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Device for supporting and transporting metal sheets during processing in a punching and/or a shearing machine.

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Proprietor: SALVAGNINI S.p.A.
Strada della Favorita
I-36040 Sarego (Vicenza) (IT)

Inventor: Salvagnini, Guido
Via della Prà
I-36040 Sarego (Vicenza) (IT)

Representative: Marchi, Massimo et al
c/o Marchi & Mittler s.r.l.
Viale Lombardia 20
I-20131 Milano (IT)

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Description

The present invention relates to a device for supporting and transporting metal sheets during processing in a punching and/or a shearing machine.

According to the known art, a punching and/or a shearing machine involves in its different embodiments a horizontal plane on which a metal sheet is placed and moved in sequence for the various processing positions, in each of which it undergoes a punching or a shearing operation. Such movement is accomplished through a clamping manipulator, movable along two axes orthogonal to each other and horizontal.

The sheet generally has large horizontal dimensions and a small thickness and the manipulator's clamps, grasping only one side of it, are thus not in a position of supporting it in the horizontal plane without the contribution of a supporting platform extended over the entire area travelled by the sheet during processing.

The supporting platform is universally accomplished with a metal structure, in general sheet metal panels reinforced by ribs, on whose upper face there is applied, to diminish friction, a large number of supporting balls. The supporting balls are balls with a diameter ranging from one to two centimetres, which roll on a layer of much smaller balls held in a hemispherical cavity whose radius is equal to the sum of the radius of the main ball and of the diameter of the smallest balls; the edges of the hemispherical cavity are turned back so that the small balls cannot escape.

The presence of supporting balls on the plane supporting the metal sheet being processed, distributed uniformly over the plane itself, transforms the friction of the sheet on the supporting plane from grazing to rotating, thus solving the twin problem of reducing the friction force which the manipulator must overcome and of not scoring the sheet's lower face, inevitable with the grazing contact.

The reduction in friction between the sheet and the supporting plane is not so important in allowing the increase in the accelerations of the manipulator, that are far more conditioned by the inertia of the manipulator and of the sheet than by the friction, but more so, rather, in the accuracy of the positioning of the sheet on the plane. In fact, in the step wherein the manipulator decelerates toward the point where the sheet shall be brough to a halt to be punched or sheared, the manipulator itself is deformed in the direction of motion by the inertia forces, which are larger than those of friction. Immediately after being brought to a halt, and before the sheet is punched or sheared, the manipulator must go back to its undeformed shape. It is precisely at this instant that the friction between the sheet and the supporting plane has great importance, because it opposes the return of the manipulator to the undeformed shape and generates inaccuracy in the position of punching or shearing on the sheet.

From this viewpoint the balls have not solved the problem completely, because they still generate some friction, sufficient to maintain the deformation of the manipulator, which tends to be increasingly lighter and thus less rigid.

The tendency to increasing the accelerations of the manipulator in modern punching and shearing machines has highlighted another weak point of the supporting balls, and more accurately that between the sheet and the balls a slipping action also takes place in addition to the rolling action and that as a consequence the sheet is scored along its lower face, because the ball's inertia is such as not to be able to accelerate with the sheet due to the effect of the friction's tangential force, which is small, because the sheet's portion bearing on a single ball is small.

If an attempt is made to eliminate this drawback reducing the inertia of the supporting balls by decreasing their diameter, the distance between one sphere and the next must be reduced also to be reduced, to prevent thinner sheets, when bent, from striking the balls with their edges at too high an angle of incidence, and thus, in addition to raising the cost of the balls unit, reducing the weight of the sheet on each ball and the capacity of accelerating its rotation to avoid scoring.

Thus the two problems, to solve which the supporting balls have been adopted on punching and shearing machines, have had a partial solution, so much more unsatisfactory the greater becomes the need to increase the productivity of these machines.

On the other hand the presence of the supporting balls on the supporting plane generates or complicates other problems such as the interference between the manipulator's clamps and the supporting plane and the evacuation of the punched or sheared sheets.

The lower jaws of the clamps clearly take up a certain space under the sheet's lower face, which rests on the balls. It is thus necessary either to prevent the interference between clamps and balls or to avoid its harmful effects.

Possible solutions to these problems involve the use of flexible clamps or sprung balls, which do not avoid interference but do prevent breakages, or of cam devices which lower the balls when the clamps arrive, thus avoiding interference.

All these solutions have a financial cost that is not negligible and become increasingly critical at higher accelerations and speeds of the manipulator, made possible by the development of electric motors, of the elements for the transmission of motion and of the electronic controls of motion.

In turn the automatic displacement of the punched or sheared sheets away from the plane on which they have been handled by the manipulator during
processing cannot be carried out by the manipulator itself, that does not have a sufficient stroke, and requires an additional device.

The ideal solution would be the concordant rotation of all the balls, upon which the sheet would travel towards the outer part of the supporting plane, but this solution is practically impossible. Another solution would be the sub-division of the supporting plane in so many segments connected together like plates of a plate-type conveyor; the latter, however, would be heavy, slow and not very effective in handling precisely because of the balls' low friction coefficient, which would have difficulty in dragging the sheet along with it.

Devices have therefore been adopted that are external to the supporting plane, such as handling clamps or batteries of suction cups on a movable carriage, which complicate the machine and make it more expensive.

It is therefore necessary to conclude that the supporting balls do not have in themselves the solution of the two other accessory problems, i.e., the interference with the clamps and the evacuation of the sheets.

Lastly it can be seen that the movement of the sheet on the supporting balls, also due to the non-planarity of the sheet and of the supporting plane, generates noise, because it takes place with a succession of small impacts between bodies connected to resonant structures.

EP-A-0 038 132 discloses a supporting device for metal sheets as defined in the preamble of claim 1.

A first object of the present invention is that of eliminating friction during the step of accurately positioning the sheet in the punching or shearing position.

A second object is that of not scoring the sheet's lower face.

A third object is that of avoiding the addition of devices against the interference between the manipulator's clamps and the supporting plane.

A fourth object is that of eliminating the noise due to the sliding of the sheet over the supporting plane.

A fifth object is that of incorporating in the supporting plane a suitable device for moving punched or sheared sheets toward the outside, that also manages to move the sheets in different positions so as to place them in different piles.

According to the invention such objects are attained with a device for supporting and transporting metal sheets during processing in a punching and/or a shearing machine, which further comprises, the features recited in the characterizing part of claim 1.

Independently of the method whereby the bristles are fastened to the supporting structure of the supporting plane, if their resistance to the peak load and their number are such as to support the weight of a sheet of maximum thickness, the simple adoption of the bristles in lieu of the supporting balls attains the first four of the five objects listed above.

In fact the residual deformation of the manipulator due to the effect of the inertia forces at the instant when it is brought to a halt determines a deviation of the sheet from the required position that is smaller than the deviation of the upper extremity of a bristle from its free position caused by the friction of the sheet; the return of the manipulator to the undeformed shape and the consequent exact positioning of the metal sheet do not thus require a sliding action of the sheet on the bristles' upper extremities, but only an elastic return of the bristles to their free position, such return not opposing any resistance. With this the first object is attained.

The hardness of the bristles is not such as to scratch a metal surface and their continuous oscillation under the action of the manipulator's clamps and of the sheet prevents them from accumulating abrasive particles. With this the second object is attained.

The flexibility of the bristles is such that the lower jaws of the manipulator's clamps displace them during their passage without meeting excessive resistance and without damaging them. With this the third object is attained. The bristles' flexibility itself causes the fourth object to be attained.

The friction coefficient between the sheet and the plane constituted by the bristles' upper extremities is ten times higher than the friction coefficient between sheet and supporting balls and this fact, that has a very limited negative effect on the accelerations of the manipulator, because inertia continues to be at a premium on friction, together with the lightness of the bristles, allows the use of the bristles as an integral part of an unloading conveyor. Such conveyor can constitute that part of the supporting plane of the punching or shearing machine, upon which the manipulator abandons the punched or sheared sheets to take them away from the machine; the high friction and the lightness of the means (belts and pulleys) that can be used for displacing the bristles allow good accelerations of the outgoing sheets.

The conveyor thus conceived has another highly useful feature, in addition to that of being itself an integral part of the supporting plane and of not requiring additional devices for handling the sheets: a metal batten parallel to the rectilinear sections of the belts can «stroke» in a direction parallel to that of handling and in one or the other of the two directions, pushing the sheet being handled in the position corresponding to the stacking position in an stacker downstream from the punching or shearing machine; said batten, in fact, interfering to a limited extent with the bristles, which in the meantime are moving along together with the belts, touches the sheet only on one side.

The features of the present invention shall be
made more evident by an embodiment illustrated as a non-limiting example in the enclosed drawings, wherein:

Fig. 1 shows an overall view of a punching and/or shearing machine provided with a supporting plane for the metal sheet, with a manipulator and with a conveyor of the punched or sheared sheet; Fig. 2 shows an enlarged detail of the supporting plane, in a sectional view taken along the line II-II of Fig 1;

Fig. 3 shows the same detail in a sectional view taken along the line III-III of Fig 2;

Figs. 4, 5 and 6 show a tuft of bristles of the above supporting plane, in its natural position, at the instant when the manipulator is brought to a halt and at the instant of punching or shearing, respectively;

Fig. 7 shows an enlarged detail of the conveyor;

Fig. 8 shows a partial view of a row of bristles, in a sectional view taken along the line VIII-VIII of Fig. 7;

Figs. 9 and 10 are sectional views taken along the lines IX-IX and X-X of Fig. 8.

With reference to Fig. 1, to a punching and/or shearing machine 3 there are associated, on a base 11, a supporting plane 1 for a metal sheet 6, a manipulator 2 for handling the sheet during the step of punching and/or shearing and, as part of the supporting plane 1, a conveyor 18 for unloading the punched or sheared sheet.

With reference to Figs. 2 and 3, the base 11 is formed by tubular metal sections 5 placed side by side and welded together, that form longitudinal spaces 26, in which strips 7 of a rigid plastic material are introduced, in which there are inserted, with the traditional technique of brush construction, respective rows of bristle tufts 8 of synthetic material. The strips 7 can easily be replaced in the spaces 26, where they are lightly jammed thanks to the flexibility of their limbs 10.

The manipulator 2 is provided with clamps 9 which, after grasping an edge of the metal sheet 6, move in a direction parallel and/or transversal to the rows of bristle tufts 8, interfering with them without damaging them.

As illustrated in Fig. 4-6, each bristle tuft 8, jammed in a strip 7 and, in cooperation with many other bristle tufts, supporting the metal sheet 6, can assume all the positions ranging from its natural one of Fig. 4 to that of maximum deflection of Fig. 5, determined at the instant when the manipulator is brought to a halt by the friction force that is produced when contact is made between the upper extremities of the bristles 8 and the sheet 6, when the sheet 6 slides with respect to such extremities of the bristles 8. An intermediate position such as that of Fig. 6 is assumed by the bristle tuft 8 at the instant when the sheet 6 is punched or sheared, when the manipulator moving the sheet 6 has recovered its normal shape after being brought to a halt, eliminating the deformations due to the inertia forces; the passage of a certain number of bristle tufts 8 from the position of Fig. 5 to the position of Fig. 6 takes place without the sheet 6 sliding on the upper extremities of the bristles 8 and thus without any resistant forces: this means that the position desired for the sheet 6 is attained without any errors in addition to those of positioning the manipulator on its numerically-controlled axes.

With reference to Fig. 7, the conveyor 18 is formed by two toothed belts 12 wound over two pairs of pulleys 13 and 14, of which the 13 are driving. The belts 12 are connected one to the other by a certain number of braces 15 connected to them with their parts 20 coupled, with the interposition of rubber inserts 25, to projections 21 of the belts 12 (Figs. 8-10).

The strips 7 with the bristle tufts 8 are jammed into the braces 12. A clip 16 fastened with a screw 22 to the brace 15 urges the strip 7 elastically against the wall of the brace 15 itself, and keeps it clamped up against it.

A batten 17 parallel to the belts 12 (Fig. 7) is guided and moved by conventional means 30 in a direction parallel to itself and in a horizontal direction parallel to the braces 15 of the conveyor 18, interfering to a limited extent with the upper extremities of the bristles 8 of the conveyor 18. It can displace in a direction transversal to the belts 12 the sheet 6 moved by the conveyor 18 and bring it into line with the desired stacking position.

During operation, in a manner known in itself, the metal sheet 6, after being positioned on the supporting plane 1, is grasped by the manipulator 2 to be delivered and handled with respect to the punching and/or shearing machine 3. Once the processing operation is over, it is positioned on the conveyor 18 where it is aligned by the batten 17 so that, following the operation of the driving pulleys 13 and consequent movement of the rows of bristles 8 of the conveyor, it is brought to the desired unloading position for possible stacking.

Claims

1. A device for supporting and transporting a metal sheet in a working machine such as a punching or shearing machine, comprising a stationary supporting plane (1) for supporting the metal sheet (6) during working operation at the working machine (3), said stationary supporting plane (1) including first horizontal parallel rows of vertical flexible bristles (8) having upper ends in a common horizontal plane and lower ends fastened to respective first supporting strips (7) rigidly connected to a stationary base (11), characterized in that it further comprises a loading/unloading end-
less conveyor (18) for transporting the metal sheet (6) towards and away from the working machine (3), said conveyor (18) including second horizontal parallel rows of vertical flexible bristles (8) having upper ends in a common horizontal plane and lower ends fastened to respective second supporting strips (7) rigidly connected to endless toothed belts (12) having an upper horizontal carrying run extending transversally to said second supporting strips (7), a batten (17) extending horizontally perpendicularly to said second rows of vertical bristles (8) above and below said upper ends of the bristles (8) to engage an edge of the metal sheet (6) and means (30) for displacing said batten (17) in a horizontal direction parallel to said second rows of bristles (8) to move the metal sheet (6) transversally to the direction of movement of the conveyor (18).

2. Device according to claim 1, characterized in that said stationary base (11) is formed by tubular metal sections (5) placed side by side to form longitudinal spaces (26) for receiving said first supporting strips (7) in a jammed removable manner.

3. Device according to claim 1, characterized in that said endless toothed belts (12) are wound over two pairs of pulleys (13, 14), one of which is driving, said belts (12) being connected to one another by braces (15) having a respective second supporting strip (7) connected thereto.

**Patentansprüche**

1. Vorrichtung zum Stützen und Transportieren einer Blechtafel in einer Bearbeitungsmaschine wie eine Stanz- oder Schneidemaschine, mit einer stationären Stützzone (1) zum Stützen der Blechtafel (6) während des Arbeitsbetriebes an der Bearbeitungsmaschine (3), wobei die stationäre Stützzone (1) erste horizontale parallele Reihen von Büsten (8) enthält, deren oberen Enden in einer gemeinsamen horizontalen Ebene liegen und deren unteren Enden an entsprechenden ersten Trägerstreifen (7) befestigt sind, die starr mit einer stationären Basis (11) verbunden sind, dadurch gekennzeichnet, daß sie weiter aufweist einen Endlos-Lade-/Entladeförderer (18) zum Transportieren der Blechtafel (6) zu und weg von der Bearbeitungsmaschine (3), wobei der Förderer (18) zweite horizontale parallele Reihen von vertikalen flexiblen Büsten (8) enthält, deren oberen Enden in einer gemeinsamen horizontalen Ebene liegen und deren unteren Er-
res dans un plan horizontal commun et des extrémités inférieures fixées à des secondes bandes respectives de support (7) raccordées rigidement à des courroies crantées sans fin (12) ayant un brin horizontal supérieur de transport disposé transversalement aux secondes bandes (7) de support, une latte (17) disposée horizontalement en direction perpendiculaire aux secondes lignes de soies verticales (8) au-dessus et au-dessous des extrémités supérieures des soies (8) afin qu'elle soit au contact d'un bord de la feuille métallique (6), et un dispositif (30) destiné à déplacer la latte (17) en direction horizontale parallèle aux secondes lignes de soies (8) afin que la feuille métallique (6) soit déplacée transversalement à la direction de déplacement du transporteur (18).

2. Appareil selon la revendication 1, caractérisé en ce que la base fixe (11) est formée de tronçons métalliques tubulaires (5) placés côte à côte afin qu'ils forment des espaces longitudinaux (26) destinés à loger les premières bandes de support (7) de manière amovible par coincement.

3. Appareil selon la revendication 1, caractérisé en ce que les courroies crantées sans fin (12) sont enroulées sur deux paires de poulies (13, 14) dont l'une est menante, les courroies (12) étant raccordées l'une à l'autre par des entretoises (15) ayant chacune une seconde bande respective de support (7) qui lui est raccordée.