March 25, 1958 K. H. SCHULTZE 2,827,699

APPARATUS FOR THE REPEATED SETTINGS OF ONE OR SEVERAL MOVABLE MACHINE PARTS, SUCH AS THE WORK-TABLES OF MACHINE TOOLS

Filed Nov. 4, 1953

3 Sheets-Sheet 1

Fig. 1

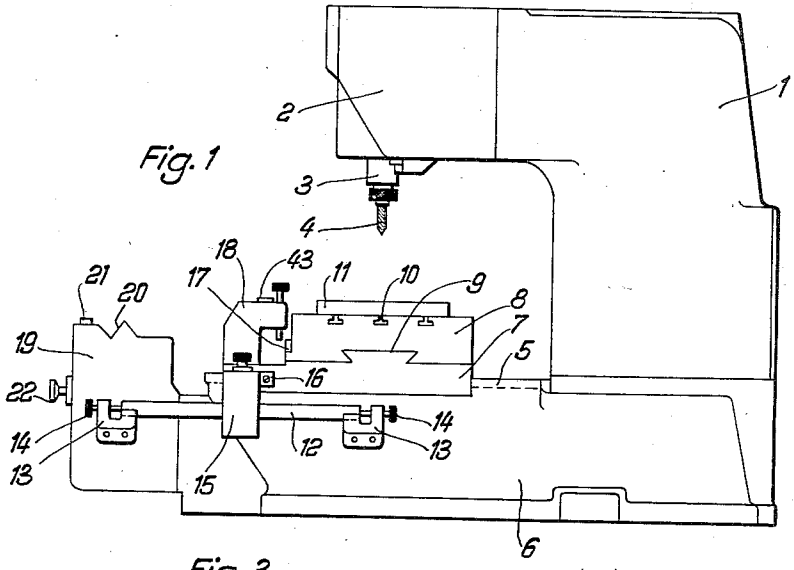


Fig. 3

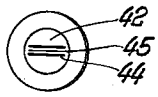
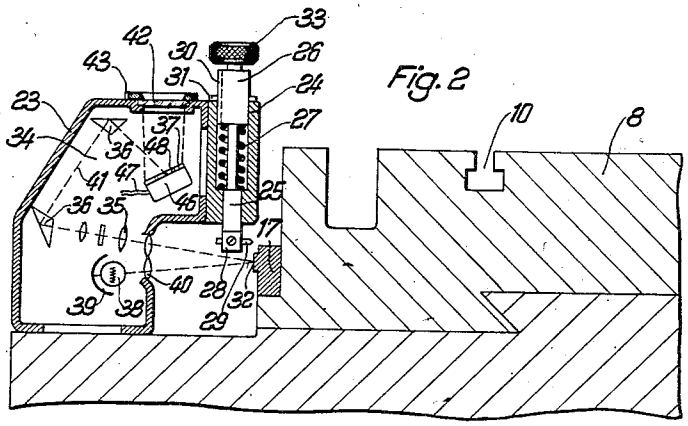


Fig. 2



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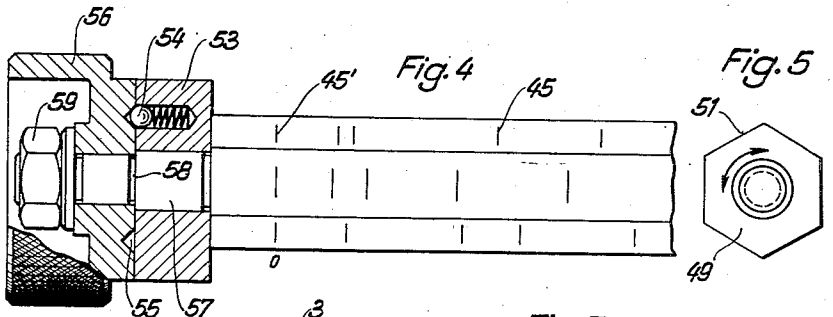


Fig. 4

Fig. 5

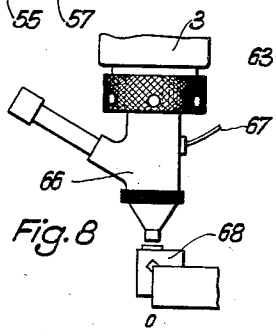


Fig. 8

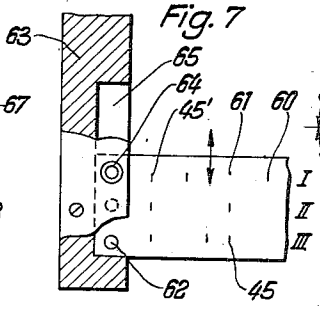


Fig. 7

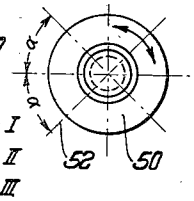


Fig. 6

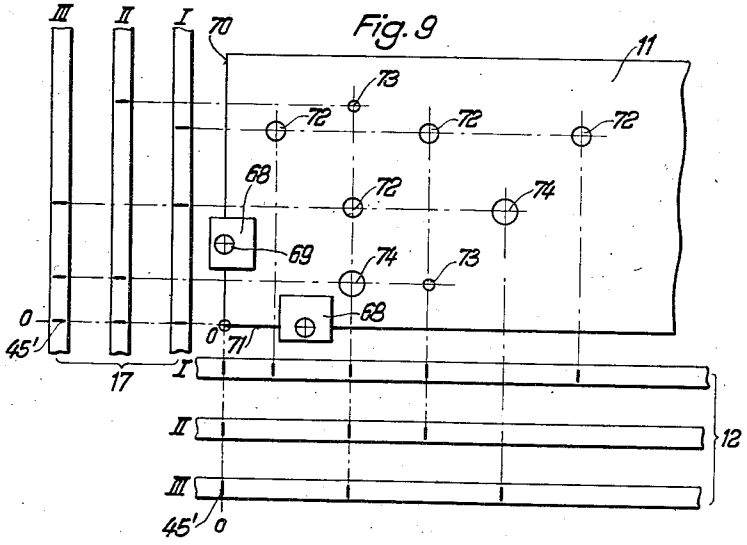


Fig. 9

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Filed Nov. 4, 1953 3 Sheets-Sheet 3

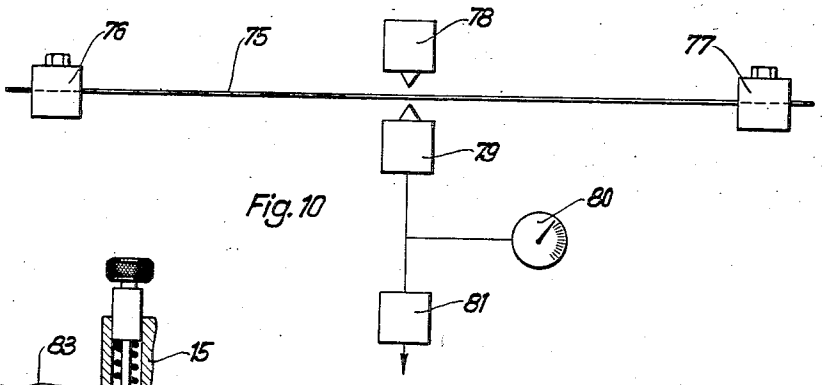


Fig. 10

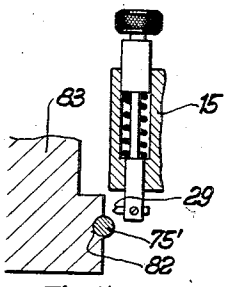


Fig. 11

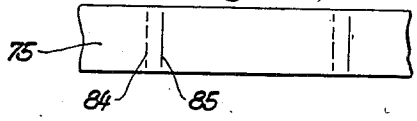


Fig. 12

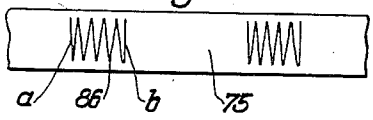


Fig. 13

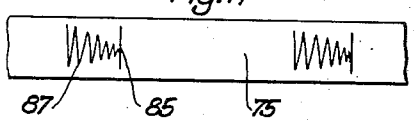


Fig. 14

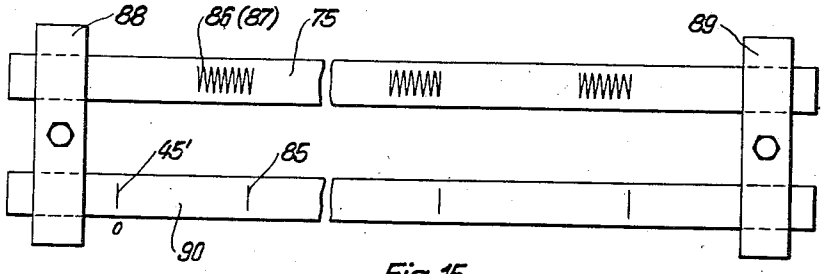


Fig. 15

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2,827,699

APPARATUS FOR THE REPEATED SETTINGS OF ONE OR SEVERAL MOVABLE MACHINE PARTS, SUCH AS THE WORK-TABLES OF MACHINE TOOLS

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Application November 4, 1953, Serial No. 390,212

Claims priority, application Germany November 11, 1952

11 Claims. (Cl. 33—1)

This invention relates to an apparatus for the setting of movable machine parts, and particularly to machine tools such as boring machines having setting gages provided with markings for setting the work table forming part of a compound slide.

It is an object of the present invention to allow a repeated setting of one or more movable parts such as the compound slide of machine tools.

It is another object of the present invention to allow the markings to be zonally produced so as to correspond to the various operations to be performed with the work pieces.

It is a further object of the present invention to provide optical means cooperating with the markings of the setting gauges.

It is still another object of the present invention to provide a pre-signal associated with the markings of the setting gauges.

It is a still further object of the present invention to provide magnetic means producing the reference marks.

Other objects and advantages of the present invention will become apparent from the following detailed description thereof in connection with the accompanying drawings.

The invention is illustrated by way of example in the accompanying drawings, which show its application to a work-carrying table of the type used in combination with a radial drill or similar tool the position of which is adapted to be adjustably fixed while the table is displaceable relatively to the tool in two mutually perpendicular directions.

In said drawings:

Fig. 1 is a side elevation view of a complete co-ordinate boring machine embodying the present invention;

Fig. 2 is an enlarged vertical section of the transmitting apparatus of the arrangement shown in Fig. 1;

Fig. 3 is a top plan view of the transparent viewing glass with the reference lines;

Fig. 4 is a setting gage with several scratched-on zones and support;

Fig. 5 is a cross section of the setting gage shown in Fig. 4, wherein the gage is a prismatic bar;

Fig. 6 is a cross section of the setting gage shown in Fig. 4, wherein the gage is a cylindrical bar;

Fig. 7 is another form of support for the setting gage;

Fig. 8 is the focusing microscope in operation;

Fig. 9 is an adjusted workpiece;

Fig. 10 is a magneto-electric setting gage;

Fig. 11 shows part of a carriage with the wire setting gage in section;

Figs. 12–14 show the magnetic markings produced on the setting gage;

Fig. 15 shows two different setting gages.

Referring to the drawings in detail, there is illustrated in Fig. 1 a co-ordinate boring machine showing the fixture of my invention associated therewith. The boring machine is provided with a supporting frame 1, a headstock 2 carrying a boring spindle 3 with a tool 4, a bed 6 with longitudinal ways 5 (termed hereinafter the first slide ways), a lower carriage 7 and a table or upper carriage 8 movable upon said lower carriage. The lower carriage 7 and the table or upper carriage 8 form a compound slide having traverse ways rail 9. The table or upper carriage 8 is provided with T-slots 10 for fixing a workpiece 11. Parallel to the first longitudinal ways 5 a first setting member or gage 12 is exchangeably mounted on the bed 6 by means of supporting devices 13 and adjustable in a longitudinal direction by set screws 14. A first transmitting or marking apparatus device 15 associated with said first setting gage 12 is mounted on the lower carriage 7 by fixing means 16. A second setting member or gage 17 is adjustably secured parallel to the traverse 9 along the table or upper carriage 8. A second transmitting or marking apparatus or device 18 associated with the second setting gage 17 is mounted on the lower carriage 7. The front of the bed 6 is provided with a control box 19 containing two microscopes or viewing glasses 20 and serving for adjusting the carriage and table, respectively, which adjustment may be effected according to a coarse or fine scale, respectively. In addition, the control box 19 is provided with push buttons such as 21 for starting and stopping the motions of the carriage and table, and with a handwheel 22 for the fine adjustment by hand for the co-ordinate measuring table.

The second transmitting or marking apparatus 18 is shown on a larger scale in Fig. 2. It should be understood that the first transmitting or marking apparatus 15 is designed in the same manner but displaced by 90° against the first transmitting apparatus 18. A casing 24 is attached to a housing 23 which contains cylindrical guide bars 25, 26 and a restoring spring 27 of a chuck 28 on which is mounted a scratching tool 29, such as a diamond. The cylindrical guide bar 26 has a slot 30 forming a guide for a counter guide 31. The operation of this device is as follows: The tip of the scratching tool 29 moves opposite a polished surface 32 of the second setting gage 17 and, in the drawing, is shown close above said second setting gage 17 which, the table 8 being in motion, and not being in contact with the scratching tool 29, moves with the table 8. In order to scratch a mark on the setting gage 17 the scratching tool 29 is moved in a short motion along the polished surface 32 by pressing a button 33 and compressing the spring 27. The housing 23 contains a setting apparatus 34 comprising a lens system 35, prisms 36, and a mirror 37. The rays 41 emitted by a lamp 38 are first reflected by a reflector 39 and the polished surface 32 of the setting gage 17 so that the enlarged projection of a scratched marking is directed by a lens system 35, the prisms 36, and the mirror 37 against a transparent viewing glass 42 which is mounted on top of housing 23 by a ring 43. Said transparent viewing glass 42 (Fig. 3) is marked with two reference lines 44 which serve for the exact adjustment of the table 8 to the markings scratched upon the polished area 32. Such a mark, illustrating a division line and projected upon said transparent viewing glass 42, is seen in Fig. 3 at 45. When this mark is in the exact center between the two reference lines 44 the table coincides exactly with the marking of the setting gage.

A photocell 46 arranged in the housing 23 serves for the automatic control of the motion of the compound slide 7, 8. A contactor controller (not shown) is connected to the photocell 46 by conductors 47. The photocell current flowing through the conductor 47 is amplified by an amplifier (not shown). The mirror 37 is provided with slots 48, analogous to the reference lines 44 permitting the light rays 41, to fall upon the photocell 46. These slots 48 are in the path of the light rays corresponding to the projected markings 45. The change in

the angle of incidence thus produced results in the automatic control of the motion of the slide. The drive is stopped when the contactor controller (not shown) operates, whereby the slide motion is braked at the same time. The projected mark releasing the control action can also be a pre-signal, as described later.

Another embodiment of the respective setting gages **12** and **17** is shown in Fig. 4 where several zones are shown lying parallel to one another. The setting gage may for this purpose be constructed either as a prismatic bar **49**, as shown in Figs. 4 and 5, or as a cylindrical bar **50**, the section of which is shown in Fig. 6. The prismatic setting gage is in form of a hexagonal prism provided with six zones **51**, corresponding to the number of the prism faces. The zones of the cylindrical setting gage **50** are arranged at angular distances defined by an angle α. The zone divisions are indicated by the dot-and-dash lines **52**. The example shown is divided into eight of such zones. The respective setting gages **49** and **50** are turnably mounted. Fig. 4 shows a support by way of example. Bearing plates **53** arranged at either side of the setting gage serve as supports. One of these bearing plates **53** is provided with an index ball **54**. The setting gage being adjusted, index ball **54** which is subject to a spring pressure, is pressed into triangular recesses **55** provided on the face of a setting button or knob **56** which is screwed upon a shoulder or projection **57** against a collar **58** by a nut **59** and connected with the setting gage. The marks **45**, corresponding to the initial settings of the workpiece, are arranged in zones according to the use of the tools, as indicated in Fig. 9. The zones are aligned so as to start at the same zero mark at **45'**. The zero marks of the prismatic and the cylindrical setting gages shown in Figs. 5 and 6, respectively, are in a plane at right angles to their axes.

Fig. 7 shows another embodiment of the setting gage. It consists of a flat bar **60**. The zones are arranged on the front area **61**, parallel to one another and designated by I, II, and III, respectively. The zero marks **45'** are on a line vertical to the longitudinal axis of the setting gage. The marks are shown at **45**. The flat bar **60** is provided with recesses **62** associated with said zones. A support **63** is provided with an index ball **64** fitting into said recesses **62**. The flat bar **60** is movable in longitudinal ways **65** so as to be adjustable to each zone. It is also possible to shift the transmitting apparatus and/or setting apparatus instead of the setting gage, in which case the setting gage is stationary.

A focusing microscope **66** provided with lighting equipment (not shown) and mounted in the boring spindle **3** serves to align the center of said boring spindle **3** upon a reference area of the workpiece. A cable **67** leads the current to said lighting equipment (not shown). A reference square **68** provided with a reticule **69** is aligned to the reference edges **70** and **71**, and the mark then brought in coincidence with the reticule (not shown) of the focusing microscope **66**. This operation is shown in Fig. 9. The workpiece **11** is adjusted so as to coincide with the reference area thereof with the reference edges **70** and **71**. The point of intersection of the reference edges **70** and **71** is the reference point of the co-ordinate system. In this initial setting the reference marks are scratched on the two setting gages.

The zones **51** are shown separately from each other and marked with I, II, and III on the setting gages **12** and **17**. The holes **72**, all of which are of the same diameter, are determined by the marks **45** in accordance with the co-ordinates of zone I; the holes **73**, also being of equal diameter, are determined by the marks according to zone II; and finally the holes **74**, also having the same diameters, are determined by the marks according to zone III of the setting gages **12** and **17**. In order to bore the holes **72** to **74** without any jig the intersecting points of the co-ordinates associated with the marks in question are set on the setting gages in sequence. For

this purpose the adjustment drive in its direction is controllable, i. e., it can be switched from a clockwise to an anticlockwise drive. This adjustment can be effected either automatically by the photocell **46** or by hand through the handwheel **22**.

Fig. 10 shows a magnetic setting gage consisting of a band or wire **75** fixed in the supports **76** and **77**. The markings are transmitted to the wire **75** by a transmitter **78**, and are scanned by a receiver **79**. With said receiver a dial indicator **80** is coupled by which the adjustment of the table can be read at any time. The marks received by the receiver **79** are amplified by an amplifier **81**, and actuate a contactor controller (not shown). Transmitter **78** and receiver **79** are designed as in any well-known wire recording apparatus.

It is also possible to combine the magnetic transmission of markings with the above-described one. This is shown in Fig. 11. The magnetizable wire **75'** rests in a semi-cylindrical recess **82**, of, for example, the slide **83**. The scratching tool **29** shown in Fig. 2 scratches the markings into the wire **75'** which are scanned by an optical system, also shown in Fig. 2. This equipment makes it possible to produce a magnetic mark as a pre-signal and a scratched mark as an end signal, as shown diagrammatically in Fig. 12 in which the magnetic setting gage at **75** is given a pre-signal as a magnetic impulse shown by the dash line **84**, while the end signal is scratched-in and indicated by the full line **85**.

Another embodiment of the magnetic transmission of markings is shown diagrammatically in Fig. 13. The marking is in form of a continuous zigzag line **86** between points *a* and *b* on the setting gage **75**. In this connection, *a* indicates the start of the pre-signal, and *b* the end of same; *b* being the end signal.

It is also possible to produce the magnetic transmission of marks by indicating their decreasing and increasing intensities or frequencies, as shown in Fig. 14. The decreasing zigzag line **87** indicates the decreasing intensity or frequency. It controls the slowing-down of the table motion up to its stop, which is effected by the scratched-in end signal **85**. The magnetic and the scratched-in markings are on the same setting gage **75**. However, the setting gauge **75** for the magnetic and that **90** for the scratched-in signs may be arranged separately as shown in Fig. 15 and mounted in common supports **88** and **89**, which are mounted on the machine frame or carriage, respectively. The magnetic markings on the setting gage **75** are analogous to those shown in Figs. 13 or 14. The scratched-in markings **85** are produced on the other setting gage **90** and constitute the end signals. By producing scratched-in markings the magnetizable setting gage can be read, thus eliminating the dial indicator **80**.

The operation of the device is as follows:

The initial settings of the carriage and table, respectively, are effected on the first workpiece to be machined, as shown in Fig. 9. The workpiece having been adjusted the co-ordinate reference point O is transferred as reference markings to the setting gages **12** and **17**. The initial settings, effected in zones, are produced as markings upon the setting gauges **12** and **17**. By this the setting gauges **12** and **17** are in working connection with the machining of the first workpiece. In order to machine the subsequent workpieces of the same series the setting gauges **12**, **17** remain fixed in the machine tool. Both the carriage and the table are set to the reference marks of both setting gages **12**, **17**, and in this position the new workpiece is aligned to the reference edges **70** and **71**. Then markings are bored in zones in accordance with the markings on the setting gages **12**, **17**. The zonal setting at the setting gage is done by turning or by a parallel adjustment, the correct setting being determined by the recesses such as **55** and **62**. Also in the case of magnetic setting gages the initial table setting is done by virtue of magnetic or scratched-in

reference marks. When sufficient width is available a zonal division is possible.

When working with the pre-signal, immaterial whether this has been produced magnetically or is scratched-in, the rapid motion of the adjustment drive is switched off and changed to slow motion. The final setting of the carriage is effected by automatic photocell control. When the final setting is effected by hand followed by a microscopic recheck of the scratched-in sign the slow motion is stopped shortly prior to reaching the final position. The same settings take place when the setting gages are being changed.

While I have illustrated and described a specific embodiment of my invention, it will be understood that this is by way of illustration, and that various changes and modifications may be made in the construction and arrangement of parts within the contemplation of my invention, and under the scope of the following claims.

What I claim is:

1. A machine tool for machining a plurality of work pieces in an identical manner including in combination, a base, a lower carriage mounted to said base and slidable longitudinally in guide ways formed in said base, an upper carriage mounted to said lower carriage and slidable in a transverse guide way formed in the upper surface of said lower carriage, means for mounting a plurality of work pieces to the upper surface of said upper carriage, a first linear setting member mounted to said base and longitudinally adjustable relative thereto, said first setting member being substantially parallel to said longitudinal guide ways, a first marking device mounted to the lower carriage associated with said first setting member, whereby the longitudinal position of said movable lower carriage is determined, a second linear setting member adjustably mounted to said upper carriage disposed substantially parallel to said transverse guide way, a second marking device mounted to the lower carriage and associated with the second setting member, said second marking device including scratching means adapted to incribe a setting mark on a surface of said second linear setting member, said second marking device including setting means whereby the mark inscribed in said second linear setting member is magnified so that adjustment of said upper carriage is obtained and positioning means mounted to said base to adjust the position of said upper and lower carriage relative to said first and second marking members respectively.

2. A machine tool as claimed in claim 1, each of said setting members being formed as a setting gauge provided with a plurality of longitudinal zones arranged parallel to one another, said zones being adapted to have markings produced thereon, each of said zones being associated with one operation of the machine tool, said setting gauges being settable in accordance with the relevant zones.

3. In a machine tool as claimed in claim 1, at least one of said setting members being formed as a many-sided prism turnably mounted about the axis thereof, holding means for said many-sided prism, said holding means having recesses, and means connected with said prism and engaging said recesses of said holding means.

4. A machine tool as claimed in claim 1, at least one of said setting members being formed as a cylinder turnably mounted about the axis thereof, and means associated with said cylinder so as to hold said cylinder in predetermined positions.

5. A machine tool as claimed in claim 1, at least one of said setting members being formed as a flat bar having zones arranged on the area thereof, said flat bar being movable in a direction transverse to said zones so as to be settable to one of said zones, and means for holding said flat bar in any of a plurality of parallel positions.

6. A machine tool as claimed in claim 1 wherein said scratching means includes a scratching tool adapted to scratch said markings in at least one of said setting members.

7. A machine tool as claimed in claim 6 wherein, said scratching tool includes a cylindrical guide bar, a slot in said bar, a rod slidable in said slot, a spring opposing the movement of said rod, a chuck at the lower extremity of said rod, and a diamond mounted in said chuck disposed opposite a polished surface of said second linear setting member.

8. A machine tool as claimed in claim 1, including an optical system associated with at least one of said setting members, said optical system including a light source and a photocell arranged in the path of the light rays emitted by said light source, said photocell being adapted to stop the travel of said setting member by means of the markings thereof which are projected upon said photocell.

9. A machine tool as claimed in claim 1 wherein said machine includes a housing enclosing said second marking device, said housing including an optical system having a photocell, a substantially vertical guide bar arranged in said housing, a scratching tool connected with said vertical guide bar, said scratching tool having a point arranged in the plane of one of said setting members, said point being in rest position out of contact with the same, and means for moving said point so as to make contact with said setting member.

10. A machine tool as claimed in claim 1, at least one of said setting members being magnetizable so as to be marked with magnetic marks, a transmitter associated with said setting member for transmitting said magnetic marks, and a receiver associated with said setting members for scanning said magnetic marks.

11. A machine tool as claimed in claim 1, wherein said first setting member is magnetizable so as to be adapted to receive magnetic impulses from the mark etched by said scratching means corresponding to a presignal, optical second markings applied to said second setting member, and a photocell associated with said second setting member, said photocell being responsive to said second markings.

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