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(54) **Fluid-balanced shock absorber of the carding brush, in a machine for carding shoe uppers**

(57) A shock-absorbing device for the carding tool (U) of a carding machine for shoe uppers in which the tool-holding assembly is mounted at the end of a mobile operating arm (B) according to multiple coordinated axes and is moved along a predetermined machining path controlled by a pre-programmed processing unit according to the features of the shoe being machined and in which the tool-holding assembly has a further degree of freedom which allows the tool (U) to be moved near to/away from the working surface in order to adjust its operating pressure, the movement of the tool-holding assembly, according to this further degree of freedom, being controlled by a double-acting, pneumatic cylinder-piston unit (P), in which the differential pressure on the piston is adjusted so as to compensate the load of the tool-holding assembly, such compensation can also be varied during machining, keeping the tool operating pressure constant.

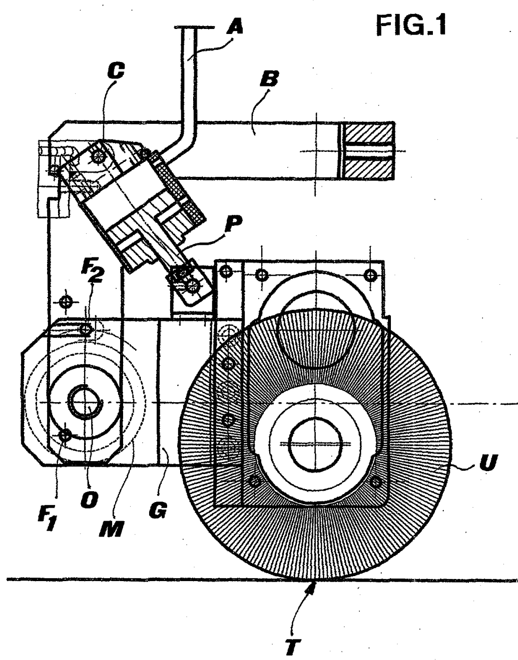

FIG.1

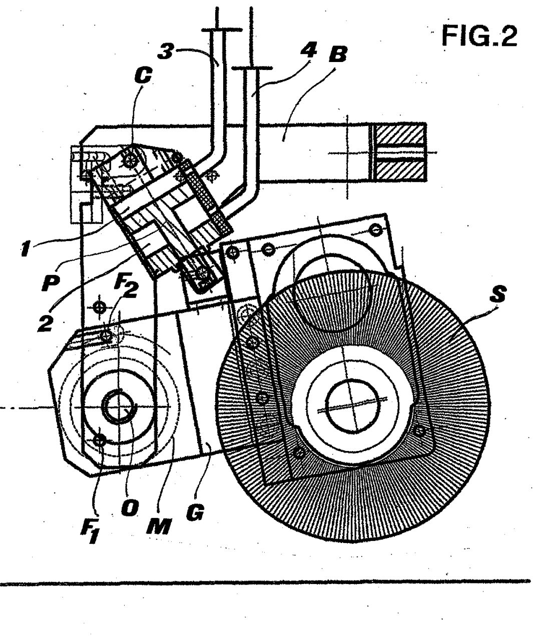

FIG.2

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Description

[0001] This invention relates to a dynamic fluid-balancing device, preferably to a pneumatic one, of the carding brush in a carding machine for shoe uppers.

[0002] In the shoe manufacturing process, carding of the shoe bottom is an important step performed after the shoe upper has been mounted on the last and fixed to the insole. This process on the one hand allows in fact to smooth the junction step-line where the shoe upper meets the insole, on the other hand enables the even roughening of the surface of the shoe upper; both these operations are necessary so that the subsequent cementing of the sole may be carried out in the best and most effective way.

[0003] Automatic carding machines have been on the market for some time, in which a multiple-axis arm controls a carding tool for performing a predetermined machining path on a last-mounted shoe, locked onto suitable clamping devices of the same machine. For each individual shoe model needing machining, the machining path to be followed and the different tilting positions that the tool needs to assume during the process are previously stored into a processing unit on board the machine. Said path will later be modified by the same processing unit, by means of suitable algorithms, according to the specific shoe number being machined from time to time.

[0004] This invention aims at improving the end portion of the tool-holding arm of the carding machine briefly described above, namely of the tool-supporting device that adjusts the operating pressure of the tool on the shoe. As above said, the position and tilt of the operating tool are in fact precision-adjusted by the multiaxial tool-holding arm controlled by the processing unit. This generally allows the three coordinates x, y, z of the tool operating point to be determined point by point. Very often, the two angles of inclination to the two axes orthogonal to the shoe and passing through the operating point are determined in the same way, too.

[0005] However, in order to achieve an continuous and even machining during tool movement, irrespectively of any vibration of the tool itself, the tool position as determined above is not maintained rigidly, but allows a certain degree of elasticity. This gives the tool a further, limited degree of free movement around the theoretical operating point determined by the control system. Said degree of freedom is controlled by a shock-absorbing device comprising an air-operated cylinder-piston unit that acts against the action of spring means. This solution achieves the aim of dampening the tool micro-motions resulting from vibrations or occasional unevenness of the shoe being machined, preventing the tool from jolting and ensuring an even carding of the shoe upper, while at the same time maintaining the tool operating pressure on the shoe within a fairly limited range.

[0006] A better understanding of the known shock-absorbing device described above can be gained by looking at fig. 1 here enclosed, which represents a particular embodiment of the device itself. The drawing illustrates the end part B of the operating arm where the tool-holding assembly G is hinged on in O, said assembly G including tool U and its driving motor. The carding tool U is normally made of a wire wheel brush S working on the shoe at its tangent point T. As already mentioned above, group G can swing around hinge O within a limited rotation angle, the amplitude of such angle being defined by suitable mechanical end-stops. The rotation of the tool-holding assembly G is controlled by the piston P of an air-operated cylinder-piston unit, hinged on arm B in C, whose action is counteracted by spring means M. In the embodiment shown, the spring means M are made of a coil spring concentric to hinge O, whose ends are fixed respectively to arm B in F1, and to the tool-holding assembly G in F2. Operating piston P, by feeding compressed air into pipe A, causes tool U to lower down towards the piece to be machined, while the spring means M act in the opposite direction, i.e. they tend to keep tool U in a raised position in respect of its operating position.

[0007] However, the shock-absorbing device described above is not free from drawbacks. A first limitation of such device consists in the fact that it is not possible to use it to perform a satisfactory carding of fine ladies' shoes, i.e. shoes in which the shoe upper is of a very limited thickness and of an extremely delicate texture. The pressure of tool U on the shoe being machined can indeed be adjusted, as said, by modifying the actuating pressure of pneumatic piston P; such pressure, however, cannot fall below a minimum value required to guarantee tool stability, and such minimum pressure may still be too high to allow the precise machining of fine footwear such as the one described above. This results in this type of footwear often still being hand-carded, which causes higher manufacturing costs.

[0008] A second drawback comes from the fact that it is not possible to constantly and satisfactorily adjust the dampening function of the device and the operating pressure of the tool according to the increased wear of brush S. It is common knowledge, in fact, that brush S must be ground at regular intervals in order to maintain its abrasive power. The grinding operation obviously implies a progressive reduction of the brush diameter and consequently of its weight, therefore of the total weight of the tool-holding assembly G on which the counteracting force of the spring means M is set, too. The modification of such setting according to brush wear being inconvenient in practice, the spring means M are generally best set at a specific brush condition (for example when the brush is new or half-worn). This means sacrificing a well-balanced ratio between the spring means counteracting force and the thrust pressure of piston P in different conditions of wear of the brush. When the elastic counteracting force of the spring means is insufficient, pressure on piston P should obviously be reduced accordingly; this however is not always feasible due to the reasons mentioned earlier. On the contrary, when the counteracting force of the spring means M is too high, pressure in cylinder P must be necessarily increased, which causes an undesirably high operating pressure.

[0009] In practice, the operative always acts so as to keep the pressure within safe limits, i.e. preventing the tool from working at an excessively low operating pressure and so performing an insufficient or uneven carding. However, this implies that the tool often works at an unduly high pressure, reducing on the one hand the working time between two successive grinding operations and, ultimately, the brush service life and, on the other hand, spoiling or weakening excessively the shoe upper due to excessively heavy carding.

[0010] The object of the present invention is hence to offer a shock-absorbing device for the tool of a carding machine for shoe uppers which is free from the drawbacks mentioned above, i.e. which provides an excellent balance between the thrust pressure and the counteracting force applied to the tool, so allowing a precise carding of extremely delicate footwear, too, and, at the same time, guaranteeing a longer tool service life.

[0011] According to the present invention, such object is achieved by means of a shock-absorbing device for the carding tool of a carding machine for shoe uppers, of the type in which the tool-holding assembly is mounted at the end of a mobile operating arm according to multiple coordinated axes and is moved along a predetermined machining path controlled by a pre-programmed processing unit according to the features of the shoe being machined and in which the tool-holding assembly has a further degree of freedom which allows the tool to be moved near to/away from the working surface in order to adjust its operating pressure, the movement of the tool-holding assembly, according to this further degree of freedom being controlled by a dynamic fluid cylinder-piston unit, characterised in that such dynamic fluid cylinder-piston unit is a double-acting one.

[0012] Further features of the shock-absorbing device for the tool of a carding machine according to the present invention, will become apparent from the following detailed description of a preferred embodiment of the tool itself, taken in conjunction with the accompanying drawings wherein:

fig. 1 is a side view of a shock-absorbing device for the tool of a carding machine according to the known art; and

fig. 2 is a side view of a shock-absorbing device according to the present invention.

[0013] The shock-absorbing device for the carding tool of a carding machine for shoe uppers, according to the present invention, is characterised by the same general construction of the known devices.

[0014] In fig. 2 the end portion of the tool-holding arm B can be seen, on which the tool-holding assembly G is hinged in O, which assembly comprises in turn brush S, its supporting block, and the driving motor of said brush. Here, too, the limited movement of the tool-holding assembly G, according to the additional rotational degree of freedom around hinge O, is controlled by the piston P of a dynamically fluid operated (and preferably air-operated) cylinder-piston unit hinged to arm B in C. According to the main feature of the invention, the cylinder-piston unit controlling piston P, unlike what happens in the known technology, is a double-acting unit comprising two chambers 1 and 2, respectively upstream and downstream the piston connected by pipes 3 and 4 to two different sources of compressed air, so that the pressure inside said chambers can be adjusted at will and independently.

[0015] In particular, during working, pressure inside the two chambers 1 and 2 is adjusted so that the differential pressure acting on piston P has such a direction and intensity to compensate the weight of the tool-holding assembly G and to keep the desired operating pressure of brush S on the shoe being machined. At the end of the manufacturing process the pressure in upstream chamber 1 is partially or completely released, thus allowing the lifting of the tool from the working surface in the position shown in fig. 2, thanks to the pressure existing in chamber 2.

[0016] It is clear from what has been said earlier that the function of downstream chamber 2, in respect to piston P, is a counteracting function entirely similar to that performed by the spring means M in the shock-absorbing devices of the known type. On the other hand, this solution has the considerable advantage that the pressure in chamber 2 can be adjusted at will, and in a programmable way, both before and during shoe manufacturing.

[0017] This allows to achieve two remarkable results: on the one hand it is possible to adjust the differential pressure acting on piston P to such a value that the operating pressure of brush S is as low as necessary, depending on the carding lightness required by the specific manufacturing process. This means that there is no risk of a lesser degree of control over the stability of the tool-holding assembly G, and so of an uneven machining, as the pressure in chamber 1 above can in any case be maintained sufficiently high to guarantee the optimal stability of assembly G.

[0018] On the other hand, it is possible to vary the differential pressure on piston P during manufacturing according to the wear of brush S, so as to adjust the value of said differential pressure to the actual weight of assembly G at any moment of the brush service life, so keeping constant the value of the operating pressure of brush S on the shoe. The actual diameter of brush S can be easily determined by any known means, and such information is enough to enable the processing unit to calculate with a simple algorithm the actual weight of the brush and the resulting total load of assembly G to be balanced. Bearing in mind that the brush diameter decrease is mainly restricted to the grinding step, reading the brush diameter can be performed from time to time at the end of each grinding operation, simply reading the end position of the tool used during the grinding operation.

[0019] From what has been described above, it should be clear that the shock-absorbing device according to the present invention is apt to function faultlessly even without the counteracting spring means M used in the known devices. However, for best results, both in terms of performance and of compressed air consumption (and hence of running costs), the two methods should be used together. This means that the load of the tool-holding assembly G should be born partly by the spring means M and partly by the counter-pressure in chamber 2 of the cylinder-piston unit. In particular, the spring means M can for example be set to compensate the weight of assembly G when the brush S is completely worn, modifying accordingly the position of the fixing point F2, while the task of compensating the weight of the part of brush S subject to wear is demanded to the counter-pressure in chamber 2 of the cylinder-piston unit.

[0020] From the preceding description it is clear that the shock-absorbing device of the carding tool in a carding machine for shoe uppers, manufactured according to the teachings of the present invention, has fully achieved the objects set. By adjusting the differential pressure on piston P it is in fact possible to accurately determine the operating pressure on the shoe according to the intrinsic features of the shoe upper and of the type of manufacture to be performed, removing any risk of negative effects on tool stability during working. Once the optimal differential pressure for a certain manufacturing process has been determined, it is also possible to maintain the same pressure during a manufacturing cycle with the same tool, regardless of the degree of wear of the tool itself. This makes it possible to avoid the safety overload normally imposed on the tool, resulting in a noticeable extension of the tool service life and in the complete overcoming of the drawback of excessively deep carding that can undermine the integrity or appearance of the shoe upper.

[0021] The present invention was described with reference to a preferred embodiment thereof, but it is clear that a variety of modifications within the reach of an expert in the art can be introduced, for example in the shape and arrangement of the dynamic fluid-actuators and/or the counteracting means, without exceeding the scope of the invention as defined in the enclosed claims.

Claims

1. Shock-absorbing device for the carding tool of a carding machine for shoe uppers, of the type in which the tool-holding assembly is mounted at the end of a mobile operating arm according to multiple coordinated axes and is moved along a predetermined machining path controlled by a pre-programmed processing unit according to the features of the shoe being machined and in which the tool-holding assembly has a further degree of freedom which allows the tool to be moved near to/away from the working surface in order to adjust its operating pressure, the movement of the tool-holding assembly, according to this further degree of freedom being controlled by a dynamic fluid cylinder-piston unit, **characterised in that** such dynamic fluid cylinder-piston unit is a double acting one.

2. Shock-absorbing device as claimed in claim 1), in which said double-acting cylinder-piston unit includes a piston upstream chamber and a piston downstream chamber, pressure in said chambers being independently and adjustably programmable, also during tool operation.

3. Shock-absorbing device as claimed in claim 2), in which, during machining, the differential pressure on the piston of such cylinder-piston unit is adjusted to compensate the load of the tool-holding assembly and to maintain a desired, constant operating pressure on the shoe being machined.

4. Shock-absorbing device as claimed in claim 2), which also includes counteracting spring means, apt to compensate, at least partially, the load of the tool-holding assembly.

5. Shock-absorbing device as claimed in claim 4), in which said spring means are set so as to compensate the load of the tool-holding assembly, when the tool is in a condition of complete wear.

6. Shock-absorbing device as claimed in any of claims 3) to 5), in which, during a series of successive machining operations with the same tool, the differential pressure on the piston is continuously or step decreased, according to the weight decrease of the tool due to its progressive wear.

7. Shock-absorbing device as claimed in claim 6), in which the differential pressure on the piston is step decreased, soon after each tool grinding operation.

8. Shock-absorbing device as claimed in claims 6) or 7), in which the machining tool is a radial wire wheel brush and the weight decrease of the tool is read by measuring the actual tool diameter.

9. Shock-absorbing device as in anyone of the previous claims, in which said dynamic fluid cylinder-piston unit is an air-operated unit.

FIG.2

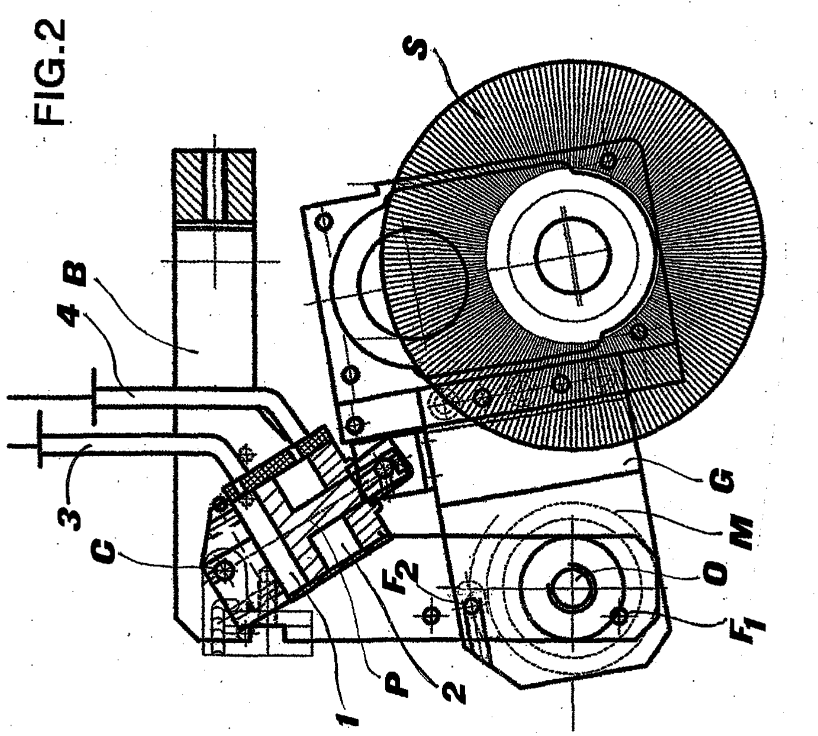
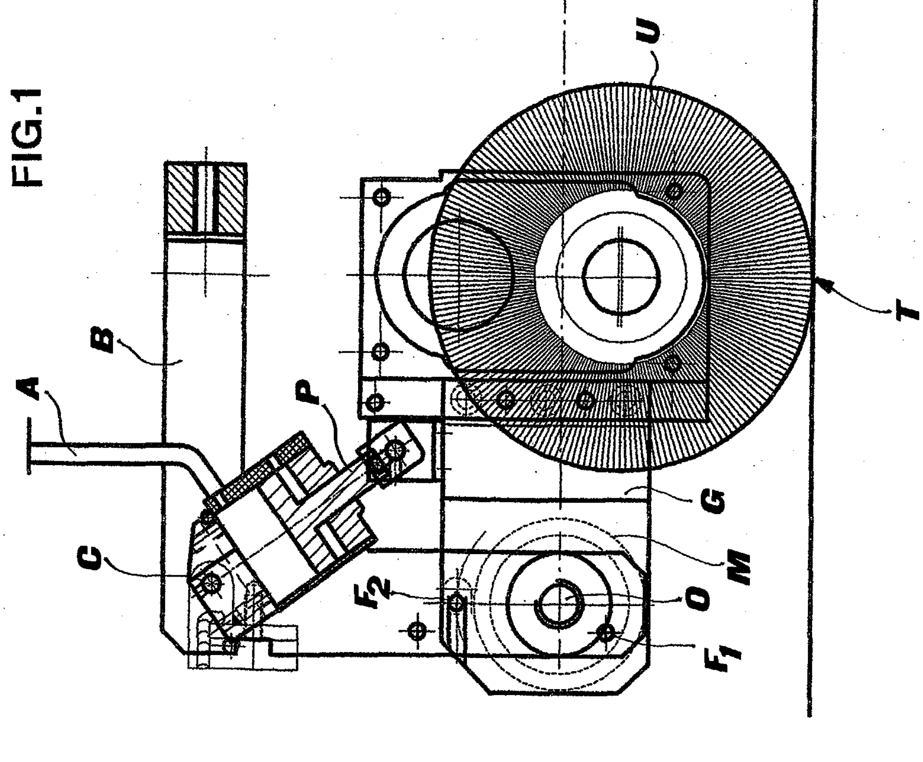


FIG.1



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EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5284

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	10 October 2003	Herry, M

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