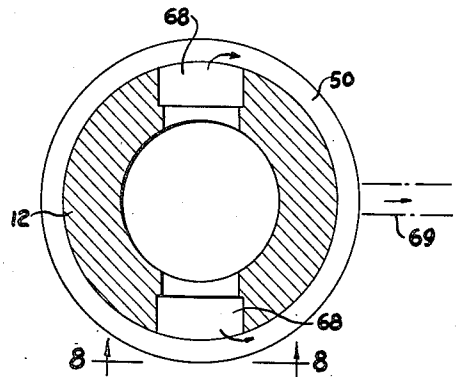


Fig. 7

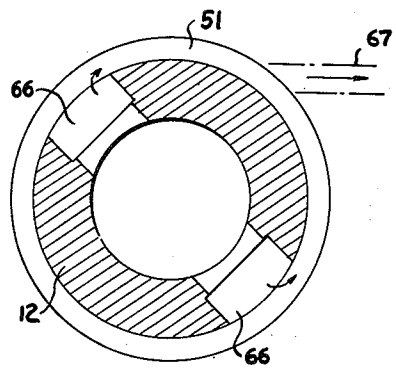


Fig. 6

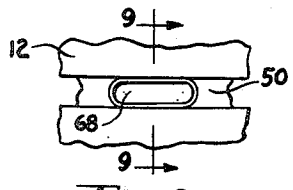


Fig. 8

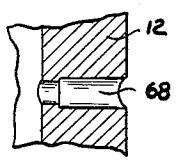


Fig. 9

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HYDRAULICALLY BALANCED TRACER WITH ECCENTRICALLY MOUNTED TRACER ARM

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Application June 9, 1949, Serial No. 98,016

4 Claims. (Cl. 137—619)

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This invention relates to tracers, and more particularly to the hydraulic tracer used in conjunction with reproducing devices and machines which employ the use of a pattern which is sought to be duplicated by the cutting tool, with the tracer contacting the surface of the pattern and by its movements in traversing the same controlling the hydraulic valve within the tracer, which in turn controls the flow of pressure fluid to one end or the other of a hydraulic cylinder, with said cylinder in turn governing the feed movement of the cutting tool with respect to a work piece.

Heretofore in tracer controlled reproducing devices of this type a source of pressure fluid is delivered to the tracer housing and by the positioning of the valve element therein is directed to one end or the other of the hydraulic cylinder which controls the relative feed movement of the cutter with respect to the work, or the relative feed movement of the work with respect to the cutter.

It is the principal object herein to provide an improved tracer construction for more facilely responding to the surface of the pattern to thereby more accurately reproduce from the pattern an identical copy thereof in the work piece.

It is the further object of this invention to provide an improved tracer valve as well as an improved tracer valve sleeve construction.

It is the further object of this invention to provide an improved and novel mounting of the tracer tip upon the end of the tracer spindle.

These and many other objects will be seen from the following specification and claims in conjunction with the appended drawings in which:

Figure 1 is an elevational section of the complete tracer construction with the tracer spindle partially broken away.

Figure 2 is an elevational section of the improved tracer sleeve.

Figure 3 is an elevational section taken on line 3—3 of Fig. 2.

Figure 4 is an elevational section taken on line 4—4 of Fig. 2.

Figure 5 is an elevational section taken on line 5—5 of Fig. 2.

Figure 6 is an elevational section taken on line 6—6 of Fig. 2.

Figure 7 is an elevational section taken on line 7—7 of Fig. 2.

Figure 8 is a fragmentary elevational section taken on line 8—8 of Fig. 7; and

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Figure 9 is a fragmentary elevational section taken on line 9—9 of Figure 8.

Fig. 10 is a fragmentary side elevational view of the tracer illustrating the arrangement of its fluid ports.

It will be understood that the above drawings illustrate merely a preferred embodiment of the present invention and that other embodiments of equivalent structures are contemplated within the scope of the claims hereafter set out.

Referring to Figure 1 the hydraulic tracer includes the hollow cylindrical body 11 within which is a press-fit sleeve 12 having at its lower end depending threaded flange 13. Hollow cylindrical barrel 14 is threadably joined at its upper end to the flange 13 and depends downwardly therefrom with its lower end interiorly threaded at 15.

The adjusting nut 16 is positioned within the lower end of barrel 14 engaging the threads 15 and is secured in the desired adjusted position by lock nut 17.

Annular bearing 18 is press-fit on tracer spindle 21 while the corresponding bearing race 19 is supported within the barrel 14 upon the adjusting nut 16, there being a plurality of ball bearings or balls 20 employed. It will be noted that the interior upper portion of the race 19 is cone shaped or inclined at point 21', and in the operation of the tracer mechanism any lateral thrust upon the tracer tip 26 will project some of said balls against said upwardly and outwardly diverging sidewalls 21'. Consequently it is apparent that the lateral thrust of a pattern upon the tracer tip 26 will effect a corresponding upward movement of the tracer spindle 21 to control the tracer valve in a conventional manner.

The lower end of the tracer has mounted thereon a tracer tip adapter 22 secured by the lock nut 23. Tracer arm 24 is secured to and projects downwardly from said adapter being eccentrically arranged out of alignment with the longitudinal axis of tracer spindle 21. Arm 24 has a transverse slot adjacent its lower end to receive tracer tip 26 which may be adjustably secured therein by the set screw 27. This is important as it is possible by this construction to arrange the pattern engaging tip of the tracer in alignment with the spindle axis, or on the other hand may be arranged out of alignment so as to be slightly in advance of said axis so as to obtain a lead, or on the other hand, could be arranged if desired upon the other side of the spindle axis.

The pattern 26' is fragmentarily shown with the tracer tip merely in contact engagement therewith so that the tracer valve 38 will be in a neutral position, and there will be no flow of pressure fluid through the tracer valve, or out either of the delivery channels 62 or 65 hereafter described.

Annular cup shaped guard 28 with a diameter in excess of the exterior diameter of barrel 14 is secured to the lower end of spindle 21 intermediate the latter and the adapter 22, with a portion of said guard extending upwardly around the lower end of said barrel. As said guard is secured to the spindle 21, it is apparent that its accidental engagement with a part of the reproducing machine, or for that matter its accidental engagement with any object will in effect transmit a lateral thrust to the lower end of spindle 21, and by virtue of the balls 20 said lateral thrust will be transmitted to a slight upward movement of said spindle causing the tracer valve which is mounted thereon to effect an outward feed movement of the support upon which the tracer is mounted until the lateral thrust is removed from said guard.

Spindle 21 has a transverse guide slot 29 formed therein to receive transverse stabilizer pin 30, the annular eccentric ends 31 of which are journalled and supported within ball bearings 32, secured within corresponding slots formed within barrel 14. Suitable plugs 33 are employed to cover said slots after said pin is properly positioned. In view of the eccentric mounting of pin 30, the latter acts as a means to prevent rotation of spindle 21, and at the same time there is sufficient clearance between said stabilizer 30 and the interior vertical walls of slot 29 so that there is a slight guiding relation between said stabilizer and said spindle. It will be noted that the axis of the stabilizer is parallel to the longitudinal axis of tracer tip 26 so that said stabilizer will not interfere with the normal operation thereof.

Conical central recess 34 is formed in the upper end of spindle 21 to cooperatively receive the ball 36, there being a transverse slot 35 formed adjacent the upper end of said spindle with its interior portion in communication with the lower end of the conical recess 34.

Tracer valve 38 is centrally arranged within the tracer body and is slidably positioned within sleeve 12 with a slip fit, but with no more clearance than is necessary to provide for a freely movable valve within said sleeve. The lower end of said valve has a corresponding conical central recess 37 at its lower end which cooperatively receives and engages a portion of the preferably metallic ball 36, whereby any upward axial movement of said spindle will be simultaneously transmitted to valve 38, and furthermore any downward movement of said spindle will permit downward movement of the valve 38 under the action of coil spring 41.

Top cap 39 has an annular portion which is projected down into the body 11, while the depending portion of said cap is threaded into the upper end of the sleeve 12. Central downwardly depending sleeve 40 forms a part of said cap, and a coil spring is loosely arranged around said sleeve with its lower end engaging valve 38, and with its upper end bearing against the bearing 42 within the upper portion of cap 39. Thus if for any reason the valve stem 43 should be manually rotated the coil spring is free to rotate therewith so that there will be no change in the relationship of the spring to the valve.

It is contemplated that the cap 39 is rotatably adjustable for regulating the tension in the spring 41 which in turn regulates its downward pressure upon the valve 38.

Central stem 43 is threaded at its lower end within a corresponding central threaded opening in the upper end of said valve, said stem being loosely projected upwardly through the sleeve 40, and with an adjusting disc 44 being mounted upon the upper end of said stem and secured thereto by the lock nut 45.

It is apparent that the stem as well as the disc 44 will permit manual adjustments upwardly or downwardly of the valve 38, however means for effecting said adjustments form no part of the present invention and further description thereof is omitted.

The valve 38 has formed therein at its upper end a plurality of downwardly converging channels 46 which terminate in the hollow interior of said valve, while the lower end thereof is provided with a plurality of downwardly diverging channels 46' as shown in Figure 1, whereby it is apparent that any pressure fluid which seeps between the upper end of said valve and said sleeve may escape downwardly through the passages 46 to the interior of valve 38 and at the lower end could possibly escape through the inclined channels 46' and into the annular cup shaped element 57 for withdrawal in the manner hereafter described. This should prevent the building up of any pressure within the interior of the valve or sleeve in excess of that which exists under normal operating conditions.

It must be remembered that the pressure fluid used is under such pressure that there will naturally be some seepage of fluid between the valve 38 and sleeve 12. It is contemplated that in the event that the passages 46 should become clogged fluid could escape through the outlet 59 and into the annular opening 58 formed in the sleeve 12, and it would be a simple matter to provide an outlet in the valve body which interconnects the opening 58 and an exhaust channel in said body.

The valve 38 is substantially cylindrical in form and has a plurality of spaced annular openings 47, 48 and 49 formed therein, whereas the sleeve 12 has a plurality of longitudinally spaced annular openings 50, 51, 52, 53, 54 and 55 whose utility will become more apparent in the following description.

From an examination of Figures 1 through 7 it is apparent that each of the annular openings 50, 51, 52, 53 and 54 are adapted for communication with the interior of the sleeve 12, and this communication is provided as follows: annular opening 54 also shown in Figure 3 is joined to the interior of sleeve 12 by a pair of diametrically formed transverse slots 60, one of which is shown in Figure 2.

Annular opening 53 as shown in Figures 2 and 4 is joined to the interior of said sleeve by another pair of diametrically formed transverse slots 62, and these slots are positioned 90 degrees from the slots 60.

Annular opening 52 is joined to the interior of sleeve 12 by the diametrically arranged staggered slots 64 as shown in Figures 2 and 5. Annular opening 51 is joined to the interior of sleeve 12 by the diametrically arranged channels 66 as shown in Figures 2 and 6; and annular opening 50 is joined to the interior of said sleeve by the pair of diametrically arranged transverse slots 68 as shown in Figures 2 and 7.

Referring now to Figures 3, 4, 5, 6 and 7 it is

seen that slots 60 and 62 are arranged approximately at right angles to each other, that slots 62 and 64 are arranged at right angles to each other, slots 64 and 66 are arranged at right angles to each other and that slots 66 and 68 are arranged at an angle of 45 degrees with respect to each other.

It follows further that the slots 60 and 64 are in substantial longitudinal alignment as are the slots 66 and 62. By this construction in arranging the outlet passages in staggered relation all the way around the interior of the sleeve 12, there is provided a hydraulically balanced control valve 38, with the pressure of the fluid in said passages being substantially equalized around the surface of said valve.

This promotes for a very well balanced freely movable valve 38 and it has been found by this construction that the controlled response thereof is substantially immediate. This is particularly desirable in machine tools of this type for the reason that the reproducing operation is substantially continuous with the best results obtained where you have a freely movable well balanced control valve.

Referring to Figures 1 and 2 as well as Figure 10, the annular sleeve opening 52 is adapted to receive pressure fluid from a suitable remote hydraulic unit which normally includes a fluid storage sump together with a suitable pump for delivering pressure fluid to the tracer. Pressure fluid is provided by a suitable conduit which is adapted to connect the pressure port 70 which is formed in the body 11. This pressure fluid is conducted through passage 71 in body 11 which terminates in the inlet passage 65 which as shown in Figure 5 provides fluid communication to the sleeve opening 52. This pressure fluid is directed inwardly upon opposite sides of sleeve 12 into the annular opening 48 of valve 38.

In the neutral position of valve 38 corresponding to the tracer 26 being in contact with the flat surface of the pattern 26' this pressure fluid is substantially locked within the valve opening 48 for the reason that the annular flange 48' completely closes sleeve passages 66; and at the same time the annular flange 48'' of said valve completely covers sleeve passages 62. As shown in Figure 1 of the drawing the aforesaid flanges 48' and 48'' are in substantially overlapped relation to the respective sleeve passages 66 and 62 so that there is no flow of pressure fluid outwardly thru said passages.

Both of the passages 66 and 62 are cylinder passages which are adapted for connection to opposite ends of a hydraulic cylinder or cylinders for effecting either movement of the cylinder relative to a stationary piston, or movement of a piston with respect to a stationary cylinder, to control feed movements of the cutting tool relative to a work piece or movement of the work piece relatively to the cutting tool.

Sleeve outlet 66 joins annular sleeve opening 51 which as shown in Figure 6 is adapted to deliver pressure fluid to the body passage 67. As shown in Figure 10 the outer end of this passage through passage 73 establishes fluid communication to the cylinder port 72. A suitable conduit is joined at one end to the port 72 while the other end thereof is joined to one end of a hydraulic cylinder.

The other cylinder port 62 as shown in Figures 1 and 4 joins sleeve opening 53 for delivering fluid through the body passage 63. As shown in Figure 10 this passage is joined to the other cylinder port 74, and the latter is adapted for connection by a suitable conduit to the opposite end of the aforementioned hydraulic cylinder.

Thus it is apparent that sleeve opening 66 supplies pressure fluid to cylinder port 72 and that sleeve opening 62 is adapted alternately to supply pressure fluid to the other cylinder port 74.

In normal operation the pressure fluid is delivered outwardly from the port 72 to one end of the hydraulic cylinder to effect movement of the piston therein, for example, then the fluid from the opposite side of said piston will be forced outwardly from the other end of such hydraulic cylinder and will be delivered to the cylinder port 74 and thence to the sleeve opening 53 through the body passage 63.

It will be remembered however, that in the neutral position of the valve 38 there will be no flow through either of the sleeve openings 66 or 62 for the reason that the same are effectively closed by the valve 38—48'—48''.

Now assuming that there is a lateral thrust delivered to the tracer tip 26 by the pattern 26' as they are fed relatively to each other due to a rise in the pattern, then as above described this lateral thrust will effect an immediate upward movement of the spindle 21 so that the pressure fluid which is constantly in valve opening 48 will bleed or flow outwardly through sleeve openings 66, into annular opening 51, passages 67, 73 and out through cylinder port 72 to cause motion of the piston within the aforementioned cylinder.

At the same time exhaust fluid from the opposite end of said cylinder is returned to the tracer through port 74 and passage 63 to sleeve opening 53, through sleeve openings 62, and with the valve slightly elevated from the position shown in Figure 1 it is apparent that this exhaust fluid will flow into valve opening 49. Valve opening 49 is an exhaust opening and is at all times in communication with sleeve passages 60 and sleeve opening 54; and as shown in Figure 3 as well as in Figure 10 this exhaust fluid is delivered to the body passages 61, 77 and 76 to the single exhaust port 75.

Said exhaust port is joined by a suitable conduit with the aforementioned fluid storage sump so that this exhaust fluid from the cylinder is returned to the hydraulic unit for reuse.

Normally the movement of the control valve 38 is only slight as a matter of thousandths of an inch, usually less than ten thousandths, but sufficient to bleed or deliver pressure fluid through the sleeve opening 66 if the valve 38 is elevated in response to a positive deflection of the tracer tip 26 such as where a high point is engaged upon the pattern 26'.

On the other hand should the tracer tip reach an area which is considered slightly inclined inwardly of the pattern i. e. a low point, then in that event the tracer valve 38 will move downwardly under the action of the coil spring 41 which transmits its pressure through said valve and through spindle 21 so as to constantly urge said tracer tip 26 into engagement with the pattern, or in other words maintain the tracer tip in engagement with the surface of the pattern continually.

As the present tracer may be described as a universal type tracer any change in the surface of the pattern causes such flow of pressure fluid through either of the cylinder ports 72 or 74 as will cause such movement of the hydraulic cylinder which will tend to return the tracer valve 38 to the neutral position shown in Figure 1, to

cut off further flow to either of the cylinder ports 72 or 74.

Now when the tracer has returned to the neutral position above described, and thereafter engages a low spot in the surface of the pattern 26', then in that case the valve 38 moves downwardly below the position shown in Figure 1 so that pressure fluid within valve opening 48 will bleed or be delivered outwardly through sleeve passage 62, sleeve opening 53, body passage 63 cylinder port 74, and thus to the opposite end of the hydraulic cylinder in such a manner as to cause movement of the piston therein tending to return the tracer valve 38 back to the neutral position shown in Figure 1, to thus cut off further flow to said cylinder.

In the manner above described in detail the aforesaid hydraulic cylinder when receiving pressure fluid from cylinder port 74 Figure 10 at one end is returning exhaust fluid from its other end back into the tracer body through cylinder port 72. As shown in Figures 10 and 6 this exhaust fluid passes through body passages 73, 67 and into sleeve opening 51, thence through the two oppositely arranged sleeve passages 66. As the tracer valve is below a neutral position the exhaust fluid in the passages 66 is free to bleed into the exhaust opening 47 in valve 38.

This exhaust fluid is then delivered outwardly through the sleeve passages 68 as shown in Figures 2 and 7, into annular opening 59 and thence through exhaust passage 69 in the tracer body 11, through passage 76, and outwardly through the exhaust port 75 for return to the hydraulic sump.

It will be noted that both exhaust openings 47 and 49 of valve 38 are constantly in communication with the single exhaust port 75 within the tracer body so that it is always possible for exhaust fluid to be returned to the hydraulic unit either from exhaust opening 47 or exhaust opening 49. Furthermore any seepage of fluid between the valve and the sleeve will be also exhausted through the exhaust port 75. Any such seepage however, is accidental and unintentional, being due to the fact that the valve 38 is slidably fitted within the sleeve 12, and with the oil under pressure there is always bound to be some seepage.

In summary, pressure fluid is delivered to the tracer at body port 70 Figure 10, and depending upon the positioning of valve 38 will be delivered outwardly to either of the cylinder ports 72 or 74. If pressure fluid is delivered outwardly through port 72 then exhaust fluid returns through cylinder port 74 for subsequent exhausting outwardly from exhaust port 75. Alternately if pressure fluid is delivered through pressure port 74, then in that case exhaust fluid from the cylinder returns to the tracer through the cylinder port 72 and subsequently out from the tracer through the exhaust port 75.

It will be noted that there is an exhaust port 78 in body 11 which is actually the low pressure port being joined to a low pressure inducing device within the hydraulic unit by means of a suitable conduit. As the method of obtaining this low pressure forms no part of the present invention further description thereof is omitted. The same thing is true with respect to the hydraulic unit above referred to which is adapted to deliver pressure fluid to the tracer body at port 70 and received exhaust fluid therefrom through the tracer exhaust port 75.

As shown in Figures 1 and 2, exhaust port 78 registers with sleeve opening 55 and the vacuum passage 56 formed therein. As more particularly shown in Figure 1 the lower end of passage 56 is shown in communication with the seepage collector 57 which is positioned within the lower portion of sleeve 12 and is adapted to collect any fluid which may seep downwardly either from valve passages 46' or from between valve 38 and the interior of said sleeve.

Before this seepage fluid overflows collector 57 it will be withdrawn through the vacuum passage 56 and therefore such seepage will not run down the outer surface of the tracer spindle.

As shown in Figure 8 all of the sleeve passages 60, 62, 64, 66 and 68 are of the generally eliptical shape indicated.

While the tracer arm 24 is shown eccentric relative to spindle 21 it is contemplated that said arm could just as well be coaxial therewith if desired.

It will be understood that while in applicant's preferred embodiment of the invention the transverse slots 60, 62, 64, 66 and 68 are arranged in staggered relation around the sleeve 12, it is contemplated that any other convenient arrangement may be employed. Said slots could be arranged in vertical rows or in any other convenient position if desired.

The important thing is that each of the pairs of said slots are opposed to each other being oppositely arranged and formed within the sleeve 12. The valve which is movable within said sleeve is balanced by the fact that in each individual groove the corresponding inlet slots 60, 62, 64, 66 and 68 are exactly opposed.

The respective inlet passages 65, 67, 63, 61 and 69 are normally arranged intermediate the outer ends of each pair of opposed inlet slots. Thus the fluid flow is split up and either enters or leaves the valve and sleeve upon opposite sides thereof; and by this construction each pair of said inlet slots or ports is in hydraulic balance.

Thus at all times the pressure is equalized upon the valve and upon all portions thereof.

Having described my invention reference should now be had to the claims which follow for determining the scope thereof.

I claim:

1. In a hydraulic tracer having a housing and an axially movable pattern responsive spindle therein, said spindle having a transverse slot formed therein, a stabilizer pin loosely projected through said slot, and eccentric trunnion shafts at the opposite ends of said pin pivotally mounted within said housing.

2. In a hydraulic tracer having a housing and an axially movable pattern responsive spindle therein, said spindle having a transverse slot formed therethrough, and a stabilizer pin loosely projected through said slot with its ends eccentrically arranged with respect to the axis of said pin, and with said ends pivotally mounted within said housing.

3. In a hydraulic tracer having a housing and an axially movable pattern responsive spindle therein, a transverse adaptor at the lower end of said spindle, a tracer arm depending from said adaptor with its longitudinal axis offset with respect to the spindle axis, a transverse tracer tip with its axis at right angles to the spindle axis adjustably positioned within said tracer arm, and means to secure said tracer tip in adjusted position.

4. In a hydraulic tracer having a housing and an axially movable pattern responsive spindle therein, said spindle having a transverse slot

formed therein, a stabilizer pin loosely projected through said slot, eccentric trunnion shafts at the opposite ends of said pin pivotally mounted within said housing, a hollow pressure fluid conducting sleeve having a plurality of longitudinally spaced annular fluid openings at its outer surface, there being a pair of oppositely arranged transverse channels formed in said sleeve connecting each of said openings with the interior of said sleeve, said pairs of channels being arranged in staggered relation around said sleeve, a fluid control valve slidably positioned within said sleeve and bearing upon said spindle, there being a plurality of fluid passages formed in said housing each respectively joining one of said annular fluid openings and being arranged intermediate the outer ends of each pair of opposed channels to thereby equalize the fluid pressure effect throughout the entire exterior surface of said valve.

GALE HUMES.

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