TRACERS OR DUPLICATE FOR MACHINE TOOLS
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This invention relates to tracers or duplicators for use with machine tools and of the kind in which the movement of the tracer head, foot or stylus which follows the template or pattern actuates a hydraulic tracer valve which controls the flow of pressure fluid to and from the ram cylinder to produce a corresponding relative movement between the milling or other tool and workpiece.

The object of the present invention is to provide an improved construction of such tracers or duplicators with a view to giving greater sensitivity, accuracy and stability and enabling the degree of sensitivity to be varied.

In carrying out this invention the tracer valve used must be capable of being actuated by very small movements from the tracer foot of the order of one thousandth of an inch. Such a valve is described and claimed in the specification of my British Patent No. 692,642 and is the kind of tracer valve which will hereinafter be referred to in this specification, although any other suitable valve capable of being actuated by such small movements might be used.

According to the present invention the construction is such that the deflection of the stylus rod can be converted into reduced axial movements of a slide valve member or spool by means of connecting elements which include a rotary cam or eccentric device. The stylus rod and valve member have their longitudinal axes parallel to one another and preferably co-axial with one another, and a rocker arm adapted to be rocked by movement of the stylus rod is adapted to produce angular movement of the rotary cam or eccentric and thereby to transmit a proportional reduced axial movement to the valve member. The proportion between the movements of the stylus rod and the valve member can be varied at will within limits by adjusting the angular setting of the cam or eccentric.

The use of the rotary cam or eccentric device has a damping effect tending to prevent transmission of vibration from the valve member back to the stylus.

The stylus rod and rocker arm are controlled and steadied by spring action.

Spring pressure is necessary to obviate turbulence and vibration of the spool and stylus and to eliminate what is known as changeover faults, but this spring pressure may be applied to the rocker arm in various ways.

It is preferred to arrange for a spring housed in the spool (similar to that in my British Patent No. 692,642 but not bearing upon the spool) to bear on a pressure rod which is freely slidable through the spool and which bears with its lower end indirectly on the top of the stylus rod through the intermediary of the rocker arm.

In order that the invention may be more clearly understood and readily carried into effect the same will now be more fully described with reference to and by the aid of the accompanying drawings, wherein:

FIGURE 1 is a vertical section through one construction of the tracer head having valve actuating mechanism according to this invention, the view being taken in the direction of the arrows L—L shown in FIGURE 2.

FIGURE 2 is a view in the direction of arrow A in FIGURE 1 with the lower part of the tracer removed below line X—X.

FIGURE 3 is a view similar to FIGURE 1 but showing only the central portion of the tracer head and with a slightly modified construction of the valve actuating mechanism.

FIGURE 4 is a view in the direction of arrow B in FIGURE 3 with the lower part of the tracer removed below the line Y—Y.

FIGURE 5 is a full elevational view of the rocker arm shown in FIGURE 1.

FIGURE 6 is a full plan view of an actuating arm shown in FIGURE 1.

Referring to the illustrated examples of construction in which the stylus rod and valve member are mutually co-axial, the top part 1 of the tracer head supports a slide valve whose spool 2 and valve spindle 3 are arranged for axial movement only.

This valve, as already explained, is preferably of the kind described and claimed in the specification of my British Patent No. 692,642 and is indicated merely schematically in the present drawings. The stylus rod 4 has a part spherical portion 5 by which it is supported on a part spherical seating 6 in the base of the tracer head so as to be rotatable through 360°. This seating 6 is formed in a plate 7 secured by a flanged sleeve 8 which is inserted in and secured to a barrel portion 9 at the base of the tracer head, these parts being constructed and arranged substantially as described and claimed in the specification of my said Patent No. 692,642, and my British Patent No. 757,589.

Between these two parts of the tracer head a two-part housing 10, 11 is secured, part 10 having a spigot 10x by which it is screwed to the top part 1 of the tracer head and part 11 being screwed to barrel 9 by means of a screw-threaded connector sleeve 12. The two housing parts 10, 11 are clamped together by screwed studs (not shown) inserted in stud holes 13.

A piston member 14 has a skirt 15 which is axially slidable in the connector sleeve 12 and a hardened bush 16 is held between coned faces 17, 18 formed respectively at the top of the skirt 15 and on the top of the stylus rod 4, the top of rod 4 and the bush 16 having room for slight lateral movement.

Within the housing 10, 11 the flat top of the piston member 14 and a coned cap 19 held between them a hardened bush 20 and the cap 19 is clamped in the split end of a rocker arm 21 whose other forked end is clamped on an eccentric shaft 22 on which is secured an eccentric cam 23, this shaft 22 being journaled in bearing housings 24 supported by bearing blocks 25 in the housing part 10. This cam has a neat fit in a fork 26 which has a stud 27 by which it is clamped in one split end of an actuating arm 28 whose other split end is clamped upon the valve spindle 3, so that angular movement of the cam causes axial reciprocation of the valve spool 2.

The angular position of the cam on its shaft can be altered as desired within limits, thus altering the ratio of movement between the rocker arm 21 and the actuating arm 28 and hence the proportion between the movements of the stylus rod and valve member, but the transmitted movement will always be on a reduced scale.

The modified construction of the valve actuating mechanism shown in FIGURES 3 and 4 only differs from that of FIGURES 1 and 2 in respect of parts 19, 20, 21 and 23. Instead of these parts, the rocker arm 21 is replaced by a screw-threaded pin 30 screwed into the cam 23 and locked by nut 31, the pin having a part spherical end 32 which is acted upon by the pin member 14 in a similar way to the cap 19 and ball 20 previously described, this pin thus acting as the rocker arm. The shape of the pin end may vary provided it offers as little
friction as possible in transmitting the movement of the stylus to the cam.

To steady the movement of the stylus rod and rocker arm a compression spring 29 (see FIGURE 1) housed in the valve spool 2 is held by an adjusting screw 29a in a cap 29b secured in the top part 1 of the tracer head and bears on a pressure rod 29c which is freely slidable through the spool and which bears with its lower end upon the cap 19 (or the pin end 32 as the case may be). This gives great sensitivity of control over the movement of the stylus rod and at the same time allows the spool to move more freely as it is not acting against direct spring pressure. Also this arrangement enables the valve spool to move with a smooth and positive action over the very small distance required to reverse the oil flow to the ram, and so makes for greater accuracy and less risk of changeover faults.

The spring control of the stylus might be achieved satisfactorily by other constructions, for example by inserting a spring in the base of the tracer head surrounding the upper part of the stylus rod so as to bear down on the latter.

Important advantages given by this invention are a more stable action of the valve member as it is locked in any position by the cam thereby damping out reverse transmission of vibration or unwanted movement from the valve to the stylus rod, and increased accuracy at the point of changeover when oil is diverted from one end of the hydraulic ram to the other. Other suitable forms of connection between the stylus rod and the rocker arm may be used as, for example, those described in my said previous patent specification.

I claim:

1. A hydraulic tracer mechanism for a machine tool comprising the combination of a tracer head housing having two bores formed therein, a tracer controlled valve member, a valve spindle mounting said valve member for axial sliding movement in one of said bores, a stylus rod mounted for valve actuating movement in the other of said bores, a rocker arm mounted in the housing for rocking movement in response to actuation by said stylus rod, said stylus rod and valve member having their longitudinal axes mutually co-axial, a movement transmitting assembly including a rotatably mounted eccentric cam device operatively connected to said stylus rod through said rocker arm and a shoe which embraces and is operable by said cam device and which is positively connected to said valve member, said movement transmitting assembly being effective to damp vibrations from said valve member back to said stylus and to transmit small positive movements from the stylus to said valve spindle with proportionally reduced axial movement.

2. The combination as claimed in claim 1 wherein said movement transmitting assembly further includes a spring housed in said valve member and a pressure rod, said spring bearing on said pressure rod, said pressure rod being freely slidable through said valve member and the lower end of said pressure rod bearing upon the top of said stylus rod through said rocker arm.

3. The combination as claimed in claim 2 wherein said movement transmitting assembly further includes at least one set of co-acting conical surfaces and curved surfaces through which the top of said stylus rod engages said rocker arm.

4. The combination as claimed in claim 3 wherein said movement transmitting assembly further includes an axially slidable piston having one of said conical surfaces which is co-axial with said stylus rod and valve member, said piston having a sleeve portion fitting loosely over the top of said stylus rod, and one of said curved surfaces comprising a ball positioned between said conical surface on said piston and the top of said stylus rod.

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