June 10, 1958 G. E. RYCKMAN 2,838,268

TRACER

Filed May 4, 1955 3 Sheets-Sheet 1

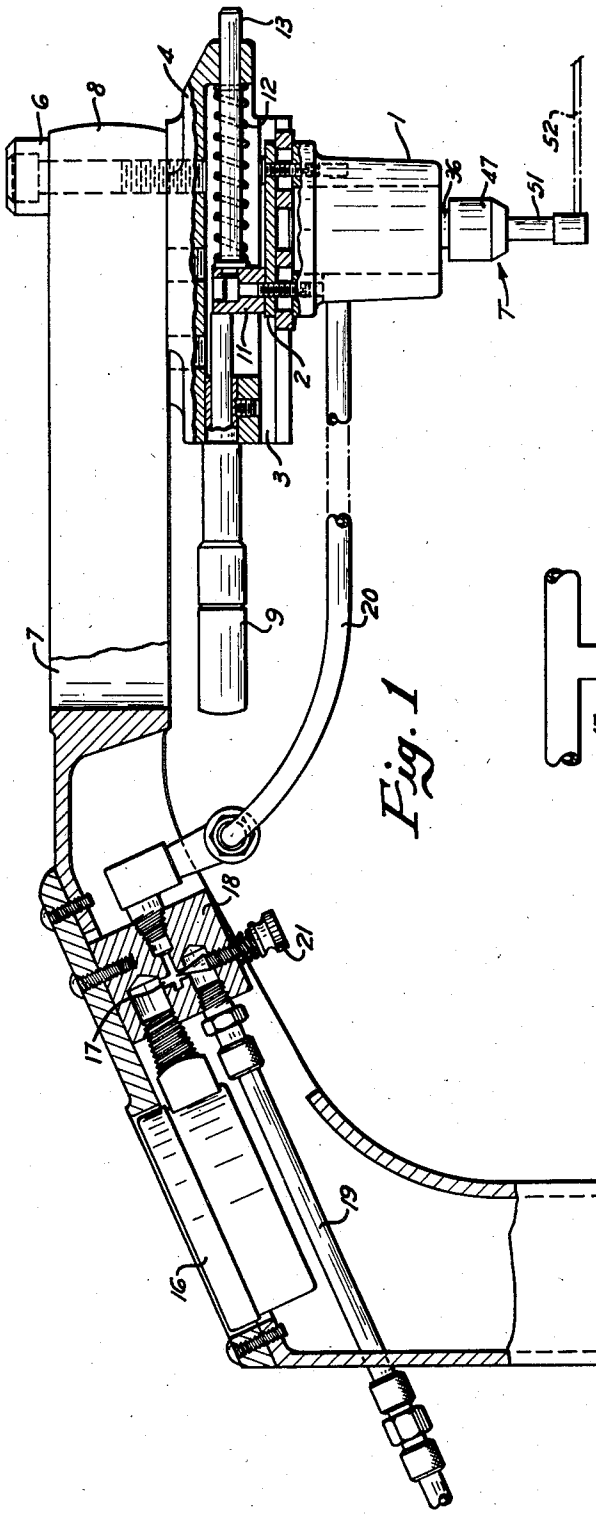


Fig. 1

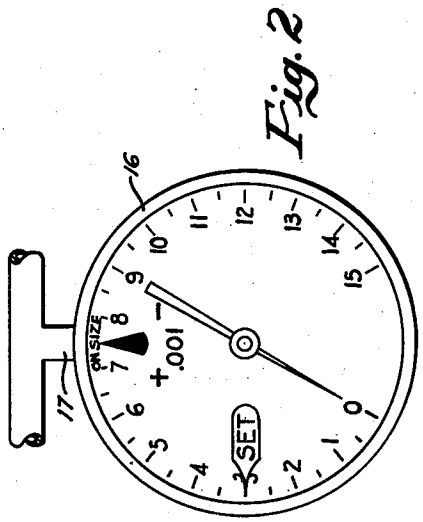


Fig. 2

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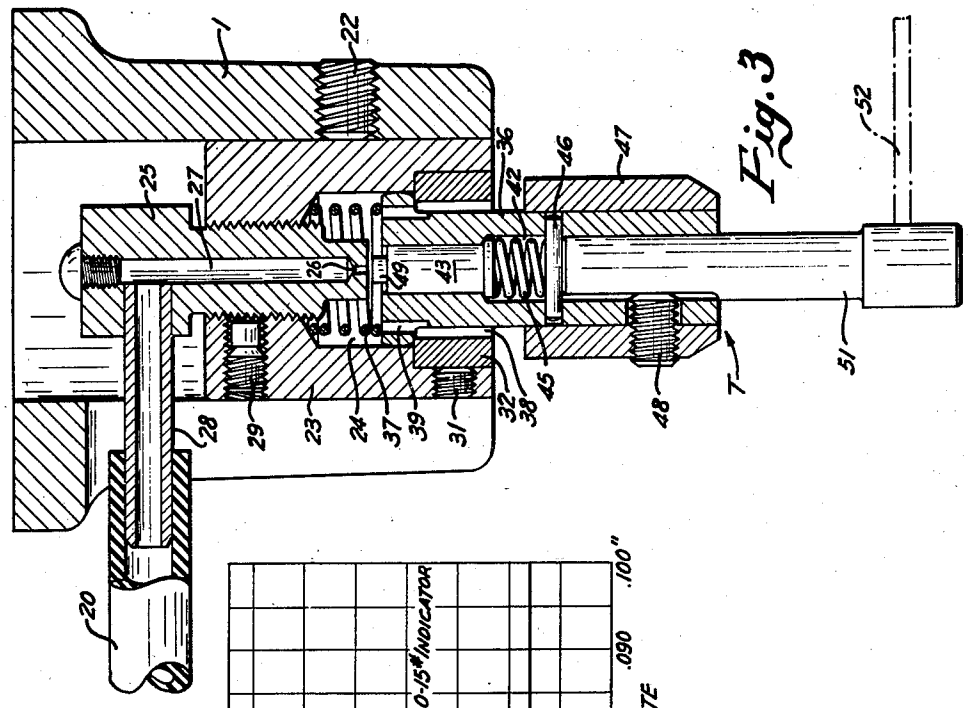


Fig. 3

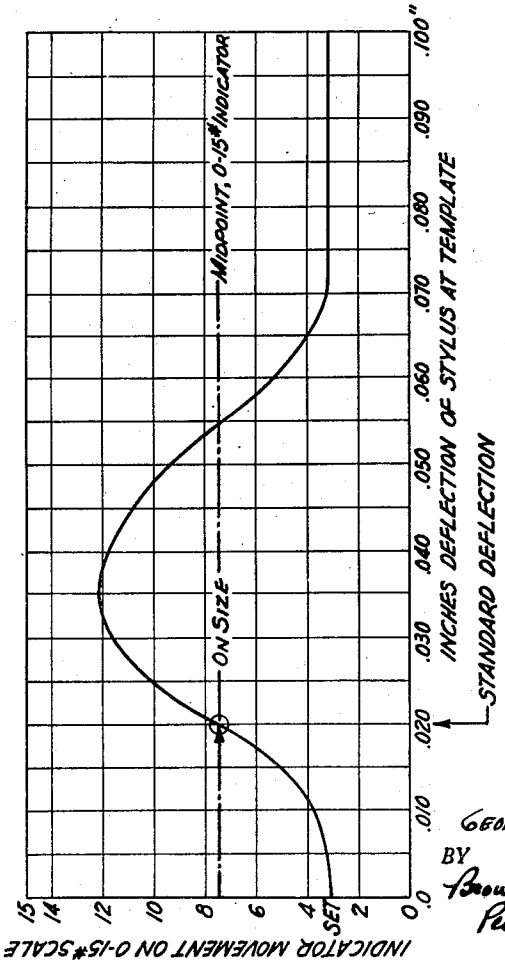


Fig. 6

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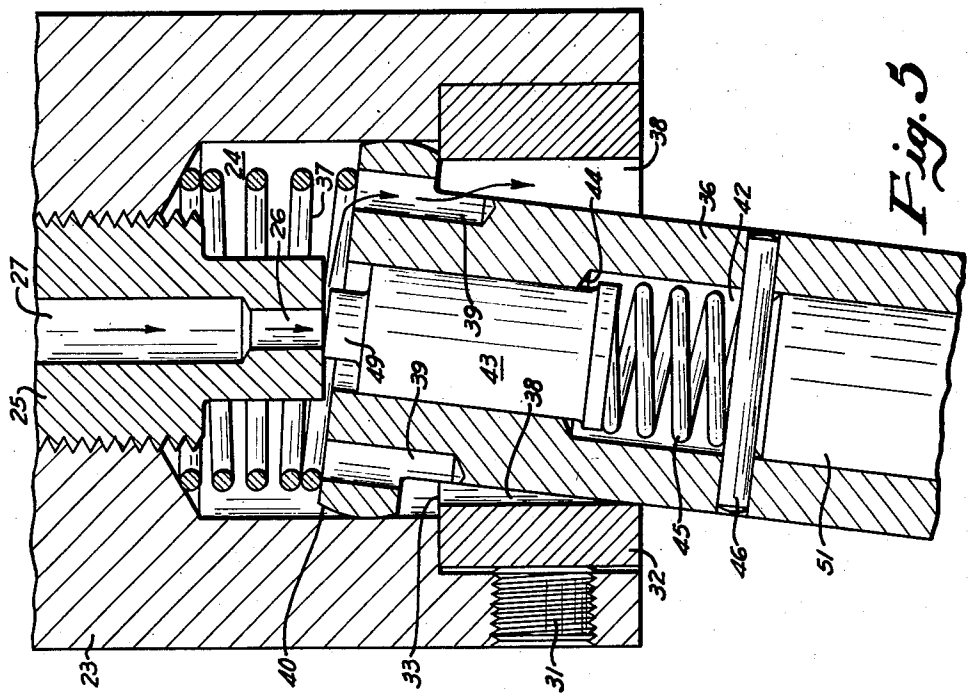


Fig. 5

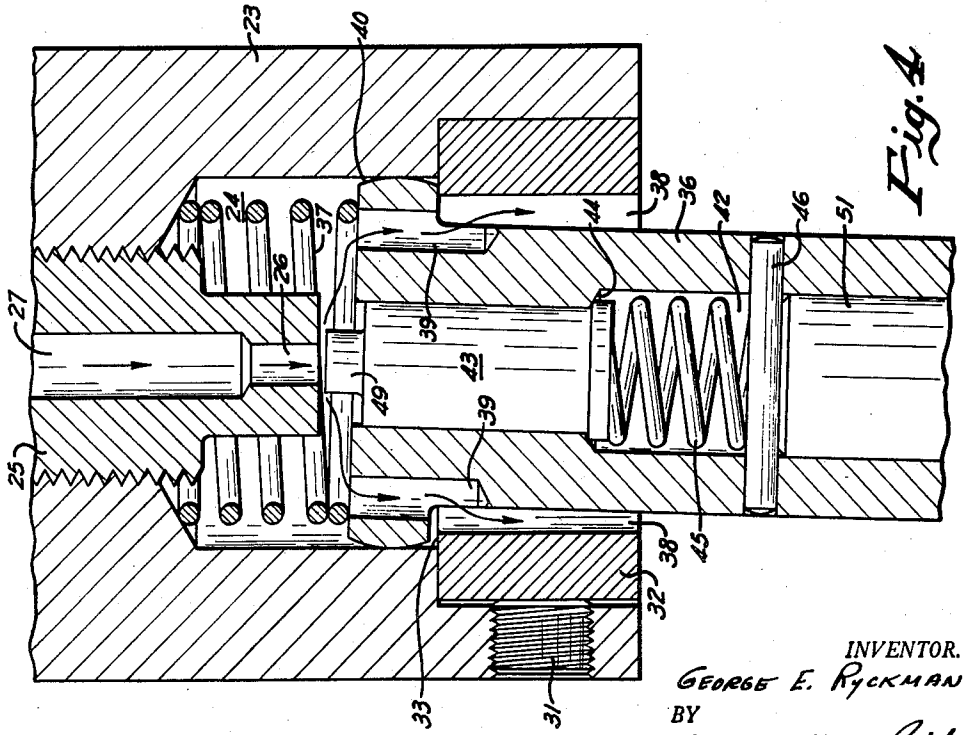


Fig. 4

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TRACER

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Application May 4, 1955, Serial No. 505,890

6 Claims. (Cl. 251—3)

This invention relates to tracers that are used for following templates and other patterns in metal working machines, such as lathes, milling machines, shapers and planers.

It is among the objects of this invention to provide a tracer which is simple in construction and operation, which requires only a very slight pressure to operate it, which is strong and durable, which can be used with either fully automatic or manually controlled machines, and which will protect from injury any fluid pressure indicator that is connected with it.

In accordance with this invention, the tracer head is provided with an inwardly extending cylindrical recess that has an annular shoulder facing the inner end of the recess. The head also is provided with a fluid passage having an outer end adapted to receive fluid under pressure from a line connected with a gauge. The inner end of the passage terminates in a central orifice at the inner end of the recess. A barrel is disposed in the recess, from which it projects, and has an enlarged inner end normally pressed against the shoulder by a spring. The periphery of the barrel's enlarged end is spherical and slidably engages the encircling wall of the recess. The portion of the barrel between its enlarged end and the outer end of the recess is spaced from the wall of the recess so that the barrel can be rocked in the head. The inner end of the barrel is provided with fluid ports connecting the portions of the recess at opposite sides of the enlarged end of the barrel. Carried by the inner end of the barrel is a valve member that normally is spaced axially of the recess from the fluid orifice. Projecting from the outer end of the barrel is a stylus that is adapted to be swung laterally, such as by a template or a surface being gauged, to tilt the barrel in the head. When the barrel is tilted, the valve member will be moved closer to the orifice to restrict flow of fluid therefrom. Preferably, the valve member is formed from a plunger slidably mounted in an axial bore in the inner end of the barrel. A spring normally holds the plunger projected from the barrel a predetermined distance so that further tilting of the barrel after the plunger engages the head beside the orifice will cause the plunger to be pushed into the barrel.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

Fig. 1 is a side view of my tracer mounted on the outer end of an arm attached to a lathe or the like;

Fig. 2 is a view of the dial of the fluid pressure indicator that is mounted in the arm;

Fig. 3 is an enlarged vertical section through the tracer;

Fig. 4 is a fragmentary section showing the stylus deflected a standard amount;

Fig. 5 is a similar view showing the stylus deflected the maximum amount; and

Fig. 6 is a graph showing the relation between indicator reading and stylus deflection.

Referring to Fig. 1 of the drawings, the tracer T is mounted in a socket 1 projecting from the bottom of a

slide 2 that is mounted in longitudinal guideways 3 in a hollow block 4. The block is supported by a screw 6 which extends up through a longitudinal slot 7 in an arm 8. For rough adjustments the block can be turned and moved lengthwise of the slot by means of a handle 9 projecting from one end of the block. The handle is a micrometer which engages a boss 11 fastened to the top of the slide. The boss is held against the inner end of the micrometer by a coil spring 12 encircling a rod 13 that is slidably mounted in the end of the block. By turning the micrometer, the slide can be moved along the block to obtain fine adjustments for the position of the tracer. A template of the profile to be duplicated is mounted securely on the machine frame within reach of arm 8, and the relationship between tracer and template is perfected by the micrometer.

Arm 8 has a hollow downwardly-extending portion, the lower end of which is formed for adjustable connection to the tool slide 15 of a metal cutting machine, such as a lathe, for example, in such a way as to permit normal motion of the tool slide. Disposed in an opening in the upper part of the hollow portion of the arm is a fluid pressure indicator 16, the inlet of which is connected with a passage 17 that branches out opposite sides of a block 18 secured to the arm. One branch is connected by a conduit 19 with a source of fluid under pressure, such as compressed air, and the other branch is connected by a flexible hose 20 with the tracer T. Flow of air from the first branch into the rest of the passage is controlled by a needle valve 21. As is customary with apparatus of this kind, the compressed air flows through the tracer and out to the atmosphere, but its flow through the tracer is restricted so that back pressure is created which registers on the indicator. Any deviation of the indicator needle from a predetermined point will indicate a change in the flow restriction at the tracer.

As shown in Fig. 3, the tracer head, which is held in slotted socket 1 by a set screw 22, includes an inverted cup-like housing 23 provided with a cylindrical recess 24 that extends upward from its lower end. The housing above the recess is provided with a threaded axial bore through it concentric with the recess and containing a plug 25 that, preferably, projects down into the recess. The downwardly projecting portion of the plug forms the central portion of the wall of the upper or inner end of the recess. The lower end of the plug is provided with a central orifice 26 that opens into an axial passage 27, the upper end of which opens laterally into a radial nipple 28 extending through a vertical slot in the side of the socket. The nipple is connected to the flexible hose 20 leading to indicator 16. By turning the housing on the plug, the orifice at the lower end of the plug can be adjusted vertically in recess 24. The desired adjustment is maintained by a set screw 29 in the housing, bearing against the plug. Another set screw 31 holds a bushing 32 in the enlarged lower end of the recess. The internal diameter of the bushing is a little less than the diameter of the recess above it, so that the bushing forms supporting means in the form of an annular shoulder 33 (Figs. 4 and 5) in the recess facing its inner or upper end. All of the elements 23 to 33 make up the tracer head.

Loosely mounted in the recess is a barrel 36, which has an enlarged upper end that normally rests on shoulder 33 a short distance below orifice 26. Although this end may rest against the shoulder by gravity and the fluid pressure above it, it is preferred to press the barrel down against the shoulder by means of a light coil spring 37 encircling the lower end of plug 25 and compressed between the barrel and the upper end of the recess. The portion of the barrel that extends down through the bushing to the lower or outer end of recess 24 has a smaller diameter than the inside of the bushing so that there is an annular

space **38** between them that will permit the barrel to be tilted or rocked in the head. As provision must be made for escape of fluid from the head, the barrel preferably is provided with several circumferentially spaced fluid ports **39** extending down through its enlarged upper end and opening into space **38** so that fluid issuing from orifice **26** can flow out of the lower end of the head. To keep the barrel centered in the recess at all times, the periphery **40** (Figs. 4 and 5) of its large upper end is spherical and slidably engages the wall of the recess. The two, therefore, remain in contact even when the barrel is tilted.

The barrel is provided with an axial bore **42** through it, in the upper end of which a plunger **43** is slidably mounted. The plunger has an enlarged lower end that normally is pressed up against a shoulder **44** (Fig. 5) by means of a light coil spring **45** compressed between the bottom or inner end of the plunger and a cross pin **46** extending through the center of the barrel. The pin is held in place by a sleeve **47** encircling the barrel, on which it is held by a set screw **48** threaded in the sleeve and extending through a hole in the side of the barrel. The upper end of the plunger normally projects a short distance from the barrel and serves as a valve member **49** spaced a predetermined distance from orifice **26** directly above it. This distance depends upon the vertical position of the plug **25** in the head, and, as pointed out before, is adjustable.

In the lower end of barrel bore **42** a vertically adjustable stylus **51** is mounted. It is held in place by means of sleeve set screw **48**. The side of the lower end of the stylus is adapted to engage a template **52** or the like, indicated in broken lines, and normally to be deflected or pushed laterally by the template a predetermined or standard amount such as, for example, .020 inch.

Before the tracer is pressed against a template or the like, the stylus extends straight down from the head as shown in Figs. 1 and 3, because the upper end of barrel **36** rests flat against shoulder **33**. This is the zero deflection position of the stylus, in which the resistance to flow of compressed air through the tracer will cause the indicator needle to move to the "set" position on the dial shown in Fig. 2. As the stylus is deflected from zero position, the barrel will be tilted in the tracer head and will move the valve member **49** at the upper end of the plunger closer to orifice **26**, as shown in Fig. 4. This will restrict the orifice still more, so the back pressure will rise and the indicator needle will approach the "on size" position. When that position is reached, the operator will know that the work is being cut correctly. Any greater or lesser deflection of the stylus, caused by improper tracing of the template, will be shown immediately on the indicator by movement of its needle one way or the other from the "on size" position, because the air passage through the tracer will be closed or opened more.

As the stylus deflection increases, the upper end of the plunger valve **43** will approach closer to plug **25** until they touch at one side of orifice **26**. However, the stylus can be deflected still further in order to reduce the likelihood of the stylus being bent or the template damaged, because the barrel **36** can move up around the plunger that is stopped by plug **25**. On the other hand, this further tilting of the barrel and plunger will not close the orifice still more, which might damage the indicator by exposing it to too much air pressure. To the contrary, the point at which maximum closing of the orifice occurs is when the plunger first touches the plug, and further deflection of the stylus as the barrel slides up on the plunger serves only to swing the upper end surface of the plunger down away from the orifice and thereby allows increasing air flow through the orifice. This is a very desirable feature because it prevents the back pressure on the indicator from becoming excessive and ruining it. Fig. 5 shows the tracer in maximum deflection position, with the side of the barrel engaging the lower end of bushing **32**.

The relation between stylus deflection and indicator reading is shown graphically in Fig. 6, which is practically self-explanatory. It will be seen on the graph that the tool will be on size when the stylus is deflected .020 inch, and that before the indicator needle can run off the scale because of over deflection of the stylus, the valve in the tracer will start to open wider and the needle will fall back toward "set" position. This reversal of needle movement will start to occur when the stylus deflection reaches .035 inch in the example illustrated. Of course, this is a situation that the operator should do his best to avoid, by holding the indicator needle at "on size" position on the dial. Nevertheless, if he does run over too far, the indicator will be protected from damaging back pressure in the manner described in the preceding paragraph.

Since during normal operation of this tracer the only part that is moved by the template or other surface being traced or gauged is the barrel-stylus unit, and since the movement is only a slight tilting resisted by a very light spring, the pressure required to deflect the stylus is so small that the templates can be made of very light material, such as heavy paper. In spite of this, the tracer is sturdy, inexpensive and simple in construction.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A tracer comprising a head provided with an inwardly extending cylindrical recess having supporting means facing the inner end of the recess, the head also being provided with a fluid passage having an outer end adapted to receive fluid under pressure and having its inner end terminating in a central orifice at said inner end of the recess, said orifice being positioned to direct fluid from said passage toward the outer end of the recess, a tiltable barrel in the recess and projecting therefrom and having an enlarged inner end normally seated on said supporting means, the periphery of said enlarged end being spherical and slidably engaging the encircling wall of the recess, the portion of the barrel between its enlarged end and the outer end of the recess being spaced from the encircling wall of the recess, the tracer being provided with fluid outlet ports leading out from the recess, a valve member carried by the inner end of the barrel and tiltable therewith and normally spaced axially of the recess from said orifice, and a stylus projecting from the outer end of the barrel and adapted to be swung laterally to tilt the barrel and valve member in said head, whereby the valve member will be moved closer to the orifice to restrict flow of said pressure fluid therefrom.

2. A tracer according to claim 1, in which said head includes a housing containing said recess and having an axial bore extending into the inner end of said recess, and a plug mounted in said bore and adjustable axially thereof, the plug containing said fluid passage and orifice.

3. A tracer according to claim 1, in which the inner end of the barrel is provided with said fluid outlet ports connecting the portions of said recess at opposite sides of said enlarged end of the barrel.

4. A tracer comprising a head provided with an inwardly extending cylindrical recess having supporting means facing the inner end of the recess, the head also being provided with a fluid passage having an outer end adapted to receive fluid under pressure and having its inner end terminating in a central orifice at said inner end of the recess, a tiltable barrel in the recess and projecting therefrom and having an enlarged inner end normally seated on said supporting means, the periphery of said enlarged end being spherical and slidably engaging the encircling wall of the recess, the portion of the barrel be-

tween its enlarged end and the outer end of the recess being spaced from the encircling wall of the recess, the tracer being provided with fluid outlet ports leading out from the recess, the inner end portion of the barrel being provided with an axial bore, a plunger slidably mounted in said bore, a spring normally holding the plunger projected from the barrel a predetermined distance, and a stylus projecting from the outer end of the barrel and adapted to be swung laterally to tilt the barrel and plunger in said head, whereby after the barrel is tilted in the head far enough for the plunger to engage the head beside said orifice, further tilting of the barrel will cause the plunger to be pushed into said bore.

5. A tracer comprising a head provided with an inwardly extending cylindrical recess having an annular shoulder facing the inner end of the recess, the head also being provided with a fluid passage having an outer end adapted to receive fluid under pressure and having its inner end terminating in a central orifice at said inner end of the recess, a tiltable barrel in the recess and projecting therefrom and having an enlarged inner end normally seated on said shoulder, the periphery of said enlarged end being spherical and slidably engaging the encircling wall of the recess, the portion of the barrel between its enlarged end and the outer end of the recess being spaced from the encircling wall of the recess, the inner end of the barrel being provided with fluid ports connecting the portions of the recess at opposite sides of said enlarged end, the barrel being provided with an axial bore therethrough, a plunger slidably mounted in the inner

end portion of said bore and projecting therefrom, a pin extending across the central portion of the bore, a coil spring in the bore compressed between the pin and the inner end of the plunger, means limiting the distance the plunger can be moved away from the pin, and a stylus projecting from the outer end of said bore and axially adjustable therein, the outer end of the stylus being adapted to be swung laterally to tilt the barrel and plunger in said head.

6. A tracer comprising a head provided with a fluid passage having an outlet, a plunger spaced a short distance from said outlet in the path of fluid issuing therefrom, a tiltable barrel provided with an axial bore slidably receiving the plunger, means supporting the barrel for tilting movement, a spring normally holding the plunger projected from the barrel a predetermined distance, and a stylus projecting from the outer end of the barrel and adapted to be swung laterally to tilt the barrel and plunger, whereby the plunger will be moved closer to said outlet to restrict flow of pressure fluid therefrom.

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