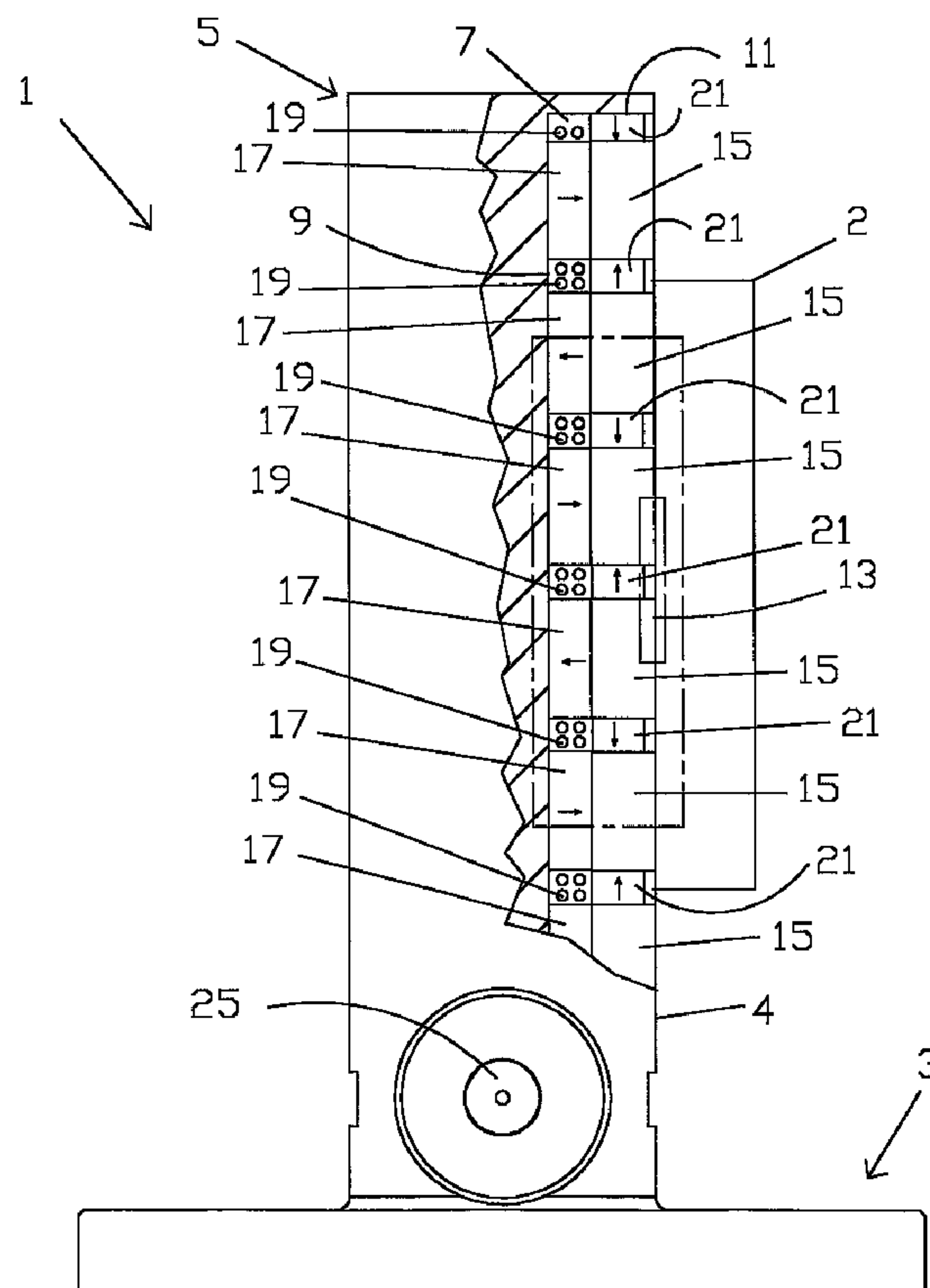




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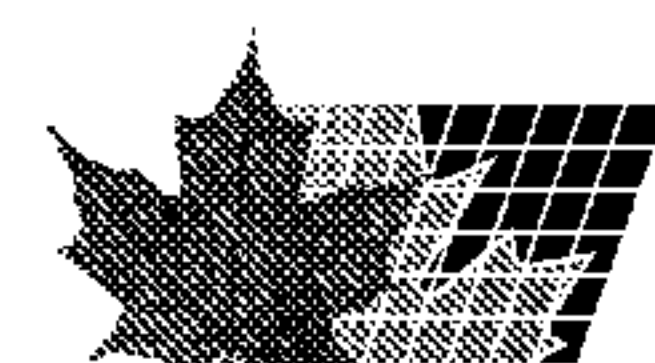
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(54) Titre : PALETTE MAGNETIQUE DESTINEE A L'ANCRAGE DES PIECES FERROMAGNETIQUES USEES PAR
MACHINES-OUTILS A AXE HORIZONTAL DE L'OUTIL
(54) Title: MAGNETIC PALLET FOR ANCHORAGE OF FERROMAGNETIC PARTS FOR MACHINING BY MACHINE
TOOLS WITH HORIZONTAL TOOL AXIS



(57) Abrégé/Abstract:

A magnetic pallet (1) for anchorage of a ferromagnetic part to be taken for machining to a machine tool with horizontal tool axis, said magnetic pallet (1) comprising a base plate (3), a vertical parallelepiped shoulder (5) extending from the base plate (3), a first



(57) **Abrégé(suite)/Abstract(continued):**

plurality of magnetic conductors (15) arranged in a matrix and which can be polarised magnetically so as to define a first surface for vertical magnetic anchorage of ferrous parts at a first lateral face (4) of said shoulder (5), characterised in that said base plate (3) and said shoulder (5) are formed from a single ferromagnetic monolithic block, and in that from said ferromagnetic monolithic block, at said first lateral face (4) of said shoulder (5), a first recess (7) is formed for housing said first plurality of magnetic conductors (15).

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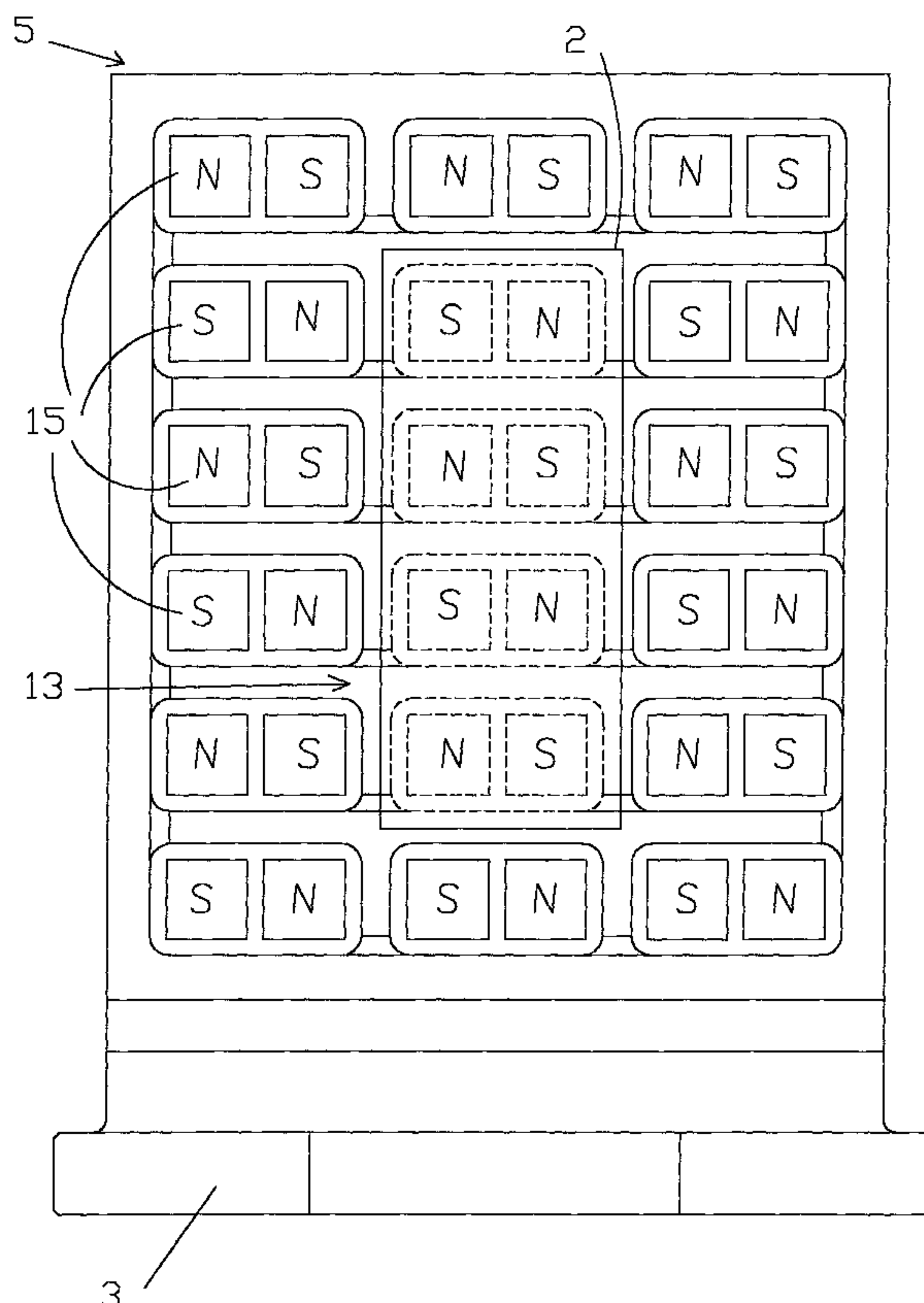
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(54) Title: MAGNETIC PALLET FOR ANCHORAGE OF FERROMAGNETIC PARTS FOR MACHINING BY MACHINE
TOOLS WITH HORIZONTAL TOOL AXIS

(57) **Abstract:** A magnetic pallet (1) for anchorage of a ferromagnetic part to be taken for machining to a machine tool with horizontal tool axis, said magnetic pallet (1) comprising a base plate (3), a vertical parallelepiped shoulder (5) extending from the base plate (3), a first plurality of magnetic conductors (15) arranged in a matrix and which can be polarised magnetically so as to define a first surface for vertical magnetic anchorage of ferrous parts at a first lateral face (4) of said shoulder (5), characterised in that said base plate (3) and said shoulder (5) are formed from a single ferromagnetic monolithic block, and in that from said ferromagnetic monolithic block, at said first lateral face (4) of said shoulder (5), a first recess (7) is formed for housing said first plurality of magnetic conductors (15).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

**MAGNETIC PALLET FOR ANCHORAGE OF FERROMAGNETIC
PARTS FOR MACHINING BY MACHINE TOOLS WITH
HORIZONTAL TOOL AXIS.**

5

The present invention relates to a magnetic pallet for the anchorage
of a ferrous part to be machined by a machine tool with horizontal
10 tool axis.

This magnetic pallet comprises notoriously a base plate driven to
traverse the bed of the machine tool to bring the part to be machined
into the work area and to remove the machined part from the work
15 area, and a vertical parallelepiped shoulder attached to the base
plate and at least one vertical magnetic surface which can be
polarised to achieve anchorage of the part.

Each magnetic anchorage surface with which the pallet is provided is
20 composed of a plurality of magnetic conductors arranged in a matrix
and each one is supplied by a corresponding permanent and
reversible magnet encircled by an electric induction coil capable of
changing the direction of polarisation of the permanent magnet so as
to commutate the magnetic surface from the activated condition to
25 the de-activated one and vice versa.

The magnetic surface is surrounded and protected by a
ferromagnetic crown which is part of the magnetic circuit generated
by the permanent reversible magnets both in the activated condition
30 and in the de-activated condition of the magnetic surface.

The ferromagnetic crown, inside of which the magnetic conductors
are placed with the relative permanent reversible magnets and, if

necessary, with other secondary permanent magnets also supplying the magnetic conductors, is placed on a corresponding lateral face of the shoulder of the magnetic pallet.

5 The magnetic pallet has to have structural rigidity and stability so as to guarantee that machining of the part can be performed while maintaining extreme machining precision.

10 Nevertheless, for example when machining of the part moves to the apex portion of the magnetic pallet, the action of the tool on the part may cause slight yields or temporary deformation of the structure of the magnetic pallet and the movement induced in this way of the relative position between the workpiece and tool may jeopardise machining precision.

15 Clearly the slight structural yields which may occur inside the structure of the pallet mainly originate at the areas of joining, formed by welding or by means of tightening screws, or another known manner, between the base plate and the shoulder, and between the
20 shoulder and the ferromagnetic crown placed on the shoulder.

The object of the present invention is therefore that of providing a magnetic pallet and a method for the production of a magnetic pallet for anchorage of a ferrous part to be machined by a machine tool
25 with horizontal tool axis, which magnetic pallet has intrinsic stability and rigidity such as to allow extremely precise and thorough machining of the part.

Another object of the present invention is that of providing a
30 magnetic pallet and a method for production of a magnetic pallet which are inexpensive.

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According to an aspect of the invention, there is provided a magnetic pallet for the anchorage of a ferrous part to be taken for machining by a machine tool with horizontal tool axis, said magnetic pallet comprising a base plate, a vertical parallelepiped shoulder extending from the base plate, a first plurality of magnetic conductors arranged in a matrix and which is polarised magnetically so as to define a first magnetic anchorage surface at a first lateral face of said shoulder, wherein said base plate and said shoulder are formed from a single ferromagnetic monolithic block, and wherein, in said ferromagnetic monolithic block, at said first lateral face of said shoulder, a first recess is provided for housing said first plurality of magnetic conductors.

According to another aspect of the invention, there is provided method for the production of a magnetic pallet for the anchorage of a ferromagnetic part to be taken for machining to a machine tool with horizontal tool axis, providing the following phases of machining of a ferromagnetic monolithic block: forming, from said monolithic block, a base plate; forming, from said monolithic block, a vertical parallelepiped shoulder extending from the base plate; and forming, from said monolithic block, at least a first recess for housing a corresponding first plurality of magnetic conductors arranged in a matrix and which is polarised magnetically so as to define a first magnetic anchorage surface at a first lateral face of said shoulder.

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The magnetic pallet is obtained by machining a round or square rod or more generally a ferromagnetic slab, preferably in steel, so as to shape the base plate, the shoulder and a recess for each of the magnetic anchorage surfaces provided.

5

Production of a magnetic pallet from a monolithic block allows considerably improved structural rigidity and stability thanks to elimination of the areas of joining between the base plate and the vertical shoulder and between the vertical shoulder and the ferromagnetic crown of the magnetic anchorage surfaces of traditional apparatus.

10

The magnetic pallet of the present invention is therefore suitable for use for machining parts with high precision.

15

These advantageous aspects will be made clearer by the following description of a preferred embodiment of the invention, to be read by way of a non-limiting example of the more general principle claimed. The description refers to the accompanying drawings in which:

20

Fig. 1 illustrates a front view of a magnetic pallet in accordance with a preferred embodiment of the present invention with the magnetic anchorage surface activated.

25

Fig. 2 shows a side elevation view of the magnetic pallet of Figure 1 partially sectioned in the condition of activation of a magnetic surface; and

Fig. 3 shows a side elevation view of the magnetic pallet of Figure 1 partially sectioned in the condition of de-activation of a magnetic surface.

5 Referring to the drawings, the magnetic pallet 1 for anchorage of a ferrous part 2 to be machined by a machine tool with horizontal tool axis comprises a base plate 3 which can be made to traverse the bed of the machine tool to bring the ferrous part to be machined towards the work section and to remove the machined ferrous part
10 towards the unloading section, and a vertical shoulder 5 with a parallelepiped shape which extends upwards from the base plate 3. The base plate 3 and the shoulder 5 are formed in one single part by the machining of a single ferromagnetic monolithic block, preferably in steel.

15 At a vertical lateral face 4 of the shoulder 5 a rectangular recess 7 of the shoulder 5 is provided, defining a back 9 and a lateral wall 11 (in addition to any vertically and horizontally extended intermediate walls), which recess 7 serves to house a plurality of magnetic
20 conductors 15 arranged in a matrix and aimed at defining a vertical magnetic anchorage surface 13.

It should be noted that the recess 7 is formed by chip machining from the same ferromagnetic monolithic block which forms the base
25 plate 3 and the shoulder 5 of the magnetic pallet 1.

As mentioned, in the recess of the shoulder 5 the magnetic conductors 15 are fixed, which conductors have a parallelepiped shape with horizontal axis orthogonal to the lateral face 4 of the
30 shoulder 5, the end bases of the magnetic conductors 15 in relation to said axis being square in shape.

Between the internal base of each magnetic conductor 15 and the back 9 of the ferromagnetic crown 7 a primary reversible permanent magnet 7 is interposed, having the horizontal magnetic polarisation axis (indicated by the direction of the arrow represented in the permanent magnets 17) directed orthogonally to the internal base of the magnetic conductor 15, which primary permanent magnet 17 is surrounded by an electrical coil 19 which can be supplied with an electrical current in one direction or in the opposite direction so as to reverse the direction (indicated by the tip of the arrow represented in the primary permanent magnets 17) of the magnetic polarity of the primary permanent magnet 17.

Between each of the lateral faces of each magnetic conductor 15 and the opposite lateral face of the adjacent magnetic conductors 15 or the opposite lateral wall 11 of the recess 7, if the magnetic conductor 15 is peripheral in relation to the matrix arrangement of the magnetic conductors 15, a secondary permanent magnet 21 is interposed. The axis of magnetic polarisation (denoted by the direction of the arrow represented in the permanent magnets 21) of each secondary magnet 21 is orthogonal to the lateral face of the magnetic conductors 15, while the direction of magnetic polarisation (indicated by the tip of the arrow represented in the permanent magnets 21) of each secondary magnet 21 is such that each magnetic conductor 15 is supplied laterally by magnetic poles of the same sign.

In the case of the peripheral magnetic conductors 15 in the matrix arrangement of the magnetic conductors 15, the secondary permanent magnets 21 arranged on the peripheral sides of the magnetic conductors 15 are in contact directly with the lateral wall 11 of the recess 7.

An epoxy resin 23 or another non-magnetic material is poured inside the recess 7 to fill the gaps between the adjacent magnetic conductors 15, between the magnetic conductors 15 and the lateral wall 11 of the recess 7, and between the magnetic conductors 15 and the back 9 of the recess 7.

25 in Figs. 2 and 3 denotes a channel formed in the lower portion of the shoulder 5 for laying of the electrical wiring required for supplying the coils 19 of the reversible permanent magnets 17.

10 In the de-activated condition of the magnetic surface 13 each primary permanent magnet 17 supplies the corresponding magnetic conductor 15 with a magnetic pole of opposite sign to the magnetic poles supplied to the same magnetic conductor 15 by the secondary permanent magnets 21 which surround it. In this situation the magnetic flux generated by the primary permanent magnets 17 and by the secondary permanent magnets 21 closes entirely through the recess 7 without influencing the magnetic surface 13, as illustrated by the line of magnetic flux indicated by a dotted line in Figure 3. In order to do this it is only necessary to ensure that the magnetic flux generated overall by the four secondary permanent magnets 21 of each magnetic conductor 15 is equal to that generated by the primary permanent magnet 17.

25 In the activated condition of the magnetic surface 13 the primary permanent magnet 17 and the secondary permanent magnets 21 surrounding each magnetic conductor 15 supply the same pole to the magnetic conductor 15. Each magnetic conductor 15 is polarised so that the magnetic anchorage surface 13 activates, defining a matrix of poles wherein each pole has laterally poles of opposite sign to its sign, and diagonally poles of identical sign to its sign ("N" stands for north pole and "S" for south pole in Figure 1). In this situation the magnetic flux generated by the primary reversible

permanent magnets 17 and by the secondary permanent magnets 21 closes entirely through the ferrous part 2 as illustrated by the lines of flux indicated by a dotted line in Figure 2.

5 The through section of the lateral wall and of the back of the recess 7 must be sufficient for sustaining without dispersion the magnetic flux generated by the primary and secondary magnets. In this way, in addition to optimising the power of magnetic anchorage in the activated condition of the magnetic anchorage surface,
10 advantageously the magnetic pallet becomes completely inert in the de-activated condition of the magnetic anchorage surface.

It must be clear that the distribution of the polarities of the poles of the magnetic anchorage surface can be differentiated from that
15 illustrated here with a different arrangement of the permanent magnets which generate the magnetic circuit.

For example a distribution in groups of poles of the same polarity is possible in such a way as to vary the depth of penetration of the
20 magnetic field through the parts to be anchored.

Although a magnetic pallet with a single magnetic anchorage surface has been described for the sake of simplicity, it is clear that by the same principle a magnetic pallet can be provided which has up to
25 five magnetic anchorage surfaces which can be activated independently, namely one per vertical lateral face of the magnetic pallet plus one on the upper horizontal face of the pallet.

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CLAIMS:

1. A magnetic pallet for the anchorage of a ferrous part to be taken for machining by a machine tool with horizontal tool axis, said magnetic pallet comprising a base plate, a vertical parallelepiped shoulder extending from the base plate, a first plurality of magnetic conductors arranged in a matrix and which is polarised magnetically so as to define a first magnetic anchorage surface at a first lateral face of said shoulder, wherein said base plate and said shoulder are formed from a single ferromagnetic monolithic block, and wherein, in said ferromagnetic monolithic block, at said first lateral face of said shoulder, a first recess is provided for housing said first plurality of magnetic conductors.
2. A magnetic pallet according to claim 1, further comprising at least a second plurality of magnetic conductors arranged in a matrix and which is polarised magnetically to define at least a second magnetic anchorage surface at a second lateral face of said shoulder, at said second lateral face of said shoulder a second recess being formed for housing said second plurality of magnetic conductors.
3. A magnetic pallet according to claim 1 or claim 2, wherein said monolithic block is in ferromagnetic steel.
4. A magnetic pallet according to claim 1, wherein said first plurality of magnetic conductors has a parallelepiped shape with horizontal axis orthogonal to said first lateral face of said shoulder, and wherein a first plurality of primary reversible permanent magnets is provided, each of said reversible permanent magnets being surrounded by a corresponding electrical induction coil and being interposed between the back of said recess and the

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axially internal base of a corresponding magnetic conductor of said first plurality of magnetic conductors, each of said reversible permanent magnets having the horizontal polarisation axis orthogonal to said axially internal base
5 of said corresponding magnetic conductor.

5. Method for the production of a magnetic pallet for the anchorage of a ferromagnetic part to be taken for machining to a machine tool with horizontal tool axis, providing the following phases of machining of a
10 ferromagnetic monolithic block:

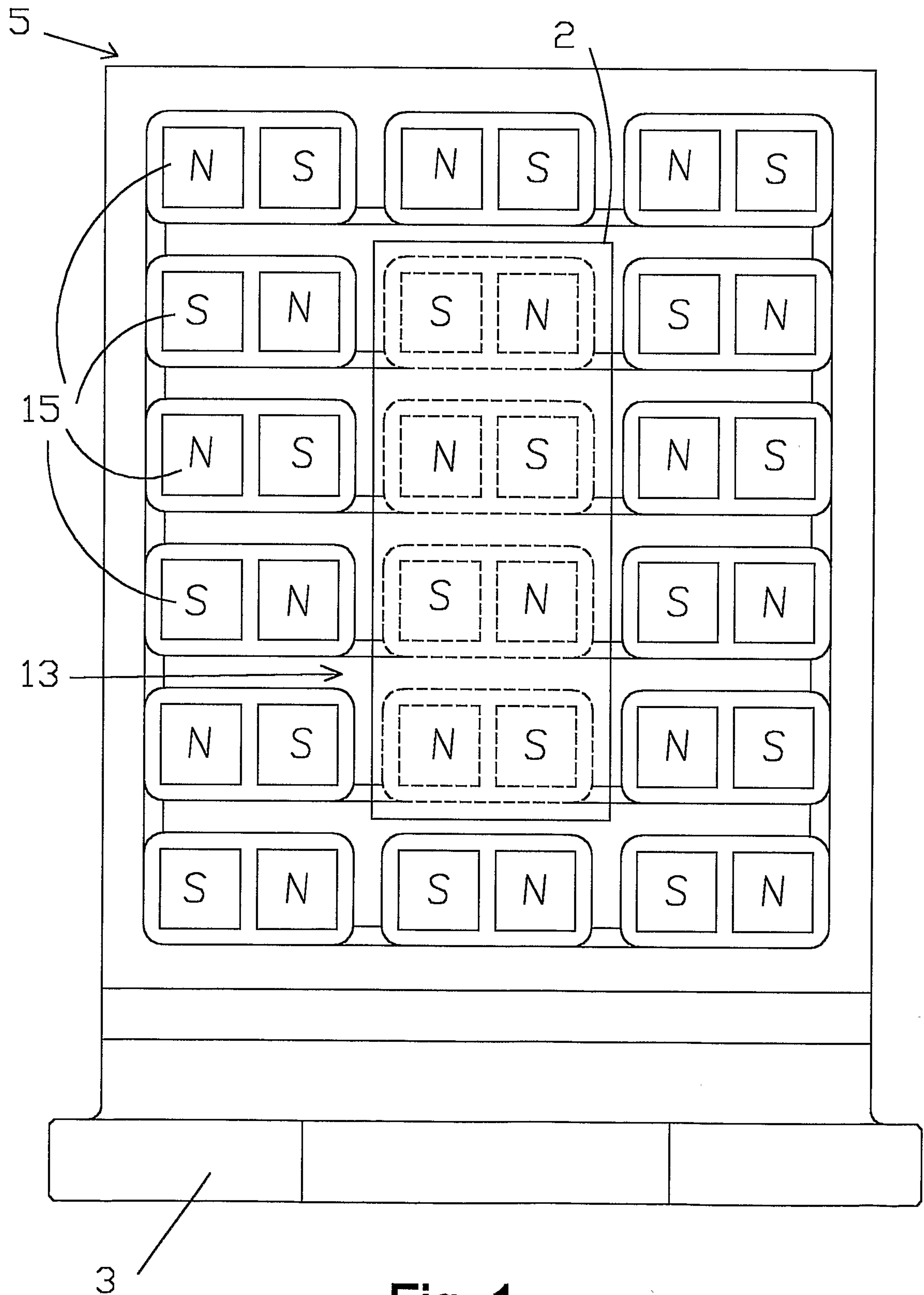
- forming, from said monolithic block, a base plate;

- forming, from said monolithic block, a vertical parallelepiped shoulder extending from the base plate; and

- 15 - forming, from said monolithic block, at least a first recess for housing a corresponding first plurality of magnetic conductors arranged in a matrix and which is polarised magnetically so as to define a first magnetic anchorage surface at a first lateral face of said shoulder.

20 6. Method for the formation of a magnetic pallet according to claim 5, further comprising the following phase:

- forming, from said monolithic block, at least a second recess for housing a corresponding second plurality
25 of magnetic conductors arranged in a matrix and which is polarised magnetically so as to define at least a second magnetic anchorage surface for ferrous parts at a second lateral face of said shoulder.

**Fig. 1**

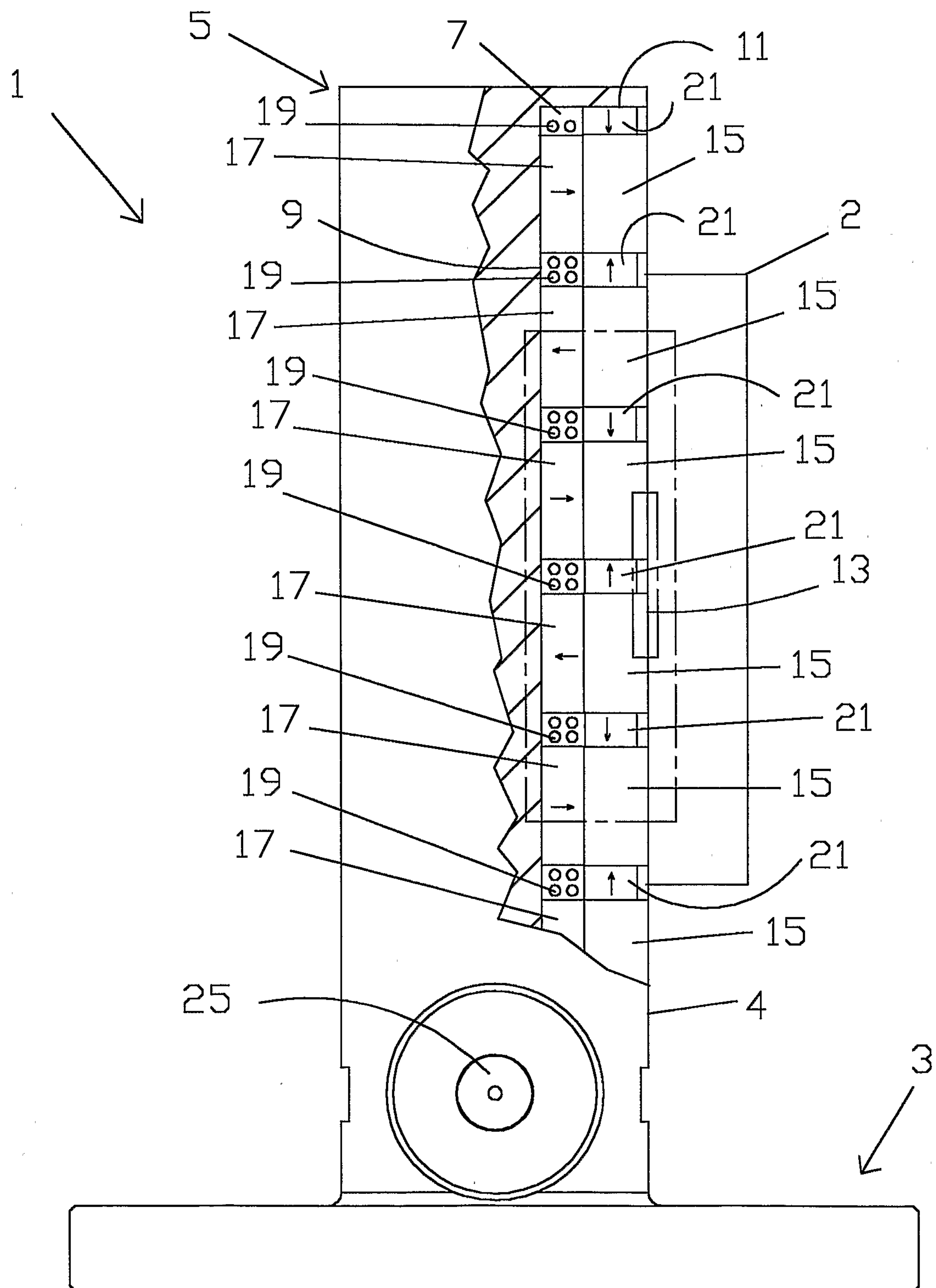
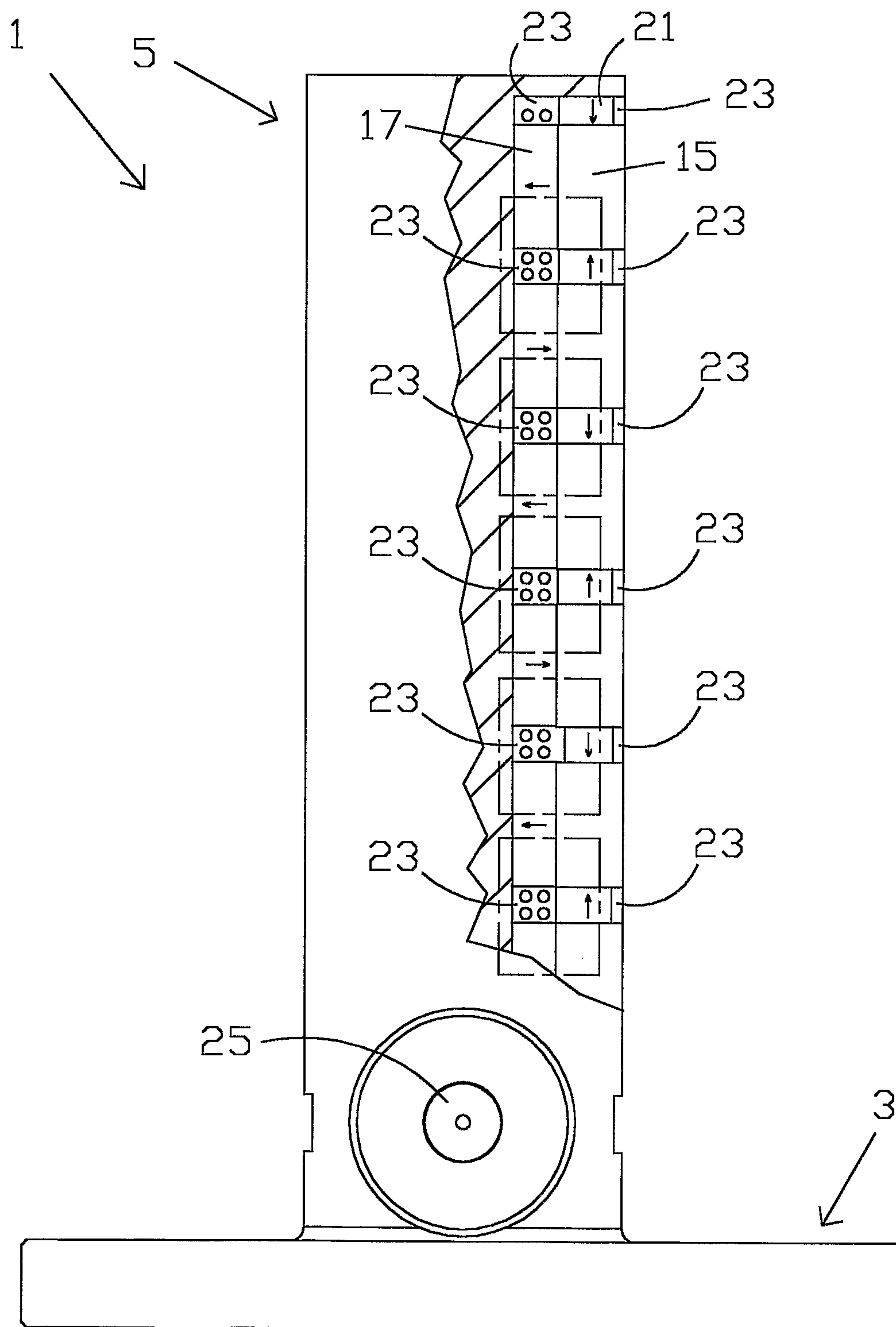


Fig. 2

**Fig. 3**

