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TRACER CONTROL FOR MATERIAL WORKING MACHINES

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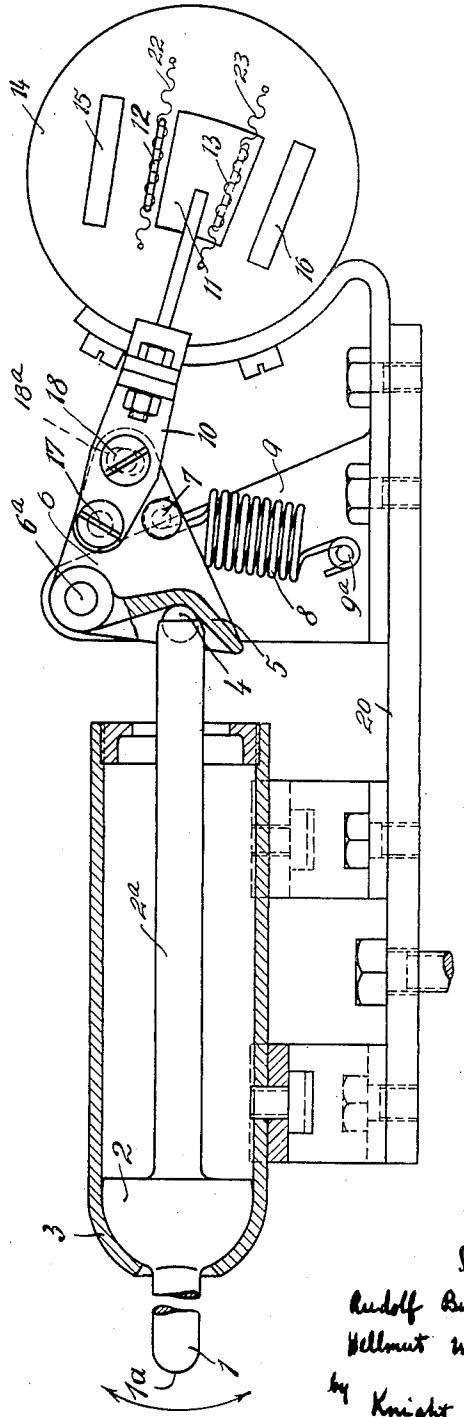


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## TRACER CONTROL FOR MATERIAL WORKING MACHINES

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3 Claims. (Cl. 90—62)

Our invention relates to a tracer control for tool machines, and more particularly to material removing tool machines.

For manufacturing complicated work pieces such as, for instance, dies, the well-known tracer controls are employed to advantage. The latter are substantially based upon the idea that a tracer moves along a template or pattern, thereby controlling the feed motors of the tool in accordance with the resistance which opposes its movement. It is evident that such a tracer control will be only employed in such cases, in which the template or pattern coincides with the work to a sufficiently high degree, i. e., the path of the tool must coincide with that of the tracer as accurately as possible. The tracer cannot, consequently, release control operations, if it has not at first been moved. The movements of the tracer then cause control impulses to be transmitted. Even if these initial movements are relatively small they make themselves nevertheless conspicuous during the working operation, that is to say, the finished work differs from the pattern by these initial control paths. Attempts must, consequently, be made in maintaining the initial control paths very small. To this end, it has already been proposed to arrange the control contacts not directly on the tracer, but to employ a mirror in connection with the tracer, which mirror reflects light upon photocells. If the movement of the mirrors is increased sufficiently by the optical method very small deflections of the mirrors cause great fluctuation of a beam of light, i. e., great control movements. The use of such a mirror device is, however, not simple and requires a careful attendance, insofar as a soiling of the mirror by dust or the like in the workshop may impair the accuracy of the control operation.

The object of my invention is to provide a tracer control, whereby the above drawbacks are eliminated. This may be accomplished according to the invention by employing the hitherto known nozzle bolometer as an impulse transmitter for the control impulses. The nozzle bolometer as is well known is based upon the fact that two heated branches of a Wheatstone bridge connection are cooled by two currents of air equal in the position of rest, which currents issue from nozzles having very small inner diameters and which are capable of being obstructed by a diaphragm. The diaphragm is adjusted by an impulse transmitter. If the diaphragm is brought out from its central position by rotation, then the intensity of the currents of air for the two heated branches of the bridge connection varies, thus causing practically instantaneously a considerable change in resistance, which may be taken advantage of for the control current. The amplifying effect of the nozzle bolometer is so great that a vacuum discharge tube for the control circuits of the machine (for instance for the magnetic clutches) may be readily controlled thereby. The mechanical contacts of the tracers hitherto employed are, consequently, replaced in the arrangement according to the invention by the nozzle vane of the bolometer. The sensitiveness of this arrangement is so great that it probably represents as far as accuracy is concerned the maximum that may be obtained. In some cases it will perhaps be necessary to provide a damping device for reducing the frequency of the control operations. Above all the combination of the nozzle bolometer with the vacuum discharge tube, whereby intermediate relays are eliminated, results in a construction of such working accuracy that the finished work practically does not differ from the pattern. The arrangement according to the invention is so compact owing to the design of such bolometers that it may also be readily employed for complicated cases.

In the accompanying drawing an embodiment of my invention is illustrated in diagrammatic form. The tracer 1 is supported by a semispheric head 2 in the similarly shaped bottom of a tubular casing 3 in such a manner that the feeler end 1a may be moved in a spherical path. The rear end 4 of the tracer bar 2a, which end is designed in this case in the form of a ball loosely mounted in the end of the bar, engages a ball socket 5 which forms one arm of a bell crank 6 pivotally mounted at 6a on a bracket 9. The position of bell crank 6 is biased by a spring 8 which is secured to the pin 9a provided on bracket 9. The force of the spring 8 causes rocking of the ball socket 5 in such a manner that the socket always maintains the tracer head 2 pressed against the semi-spherical bottom of the hood 3. An arm 10 is connected to the other arm of bell crank 6 and carries the nozzle vane 11 of the bolometer. 12 and 13 denote the air outlet ports of the bolometer which are controlled by the bell crank operated vane 11 and 14 the diaphragm casing of the blower. 22 and 23 represent the heated bolometer wires, the temperatures of which are controlled by vane 11, which is assumed to move between the wires and their operating nozzles 12, 13 respectively as is well-known in the art. The stops 15 and 16 limit the deflection of the vane within a given range. For adjusting the

nozzle vane 11 with respect to the air outlet ports 12 and 13 the arm 10 is not firmly secured to bell crank 6, but by means of bolts 17 and 18, the bolt 18 passing through an elongated aperture 18a in the bell crank arm. The arrangement as shown, which consists of a bolometer and a tracer control, is, for instance, arranged on the tool support 20.

The tracer control may be improved according to the invention by rendering the bolometer arrangement electrically so sluggish that mechanical oscillations of the order of magnitude of those generally occurring in workshops and the like are rendered ineffective. This thermal sluggishness may be attained, for instance, by correspondingly increasing the thickness of the vane controlled bridge wires 22, 23, to impart to them greater heat inertia, which prevents an appreciable cooling by accidental vibrations of the vane. This arrangement has the following advantage: The nozzle bolometer is, as is well-known, an extremely sensitive instrument, which produces great effects even in the case of the smallest impulses. If the instrument is employed for the control of tool machines, above all for material removing tool machines, it is exposed besides to the control forces proper, also to the unavoidable shocks occurring in the workshop. The shocks are not alone produced by the tool machine itself, but also by machines located nearby, street cars, traveling cranes etc. When using any of the standard nozzle bolometers with the ordinary fine heated wires, it would be very difficult to prevent the nozzle vane when oscillating due to these accidental shocks, from releasing undesired control movements. As a matter of fact a mechanical damping device for the vane of the nozzle bolometer might be used. This method, however, is employed according to the invention, but the movement of the nozzle vane is damped only to a very slight extent and the elimination of the effect of the undesired vibrations occurs instead in the electrical portion of the control by making the controlled resistances so sluggish that the detrimental oscillations of undesired frequency are rendered ineffective. The extent to which the frequency must be damped depends upon the circumstances, under which the machine is to be operated. In many cases it will be sufficient if the oscillations above 5 or 10 periods are damped.

We claim as our invention:

1. In a tracer control device for tool machines or the like, the combination of a tracer bar disposed to follow a given templet, with a nozzle bolometer relay for controlling the tool movement of the tool machine, said bolometer having a nozzle control vane for controlling the temperature of the bolometer wires, said vane being operatively connected with said tracer bar to partake in the movements of the latter for controlling the bolometer wire temperatures in accordance with said tracer movements.

2. In a tracer control device for tool machines or the like, the combination of a tracer bar having a semi-spherical bearing head, a similarly contoured socket for said head to permit the tracer feeler end to move on a spherical path, a pivoted bell crank having the rear end of the tracer bar socketed in one of its arms so that the bell crank is rocked when the tracer bar is operated by the given templet, a nozzle bolometer relay for controlling the tool movement of the tool machine, said bolometer having air nozzles and electrically conducting wires, disposed in front of said nozzles and to be heated by electric current traversing them, and to be cooled by the air emanating from said nozzles, a vane disposed to move between said nozzles and said wires and being attached to the other arm of said bell crank, to control the temperature of said wires in accordance with the movements of said tracer bar.

3. In a tracer control device for tool machines or the like, the combination of a tracer bar having a semi-spherical bearing head, a similarly contoured socket for said head to permit the tracer feeler end to move on a spherical path, a pivoted bell crank having the rear end of the tracer bar socketed in one of its arms so that the bell crank is rocked when the tracer bar is operated by the given templet, a nozzle bolometer relay for controlling the tool movement of the tool machine, said bolometer having air nozzles and electrically conducting wires, disposed in front of said nozzles and to be heated by electric current traversing them, and to be cooled by the air emanating from said nozzles, a vane disposed to move between said nozzles and said wires and being attached to the other arm of said bell crank, to control the temperature of said wires in accordance with the movements of said tracer bar, said wires having a sufficient thickness to impart to them sufficient heat inertia, so that short, undesired vibrations of said vane will not produce essential temperature changes in the wires.

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