# United States Patent [19]

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[54] **GRINDING MACHINE**


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[51] **Int. Cl.** ..... **B24b 7/02**

[58] **Field of Search** ..... 51/110, 109, 74, 76, 112, 51/268; 125/13 R, 14; 198/41



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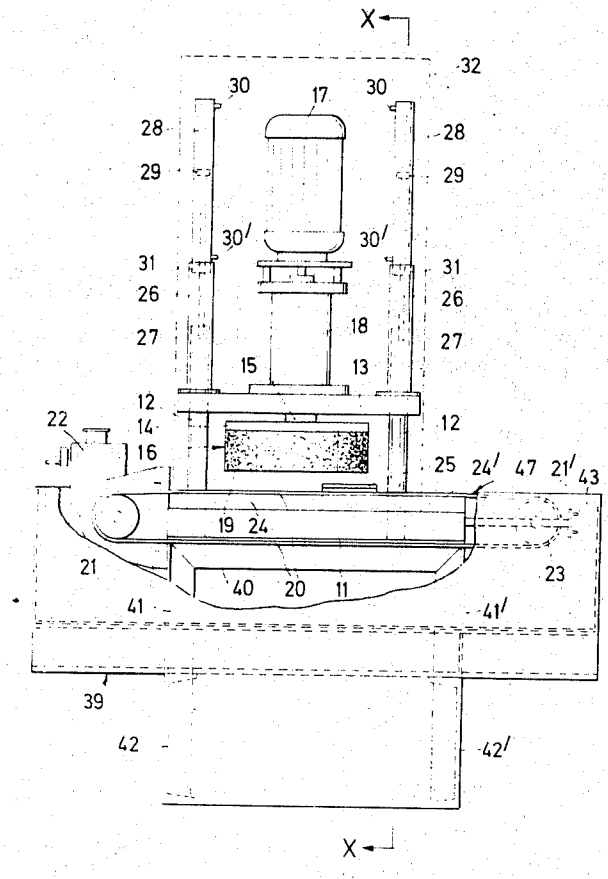
[57] **ABSTRACT**

A surface grinding machine comprising a workpiece support base, one or more rectilinear guide columns of constant cross-section extending upwardly with respect to said base, a head located on said columns and provided with rotatable support means for carrying a rotary grinding wheel, and conveying means supported by said base at least in the operative region of the grinding wheel and for traversing workpieces under the wheel during operation thereof; each of said rectilinear columns being fastened at one end region to the base or head, and said head or base respectively being relatively slidably displaceable along and adjustably locatable on said guide columns by displacing means.


**5 Claims, 4 Drawing Figures**



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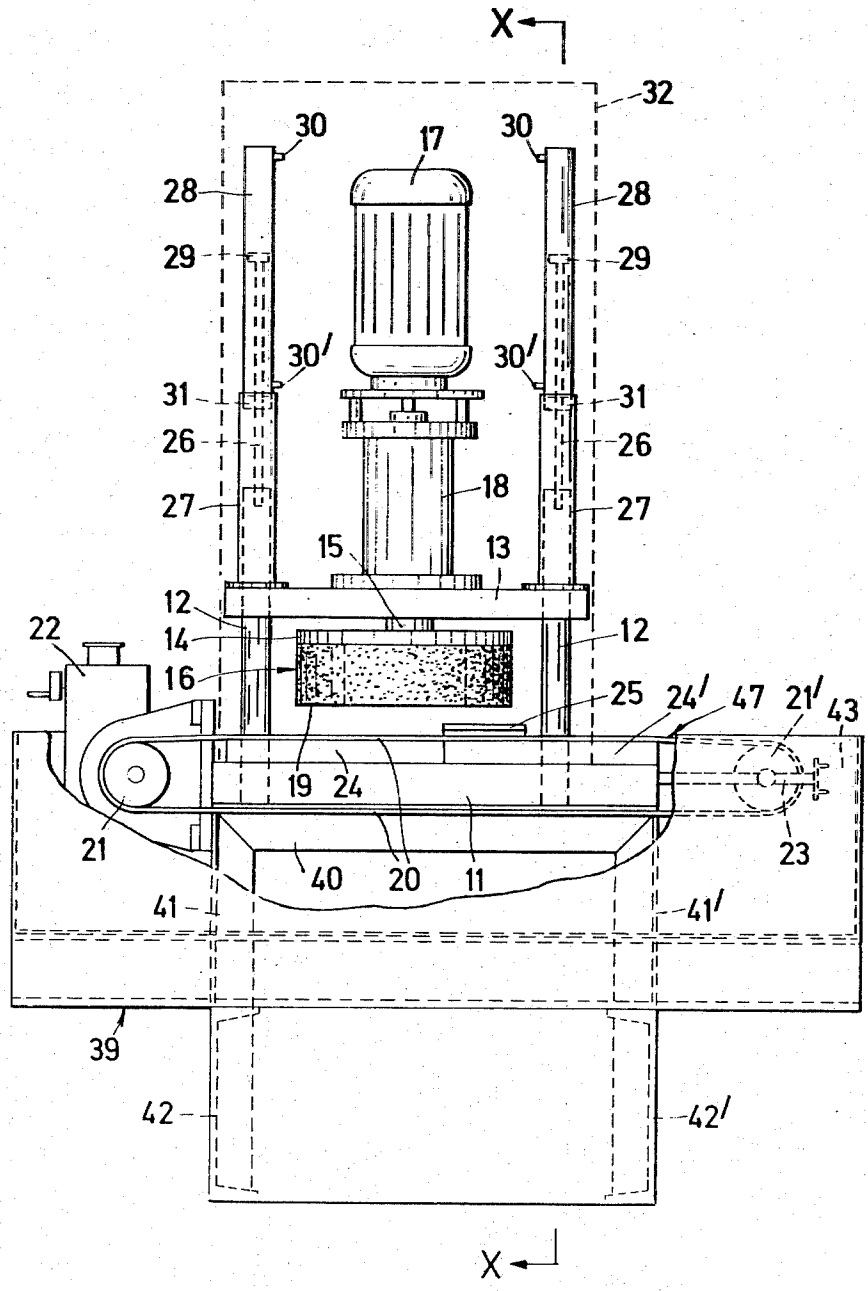


FIG. 1.

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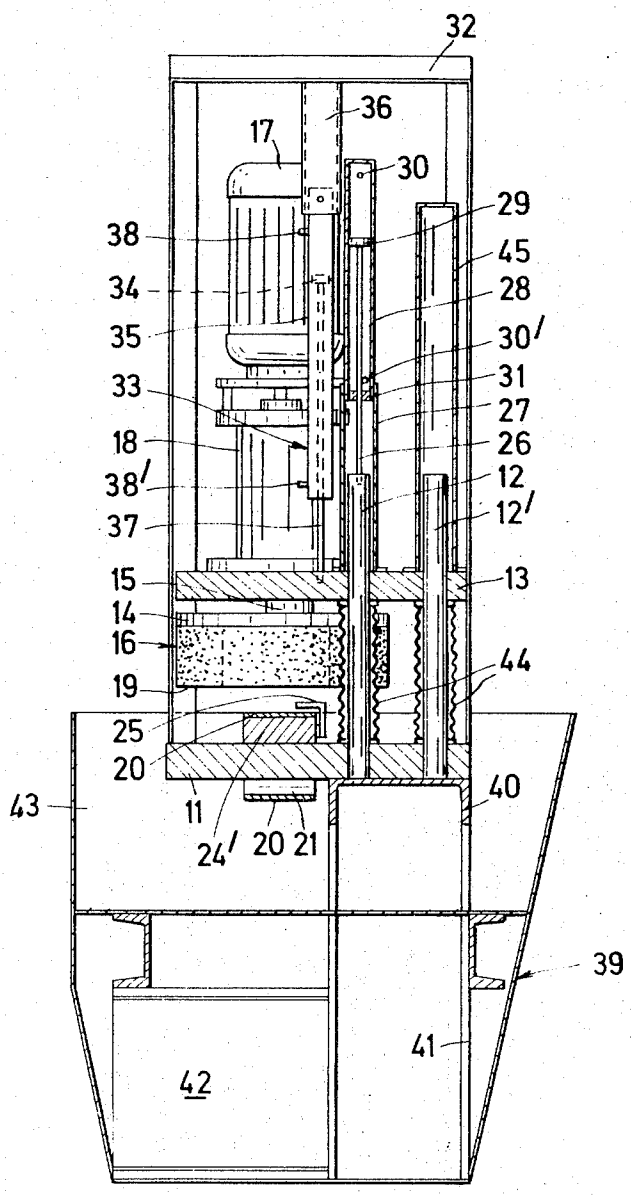


—FIG. 2.—

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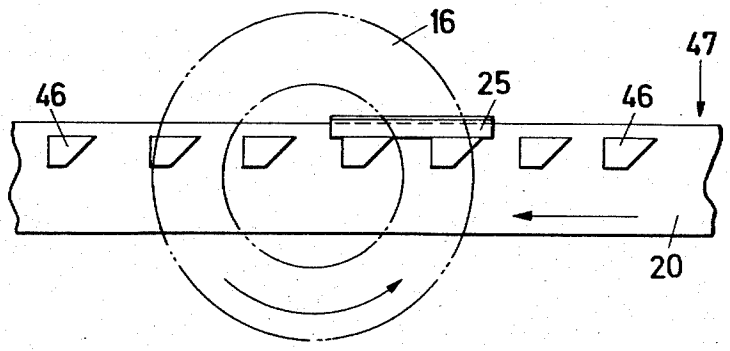


FIG. 3.

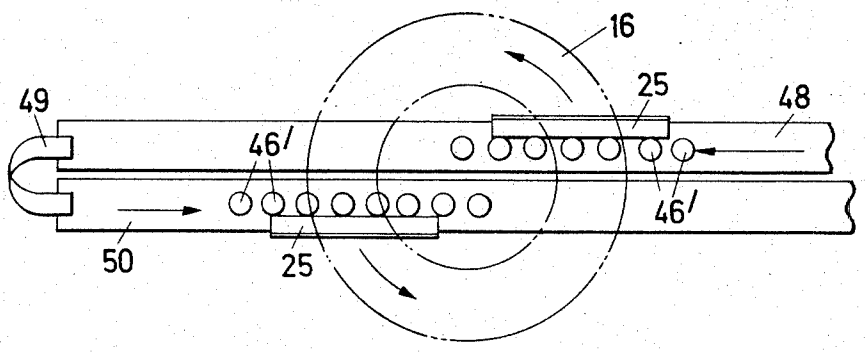


FIG. 4.

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# GRINDING MACHINE

The present invention relates to a surface grinding machine.

It is known to provide a grinding machine in which workpieces are carried under the grinding wheel by means of a reciprocating table. Such grinding machines with reciprocating tables have a limited throughput and accordingly are not entirely satisfactory for mass-produced or other articles where only a reasonable tolerance and a high output is required. It is also known to provide a grinding machine in which the support bed for the chuck and the support for the grinding wheel are formed as an integral, complex casting and wherein the support for the grinding wheel comprises an irregular sectioned bent-over arm having a machined face on which the wheel carrier travels. Such grinding machines have the disadvantages of being expensive to produce and particularly heavy and bulky.

Accordingly to one aspect of the present invention an improved grinding machine comprises a workpiece support base, at least one support column connected to and extending upwardly from the base and carrying a displaceable head provided with rotatable support means for carrying a rotary grinding wheel, and conveying means supported on the base at least in the operative region of the grinding wheel for traversing workpieces under the wheel during operation thereof; said conveying means comprising at least one continuous conveyor or a rotary table of thin sheet material, and being arranged to move under the wheel in single direction.

Preferably, the conveyor is a flexible belt made of, for example, polyurethane, phosphor bronze or carborundum, and the workpiece carrying portion thereof slides over and is supported by a flat surface of the workpiece support base or by a flat surface of an intermediate support table or device, such as a magnetic chuck, located on the support base. At least one adjustably locatable, longitudinally extending guide stop is provided along at least a section of the carrying portion of the belt and serves to maintain the workpieces on the belt during the grinding operation. If a rotary table is used, it is supported on and slidably displaceable over the surface of the workpiece support base or intermediate support table so as to carry workpieces under the grinding wheel. The rotary table is made of thin sheet material such as copper or brass, though any flexible material may be used. Drive means are provided for the conveyor belt or rotary table. Further and specific features of the conveying means and particularly the conveyor belt will be described, by way of example, hereinafter. It should, however, be noted that the machine according to this aspect of the invention enables grinding of a continuous stream of workpieces to be effected and a high output to be obtained which has not been hitherto possible with grinding machines having rotary grinding wheels.

According to a further aspect of the present invention, a surface grinding machine comprises a workpiece support base, one or more rectilinear guide columns of constant cross-section extending upwardly with respect to said base, a head located on said columns and provided with rotatable support means for carrying a rotary grinding wheel, and conveying means supported by said base at least in the operative region of the grinding wheel and for traversing workpieces under the wheel during operation thereof; each of said rectilinear columns being fastened at one end region to the base or head, and said head or base respectively being relatively slidably displaceable along and adjustably locatable on said guide columns by displacing means.



An important and advantageous feature of the present invention is the particualr nature and agreement of the main components of the grinding machine, namely the workpiece support base, the column or preferably columns, and the head for carrying the grinding wheel. The inter-relationship and agreement of these main components provides in simple and economic manner, a lightweight, rigid construction wherein a grinding wheel supported thereby is readily and accurately displaceable with respect to workpieces carried across the base. This displacement relationship is somewhat similar to that exhibited by, for example, a die-set wherein the sliding relationship of the cross-head on columns secured to the base provides accurate relative displacement without involving expensive, heavy and cumbersome, complex castings.

A plurality of spaced, parallel, rectilinear guide columns of constant cross-section are preferably provided and preferably extend normally to the support base. The number of guide columns is chosen as desired to achieve satisfactory stability of the head with the respect to the support base and are preferably four in number, with the columns located in spaced apart pairs to one and the same side of the carrying means to provide access thereto and to the grinding wheel.

The guide columns may be of any suitable cross-section but preferably are circular in section i.e. th columns are in the form of cylindrical pillars. Either the head or support base, depending upon which is to be relatively displaceable, may have one or more apertures extending therethrough with one of said columns extending in sliding relationship through each of the apertures. Suitable linear bearings may be provided to line said apertures.

Alternatively, one or more recesses may be provided in at least one edge of the head or support base, or one or more projections may be provided on the head or support base, and such recesses or projections are slidingly co-operable with the guide columns such that the displaceable head or support is non-tiltably and accurately guided thereby. Suitable bearings may be provided here also.

Perferably, the head is displaceable along the guide columns with the base being kept stationary and, accordingly, the lower ends of the guide columns are secured to the base e.g. by press or force fit in apertures in the base. It is, however, possible for the head to be kept stationary and the workpiece support base to be displaced, although this is not a preferred arrangement. It is further possible, although not preferred, for the columns with the head or base secured thereto, to be displaceable with respect to the base or head respectively. The support base and head are preferably in the form of flat, rigid metal plates which are substantially rectangular in shape.

The conveying means may comprise a rotatable table which may be of thin sheet material provided with suitable stop means. Alternatively, the conveying means may be a displaceable and possibly reciprocating intermediate support device or slide adapted to carry workpieces and is slidably supported on the workpiece support base. Preferably, however, the conveying means is

in the form of at least one driven endless conveyor belt extending around the support base and slidably displaceable across the flat upper support surface of the support base in a single direction. The workpieces are carried by the belt under the grinding wheel to provide continuous operation. The conveyor belt is directly or indirectly supported by the support base and when indirectly supplied on the base, the intermediate support means which may be a longitudinally extending magnetic chuck for use with workpieces of ferro-magnetic materials and in such instance, the belt is made of a non-magnetic material such as a phosphor bronze which has the advantage of possessing satisfactory strength characteristics and, because of its good thermal conductivity, of dissipating heat produced by friction in the working area of the grinding machine. Alternatively, an endless belt having a carborundum surface may be provided where a high coefficient of friction with the workpieces is desired. Still further, the belt may be made of polyurethane which is of advantage when grinding brittle workpieces. The belt, however, should be substantially incompressible to prevent undue tilting of the workpiece.

To ensure retention of a workpiece on a belt conveyor in the operating region of the grinding wheel, a longitudinally extnending guide-stop is provided extending along at least one edge region of the conveyor, of suitable dimensions or suitably adjustable such that its upper surface extends above the surface of the conveyor belt for a distance less than or equal to the required thickness of a finished, ground component. The guide sgop is located on the downstream side of the conveyor belt with respect to the conveyor and the direction of the rotation of the grinding wheel.

To enable workpieces to be ground on both sides in a single grinding operation, a double belt arrangement may be used wherein two parallel, spaced belts are provided, each having an associated adjustable guide-stop. At least one of the belts runs over an intermediate support table or device which is at a slightly higher level than the other belt and the difference in level between the belts is adjusted so as to be substantially equal to the amount of material removed from the workpiece in a single passage under the wheel. Suitable reversing and return means are provided so that workpieces having been ground on one surface are turned-over, returned to the input side of the belt on the higher level and then ground on their reverse surface whilst fresh workpieces are being ground at the same time on the lower belt.

The grinding wheel or stone is received by suitable rotatable support means carried by the head and these support means may comprise a spindle or shaft rotatably mounted in the head and having a circular plate or other means at its lower end to which the wheel is secured in known manner. The motor for driving rotatable shaft, plate and grinding wheel is preferably also carried on the head and suitable power supply means connected thereto. The grinding wheel preferably rotates above the conveying means about a substantially vertical axis and is a hollow, cylindrically shaped wheel with its lower annular end face being the cutting face. This face will be trimmed slanting (provided with a tapered throat) to give a uniform rate of cut as the workpiece moves thereunder.

A composite grinding wheel may be provided and comprise an outer annular section of coarse grain and/or hard grade material for high stock removal and an inner, annular section of a finer grain to provide a good finish to the workpieces in one operation and to render a seperate finishing grinding operation unnecessary.

When a continuous belt conveyor is provided, a feed station is preferably also provided and may comprise an upwardly extending stop member which is adjustably displaceable above the conveyor belt on the intake side of the machine such that a stack of workpieces to be ground are held thereby. A space is provided between the bottom of the stop and the conveyor of such dimension as to permit single workpieces to be withdrawn in sequence from the bottom of the stack by the conveyor and fed to the grinding wheel under the possible action of magnetic forces of a magnetic chuck and/or combined with frictional forces existing between the conveyor and the workpiece surface.

Displacement of the head or base may be effected by mechanical means such as a lead screw, but is preferably effected by one or more hydraulic piston-cylinder units, and auxilliary locking or locating means may be provided for maintaining the head and grinding wheel in a fixed position or at least in a controllably locatable position when in operation. Suitable control means and gauges may be provided for accurate and precise control of the movement of the head and grinding wheel or the base, and a sensor may be provided in an aperture in the centre of the grinding wheel for accurately determining the thickness and/or finish of a workpiece after having passed below the first part of the rotating grinding wheel.

A suitable supply of cooling, grinding or lubricant liquid will be provided and gaiters located on the columns to protect the machined surfaces thereof from contamination by material dislodged during the grinding operation. Suitable washing or other cleaning means may be provided to maintain the conveying means and support surface free from contamination by undesired particles. The drive means of the conveyor is also provided with control means for regulation of the speed of displacement thereof.

A mounting for the previously described machine may be provided and such mounting need not be so accurately arranged and bedded as for previous known machines, since the arrangement of the base support, columns, head, grinding wheel and conveying means ensures a satisfactory, aligned displacement relationship between the members. A collection trough for fluid used during grinding may be formed in the mounting and be provided with fluid removal means.

In operation of the grinding machine according to the present invention, a stack of workpieces to be ground is located as the feed station and the workpieces are removed individually and continuously therefrom by the conveying means, which is preferably a belt conveyor having a lateral guide stop associated therewith. The workpieces are then conveyed in line with the guide stop means in a single direction beneath the rotating grinding wheel, which grinds the workpieces substantially to size at the first encountered peripheral grinding region of the wheel, where the guide stop is located to prevent dislodgement of the workpiece from the conveyor belt. Upon completion of the grinding operation the finished workpieces are conveyed by the conveyor belt to a discharge station.

In a preferred embodiment of the present invention, a grinding machine comprises a flat, horizontal work-

piece support base, four rectinlinear guide columns of constant circular cross section extending vertically to said base, a head located on said columns and adapted to be slidably displaceable on and guided by said columns and being adjustably locatable therealong, support means rotatable about a substantially vertical axis and carried by said head for receiving a grinding wheel located substantially between the base and head, and a continuous belt conveyor supported by said base at least in the cutting region of the grinding wheel for traversing workpieces under the wheel during operation thereof; each of said rectilinear columns being securely connected at a lower end region to said base.

The columns are arranged in spaced apart pairs extending through apertures in the head which are provided with sliding bearings, and the columns are located to one and the same side of the conveyor belt. The displacing means for the head includes piston means at the upper ends of the column of each pair adjacent the grinding wheel and the pistons are each slidable in a hydraulic cylinder connected to said head. The pistons are double acting i.e. hydraulic liquid may be supplied to both sides of the piston so as to enable the head to be controllably displaced in either direction along the columns and to be locked in position thereon by suitably hydraulic locking means.

An air sensor acts on the cutting surface of the wheel and determines the amount of wheel wear. The air sensor is associated with a metering device in the hydraulic system of the displacing means cush that a lowering of the grinding wheel by an amount corresponding to the wheel wear is effected by releasing a suitable amount of hydraulic liquid from the cylinders. Suitable controls and gauges are also provided for accurate control of the displacement of the head, rotation of the grinding wheel, and drive of the conveyor belt.

A guard is displaceably mounted on the head by positioning means which may comprise two hydraulic piston and cylinder arrangements with the pistons being connected to the head via piston rods and the cylinders connected to the guard. The pistons here also are double acting so that the guard may be locked in position on the head or optionally raised or lowered with respect thereto.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a front elevation with a cut-away portion of a grinding machine and a mounting therefor;

FIG. 2 is a section on the line X — X of FIG. 1 but including a guard and associated positioning means therefor and excluding the drive motor for a conveyor belt;

FIG. 3 is a schematic plan of a grinding wheel, guide stop and conveyor belt for traversing workpieces under the wheel; and

FIG. 4 is a schematic plan of an alternative, double conveyor belt arrangement.

The grinding machine shown in FIGS. 1 and 2 includes a rigid, rectangular workpiece support base **11** having flat, machined faces and four rectilinear, cylindrical guide columns **12, 12'** rectangularly arranged and extending substantially normally therefrom (only three of the columns in fact being shown in FIGS. 1 and 2). The four columns **12, 12'** are fastened at their lower ends by force-fit in apertures in the base **11** and are arranged in pairs evenly spaced about the transverse axis of the base **11.** The columns **12, 12'** are located to one and the same side of the longitudinal axis of the base **11.**

A rectangular head **13** is displaceably mounted on columns **12, 12'** which pass through apertures therein. Pre-loaded inner ball bushes (not shown) are provided in the apertures as bearings to ensure accurate and smooth displacement of the head **13** on the columns.

A circular plate **14** and a shaft **15** connected thereto and rotatably mounted in bearings (not shown) on the head **13,** form rotatable support means for carrying a hollow grinding wheel **16.** An electric motor **17** with bearing housing **18** is mounted on the head **13** and rotates grinding wheel **16** via shaft **15** and plate **14.**

The grinding wheel **17** is secured, in known manner, to the plate **14** by a plurality of screws extending through apertures in plate **14.** The wheel **16** is supported by the plate **14** and shaft **15** so as to be rotatable about an axis which is also substantially normal to the base **11.** The annular cutting face **19** of the grinding wheel **16** is cut-slanting or throated to give a uniform rate of cut of workpieces and this tapered throat dictates the maximum cut of the wheel. The slanting face is not of appreciable dimension to be shown in the drawings and extends from the outer peripheral edge of the wheel downwardly to the inner edge of the wheel.

A continuous conveyor belt **20** made of phosphor bronze is carried by two pulleys **21** and **21'** of which pulley **21** is mounted on base **11** and driven by a variable speed electric motor **22.** Pulley **21'** is adjustably mounted on base **11** by a screw belt-tensioning device **23** which enables the belt tension to be adjusted and also the belt to be readily removed from the pulleys. The conveyor belt **20** extends substantially parallel to the front edge of base **11** and around the base **11.** The belt **20** is slidably displaceable over two longitudinally extending magnetic chucks **24, 24'** securely located on the base **11** and extending substantially parallel with the belt **20** and substantially diametrically with respect to the wheel **16.**

A guide stop **25** of substantially inverted L-shape section is removably secure to the magnetic chuck **24'** in the cutting region of the wheel **16** and serves to retain workpieces on the belt during grinding operations. Workpieces slide along the guide stop **25** during grinding. The guide stop **25** extends over and is parallel with the belt **20** and is suitably dimensioned for particular grinding operations so as to substantially avoid contact with the wheel **16** after a workpiece has been ground thereby.

Each of the two columns **12** has a piston rod **26** secured thereto and extending upwardly therefrom and through a "top-hat"arrangement or flanged sleeve **27** extending around the top portion of each column **12.** Each sleeve **27** is bolted at its lower end to the head **13** by means of its flange, and is fastened at its other end to a hydraulic cylinder **28** which slides over a double acting piston **29** carried by piston rod **26.** The cylinders **28** each have upper and lower hydraulic flow ducts **30** and **30'** communicating with a hydraulic liquid source and control system (not shown). The cylinders **28** each have a closed lower end **31** having a seal which slides along each piston rod **26.** It will be appreciated that the sleeves **27** act to transmit a displacing force to the head **13** from the piston-cylinder unit **26, 28, 29.**

The hydraulic liquid control system (not shown) supplies equal quantities of liquid to respective chambers of eqch cylinder **28** and includes locks which prevent the flow of liquid into or out of the upper and lower chambers of cylinders **28** when the grinding wheel has been located in a required position. Accordingly, the head **13** is adjustably locatable on the guide columns **12, 12'**. Further, an air sensor (not shown) acts on the cutting face of the wheel **16** and is associated with a metering device of the hydraulic grinding wheel **16,** so that lowering of the head and wheel by an amount corresponding to the wheel wear is effected by releasing a suitable amount of hydraulic liquid from the upper chambers of cylinders **28.** A pressure accumulator is provided in the hydraulic system to avoid having the hydraulic pump running whilst minor displacements of the head are being effected during grinding.

A guard **32,** indicated in dotted line only in FIG. **1,** is provided for enclosing the grinding area and is in the form of a rigid, enclosed box frame which is open at its top and bottom ends. The guard **32** is displaceably mounted on the head **13** by means of two hydraulic piston-cylinder units **33** which have been omitted from FIG. **1** for the sake of clarity. The piston-cylinder units of which only one is shown in FIG. **2,** are not located in line with columns **12, 12'** (i.e. not on line X — X) but rather inwardly thereof and on the longitudinal axis of the head **13,** on either side of the transverse axis of the head **13.**

The piston **34** of the piston-cylinder unit **33** is also double acting and slidable in cylinder **35** which is connected to a frame member **36** connected to the framework of guard **32.** Piston rods **37** each carry a piston **34** and are connected to the head **13.** The cylinder **35** is provided with hydraulic liquid flow ducts **38** and **38'** which communicate with the hydraulic control system of the machine so that the guard is displaceable on the head **13** and may be locked in position by piston-cylinder units so as to bear on the base **13** during grinding and as shown in FIG. **2.**

The guard **32** is provided with suitable inlet and outlet apertures (not shown) in opposite side walls to permit traversing of workpieces on the belt **20** under the grinding wheel **16.**

The base **11** is supported by a mounting generally indicated by arrow **39** and is bolted (not shown) to horizontal frame member **40** to overhang as a cantilever. The frame member **40** is rigidly connected to vertical frame members **41, 41'** which in turn are connected to further horizontal frame members **42, 42'** acting as feet for the mounting and providing stability therefor. The casing of the mounting **39** forms a trough **43** for collecting grinding fluid etc, during grinding operations.

Liquid removal means (not shown) are provided to prevent over-filling of the trough **43.** Washing devices (not shown) are also provided to clean the belt **20** and means (also not shown) are provided to prevent contamination of the underside of the belt and the surfaces of the chucks. Also, gaiters **44** are provided on the columns **12, 12'** to prevent contamination and damage to the machined surfaces thereof and of the bearings therefor. The two columns **12'** (only one being shown in FIG. **2**) are each provided with a covering sleeve **45** mounted on head **13** and extending upwardly therefrom to terminate in a closed end. The sleeves **45** serve to protect columns **12'** from contamination and act as supporting means for control devices of the machine.

The cantilever mounting of base **11** on the frame member **40** permits free movement of the belt around the base and, together with the location of the columns **12, 12'**, to one side of the conveyor belt **21** and chucks **24, 24'** also permits a belt to be readily removed from the pulleys **21, 21'** and replaced by another. The location of the columns **12, 12'** also permits good access to both the grinding wheel and conveyor belt and clearance for workpieces. The guard **32** is raised off the base **11** when the wheel or belt is being changed. It is to be noted from the drawings, that the pulleys **21, 21'** are arranged so as to urge the belt **20** against the upper surfaces of the magnetic chucks **24, 24'**.

The belt **20** of the machine rotates in an anti-clockwise direction as viewed in FIG. **1** and the wheel **16** also rotates in anti-clockwise direction as viewed from above. The relative belt and wheel displacement is illustrated in the schematic plan view in FIG. **3.** Workpieces **46** are fed onto the belt **20** in line with guide-stop **25** and acted upon by the wheel **16** adjacent guide stop **25** which prevents dislodgement of the workpieces from the belt. It should be noted that both ferro-magnetic and non ferro-magnetic workpieces may be ground by the machine. Suitable control means (not shown) for the drive motors **17** and **22** and the hydraulic system, and gauges for sizing the workpieces are provided.

An automatic feed means or station may be provided in region **47** and may comprise any suitable device such as an upwardly extending stop member transverse to the belt and adjustably displaceable above the belt such that a stack of workpieces to be ground may be held thereby. A space between the bottom of the stop and the belt is provided by adjustment of the stop of such dimension to permit single workpieces to be withdrawn from the bottom of the stack of the conveyor and fed to the grinding wheel under the action of the magnetic forces of the magnetic chuck and/or combined with frictional forces existing between the conveyor and the workpiece surface. The grinding wheel **16** is adjustably located along its vertical axis of rotation to remove the desired amount of material from the workpiece at the first contact region of the annular wheel.

FIG. **4** illustrates a double belt arrangement which may be used as an alternative to that provided for the machine of FIGS. **1** and **2.** This arrangement permits workpieces **46'** having flat surfaces to be ground on two surfaces during the same grinding operation.

Conveyor belt **48,** displaceable over a magnetic chuck, for example, extends parallel with a diameter of the wheel **16** and traverses workpieces **46'** under the wheel to grind one surface thereof. A reversing and return device, illustrated at **49,** is provided and may be of known kind such as a twisted tube arrangement. The device **49** inverts the workpieces and feeds them to a second conveyor belt **50** running parallel and in opposite direction to belt **48.** A second magnetic chuck is provided for belt **50** at a height above those on belt **48** substantially equal to the amount of material removed during the grinding on belt **48.** Guide stops **25** are provided for belts **48** and **50.**

Thus, it will be seen that with the structure of the invention the components **40-42** form a frame means which carries a base means formed by the base **11** which has at one side an elongated portion fixed to the

frame means and which extends in cantilever fashion freely beyond the frame means so that at its opposite side it has a free elongated portion surrounded by the endless conveyor means formed by the belt **20** which because of this construction can be readily removed from and reassembled with the base means **11**, in particular with respect to the belt pulleys **20** and **21** which are carried by the base means **11** at the region of opposed ends of the latter and by the elongated portion thereof which extends in cantilever fashion freely beyond the frame means. The columns **12, 12'** form an elongated column means fixed to and extending from the elongated portion of the base means which is fixed to the frame means while the pistons **29** and cylinders **27, 28** orm a hydraulic means carried by the column means and in turn carrying the support means **13** for adjustable movement along the column means toward and away from the base means **11.** The support means **13** serves to support the rotary grinding means **16** for rotary movement, this support means **13** of course also supporting the drive means **17** which rotates the grinding means **16.** The guide stop **25** forms a work-retaining means which operates to retain the work on the conveyor means **20** while the work is acted upon by the rotary grinding means **16.** The magnetic chuck **24'** forms a magnetic means carried by the base means **11** between the latter and the conveyor means **20,** this magnetic means **24'** forming not only a means for magnetically retaining the work on the conveyor means while the work-retaining means **25** prevents movement of the work from the conveyor means, but in addition the magnetic means **24'** defines a free flat surface on which the work-supporting portion of the conveyor means **20** slides so that the surface of the magnetic means **24'** which engages the belt **20** also supports the belt in a predetermined plane for precisely situating the work with respect to the grinding means **16.** The guard **32** forms a hollow guard means which surrounds the work area and which is hydraulically removable therefrom by way of the hydraulic means **33.**

It is to be understood that, whilst the machine according to the invention is described herein, for simplicity, as one suitable for carrying out grinding operations utilizing a grinding wheel, the machine may also be utilised by the provision of a suitable tool, performing operations other than grinding, such as milling.

I claim:

**1.** In a grinding machine, stationary frame means and base means carried by said frame means, said base means having a portion fixed to said frame means and aid base means extending freely in cantilever fashion beyond said frame means so as to have a free portion situated beyond said frame means, endless conveyer means extending along and around said free portion of said base means for conveying work past a work station, said endless conveyer means having on one side of said base means a work-supporting portion, column means fixed to and extending substantially normal to said base means at the portion thereof which is fixed to said frame means, support means guided by said column means for movement therealong toward and away from said base means, adjusting means operatively connected to said support means for adjusting the position of the latter along said column means, rotary grinding means having an annular grinding surface supported for rotary movement by said support means and situated between the latter and said base means with said work-supporting portion of said endless conveyor means situated between said base means and said rotary grinding means, said rotary grinding means being in alignment with said work station so that while work is moved past said work station it can be acted upon by said rotary grinding means, work-retaining means extending along and edge of said work-supporting portion of said endless conveyer means for retaining work at the work station while the work is acted upon by the rotary grinding means, guard means surrounding the work area where the work moves through the work station, and hydraulic means connected to said guard means for displacing the latter to give access to said endless conveyer means and work.

**2.** In a grinding machine, stationary frame means and base means carried by said frame means, said base means having a portion fixed to said frame means and said base means extending freely in cantilever fashion beyond said frame means so as to have a free portion situated beyond said frame means, endless conveyer means extending along and around said free portion of said base means conveying work past a work station, said endless conveyer means having on one side of said base means a work-supporting portion, column means fixed to and extending substantially normal to said base means at the portion thereof which is fixed to said frame means, support means guided by said column means for movement therealong toward and away from said base means, adjusting means operatively connected to said support means for adjusting the position of the latter along said column means, rotary grinding means having an annular grinding surface supported for rotary movement by said support means and situated between the latter and said base means with said work-supporting portion of said endless conveyer means situated between said base means and said rotary grinding means, said rotary grinding means being in alignment with said work station so that while work is moved past said work station it can be acted upon by said rotary grinding means,work-retaining means extending along an edge of said supporting portion of said endless conveyer means for retaining work at the work station while the work is acted upon by the rotary grinding means, a pair of said endless conveyer means surrounding the elongated free portion of said base means which extends beyond said frame means and being in the form of a pair of conveyer belts operatively connected with a drive means which drives the conveyer belts in opposite directions with both of said belts being located in a work area acted upon by the rotary grinding means and said belts being arranged in side-by-side relation with said rotary grinding means including only a single rotary grinding wheel which cooperates with work carried by both of said belts.

**3.** The combination of claim **2** and wherein a means is operatively connected with said belts for receiving work from one belt and inverting the work and returning it to the other belt so that different surfaces of the work are acted upon by the single rotary grinding wheel.

**4.** In a grinding machine, stationary frame means and base means carried by said frame means, said base means having a portion fixed to said frame means and said base means extending freely in cantilever fashion beyond said frame means so as to have a free portion situated beyond said frame means, endless conveyer means extending along and around said free portion of

said base means for conveying work past a work station, said endless conveyer means having on one side of said base means a work-supporting portion, column means fixed to and extending substantially normal to said base means at the portion thereof which is fixed to said frame means, support means guided by said column means for movement therealong toward and away from said base means, adjusting means operatively connected to said support means for adjusting the position of the latter along said column means, rotary grinding means having an annular grinding surface supported for rotary movement by said support means and situated between the latter and said base means with said work-supporting portion of said endless conveyer means situated between said base means and said rotary grinding means, said rotary grinding means being in alignment with said work station so that while work is moved past said work station it can be acted upon by said rotary grinding means, work-retaining means extending along an edge of said work-supporting portion of said endless conveyer means for retaining work at the work station while the work is acted upon by the rotary grinding means, said base means being in the form of a horizontal one-piece metal support base, said column means including a plurality of rectilinear support columns of constant circular cross section secured at their lower ends to said base and extending vertically therefrom, said support means being in the form of a carrier head formed with openings through which said columns extend, and said head also extending in cantilever fashion freely beyond said columns where said head has a cantilever portion, said cantilever portion of said head being the part thereof which supports said rotary grinding means for rotary movement, and said cantilever portion of said head being aligned with the portion of said base means which extends in cantilever fashion freely beyond said frame means.

**5.** In a grinding machine, stationary frame means and base means carried by said frame means, said base means having a portion fixed to said frame means and said base means extending freely in cantilever fashion beyond said frame means so as to have a free portion situated beyond said frame means, endless conveyer means extending along and around said free portion of said base means for conveying work past a work station, said endless conveyer means having on one side of said base means a work-supporting portion, column means fixed to and extending substantially normal to said base means at the portion thereof which is fixed to said frame means, support means guided by said column means for movement therealong toward and away from said base means, adjusting means operatively connected to said support means for adjusting the position of the latter along said column means, rotary grinding means having an annular grinding surface supported for rotary movement by said support means and situated between the latter and said base means with said work-supporting portion of said endless conveyer means situated between said base means and said rotary grinding means, said rotary grinding means being in alignment with said work station so that while work is moved past said work station it can be acted upon by said rotary grinding means, work-retaining means extending along an edge of said work-supporting portion of said endless conveyer means for retaining work at the work station while the work is acted upon by the rotary grinding means, said base means being in the form of a substantially horizontal support base, said column means including at least one rectilinear support column secured at its lower end to said base and extending vertically therefrom, said support means being in the form of a carrier head formed with an opening through which said column extends, and said head also extending in cantilever fashion freely beyond said column where said head has a cantilever portion, said cantilever portion of said head being the part thereof which supports said rotary grinding means for rotary movement, and said cantilever portion of said head being aligned with the portion of said base means which extends in cantilever fashion freely beyond said frame means.

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