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Wallin

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[54] **METHOD OF VIBRATION DAMPENING BY SURFACE GRIDING**

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[52] **U.S. Cl.** ..... **51/240 R;** 269/20; 269/26; 269/266; 248/356; 60/581; 91/411 R

[51] **Int. Cl.²** **B24B 41/06**

[58] **Field of Search** ..... 91/411 R; 92/146; 248/20, 248/350, 356, 357, 354 H; 51/216 R, 240 R; 269/20, 26, 266, 267, 311; 60/581

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[57] **ABSTRACT**

The invention refers to a method of vibration damping in order to reduce vibrations of supports of slabs, for surface grinding. Individual supports, regularly arranged over the surface of a grinding table consist of hydraulic cylinders communicating with each other and lockable in reached final positions in contact with the slab. Between groups of cylinders valves are arranged for accommodating the number of active cylinders to the size of the slab on the table.

4 Claims, 2 Drawing Figures

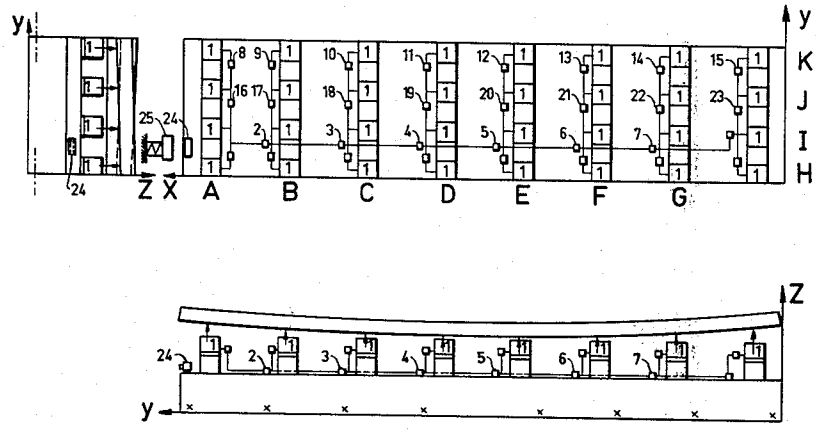


FIG. 1

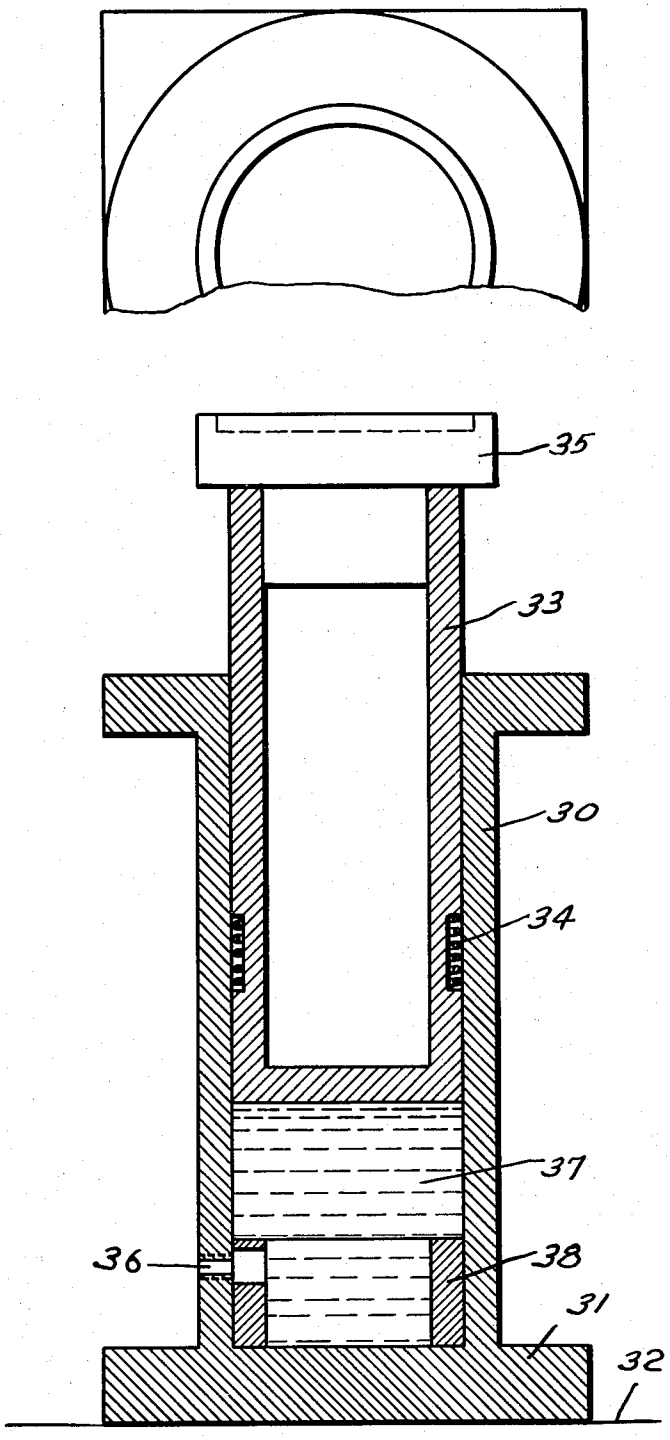
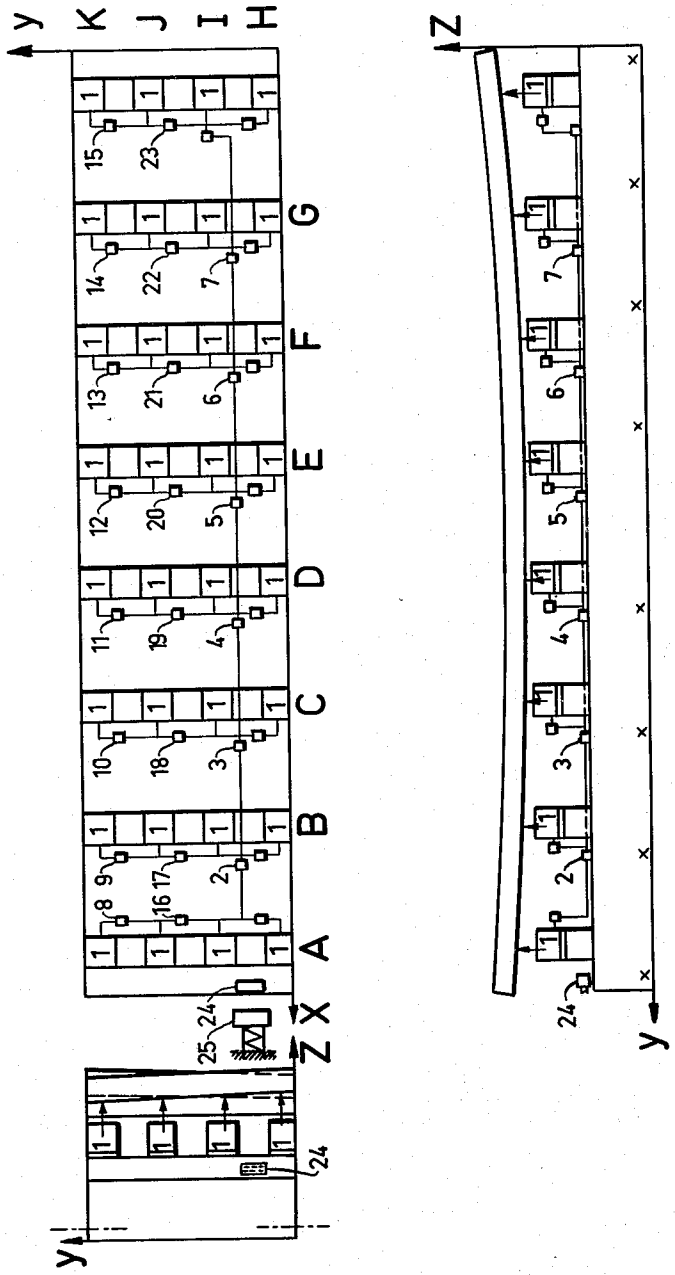


FIG. 2



METHOD OF VIBRATION DAMPENING BY SURFACE GRIDING

In surface grinding, also called fettling, there are problems when positioning the slabs, especially as these are usually bent (crooked) and frequently also warped. Large, flat (relatively thin) slabs seem to bring about specially severe problems, as only three points of support can give a statically fully determined support of the slab. If, therefore, only three symmetrically placed points of support are used the forces of reaction of said supports will be very large, and further the pressure of the grinding head is not only rather heavy but also changes its working point. As the slabs to be ground in certain types of machines vary in size between **1.25** m $\times$ **5** m and **2** m $\times$ **8** m it is easily understood that the linear distances between the points of support and the edges of the slab can be rather great even if the supports are located, owing to the dead weight, to minimize the resilience bending i.e. the deflection of the slab (the so-called support functions of Bessel). Especially when the pressure of the grinding head has its working point at the edges of the slab or at a corner the system support — slab has a low static stability, wherefore the slab in the extremes can be tilting. Because of great linear distances between the points of support and between the supports and the edges of the slab, the pliancy of the slab will permit considerable dynamic as well as static resilience bending possibilities. Especially in fettling as well as in other grinding operations vibrations are generated that can easily cause sympathetic vibrations of great amplitudes. As large and rather pliable parts of the slab are hanging freely on a few supports the vibration amplitudes can become considerable even if no sharp tuning is present as in the case for resonance vibrations. By surface grinding (fettling) (especially or rolling-mill slabs) it seems, in practice, to be extremely difficult to avoid these intense vibrations. There is one further circumstance that seems to speak against a three point supporting, as this will cause considerable free overhang and deflection at the edges and at the middle of the slab, and that is the fact that the pressure of the grinding wheel, besides the dead weight of the slab will contribute to the deflection, and will cause the grinding wheel partly to work "on an ascent" and partly to work "on a descent" when grinding from one side to the other. This greatly disturbs the grinding head control, which among other things aims at maintaining a constant average depth of cut.

For the above reasons a three point support only cannot be accepted and at the present time normally several supports of equal height (often four) are used in order to create, across the rectangular slab, a linear contact with the slab. On the top of the supports there are bearing surfaces for pads of wood or rubber. This method of positioning the slabs, however, gives a statically determined positioning only if the supports are of exactly the same height and if the slab is absolutely plane and infinitely rigid. None of these demands is fulfilled in production. If, therefore, the slabs are bent or warped the supporting pads will be differently loaded, and their elastical deformability will be made use of for a load distribution between the different supports and between the ends of the supports. This, however, means that the slab, owing to the — at least relative to its point of action — varying force at right angles to the slab due to the pressure of the grinding wheel, will obtain a resilience bending, the magnitude of which is also dependent on how much the pads have already been compressed due to the load distribution. This is especially the case when rubber pads are used because of their greater deformability than wood due to the fact that the flexibility of rubber is great for small deformations and decreases at large and increasing rates of deformation to very smmall amounts. Certainly thick rubber pads can eliminate the need of, wooden pads either to alter the thickness of the pads or to wedge between the slab to obtain individual supports when the slabs are bent and warped, but the varying force of support and the flexibility can normally not be eliminated. Very bent and warped slabs can require wood mounts under the rubber pads or wedging at the edges. When the slab has been turned upside down all support pads have to be re-arranged which takes costly time. It should be pointed out that possible corrections of the thickness of the pads are done by an estimation of the crookedness of the slab.

The result of today's methods of supporting slabs is that the way of support and the rigidness of the slab are very uncertain factors in the production contributing to extremely varying vibration conditions that seem to be very apt to favour vibrations, giving rise to poor surfaces and being detrimental to the way of cutting of the grinding wheel and consequently in the long run also being detrimental to the human ear, to the grinding wheel spindle, to the electric motor and to the complete grinding machine. In particularly, measurements seem to show that the electric motors are subject to vibration rates above **30** mm/sec, to be compared with standardized values of maximally **7.1** mm/sec.

From what has been stated above it is evident that matters need to be taken to create a better and more evenly distributed and less flexible supporting of slabs. One object of the present invention is to master the problems described above.

The present invention will be more readily understood from the following detailed description.

FIG. **1** illustrates an ordinary hydraulic cylinder with motion limited plunger.

FIG. **2** is a drawing of a table for a grinding machine with a system of communicating pressure cylinders.

The hydraulic cylinders utilized according to the invention are of a type known per se. They comprise a stationary cylindrical portion **30** suitably provided with a broadened base aprt **31** to be secured to a table bed **32.** In the cylindrical portion **30** a plunger or piston **33** is movable, and sealing means **34** is provided at the gliding surface. Exchangeable support pads **35** are provided at the top of the piston which, for this reason, suitably is hollow but is closed at its bottom end. Through an inlet and outlet opening **36** a suitable hydraulic medium **37** as oil can communicate with the interior of the cylindrical portion **30** below the piston **33.** In order to limit the motion of said piston in the downward direction a limiting ring **38** is arranged.

In order to bring about equal supporting force and equal flexibility (rigidness) for all supports, and simultaneously to be able as well to accept crookedness in longitudinal and transverse directions and warpedness of the slab to be ground, and as as to reduce vibrations, the present invention involves the use of a regular pattern of hydraulic pressure cylinders — i.e. in lateral rows or diagonally, see FIG. **2** — along a table surface. Said cylinders (FIG. **1**) carry together the weight of the

slab and withstand the maximum pressure of the grinding wheel, and after positioning the slab on the support pads of the pressure cylinders, the cylinders communicate hydraulically with each other in order to bring about an accommodation of the position of the support pads to the form of the slab. When the slab finally rests on the support pads of the present cylinders and has been positioned in a macro-geometrically horizontal position, every single pressure cylinder is locked in its position by the means of valves that cut them out from the other cylinders in the system. The communication (opening and shutting) between the cylinders is performed by means of magnetically operated valves that by absence of current shut the flow of oil by means of a spring loaded valve slide. If the slab does not entirely cover the table in the X and Y directions, see FIG. **2.**, manually or automatically row A can be disconnected by the valve **2,** rows A and B by the valve **3** and so on and row K can be disconnected by the valves **8** to **15,** the row J by the valves **16** to **23,** and so on.

When the movable table is "parked" at one end automatically a multi pole plug **24** on the table will engage a resiliently fitted socket **25,** bringing about contact actions for current supply and for the control of the valves.

In order that the support pads of the pressure cylinders shall not make impressions in the slab surface and to prevent sliding of metal to metal by great tangential components of the grinding force or by the acceleration or retardation of the table and to bring about a desired vibration damping, the pressure cylinder support pads are provided with a shallow bowl form surface **35** for the mounting of wooden pads, rubber pads or pads of other energy absorbing material, see FIG. **1.**

The elastic properties of these pads are depend upon material, thickness and surface pressure (equal for all cylinders) wherefore a well adapted and vibration damping deformation of the pads can be achieved thanks to the energy absorbing properties of the material.

What is claimed is:

1. A levelling and vibration damping support system for a slab that is to be ground, said system being characterized by

a. a horizontally disposed table bed,

b. a plurality of upright hydraulic cylinders secured in a pattern on top of said table bed so that the upper portions of said cylinders will support said slab,

c. a closed hydraulic communicating system interconnecting the hydraulic cylinders that are to support the slab,

d. a plurality of magnetically operated valves in said system for controlling the flow of hydraulic fluid to and from each hydraulic cylinder, and

e. means for activating or deactivating each of said magnetically operated valves,

whereby when a slab is placed upon said upper portions of said pattern of hydraulic cylinders, all of said magnetically operated valves can be unlocked at once so as to equalize the pressure of the hydraulic fluid in each of said hydraulic cylinders and after the loading of the slab on said cylinders is accomplished and the grinding is to start, the magnetically operated valves can be locked so that there is no flow of fluid between any of the hydraulic cylinders.

2. A system according to claim **1** in which the cylinders are arranged in a regular pattern of longitudinal and transverse rows with respect to the table bed.

3. A system according to claim **2** in which rows of cylinders not covered by a loading slab can be disconnected by said means for deactivating said magnetically operated valves.

4. A system according to claim **1** in which the magnetically operated valves are closed by the absence of a control current used for their operation.

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