(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 319 196**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **88311126.2**

(51) Int. Cl.[4]: **B28D 7/04 , B28D 1/04**

(22) Date of filing: **24.11.88**

(30) Priority: **01.12.87 GB 8728035**

(43) Date of publication of application:
07.06.89 Bulletin 89/23

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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(54) A machine for cutting stone or other materials.

(57) A machine for cutting stone or other materials has a moving bed (19) for carrying stones past a circular saw blade or blades (37 38) mounted on a columb (40) and driven in synchronism or separately from the movement of the moving bed (19). The moving bed (19) has a plurality of longitudinal corrugations (21, 22) into one or more of which the saw blade or blades (37, 38) can extend so that the material is cut right through as it is conveyed past the saw blade (37, 38) on the moving bed (19).

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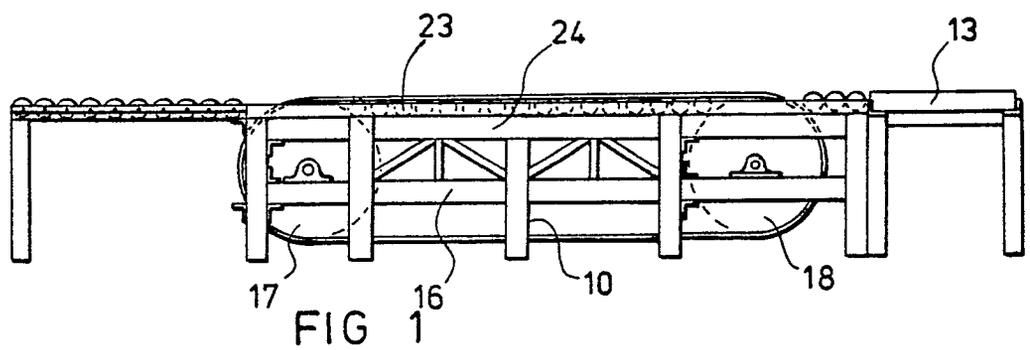

FIG 1

A MACHINE FOR CUTTING STONE OR OTHER MATERIALS

Background of the Invention:

The present invention relates generally to machines for cutting stone or other material, and particularly to a cutting machine incorporating a circular saw blade for cutting flat faces on blocks of stone or the like. Without prejudice to the generality thereof the present invention will hereinafter be described with particular reference to machines adapted to cut blocks of stone. Such machines are often referred to as stone saws. Known stone saws are large, heavy machines which operate slowly because of the heavy work involved, and require constant attention.

The Prior Art:

There are two main types of stone saw known, the first having a fixed bed with a gantry over it carrying a circular saw blade driven by a motor on a saw carriage. The bed of such a machine must be capable of adjustment vertically as well as being rotatable to vary the orientation of the stone, and further requires means for fixing the stone in position whilst the blade is passed to and fro to cut successively deeper into the slot forming the face. In order to load stone for cutting on such a machine it is necessary for the blade carriage to be displaced safely to one side of the table and the drive motor to the saw blade switched off. After cutting the stone it is likewise necessary to move the saw blade out of the working area whilst the operator unloads the cut stone and repositions the block for a further cut or replaces it with a new block for cutting. All this is highly labour-intensive and slow, and the saw blade is out of action all the time that the bed is being loaded or unloaded.

The other type of stone saw in wide use is the trolley-type in which a circular saw carried on a fixed (but adjustable) mount is driven to rotate whilst the stone is brought into contact with it by means of a trolley movable on rails. Again, it is necessary for the stone to be loaded on the trolley and fixed thereon in such a way that the stone is not displaced out of its desired orientation upon contact with the saw blade and a cut is performed by successive traverses of the trolley with the blade being successively adjusted to cut deeper and deeper into the slot until the appropriate cut right through the stone has been performed, whereupon it is necessary to pass the trolley backwards through the cutting position to the loading and unloading position.

Although in this case the saw can be continuously driven it is nevertheless inoperative for the whole length of the time during which the stone is being loaded onto and unloaded from the trolley and such a saw is therefore slow, and offers only a low production rate whilst requiring a high labour input.

The Technical Problem:

The technical problem which the present invention seeks to overcome is that of providing a stone saw in which the above-described disadvantages of the known stone saws are overcome and in which a high production rate can be achieved using less labour, and in which the operator does not require continually to supervise the machine, thereby freeing him for other tasks while the stone is being cut.

The Invention:

According to the present invention, therefore, a stone-cutting machine comprises a fixed mounting for a circular saw blade, means for driving the saw blade to rotate, and an endless conveyor for carrying blocks of stone to be sawn into contact with the saw blade, the conveyor presenting a surface having a plurality of longitudinal channels being parallel, substantially co-planar support surface portions on which stone blocks to be sawn rest, and the saw blade mounting being so arranged that the rim of the saw blade projects into a selected one of the said channels whereby to saw completely through a block of stone conveyed into contact therewith by the said conveyor.

The stone cutting machine of the present invention has several surprising aspects. First, it has been found that there is in fact no need to restrain the stone whilst in contact with the saw blade, and that the frictional engagement between the conveyor and the stone block, together with the contact between the saw teeth and the stone block (it being appreciated that the saw rotates in such a direction as to incorporate a component of movement, of the part of the blade contacting the stone, in the direction of travel of the conveyor) is sufficient to ensure that the surface of the stone being worked by the saw remains in working contact therewith. Because of this there is the possibility that stone can be loaded on one side of the conveyor, traverse the saw blade with a single pass, and be unloaded from the other side, any residual stone pieces requiring further cutting then being

returned to the input end of the conveyor whilst the saw is already cutting a fresh block.

In a preferred embodiment of the invention the conveyor comprises an endless loop of flexible material and the said support surface portions thereof are formed of a resilient material frictionally engaging stone blocks resting thereon whereby to urge them into contact with the saw blade.

The said endless loop of flexible material may be a belt having a plurality of longitudinal ribs of elastomeric material upstanding therefrom, and this conveyor belt may be formed as a composite element from laminar material with the ribs thereof being formed as separate elements attached in the form of strips to one face thereof, or alternatively, the conveyor may be formed as a monolithic elastomeric element with the surface portions being defined by adjacent channels formed in the thickness of the material.

The conveyor belt is preferably carried in a loop over two drums, one at each end of the loop, and an upper, support limb of the loop is itself preferably supported by a plurality of parallel rollers the axes of which all lie in a common plane and extend transversely of the length of the conveyor belt. These rollers, which may be freely rotatably mounted on a support frame of the conveyor, to transfer the weight of the blocks to the ground or other support surface.

The drive to the conveyor belt may be transmitted via one or a plurality of the rollers, or via one or both of the drums at the end of the loop. In the preferred embodiment of the invention drive is transmitted via a single drum driven to rotate via a chain transmission from a drive member as will be described in more detail hereinbelow.

The size of each slab cut by the stone saw can be adjusted by varying the position on the conveyor of the blocks are they approach the saw blade, and this can be achieved by the provision of an adjustable guide fence defining one edge of the path of the stone along the conveyor, this being laterally adjustable to vary the position of the path of the stone with respect to the saw blade and therefore vary the thickness of the cut stone. It would also be possible in theory to vary the position of the saw blade across the width of the conveyor and provision for such adjustment can be made if desired.

Likewise, there may be provided a plurality of circular saw blades on a common drive shaft spaced across the width of the conveyor for cutting individual stones into several slabs in one pass through the machine.

As is known, there may be provided means for spraying the contact region between the blade or blades and the stone or stones with a coolant during cutting, and this coolant may be collected for recirculation or discarded after use.

One embodiment of the present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a conveyor forming part of the stone-cutting machine of the present invention;

Figure 2 is a perspective view of a stone-cutting machine formed in accordance with the principles of the present invention; and

Figure 3 is a section through the conveyor belt taken on the line III-III of Figure 2.

Referring now to the drawings, the stone-cutting machine shown is generally indicated with the reference numeral 11 comprising a conveyor section generally indicated 12 a loading table generally indicated 13 and an unloading table generally indicated 14 with a transverse table section 15 for transferring cut stone to a discharge bay.

The conveyor section 12 comprises a robust frame of welded box-section and angle-section steel members including a plurality of upright legs 10 supporting two main longitudinal supports 16 on opposite ends of which are carried two main drums 17, 18 the former of which is a driven drum and the latter of which is a freely rotatable drum. Over the drums 17, 18 passes a conveyor belt 19 which, as can be seen in Figure 3, comprises a laminar base layer 20 on the upper surface of which are bonded a plurality of longitudinal ribs 21 which, between them, define adjacent parallel longitudinal channels 22. The conveyor belt 19 is a robust material incorporating rubber or other elastomer, and typically may be an inch or two inches thick to withstand the abrasive action of carrying stone blocks over an extended period of time. It is relatively wide (in excess of 1 metre) in comparison with the size of stone block intended to be cut, so that blocks can be placed at different positions across its width (with corresponding changes to the position of the saw blade) to even out wear of the belt over a period of use.

Beneath the upper limb or run of the conveyor belt 19 the frame 15 carries a plurality of parallel support rollers 23 closely spaced along an upper frame member 24 to provide close support for the conveyor belt 19.

As mentioned above, the conveyor drum 17 is driven in operation, to cause the conveyor belt 19 to move in a loop over the two drums 17, 18, and drive is transmitted to the drum 17 via a large chain wheel 25 over which passes a chain 26 driven via a double reduction gear box 29 itself driven via an hydraulic infinitely variable gear box 27 from a motor 44. Drive from the motor 44 is transmitted to the hydraulic infinitely variable gear

box by an output shaft 28. The drive shaft 28 also has a projecting end on the side of the motor 44 remote from the gear box 27 carrying a pulley 30 over which passes a drive belt 31 which drives a larger pulley 32 on the end of a transmission shaft 33 carrying a multiple belt pulley 34 over which pass a plurality of parallel saw-drive belts 35. The saw drive belts 35 also pass over a smaller saw drive pulley 36 on the end of a shaft (not visible in the drawings) which carries two parallel saw blades 37, 38 partially shrouded by a guard 39. In this way the saw blades 37, 38 can be driven to rotate at constant speed whilst the speed of advance of the conveyor belt 19 can be varied to compensate for the size of stone being cut since obviously, with the saw blades turning at a constant speed, the cutting rate on a larger stone, and thus the required speed of advance of the conveyor belt 19, will be slower than when the saw blade is cutting smaller stones.

The saw blade shaft is carried by a column 40 and is adjustable, by means of a hand wheel 41 whereby to vary the position of the saw blades 37, 38 across the width of the conveyor belt 19, for which purpose the saw blade shaft is formed as a composite, telescopic splined shaft mounted in an extended bearing 42 fixed to the column 40.

The stone saw 11 also incorporates means for spraying a cooling liquid, such as water, over the saw blades where they contact the stone blocks being cut, but such coolant system is conventional and is not illustrated in the drawings or described further herein.

Carried on one side of the conveyor belt 19 supported by the support frame 15 is a guide fence 43 the lateral position of which is adjustable to vary the position of the stone blocks as they are conveyed into contact with the saw blade or blades 37, 38. Although two blades are shown in Figure 2 it will be appreciated that the stone saw of the present invention may incorporate only a single blade, or may incorporate more than two blades carried on the blade drive shaft.

In use of the stone-cutting machine of the invention stone blocks are loaded onto the loading table 13 where they can be orientated into the required orientation to determine the cutting plane, and then moved into contact with the guide fence 43 and onto the conveyor 19. The rubber ribs 21 of the conveyor belt 19 contact the stone blocks and carry them into contact with the saw blade or blades 37, 38 which, being driven to rotate at a high speed in relation to the speed of advance of the conveyor belt 19 cut the stone into one or more slabs (depending on the number of saw blades) in a single pass from which the cut slab is conveyed, still in contact with the conveyor 19, onto the unloading table 14 from which the cut slabs can be displaced laterally onto the discharge table 15 and any blocks requiring further cutting can be brought back to the loading table 13 and positioned with the cut face in contact with the guide fence 43 for cutting further slabs. During cutting, if the feed rate determined by the speed of advance of the belt 19 is greater than the cutting rate of the saw blades 37, 38 a slight slippage will occur between the stone blocks and the conveyor belt, always maintaining the stone block firmly in contact with the cutting teeth of the saw blades 37, 38. In this way, one operator may position a number of stone blocks in sequence for cutting, each orientated as desired prior to transfer onto the conveyor belt 19, and having position a number of blocks in a "queue" for the saw blade may then divert his attention to other matters about the quarry for some time until one or more of the blocks has passed through the saw blade, whereupon he may return to attend to unloading of the cut stone from the unloading table 14 and return of any blocks requiring further cutting to the loading table 13. In this way the cutting blades 37, 38 are kept continuously operative at all times when the saw is working whilst the operator requires only to give periodic attention to the loading and unloading of stone and may be employed gainfully in other work in the meantime. The production rate of the machine is thus very much greater than conventional stone-cutting machines, both in absolute terms (namely tons of stone cut per day) and also in terms of stone cut per employee).

Although described herein with particular reference to the cutting of stone, it will be appreciated that the machine of the present invention may of course be used to cut materials other than stone such as metal, wood or plastics, in appropriate circumstances.

Claims

1. A machine for cutting stone or other materials, comprising a fixed mounting (40) for a circular saw blade (37, 38), means (32, 33, 34, 35, 36) for driving the saw blade (37, 38) to rotate, and means (19) for carrying blocks of stone or other material to be cut into contact with the saw blade (37, 38), characterised in that the said carrying means (19) comprises an endless conveyor (19) presenting a surface having a plurality of longitudinal channels (22) between parallel, substantially co-planar support surface portions (21), on which blocks of material to be sawn rest in use of the machine, and in that the saw blade mounting (40) is so arranged that the rim of the saw blade (37, 38) projects into

one of the said channels (22) whereby to saw completely through a block of material conveyed into contact therewith by the said conveyor (19).

2. A machine according to Claim 1, characterised in that the conveyor (19) comprises an endless loop (19) of flexible material and the said support surface portions (21) thereof are formed of a resilient material frictionally engaging blocks of material resting thereon whereby to urge them into contact with the saw blade (37, 38).

3. A machine according to Claim 2, characterised in that the said endless loop (19) of flexible material is a belt having a plurality of longitudinal ribs (21) of elastomeric material upstanding therefrom.

4. A machine according to any preceding Claim, characterised in that the conveyor belt (19) is a composite material and the ribs (21) thereof are formed as separate elements attached thereto on one face.

5. A machine according to any of Claims 1 to 3, characterised in that the conveyor belt (19) comprises a monolithic elastomeric element.

6. A machine according to Claim 4 or Claim 5, characterised in that the conveyor belt (19) is carried in a loop over two drums (17, 18), one at each end of the loop (19), and an upper, support limb of the loop (19) is itself supported by a plurality of parallel rollers (23) the axes of which all lie in a common plane and extend transversely of the length of the conveyor belt.

7. A machine according to Claim 6, characterised in that the said plurality of rollers (23) are free to rotate in contact with the under surface of the belt (19).

8. A machine according to Claim 6 or Claim 7, characterised in that the drive to the conveyor belt (19) is transmitted via one of the drums (17) at the end of the loop.

9. A machine according to any preceding Claim, characterised in that there are provided adjustable longitudinally extending guide means (43) defining one edge of the path of the stone along the conveyor (19), the said guide means (43) being laterally adjustable to vary the position of the path of the material to be cut with respect to the saw blade (37, 38) and thereby vary the thickness of the material cut by the machine.

10. A machine according to any preceding Claim, characterised in that there are provided a plurality of circular saw blades (37, 38) on a common drive shaft (36) for cutting individual stones into several slabs in one pass through the machine.

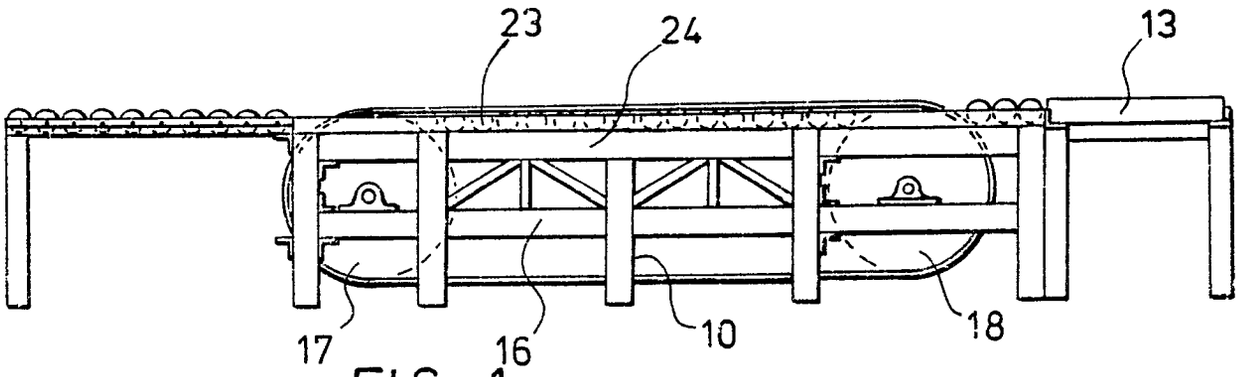

FIG 1

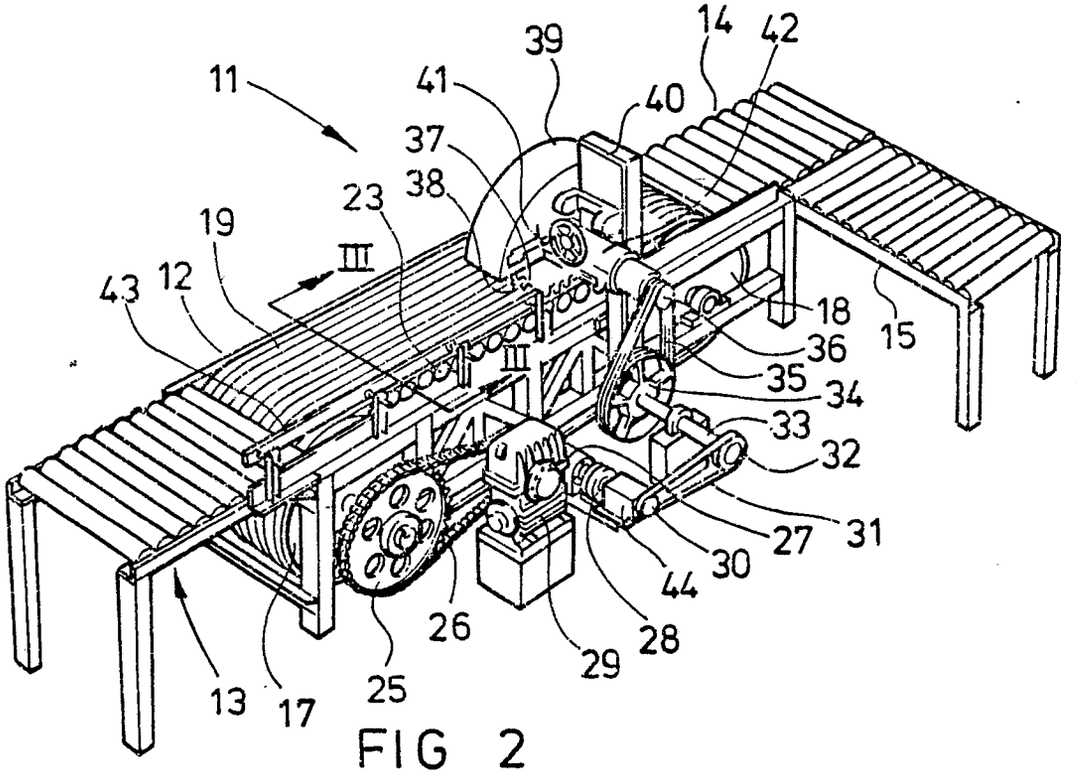

FIG 2

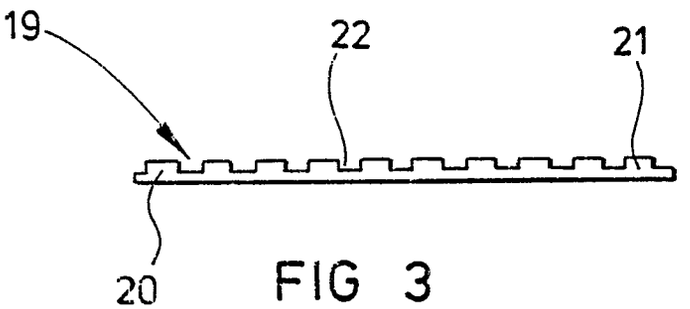

FIG 3