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Galbarini et al.

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[45] **July 31, 1973**

[54] **ANGULARLY ADJUSTABLE ATTACHMENT FOR A MACHINE TOOL HEADSTOCK**

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[22] Filed: **Jan. 31, 1972**

[21] Appl. No.: **221,964**

[30] **Foreign Application Priority Data**

Mar. 31, 1971 Italy 68076 A/71

[52] **U.S. Cl.** ..... **90/17**, 90/11 A

[51] **Int. Cl.** **B23c 1/12**

[58] **Field of Search** ..... 90/11 A, 17

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Primary Examiner—Francis S. Husar

Attorney—Richard C. Sughrue, Robert V. Sloan et al.

[57] **ABSTRACT**

A machine tool having a device on the end of the headstock for the automatic attachment of various fittings which are used on the machine from time to time. The device comprises two relatively rotatable members, a first one attached securely to the headstock and a second one adapted for carrying the fittings. A motor is provided on the first member for effecting rotational movement of the second member so that a fitting on the device can take up any desired angular position with respect to the headstock. The machine is provided with a deposit or store arrangement having a plurality of frames for storing the fittings in predetermined orientations such that the machine can deposit and take up fittings automatically. To this end each frame is fitted with automatic sinewing devices which sinew on the fittings when the headstock of the machine is correctly aligned with the fitting.

10 Claims, 14 Drawing Figures

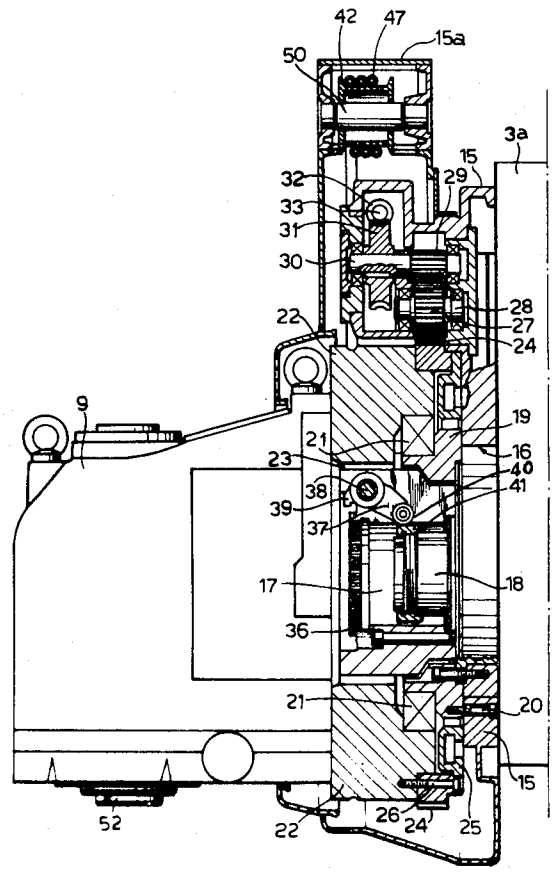
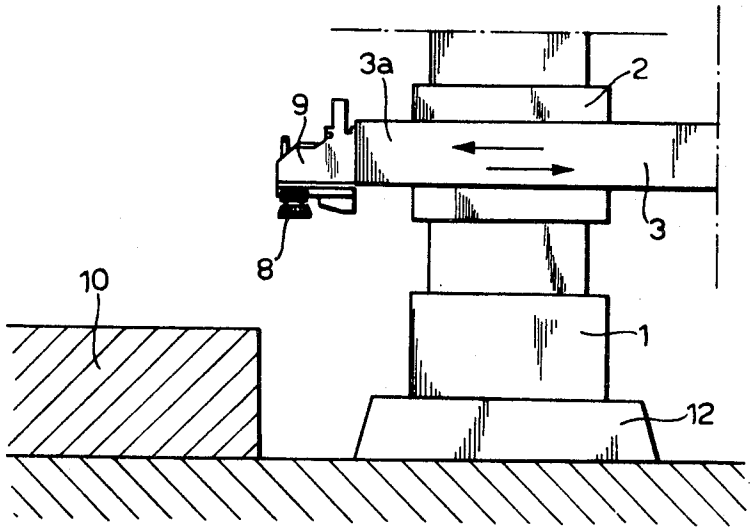


Fig. 1



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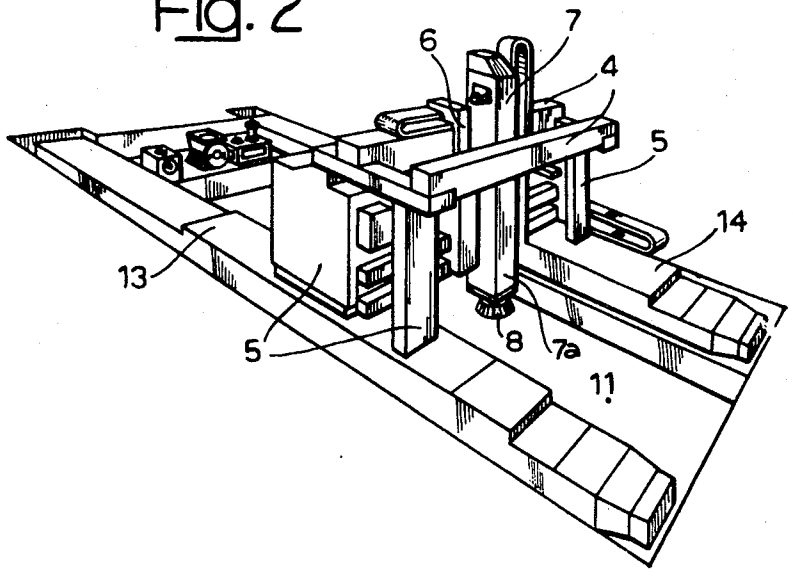

Fig. 3

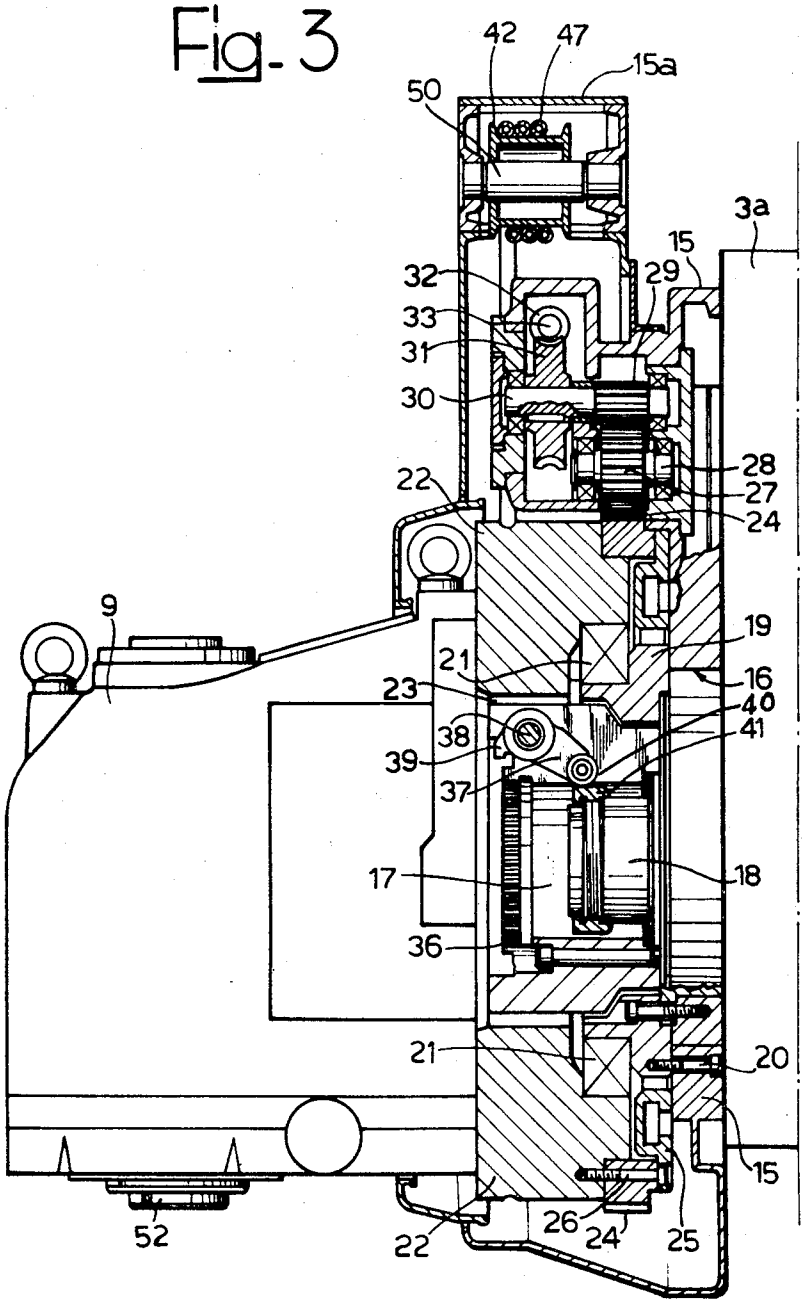
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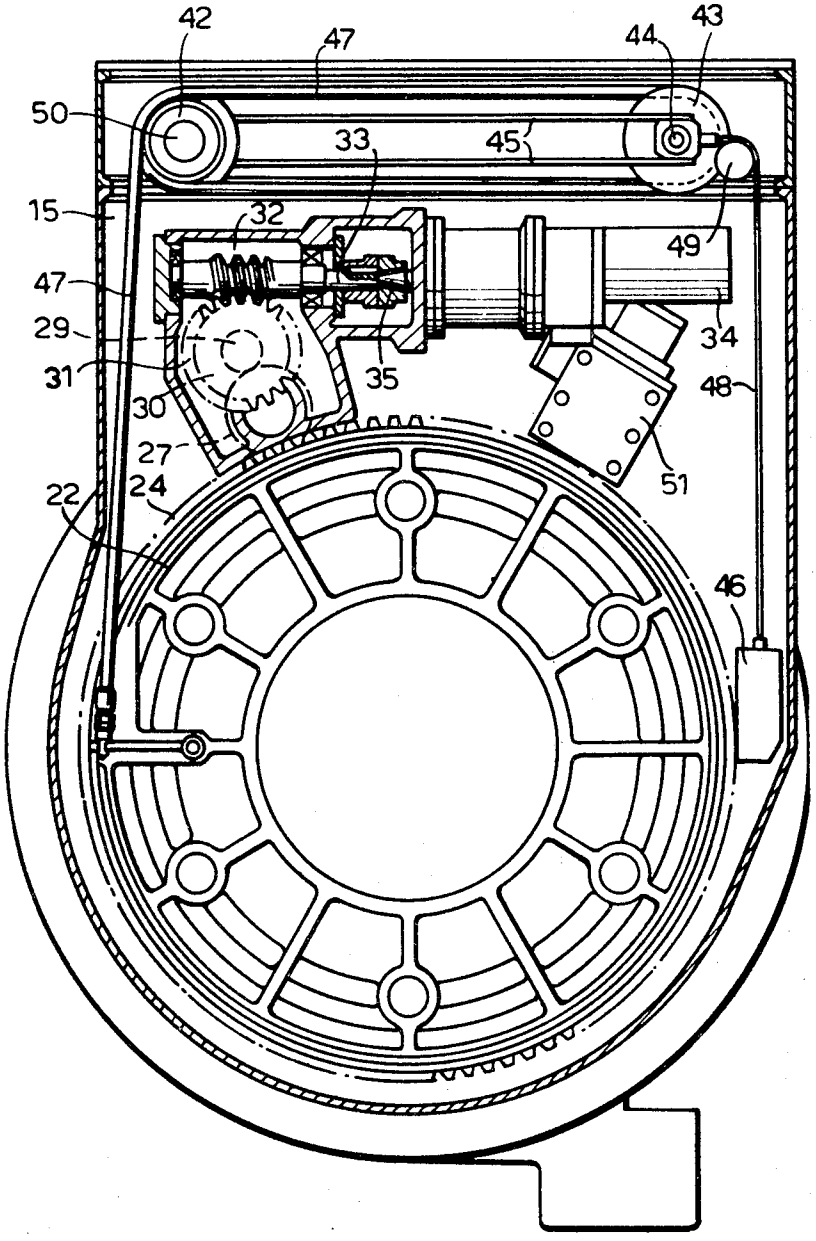
Fig. 4



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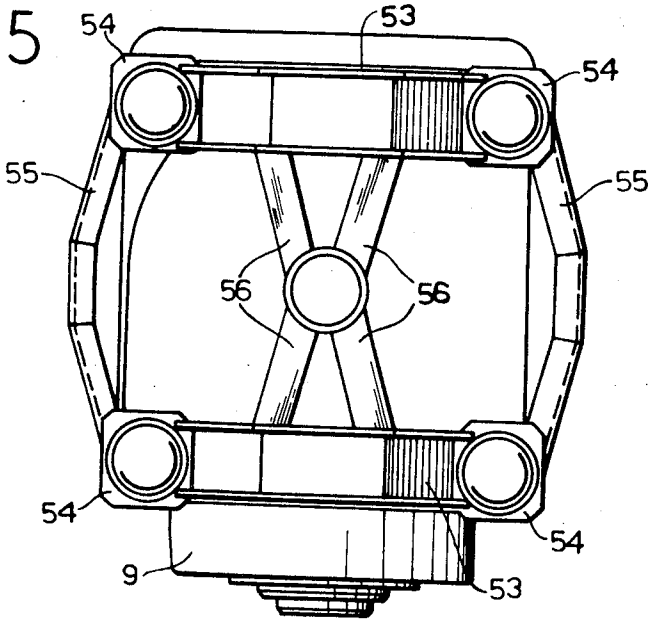

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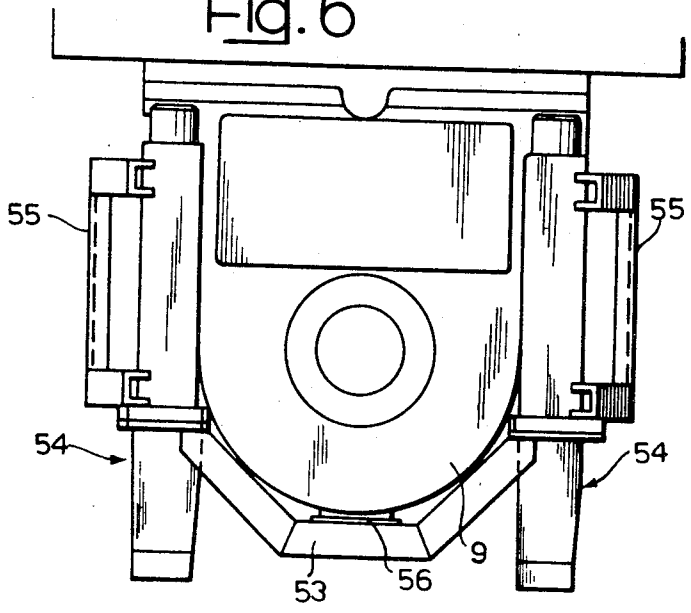


Fig. 7

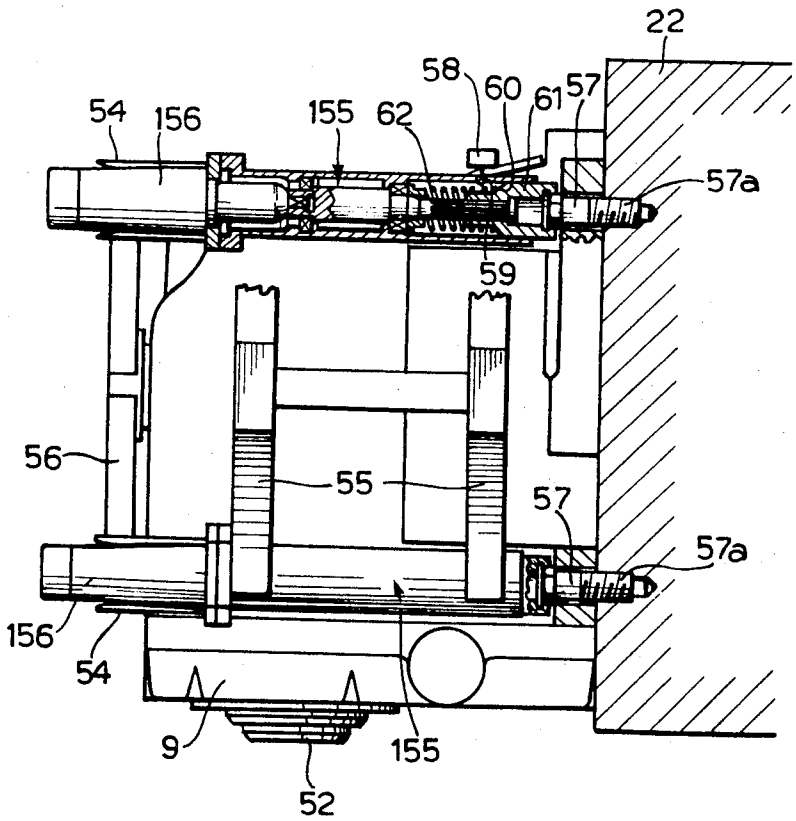
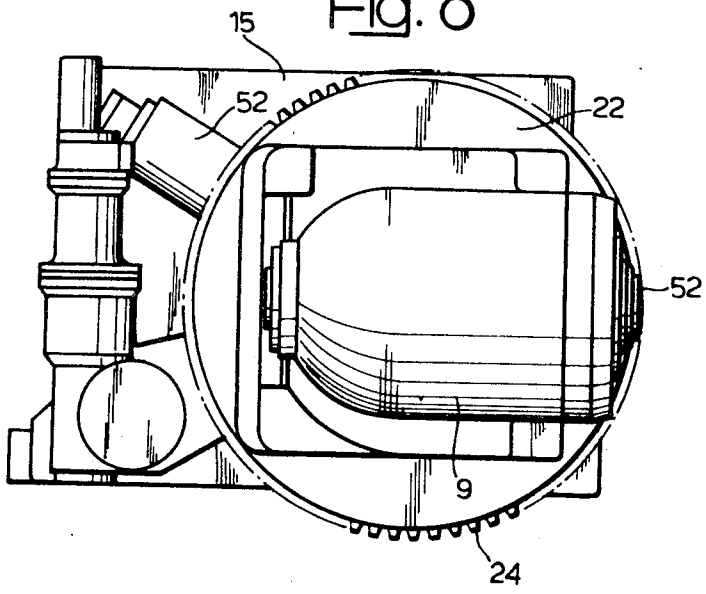


Fig. 8



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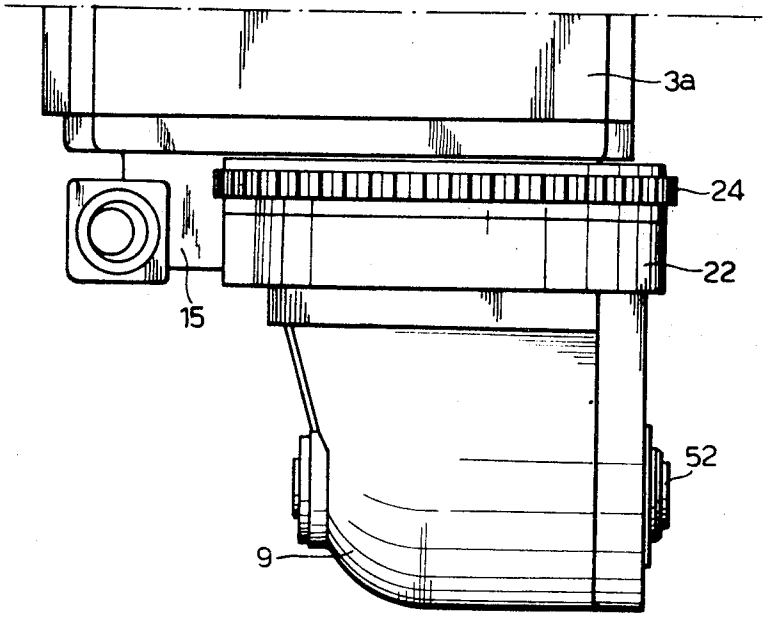
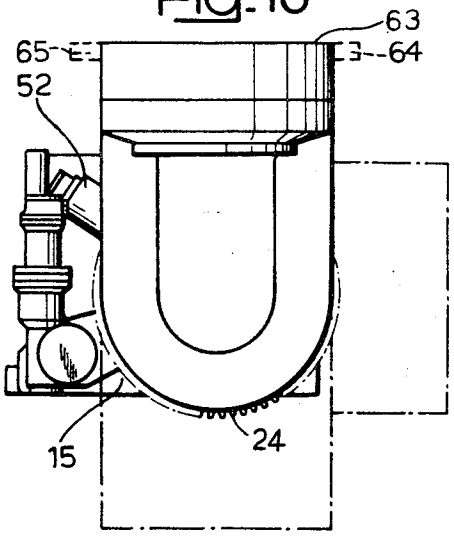


Fig. 10



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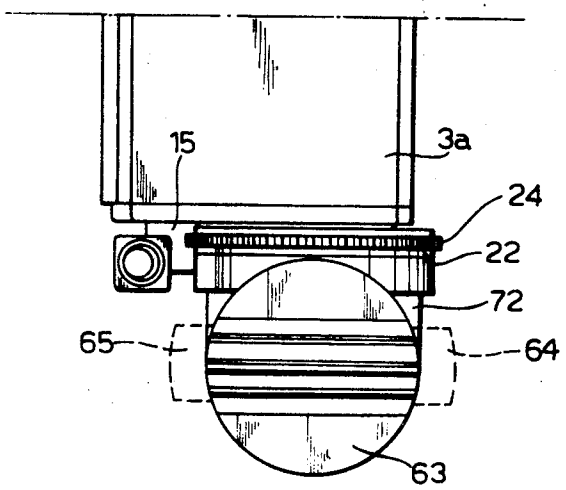

Fig. 12

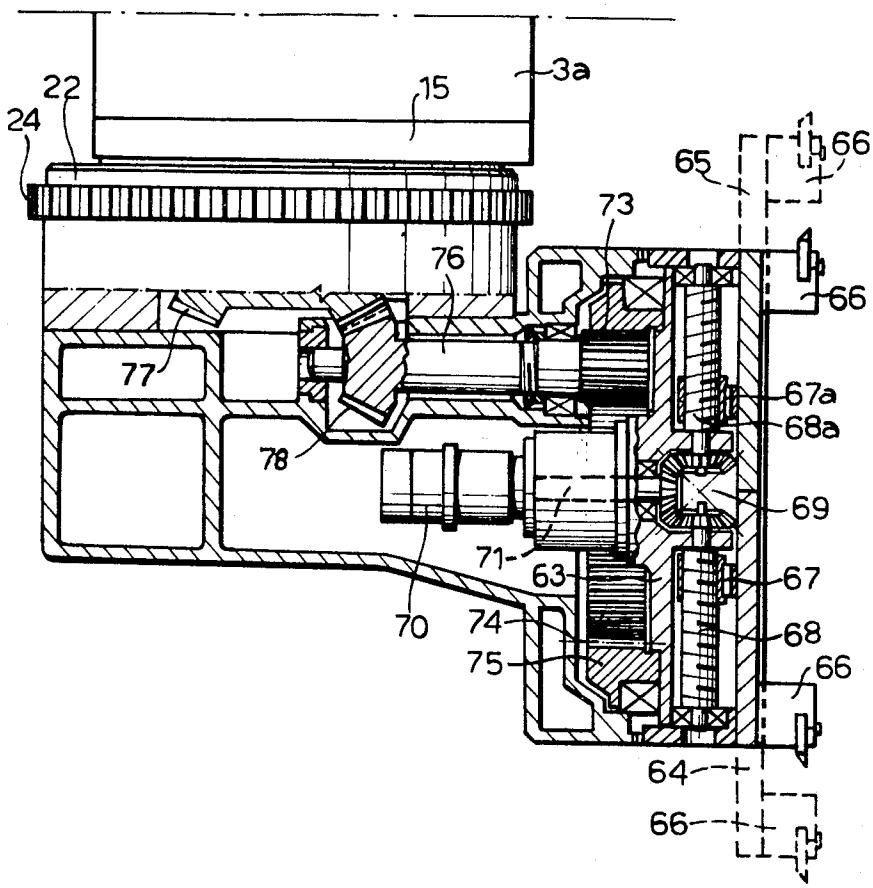
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Fig. 13

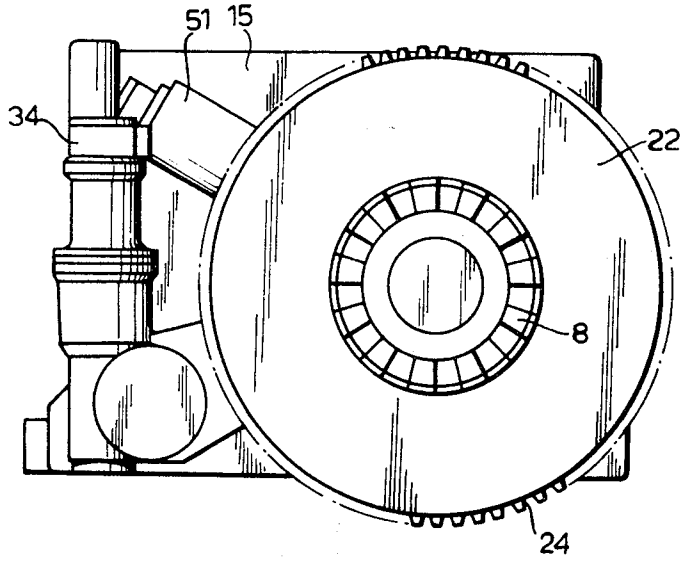
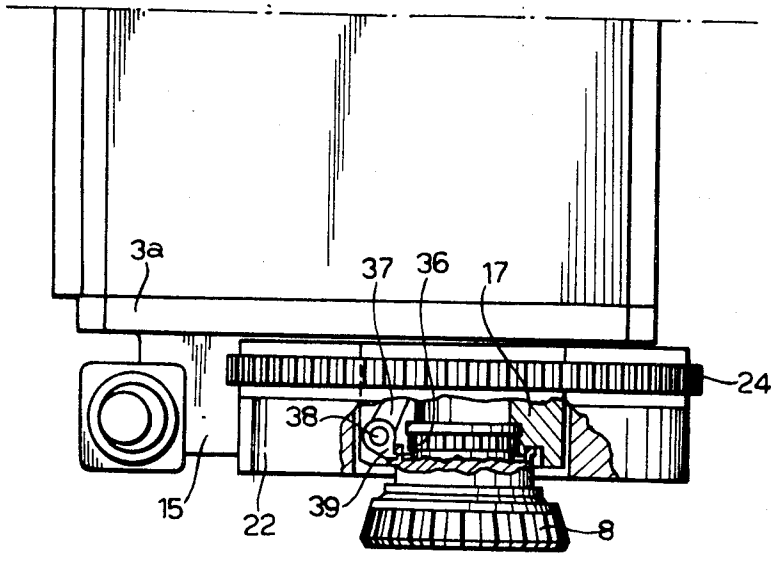


Fig. 14



ANGULARLY ADJUSTABLE ATTACHMENT FOR A MACHINE TOOL HEADSTOCK

BACKGROUND OF THE INVENTION

The present invention relates to machine tools, and particularly to a device for machine tools by means of which automatic attachment of various types of fittings to the headstock of a machine tool such as a milling or a milling-boring machine can be effected. In addition the device allows the angular orientation of the fitting to be changed with respect to the headstock to which the fitting is attached.

Milling-boring machines, or more generally, milling machines fitted with a mobile headstock such as, for example, the portal type or trestle type milling machines, are capable of executing a number of different operations on one workpiece, provided they are equipped with a suitable range of fittings. Such fittings make possible the use of tools which, owing to their adjustment angle or type, could not otherwise be borne by the operating spindle of the machine.

In general such fittings are attached to the mobile headstock of the machine in order to be able to make use of the feeding movement of the headstock, and the attachment is carried out manually. This is a disadvantage because of the considerable loss of operating time necessary in taking up a fitting from the place where it is stored, carrying it to and positioning it on the machine, and finally accurately attaching it to the machine. The attachment must be effected with particular care because of the high precision of operation normally required from such machines.

Moreover, since the fittings for a large machine tool can be of considerable size, and since they sometimes include adaptor pieces for the transmission of drive through the fitting, the setting up of which adaptor pieces requires a certain time, the manual mounting of such fittings on the headstock of a machine tool is not always easy.

It is an object of this invention to provide a device for the coupling and attachment of different fittings to the headstock of a milling machine, which enables the coupling and attachment to be carried out automatically irrespective of the type of fitting to be attached.

It is another object of this invention to provide a machine tool where the various fittings are stored in a convenient position from whence they may be taken up, if desired, directly by the machine to which they are to be attached.

It is a further object of the invention to provide a device in which the various operations involved in depositing the previously used fitting and in taking up the next fitting including the maneuvering of the clamping members on the headstock, can all be achieved through programming or by digital control.

It is a further object of the invention to provide a device for the attachment of fittings to the headstock of a milling machine, which enables adjustments of the angular orientation of the fitting with respect of the headstock to which it is attached to be obtained.

It is yet a further object of this invention to provide a device in which the fitting can be placed in the most suitable angular position for any particular operation on the workpiece while the fitting and the tool or tools it carries nevertheless rigidly attached and accurately moved by the headstock for precise operation on the workpiece.

It is yet another object of the invention to provide a device in which the adjustment of angular orientation of the fitting can be carried out automatically by programming or digital control, thereby eliminating the need for any manual operation.

SUMMARY OF THE INVENTION

According to the present invention there is provided a device for the automatic attachment of fittings of various types to the headstock of a milling or milling-boring machine, comprising a first member rigidly attached to the front end of the headstock of the machine, a second member adapted to support any selected fitting and rotatably mounted with respect to the first member, means on the said first member for effecting angular displacement of the second member with respect to the first and means for attaching the selected fitting to the second member, both the first and second members being provided with respective coaxial openings to allow the passage of the operating spindle of the machine and a transmission device for coupling drive from the said spindle to the tool or tools borne by the said fittings.

In accordance with another aspect of the invention, a machine tool such as a milling machine includes a store for storage of the various fittings, which store contains a number of housings formed by polygonal frames each adapted for supporting a single fitting, the frames being provided with automatic screwing devices of a type known per se, positioned in alignement with means for screwing the respective fitting to the said second member of the attachment device on the headstock of the machine, means being provided for automatic operation of the said screwing devices when the said second member is in correct alignment in front of one of the said frames to connect or disconnect the fitting associated with that frame.

Various embodiments of the invention will now be described in greater detail, by way of example, with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic side view of a milling machine of the upright type having a fitting mounted on the headstock by means of a device constructed as an embodiment of this invention;

FIG. 2 is a diagrammatic perspective view of a portal type milling-boring machine the headstock of which is suitable for being equipped with an attachment device constructed as an embodiment of the invention;

FIG. 3 is a diagrammatic cross section of the embodiment of the invention illustrated in FIG. 1;

FIG. 4 is a diagrammatic front view, partially in section, of the device illustrated in FIG. 3;

FIG. 5 is a diagrammatic rear view of a frame for the deposit and storage of fittings which are not in use, showing a fitting in position on the frame;

FIG. 6 is a view of the under part of the frame illustrated in FIG. 5 showing a fitting in position;

FIG. 7 is a diagrammatic longitudinal vertical section of the frame illustrated in FIGS. 5 and 6, illustrating the positioning of the automatic screwing devices for the attachment of the fittings to the attachment device on the headstock of the machine;

FIG. 8 is a front view of one type of fitting suitable for use with the embodiment illustrated in FIG. 3;

FIG. 9 is a diagrammatic side view of the fitting shown in FIG. 8;

FIG. 10 is a diagrammatic front view of a second type of fitting suitable for use with embodiments of the invention, and having an adjustable facing platform, mounted on the device for attachment to the headstock of the machine;

FIG. 11 is a side view of the fitting illustrated in FIG. 10;

FIG. 12 is a sectional diagrammatic view of the fitting illustrated in FIGS. 10 and 11;

FIG. 13 is a diagrammatic front view of another embodiment of the invention illustrating the possibility of using tools directly linked to the spindle of the machine in spite of the presence of the embodiment; and

FIG. 14 is a diagrammatic sectional view illustrating the direct connection of a tool onto the spindle of the machine which is fitted with an embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2 there are shown known types of milling machines: in FIG. 1 there is shown a milling machine 1 of the upright type on which there is a slide 2 to which is linked a horizontal headstock 3. In FIG. 2 there is shown a portal type milling machine 4, mounted on lateral uprights 5 and including a mobile carriage 6, on a portal 4, A headstock 7 mounted for vertical movement is supported by the mobile carriage 6.

The end 3*a* of the headstock 3 of FIG. 1, and the end 7*a* of the headstock of 7 of FIG. 2 are adapted to be linked directly to the tools 8 or to fittings of various types such as that indicated by the reference numeral 9 in FIG. 1. The workpieces are mounted on a bench 10 in the machine illustrated in FIG. 1 and a bench 11 in the machine illustrated in FIG. 2. The upright 1 of the machine illustrated in FIG. 1 can slide parallel to the bench 10 on a base 12 while the uprights 5 of the machine illustrated in FIG. 2 can slide horizontally upon the bases 13 and 14 parallel to the bench 11.

Referring now to FIG. 3 a device for automatically attaching a fitting, such as the fitting 9 illustrated in FIG. 1, to the front part 3*a* of the headstock of the milling machine (or 7*a* in the case of the machine of FIG. 2), comprises a first member, in the form of a support plate 15 which is rigidly fixed to the front wall at the end 3 of the headstock 3 of the milling machine. The member 15 is substantially disc shaped and has a certain opening 16 through which extends the main operating spindle 17 of the milling machine. The spindle 17, as in known machines, is coaxial with a second spindle 18 which is used for boring and therefore mounted for axial movement.

In the embodiment illustrated in FIG. 3, the plate-like member 15 has a ring member 19, rigidly attached to it by means of screws 20; the ring member 19 provides a circular support guide for a second member 22 which will hereinafter be referred to as the attachment plate 22, which is mounted, by means of radial bearings 21, on the first member 15.

The second member, or attachment plate 22 is also provided with an opening 23 which is coaxial with the opening 16 of the support plate 15 to allow free access to the main spindle 17.

On the periphery of the attachment plate 22 there is formed a ring gear 24 which, as shown in FIG. 3, is formed on the edge of an annular member 25 which is attached, for example, by means of screws 26 to the attachment plate 22. This ring gear 24 engages with a gear wheel 27 whose shaft 28 is supported by the support plate 15 rigidly mounted on the front 3*a* of the headstock 3 of the milling machine. The gear wheel 27 engages with a pinion 29 carried on a shaft 30 which is also supported by the support plate 15. On the shaft 30 there is keyed a worm wheel 31 which engages with a worm gear 32 on a shaft 33 which is driven by a motor 34 (see FIG. 4) via a transmission coupling indicated at 35. Both the motor 34 and shaft 33 are supported on members which are rigidly attached to the support plate 15.

The fitting 9 is supported by the attachment plate 22 by a known type of screwing means which is not visible in FIG. 3. To the main spindle 17 is attached an automatic coupling mechanism for the drive to the tool or tools borne on the fitting 9. At the end of the coupling mechanism there is provided an arrangement of teeth 36, shaped to engage with a corresponding arrangement of teeth (not illustrated), on the input shaft of the fitting 9. The tooth arrangement 36 may alternatively be mounted on an adaptor (not shown) attached to the spindle 17.

With reference to the structure illustrated in FIG. 3, the opening 23 of the attachment plate 22 is sufficiently wide to accommodate a mechanism for coupling the input shaft of a fitting 9 to the shaft 17 or 18. The mechanism is arranged so that it can couple a tool directly to the shaft 17 in the case of operations where fittings such as the fitting 9 are not necessary. Such coupling mechanisms, which do not form part of the present invention, are shown in diagrammatic form by a lever 37 pivoted at 38 and provided with a hooking device 39 and a small roller 40 running on a cam 41 borne by the boring spindle 18. Mechanisms such as this, which form the subject of another patent by the same applicant, permit the locking of a tool by means of the hooking device 39 by means of an axial movement of the boring spindle 18 which moves the cam 41 and causes the lever 37 to rotate about its pivot 38.

Again, with reference to FIGS. 3 and 4, it will be seen that the support plate 15 has a projection 15*a* on which are mounted two pulleys 42 and 43; the former is pivoted at 50, and the latter, pivoted at 44, is mounted on rails 45 and biased by a counterweight 46 to which is attached the end of a cable 48. Around the pulleys 42 and 43 is wound a flexible tube 47 which enables lubricating liquid to reach the fitting 9, in a known manner.

With particular reference to FIG. 4, it will be seen that the device is completed by a damper 51 which operates on the periphery of the attachment plate 22 to lock the plate 22 in any desired angular position to which it is moved in relation to the support plate 15. The rotary movement of main spindle 17, in the specific case of the fitting 9, illustrated, is transferred to the delivery spindle 52 of this fitting 9, whose axis is at 90° with respect of the axis of the main spindle 17 of the machine.

OPERATION

The device described above operates as follows:

When the fitting 9 is assembled upon the attachment plate 22 and the input shaft of the fitting 9 is coupled,

by means of the toothing 36 of the coupling mechanism, to the spindle 17, it is possible to carry out the desired milling operations with the output spindle 52 of the fitting 9 in various angular positions about the axis of the spindle 17. In fact, by operating the motor 34, which may be a stepping motor, for a predetermined period, the gear train comprising the worm screw 32, the gears 31, 29 and 27, and the ring gear 24, effects rotation of the assembly formed by the attachment plate 22 and the fitting 9 by any desired angle with respect to the support plate 15 which is fixed to the headstock 3*a* of the machine.

On the other hand, if the fitting 9 is not attached to the attachment plate 22, the main spindle 17, and also the auxiliary spindle can be directly joined to the tool without the attachment device being removed from the headstock of the machine. This situation is diagrammatically illustrated in FIGS. 13 and 14 in which a cutter 8 is shown joined to the spindle 17 by the automatic coupling means described above while at the same time the headstock 3*a* of the machine carries a device for automatically attaching the fittings of the type which has been described above.

The present invention lends itself to the adaption of a machine tool possibly programmed with digital control to have automatic attachment of the fittings to the headstock of the machine tool with the help of a deposit or store for receiving and storing the said fittings.

With reference to FIGS. 5, 6 and 7, one embodiment of a suitable deposit or store is shown: this comprises a polygonal frame made of cross pieces 53 and longitudinal beams 54 connected by transverse struts 55 on the sides and transverse struts 56 on the bottom. A fitting 9 is shown supported by this frame; the frame is located near to the machine so that it can be reached by the end of the headstock by means of the normal displacement movements of the headstock.

The beams 54, in the frame shown in FIG. 7, house automatic screwing devices generally indicated 155 in FIG. 7. The devices 155 operated by respective motors 156. The automatic screwing-on devices 155 and consequently the beams 54 which house them, in the embodiment illustrated, are aligned with the screw devices 57 on the fitting 9 which serve to fix the fitting to the attachment plate 22 of the attachment device on the headstock of the machine. These screw devices comprise a microswitch 58 the trigger 59 of which is engaged by a cam 60 borne on a sliding component 61 restrained by a spring 62. The screw devices operate as follows:

Supposing a fitting, such as the fitting 9, for example, is resting on a frame and it is desired to attach the fitting 9, on to the component 22 of the automatic attachment device on the headstock 3*a* of the machine: The headstock is driven, until it is adjacent the frame in which the fitting 9 is housed; this can be effected, for example, by means of a programming device (not shown). The headstock is then driven to approach the fixing device 57 frontally until they are inserted into the corresponding holes 57*a* of the attachment plate 22. This operation is facilitated by suitable centering means of known type. As soon as the fixing devices 57 reach the exact position in relation to the attachment plate 22, a subsequent movement of the headstock 3*a* of the machine is made to displace a component 61 by means of the screws 57, against the action of a spring 62. Under this displacement a cam profile 60 moves to act upon a trigger 59 of a microswitch 58 operation of which switches on the motors 56. The automatic screwing devices 155 are thus actuated, thereby screwing the members 57 into their respective seatings on the attachment plate 22. Once the attachment is completed, the motors 56 stop due to a disengagement of the cam 60 by the trigger 59. The headstock can then be moved away, with the fitting 9 now firmly fixed to the attachment plate 22. The fitting 9 is removed from its housing by this movement and, together with the headstock of the machine, moves to the work area. The screw devices 55 are provided with safety means (not illustrated) which switch to prevent continuation of the cycle of taking up the fitting if one or more of the fixing screws is not properly screwed on. In the case of replacement of one fitting by another, the programming device will obviously include a step in which the fitting previously in use is deposited upon its respective frame before the headstock moves automatically in front of the frame holding the next fitting to be taken up.

The fittings can be of various types. By way of example there is shown, in FIGS. 8 and 9, a fitting very commonly in use, in which the output spindle 52 is at an angle of 90° in relation to the axial direction of the main spindle of the machine to which it is to be attached. This corresponds to the fitting marked 9 in FIGS. 1 to 7. Also by way of example, FIGS. 10, 11 and 12 illustrated another fitting which is very frequently used; this consists of a facing platform 63 provided with removable parts 64 and 65 which carry tools 66. The removable parts 64, 65 slide upon rails on the platform 63 and are moved along these rails by respective nuts 67 and 67*a* which in turn, are moved by screws 68 and 68*a*. The screws 68 and 68*a* are driven by a bevel opinion transmission 69 which is driven by a motor 70 via a shaft 71; the motor 70 may be, for example, a stepping motor. The whole assembly described above is rotatably mounted on a fixed platform 72 by means of a pinion 73 which meshes with a ring gear 74 which is integral with the inner structure 75 of the platform 63. The pinion 73 is driven by the main spindle of the milling machine through the shaft 76 and the bevel gears 77 and 78.

Naturally the invention can undergo numerous variants of a constructional nature which, while the inventive idea above set out remains unchanged, nevertheless all come within the scope of the invention hereinafter claimed.

What is claimed is:

1. A device for the automatic attachment of one of a plurality of fittings, each having an input shaft and carrying at least one tool, to a machine of the milling or milling-boring type, having a headstock and an operating spindle comprising:

a first member rigidly attached to the front end of said headstock,

a second member adapted to support any selected one of said fittings, said second member being rotatably mounted on said first member,

means on said first member for rotating said second member to any desired position with respect to said first member,

means on said second member for attaching said selected fitting to said second member and said second member having means defining respective coaxial openings whereby said operating spindle can pass through said first and second members, and

means for coupling said spindle to said input shaft of said fitting whereby drive is transmitted from and spindle to said tool on said fitting.

2. The device of claim 1 wherein said means for rotating said second member with respect to said first member comprises,

a motor mounted on said first member,

a ring gear mounted on the periphery of said second member, and

a gear train interconnecting said motor and said ring gear.

3. The device of claim 1 wherein said second member is rotatably mounted on said first member by means of a ring guide, said ring guide providing rigidity and precision of movement to said second member.

4. The device of claim 1 wherein said second member is rotatably mounted on said first member such that it can rotate through 360° with respect to said first member.

5. The device of claim 1 wherein said second member has means for locking it in any desired angular position with respect to said first member.

6. The device of claim 1 wherein said second member is provided with centering means for exactly positioning said selected fitting to be attached before said attaching means are operated to attach said fitting to said second member.

7. The device of claim 1 wherein said means for attaching said selected fitting to said second member comprise screw means.

8. The device of claim 1 wherein said means for coupling said spindle of said machine to said input shaft of said fitting comprises an arrangement of teeth carried on the end of said spindle,

an adaptor on said spindle, and

an arrangement of teeth on the end of said input shaft of said fitting, said tooth arrangements meshing together to transmit said drive.

9. A machine tool having the device of claim 7, and further comprising,

a store for said plurality of fittings, said store having a plurality of frames adapted for receiving and storing each said fitting,

automatic screwing devices, known per se, on said frames, said automatic screwing devices being disposed about said frame in line with said screwing means on said second member, and

means for operating said automatic screwing devices when said second member is correctly aligned with respect to said frame to deposit or lift out a fitting.

10. The machine tool of claim 9 wherein said automatic screwing devices are provided with safety means which operate to prevent the completion of a lifting cycle if one or more of said screw means one not adequately screwed in.

* * * * *