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

(11) **EP 1 318 241 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.06.2003 Bulletin 2003/24

(51) Int Cl.[7]: **E01C 23/09**, E01C 11/10

(21) Application number: **02258333.0**

(22) Date of filing: **03.12.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK TR
Designated Extension States:
AL LT LV MK RO

(30) Priority: **05.12.2001 GB 0129116**

(71) Applicant: **Eurovia S.A.**
92565 Rueil-Malmaison Cedex (FR)

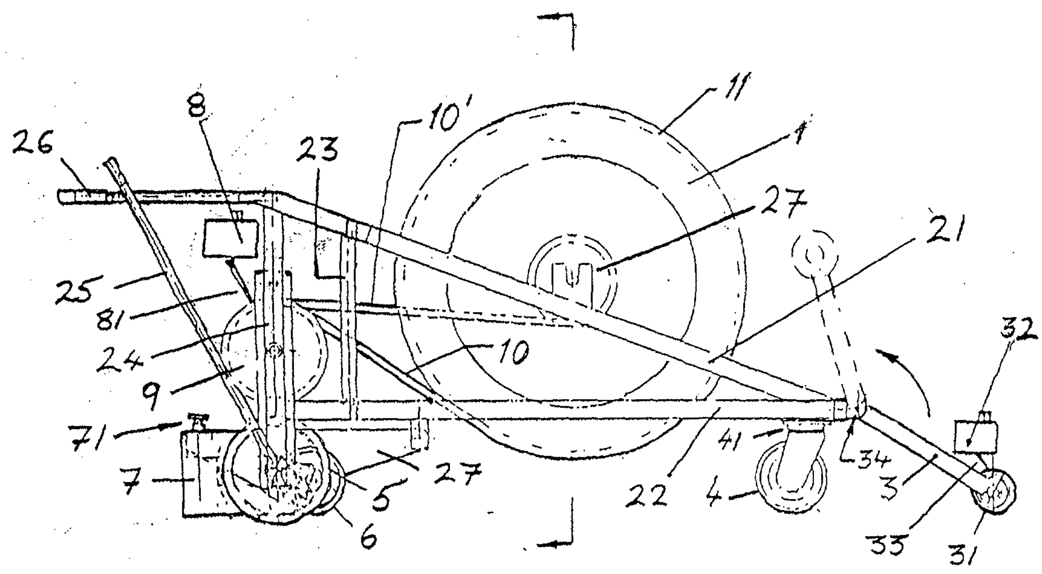
(72) Inventor: **KILNER, David**
RH13 8PD (GB)

(74) Representative: **Stuart, Ian Alexander et al**
MEWBURN ELLIS
York House
23 Kingsway
London WC2B 6HP (GB)

(54) **Joint sealing system**

(57) To seal between slabs (100,100'), a narrow-mouthed slot (102) is created at their adjoining edges and a correspondingly shaped sealing strip (10) is provided therein. A device may insert a preformed resilient strip (10) by guiding it to a compression and insertion device (5), e.g. employing an opposed pair of non-parallel discs (51,51') which project into the slot where they are mutually closest. The strip is inserted into a wide part of the gap between the discs, compressed laterally as they rotate, and ejected into the slot from the narrow part.

Fig 1a



EP 1 318 241 A2

Description

[0001] The invention relates to a method of sealing joints between concrete or asphalt slabs usually associated with airfields or highways. The joints are normally provided for production reasons, or they are designed to prevent thermal cracking of the slab. They are furthermore also provided as a means to prevent the ingress of water, chemicals and debris between slabs.

[0002] These sealing methods normally entail the creation of a vertical sided slot in or between the slabs which is then filled with some form of sealant. The slot depth is normally between 5% and 50% of depth of the slab but there are exceptions. The slot can be cast in situ or machined in after casting the adjacent slabs.

[0003] The more common sealing systems use either hot or cold "cut and pour" applied elastomeric, thermoplastic or thermosetting materials. They are either machine processed on site and extruded into the slot under pressure or they are hand prepared and then poured into the sealing cavity. Alternative systems use preformed elastomeric materials which can be either forced into a pre-machined slot or cast in during the slab laying process by applying the seal to the edge of an existing concrete or asphalt slab.

[0004] The objective of the present invention is to provide a joint sealing system including a convenient and labour saving system of insertion of a sealing strip in the joints between adjacent slabs of structural material, typically rigid or flexible slabs such as concrete or asphalt, which results in high quality joint sealing.

[0005] This objective is achieved according to a first aspect of the invention, by a device for applying a strip of sealing material to a slot provided between slabs of structural material during relative movement of the device along the slot, said device including a guide means and a strip compression and insertion means, the guide means being arranged to guide successive portions of a sealing strip into the sealing strip compression and insertion means, which is arranged to apply a compressive force across the sealing strip, and to insert the compressed sealing strip into the slot.

[0006] Preferably the compression and insertion means is adapted to project at least partially between the opposing walls of the slot and preferably the compression and insertion means further includes means to extricate, within the slot, the sealing strip, whereafter the sealing strip is free to expand an make contact with the opposing walls thereby sealing the slot.

[0007] The sealing strip suitable for use with the insertion device is preferably of tapered, dovetail or substantially isosceles trapezium cross sectional shape which when inserted has a wider parallel side positioned at the bottom of the slot. The use of such a sealing strip has been found to be particularly advantageous since its wider parallel wall enables it to seat securely in the bottom of a correspondingly shaped slot, whilst exposing a top wall (the other parallel side) which is in the vicinity of the slab surfaces, presenting an exposed flat transitional jointing strip.

[0008] Preferably, the device includes a means for applying longitudinal compression to the sealing strip before and/or during extrication from the compression means so that the sealing strip remains under longitudinal compression after insertion in the slot. This is aimed at reducing longitudinal "creep" which is caused by the sealing strip being stretched and therefore under tension during insertion into the slot. Creep can also be caused by changes in temperature and relative longitudinal expansion/contraction between the sealant strip and the slabs. The presence of such creep can give rise to leaks around the joint and abutment zones. This is a particular problem at airfields and other areas where hazardous or aggressive chemicals may be present on taxiway/road surfaces and such like. An example of this is aircraft de-icer.

[0009] In such situations, the chemicals may not only attack and therefore eventually degrade the side walls of the sealing strip causing premature failure. The chemicals may also penetrate directly into foundation layers beneath the slabs and from there into the ground, which self-evidently is highly undesirable.

[0010] Longitudinal compression is preferably achieved by gearing means "gearing" the ratio of the length (as supplied) of sealing strip to the length of the same material after insertion, e.g. typically the distance travelled by the insertion device, to be greater than 1. The compression means preferably takes the form of a disc assembly comprising a pair of rotating discs which face one another and which lie in two planes respectively, the planes being inclined relative to one another, so that the discs are relatively further apart at a region which serves to receive the sealant strip from the guide means than at a region which, in use, projects into the slot and where the sealant strip is extricated. The longitudinal compression is preferably up to 5% of the fixed length of the sealing strip.

[0011] The aim is to provide a simple, mechanically robust means to guide a sealing strip, compress and locate it at least partially between the opposing walls of a slot. The sealing strip is preferably inserted substantially entirely between the walls of the slot, however a small portion may protrude, for example during warm ambient temperatures, when the slabs on either side of the slot expand and tend to compress the sealing strip.

[0012] Preferably the compression means comprise a disc assembly including a pair of rotating discs which face one another and which lie in two planes respectively, the planes being inclined relative to one another, so that the discs are relatively further apart at a region which serves to receive the sealant strip from the guide means than at a region which is capable of projecting into the slot and where the sealant strip is extricated.

[0013] Preferably a position setting means is provided for setting the depth within the slot at which said sealing strip is extricated from the compression means. The position setting means, provided for setting the depth of the inserted sealing strip, is preferably capable of manual adjustment.

[0014] Preferably a support wheel is provided which is capable of rolling contact with the slab surface at the side of the slot into which the discs project, thereby setting the extent to which the discs project into the slot and therefore the depth of the sealing strip within the slot before it is extricated. The support wheel is preferably attached to one of the rotating discs, the support wheel being of smaller diameter than the discs.

[0015] The support wheel, when provided, serves the purpose of both providing a rigid and robust backing flange for each of the two rotating discs. The rotating discs are preferably attached directly to each of two support wheels respectively which are both in rolling contact with the slab surface. This enables the discs to be made of relatively thin material, which is preferable if the discs are not to occupy unnecessary lateral space within the slot into which the sealing strip is being inserted.

[0016] The support wheels preferably rotate on each of two inclined axles respectively, the axes of which substantially intersect. Each of the discs preferably has a central aperture permitting the axles to come into near abutting relationship.

[0017] The discs are preferably permitted to rotate relative to one another, since the presence of a compressed sealant strip, as well as the contact between each of the support wheels and the slab surface, will tend to rotationally lock the discs, when in use.

[0018] By the use of such support wheels, a relative difference in radius between the position occupied by the sealing strip, when in its axially compressed state within the slot and the outer circumference of the support wheels in contact with the upper surface of the slabs on either side of the slot, is provided. This difference in radius may serve to introduce, when the device is in use, a longitudinal compression into the sealing strip as the insertion device moves along the slot. This is intended to reduce the effects of "creep" discussed earlier.

[0019] In order to permit the insertion device to be used for a variety of slot sizes, sealing strip sizes and to vary the extent to which longitudinal compression is introduced into the sealing strip, the disc assembly is preferably detachable and interchangeable with other disc assemblies (e.g. of different diameters) designed for different slot and sealing strip sizes and longitudinal compression requirements.

[0020] The invention also envisages other means of introducing longitudinal compression to the sealing strip as it is inserted. According to one preferred embodiment, the ratio of the rotation of the disc assembly relative to the distance travelled by the insertion device, is fixed by a gearbox or other such gearing mechanism which indirectly connects a wheel travelling along and in contact with the slab surface to the disc assembly.

[0021] The extrication means preferably comprises a plate or such like which is attached to the insertion device and referred to sometimes as a "slipper" which carries a leading edge substantially fixed in position relative to the disc assembly. The leading edge preferably faces substantially in the direction of movement of the device during sealing strip insertion so that the slipper cooperates with the disc assembly as it rotates to contact the radially inner surface of the sealing strip and diverts the sealing strip from between the discs and into its final position within the slot.

[0022] The leading edge of such a slipper acts to "peel" the strip out of the disc assembly. The surface of the slipper behind and to the underside of the leading edge preferably serves to guide the strip after it has been diverted by the leading edge along a path which is substantially parallel to the slab surface and where the strip is free to expand and therefore to seal the slot.

[0023] The height at which the slipper is set relative to the axis of the disc assembly, and therefore in use to the slab surface, will determine the final insertion depth of the strip within the slot.

[0024] The slipper is preferably adjustable in height and/or interchangeable with other slippers of different size in order to suit the different slot dimensions and insertion depths which may be required in use.

[0025] The use of such a slipper may also be arranged to serve as a guide within the slot so as to restrict lateral movement of the insertion device relative to the slot, thereby protecting the disc assembly from damage caused by lateral movement and collision with the slot walls.

[0026] The insertion device is preferably provided with means for applying adhesive to the slot before the sealing strip is inserted into the slot.

[0027] The insertion device may alternatively or additionally be provided with means for applying adhesive to the sealing strip before it is inserted into the slot.

[0028] The use of adhesive preferably serves to provide a strengthened bond and/or improved seal between sealing strip and the walls of the slot consistent with the aims of the invention. The application of adhesive to the sealing strip also preferably serves to lubricate the sealing strip as it passes through the compression means and into the slot which in turn reduces the resistance to motion of the insertion device as it moves along the slot. The lubrication effect is also present when adhesive is applied just to the slot, but to a lesser extent. The insertion device preferably includes mechanically driving means capable of propelling the device along the slot as well as providing the motive force to guide, compress and insert the sealing strip. This may self-evidently reduce the manual labour required to insert the sealing strip.

[0029] According to a second aspect of the invention a method of applying a sealing strip to a slot provided between slabs of rigid structural material is envisaged, comprising the steps of applying a compressive force across the sealing strip, directing the sealing strip to the space between the opposing walls of the slot and releasing, within the slot, the sealing strip from the compressive force so that the sealing strip is then free to expand and make contact with the opposing walls and thereby seal the slot.

[0030] Preferably, a sealing strip of tapered, dovetail or substantially isosceles trapezium cross-sectional shape is inserted into the slot, the broadest parallel wall of which is preferably located at the base of the slot.

[0031] According to a further aspect, a plurality of slabs of structural material provided with one or more joints where peripheral walls of the respective slabs are adjacent one another, the joints including a slot extending from the slab face a predetermined depth into the joint, the opposing walls of the slot being closer at the slab face than at said predetermined depth in the joint, said slot retaining sealing material.

[0032] The sealing material is preferably a pre-formed sealing strip or more preferably a hot or cold poured sealant which is cast in-situ in the slot i.e. a cast sealing strip.

[0033] The use of a slot shaped in such a manner, i. e. a tapered or dovetail shape, is that it helps to prevent the sealant strip joint from being extruded out of the slot when the walls of the slot move closer due for example to thermal expansion of the slabs or due to general movement of the slabs with vehicular use, ground settlements and such like. Instead of being extruded outwards, the sealing strip becomes compressed in on itself and therefore exhibits less tendency of being pushed upwards and out of the slot. This means that there is less likelihood of the joint material moving upwards to a position where it projects from the slot, thereby exposing it to the possibility of mechanical damage from vehicular use and such like, as a result. Such upward extrusion of the joint material can furthermore also weaken and break the adhesive bond between the sealing strip and the walls of the slot, when an adhesive has been used.

[0034] Advantageously the opposing walls of the slot taper away from the centre line of the joint with increasing depth from the slab face.

[0035] Preferably the opposing walls of the slot are substantially flat and taper away from the centre line of the joint with increasing depth from the slab face to where they meet their respective portion of the bottom surface of the slot.

[0036] The bottom surface of the slot is preferably substantially parallel to the slab face.

[0037] Preferably the slot has substantially a tapered, dovetail or an isosceles trapezium cross sectional shape.

[0038] The slot preferably has a width at the top in the range of 5 to 25mm and a width at its base in the range of 20 to 60mm and preferably a minimum width of 5 to 10 mm at its top and a width of 40 to 60mm at its base. The sides of the slot are preferably inclined at an angle of between 5 degrees and 50 degrees relative to the plane of the joint between the slabs, i.e. a plane substantially perpendicular to the slab face or more preferably in the range of 5 degrees to 20 degrees to the same plane. Preferred angles include 5, 7.5, 10, 12.5, 15, 17.5 or 20 degrees. The depth of the slot will preferably be in the range 10 mm to 50 mm, or more preferably in the range of 15 mm to 40 mm.

[0039] The slot walls are preferably finished with sufficient precision so as to be capable, when cooperating with a sealing strip, of maintaining a liquid tight seal. For compression seals being used without an adhesive/sealer, the surface texture of the side walls of the slot is preferably less than 8 Micro CLA. For seals using an adhesive/sealer, the surface texture of the side walls of the slot is preferably up to 125 Micro CLA or more.

[0040] In order to avoid a weak edge where the side walls of the slot meet the slab surface, which may be weak and vulnerable to breakage under load, due to the undercut of the wall of the slot, it is preferable to chamfer, between the side wall of the slot and the slab surface, preferably at an angle of 30 to 90 degrees or more preferably 45 to 90 degrees e.g. 77.5, 80 or 82.5 degrees relative to the plane of the slab surface. Preferably the edge of the chamfer begins at 1-6mm e.g. 3, 4 or 5mm along side wall and/or slab surface respectively from the corner (before it is chamfered) in order to remove the sharp corner. According to a further aspect of the invention a slab assembly comprising a plurality of slabs of structural material provided with one or more joints where peripheral walls of the respective slabs are adjacent one another, at least one said joint including a slot extending from the slab face a predetermined depth into the joint, the opposing walls of the slot being closer at the slab face than at said predetermined depth in the joint, and a sealing material retained in said slot.

[0041] The sealing material is preferably a pre-formed sealing strip or more preferably a hot or cold poured sealant which is cast in-situ in the slot i.e. a cast sealing strip.

[0042] According to a further aspect, the sealing strip is suitable for the above slab assembly and has a substantially tapered, dovetail or isosceles trapezium shaped cross section.

[0043] Preferably the sealing strip has two parallel walls between which the sealing strip tapers. The broadest parallel wall of the sealing strip is preferably concave in cross sectional shape.

[0044] The sealing strip is preferably made substantially entirely of neoprene rubber material.

[0045] The sealing strip preferably includes an additional layer of protective material, such as nitrile rubber (polynitrile), at the narrower of the two parallel outer walls which, after insertion, remains exposed to the environment.

[0046] The additional protective layer may provide added protection to the sealing strip against the effects of aggressive agents at the slab/road surface. These include typically agents such as aircraft de-icer, chemical spillages and such like.

[0047] The sealant strip is preferably structured to include a micro-cellular core surrounded by a solid outer skin layer. The elastomeric micro-cellular core preferably has a density of between 0.4 and 0.8 g/cc (grams per cubic centimetre), or more preferably between 0.5 and 0.65 g/cc. The core is preferably skinned with skin thickness in range of 0.1 mm to 2 mm or more preferably 0.5mm to 1.5mm or 0.75 to 1.25mm. The micro-cellular core preferably comprises a material such as neoprene rubber and has pores or interstices to increase the compressibility of the strip, whilst at the same time reducing its density. The outer skin is preferably of the same material as the micro-cellular core, or more preferably is of a different material and should preferably be fuel and flame resistant. The cross sectional area of the core is preferably in the range 50 mm^2 to 1600 mm^2 or more preferably 400mm^2 to 1200mm^2 or 600mm^2 to 1000mm^2. The side angles are preferably in the range 5 to 60 degrees or more preferably 5 to 45 degrees or 5 to 20 degrees and more preferably 10 degrees relative to a plane substantially perpendicular to a plane substantially aligned with one or both parallel walls of the sealing strip.

[0048] The outer skin is preferably attached, for example by an adhesive coating, to the outside of the micro-cellular core so as to effectively seal the core from the environment. Alternatively, the outer skin and the micro-cellular core are preferably extruded together as one component.

[0049] According to a further aspect of the invention, a method for cutting a slot for the retention of a sealing material, in a slab of structural material or in the joint between the peripheral walls of adjacent slabs of structural material is envisaged, a slot being cut which extends from the slab face to a predetermined depth in the slab or into the joint between slabs, the opposing walls of the slot being closer at the slab face than at said predetermined depth the method including the steps of positioning circular saw blade or grinding wheel at a predetermined inclination relative to the surface of the slab on which the device is positioned, positioning said blade or wheel to project beneath the surface of the slab so as to be capable of cutting into the slab, moving the device in one direction along the joint and/or centre line of the slot to be cut to produce one of the opposing walls of the slot and then moving the device in the opposite direction along the same centre line to produce the other of the opposing walls of the slot.

[0050] Preferably the device is rotated by 180 degrees between being moved in one direction and being moved in the opposite direction.

[0051] According to a further aspect of the invention, there is provided a device suitable for carrying out the above method said device comprising a chassis, e.g. carried on wheels, skids or such like, the chassis carrying a circular saw blade or grinding wheel at a predetermined inclination relative to the surface of the slab on which the device is positioned, the saw blade or grinding wheel projecting beneath the surface of the slab to permit the slot to be cut.

[0052] Preferably said predetermined inclination relative to the slab surface is in the range 45 to 90 degrees or more preferably 60 to 90 degrees or 75 to 85 degrees or approximately 80 degrees.

[0053] Preferably the device includes alignment means capable of being inserted in a slot as it is being cut in a first direction or in a slot which has been cut in a first direction when the device is moved along the cutting line in an opposite direction.

[0054] The device is preferably carried on a set of wheels or such like, a subset or all of which are preferably fixedly aligned with the cutting line of the device. This may improve the directional stability of the device and helps the operator to maintain an accurate cutting line. Alternatively, a subset of the wheels may be rotatably mounted on the chassis to improve the manoeuvrability of the device. Preferably one or more guide means, preferably guide wheels, are provided on the device, the guide means fit at least partially into the joint between adjacent slabs before the slot is cut and/or the slot as it is cut by the device when travelling in said first direction or in said opposite direction. This may enable the device to maintain its alignment relative to the joint by improving the axial stability of the device as it moves along the joint/cutting line and therefore may assist in the production of a slot which is symmetrical relative to the original joint line/intended cutting line.

[0055] According to a further aspect of the invention a method for cutting a slot, for the retention of a sealing material, in a slab of structural material or in the joint between the peripheral walls of adjacent slabs of structural material is envisaged, a slot being cut which extends from the slab face to a predetermined depth in the slab or into the joint between slabs, the opposing walls of the slot being closer at the slab face than at said predetermined depth wherein the method includes the steps of positioning two circular saw blades or grinding wheels one behind the other and inclined relative to one another, inserting the saw blades or grinding wheels into the slab or into a joint between the peripheral walls of adjacent slabs, and moving the saw blades or grinding wheels along the joint and/or a cutting line to cut away the slab material on either side of the joint and/or cutting line to produce respectively each of the opposing walls of the slot.

[0056] According to a further aspect of the invention, there is provided a device suitable for carrying out the above method, said device comprising a chassis, e.g. carried on wheels, skids or such like, the chassis carrying two circular saw blades or grinding wheels, mounted one behind the other relative to the cutting line of the device and/or joint and projecting below the chassis so as to be capable of cutting into the slab of structural material on which the device is positioned, the two saw blades being inclined relative to one another as well as being inclined relative to the slab so that as the device is moved along the cutting line and/or the joint, each blade cuts away the slab material on either side respectively of the cutting line and/or joint to produce respectively each of the opposing walls of the slot.

[0057] The two circular saw blades are preferably arranged to be inclined at substantially the same angle relative to the slab surface or to a plane perpendicular to the slab surface or a plane in the cutting line of the device or the joint between adjacent slabs which is perpendicular to the slab surface.

[0058] Preferably the predetermined inclination relative to the slab surface of one or both saw blades is in the range 45 to 90 degrees or more preferably 60 to 90 degrees or 75 to 85 degrees or approximately 80 degrees.

[0059] The device is preferably carried on a set of wheels, preferably four wheels, some or all of which are preferably fixed in alignment with the cutting line of the device. This may improve directional stability. A subset of wheels may be rotatably attached to the chassis to give the device added manoeuvrability.

[0060] Preferably a guide wheel is also provided on the device which is capable of fitting at least partially into the joint between adjacent slabs before the slot is cut or into the slot which has just been cut by the device. This may once again improve the directional stability of the device, helping to maintain its alignment relative to the joint and/or slot as it is moved along its cutting line. This may therefore assist in the production of a straight slot, and in the case of adding a slot to a pre-existing joint, the production of a slot which is symmetrical relative to the original joint line.

[0061] Preferably both saw blades are powered independently, however alternatively both saw blades may be driven by one power source.

[0062] According to a further aspect of the invention a method for cutting a slot, for the retention of a sealing material, in the joint between the peripheral walls of adjacent slabs of structural material is envisaged, a slot being cut which extends from the slab face to a predetermined depth in the joint, the method includes the steps of providing a single circular saw blade which is mounted so as to be tiltingly oscillatable or able to be "scanned" or "see-sawed" as it rotates, inserting the saw blade into the joint between the peripheral walls of adjacent slabs, and moving the saw blade along the joint to cut away the slab material on either side of the joint to produce respectively each of the opposing walls of the slot.

[0063] This requires only one rotating saw blade to produce a slot of the desired shape and dimensions for a sealing strip of tapered, dovetailed or isosceles trapezium shaped cross section. The result is a particularly simple, light, reliable and compact version of the invention.

[0064] According to a further aspect of the invention, there is provided a device suitable for carrying out the above method, said device comprising a chassis, e.g. carried on wheels, skids or such like, the chassis carrying a circular saw blade or grinding wheel which is powered by tilting drive means to repeatedly tilt the saw blade or grinding wheel from one side to the other of the joint in which the slot is being cut or of the cutting line of the device, so that as the device is moved along the joint and/or cutting line, the slab material on either side of the joint and/or cutting line is cut away to produce each of the opposing walls of the slot.

[0065] This requires only one circular saw blade or grinding wheel and movement in one direction only to produce the desired shape of slot. Preferably the circular saw blade is powered to tilt successively from one side to the other of the plane of the joint in which the slot is being cut or of the plane in the centre of the slot being cut i.e. the plane containing the centreline of the slot. Preferably said plane is substantially perpendicular to the slab surface or surfaces.

[0066] Preferably the saw blade is arranged to tilt through an angle in the range of 0 to 45 degrees to either side of said plane i.e. the plane substantially perpendicular to the slab face or more preferably 0 to 30 degrees or 0 to 20 degrees or 0 to 10 degrees.

[0067] The use of this arrangement means that the opposing walls of the slot can be closer at the slab face than at said predetermined depth, or alternatively they can be closer at said predetermined depth than at said slab face, depending on how the mechanism of linkages and pivoting points which control the tilt of the saw blade is arranged.

[0068] Preferably the saw blade path and orientation are controlled by linkage means comprising a combination of pivotally interconnected links one or more of which may be pivotally mounted on the chassis and one or more of which may connect to a tilt drive means.

[0069] Preferably the design incorporates a tilt adjustment means for providing an adjustment which, is capable of changing the cross sectional geometry of the cut slot from various widths of tapered slots, where the slot is wider at the bottom than at the top, through a range of parallel sided slots to a 'Vee' slot where the slot is wider at the top than the bottom.

[0070] Using the single pivot point positioned some distance above the substrate is a preferred solution to the problem of machining the tapered shaped slot.

[0071] Preferably the blade is pivoted at a pivot point substantially at the intersection of a plane aligned with the substrate surface and the proposed slot centreline.

[0072] It has been found that by reducing the width of the saw blade for a given slot width, this pivot point can be raised above the substrate surface, but only up to about 40mm for a 350 diameter blade when the saw blade cutting width becomes less than 6mm for a top slot width of 13mm. Thinner blades could have effects on the cutting accuracy due to blade flex, which is due in turn to the side forces involved.

[0073] The pivot point is preferably some distance above the substrate to allow a compliant engineering solution.

[0074] The scanning speed is preferably in the range 100-1000 or more preferably 300-800 or 500-600 or approximately 600 cycles per minute. This typically limits the blade side cutting zone to less than 1mm for a cutting rate of about 1 metre per minute.

[0075] To help this speed to be achieved and accuracy maintained, the movement is preferably powered and controlled by a crank, connecting rod and drive means i.e. a hydraulic motor arrangement. Preferably slot width variation means are provided, to vary the crank stroke so that the width of the slot can be varied.

[0076] According to a preferred embodiment then with no blade transverse movement, the device will produce a parallel sided slot whose width is limited to the width of the blade.

[0077] According to an alternative preferred embodiment a linkage means comprising a linkage with adjustments is envisaged, which enables the path and movement of the saw blade to be controlled with pivot points above the substrate. Preferably such a linkage is able to vary the path and movement of the blade so that the described slot cross section could be changed from a tapered, dovetail or trapezium shaped cross section, whose narrowest parallel side is at the top of the substrate, through to a substantially parallel sided slot and then to a tapered, dovetail or trapezium shaped cross section whose widest parallel side is at the top of the substrate.

[0078] This adjustment facility may be used in combination with an adjustable scanning amplitude i.e. tilt adjustment means may control and vary the width of the slot, is of significant benefit to practitioners, as a variety of slot shapes and widths be produced using a single width of blade.

[0079] Preferably an adjustable three link i.e. trapezoidal arrangement of control links is employed in which two pivot points are mounted on the chassis each of which is attached through a respective link to each of two pivot points on a transverse member. The transverse member is preferably attached either directly or indirectly to the blade via its rotating axle. Preferably either one or both sets of pivot points can be adjusted transversely along the transverse member and/or on the chassis respectively and if desired symmetrically.

[0080] Examples of the invention are now described, with reference to the accompanying drawings, in which

Figure 1a is a front view of an insertion device;
Figure 1b is an end elevation;
Figure 1c is a top view;
Figure 2 is a view of a compression means in the form of a disc assembly and support wheels;
Figure 3a is a front view of a slipper;
Figure 3b is an end elevation of a slipper;
Figure 4 illustrates a slot between two adjacent slabs and a sealing strip for insertion therein;
Figure 5 illustrates a sealing strip.
Figure 6a illustrates a conventional device for cutting a slot.
Figure 6b illustrates a device for cutting a tapered slot.
Figure 7 illustrates a method of cutting a tapered slot with two passes of an inclined saw blade.
Figures 8a and 8b illustrate a slot cutting device having two saw blades.
Figures 9a and 9b illustrate a method of cutting a slot by scanning a single saw blade.
Figures 10a, 10b and 10c illustrate linkage arrangements for scanning a single saw blade to cut different types of slot.
Figure 11 illustrates a crank/linkage arrangement for scanning a saw blade.
Figure 12 illustrates a scanned saw blade being used to produce a slot with a chamfered top.

[0081] The illustrated first embodiment in Figures 1 to 3 illustrates an insertion device for the insertion of a sealing strip into a prepared slot between adjacent slabs, such as adjacent paving slabs of a road, apron of an airport, taxiway, runway and such like.

[0082] The insertion device illustrated consists of a chassis of tubular or boxed metal and which is carried by four wheels (4,6) which are attached to the chassis. The two front wheels (4) are arranged to swivel about a horizontal frame (21 to 26) and this permits the insertion device to be steered by an operator. One member of the frame (21) supports a supply of sealing strip, in the form of axle supports (27) which are for supporting an axle (28) which carries a drum or reel (11) of sealing strip which is capable, when full, of being placed in the insertion device and removed for replacement when empty and so on. In Figures 1b and 1c, two reels (11) of sealing strip are illustrated which are positioned side by side on the same common axle. This means that when one of the reels is empty, the operator can directly continue with the second reel which is full, during which time the empty reel can be removed and replaced with a minimum of disruption to the insertion process. Alternatively, each of the reels may carry a different type of sealing strip in order to make the insertion device more versatile.

[0083] Sealing strip (10) is fed from the reel (11) and onto a further wheel (9) which serves as a guide means which is capable of delivering the sealing strip (10) in one position despite receiving the sealing strip from any position within the stored supply of strip on the reel. The sealing strip illustrated therefore passes around the guide reel (9) and is then fed onto the compression means (5) which is shown in greater detail in Figure 2. The compression means (5) is in the form of a disc assembly which projects into the slot into which the sealing strip is to be inserted. This can be seen from Figure 1a where the disc assembly (5) projects below the level of the chassis support wheels (4,6).

[0084] In the illustrated embodiment, guide wheel (9) rotates in the opposite direction to the supply reel (11).

The sealing strip is fed from the left side of the guide wheel (9) to the right side of the disc assembly (5) (as illustrated) and therefore disc assembly (5) rotates in the opposite direction to the guide wheel (9). The disc assembly (5) rotates in the same direction as the wheels (4,6) which carry the chassis and this permits the sealing strip to be diverted out of the disc assembly at the back of the insertion device by the slipper (7).

[0085] The frame (21 to 26) of the insertion device includes two projecting frame members (26), these project towards the back of insertion device and provide a pair of handles which can be held by the operator in order to push and/or steer the device.

[0086] The frame also includes levers (25) which pivot about an axle (25c). The levers (25) project beyond the axle (25c) to provide further members (25a) which carry the axles (25b) of the wheels (6). The function of the levers (25) is to permit the operator, by pushing the lever forwards, to rotate the members (25a) and axles (25b) relative to the chassis, thus lowering the wheels (6) relative to the rest of the device. This causes the back of the device to be raised relative to the position illustrated in Figure 1a, causing the disc assembly (5) and slipper (7) to be lifted clear of the ground level and therefore self-evidently clear of any slot into which sealing strip has been inserted. The purpose of levers (25) is therefore to permit, by a simple rotating action towards the front of the device (clockwise in Figure 1a), the insertion device to be transported on its own wheels (4,6) without any contact between disc assembly/slipper (5,7) and the ground, thereby avoiding damage to these components during transportation of the device.

[0087] Also illustrated in Figures 1a and 1c is an adhesive applying apparatus (3) which is included in the insertion device. The adhesive applying apparatus comprising support members (3) attached to the frame of the insertion device at pivot (34). This pivoting arrangement permits the first adhesive applying device to be rotated (anticlockwise in Figure 1a) to a position suitable for transportation or to permit the first adhesive applying device to be put in a non-operative state. The first adhesive applying device includes a reservoir (32) which contains a supply of liquid adhesive and a channel (33) for feeding, under gravity, adhesive from the reservoir to the surface of an adhesive applying wheel (31) which rotates on an axle which is attached to the pivoting member (3). The adhesive applying wheel is capable of projecting into the slot into which the strip is to be inserted, the wheel rotating as it travels along the slot, due for example to contact with the bottom of the slot and as it does so, it applies the liquid adhesive on its outer surface which has come from the reservoir (32) to at least the side walls of the slot. This means that the adhesive strip is delivered from the disc assembly (5) into a slot, the side walls of which have already been at least partially covered with adhesive which serves to bond the strip to the side walls thereby providing an additional sealant between the strip and the adjacent slabs.

[0088] The adhesive applying wheel (31) can take the form of a narrow circular brush, circular sponge or fibrous roller and such like. Preferably, the adhesive applying wheel serves as a guide wheel, whether in use to apply adhesive or not, to maintain the position of the device in the slot.

[0089] The insertion device also includes a second adhesive applying device (8) which includes a reservoir for the liquid adhesive and a delivery channel (81) which delivers the adhesive onto the sealing strip as it is rotated at the circumference of the guide wheel (9) towards the compression means (5). The application of adhesive directly to the strip can be additional to the application of adhesive by the first adhesive applying device or as an alternative thereto, both adhesive applying devices being capable of being switched on and off individually. Similarly the flow of liquid adhesive down the delivery channels (33,81) can be manually adjusted and be arranged to feed a brush or sponge or such like, which is in contact with the adhesive applying wheel (31) or sealing strip (10) of said first and second adhesive applying devices respectively.

[0090] The application of liquid adhesive directly to the sealing strip (10) acts to lubricate the strip before it passes into the disc assembly and continues to lubricate the strip during insertion from a disc assembly into the slot. This means that there is less resistance to forward movement of the insertion device as it inserts the strip, making it easier for an operator to carry out the insertion procedure.

[0091] Figure 2 shows a more detailed view of the disc assembly (5) which serves as the compression means of the insertion device. The disc assembly includes two metal discs (51,51') which are inclined relative to one another and have substantially the same angle on either side of a centre line about which the disc assembly is substantially symmetrical and which, in use, coincides approximately with the plane of the joint between adjacent slabs to be sealed. The metallic discs (51,51') are supported and reinforced by their respective support wheels (53,53') which are in turn seated on their respective axles (55,55') which are carried by the frame of the insertion device by means of a structural member (113) which also serves to support the axle of the guide wheel (9).

[0092] The metallic discs (51,51') are secured to the support wheels by tapered headed screws inserted through holes in the metallic discs and into bores (531) in the support wheels. The support wheels are furthermore provided with an outer wearing layer (56) which acts as a kind of tyre around the support wheels ensuring a good frictional engagement between the support wheels and the upper surface of the slab (100,100') on either side of the slot.

[0093] As can be seen from Figure 2, the sealing strip in its relative uncompressed state (10b) is located at the top of the disc assembly. The sealing strip is gradually compressed as it rotates with disc assembly towards its insertion position within the slot, where the lateral compression on the strip is at its maximum, indicated by (10c). The sealing strip is fed from the guide wheel (9) into the space between the metallic discs (51,51') at their outer circumference. The fact that the discs are inclined relative to one another i.e. they rotate about axes which are inclined relative to one another, means that a strip will come under increasing lateral compression as it rotates from the top to the bottom of the disc assembly illustrated. The sealing strip may expand radially as it comes under lateral compression, however this does not give rise to any adverse effects as the strip is still easily accommodated between the discs. As shown in Figure 2, the metallic discs (51,51') have a greater radial extent than the support wheels (53,53'). This permits the outer periphery of the discs to project into the slot (102) between the adjacent slabs (100,100'). At the same time, the support wheels (53,53',56) make contact with the upper surface of the slabs on either side of the slot (102).

[0094] A forward movement of the insertion device imparts, through frictional engagement between the outer surface (56) of the support wheels and the upper surfaces of the slabs (100,100'), a rotational motion onto the support wheels (53,56). The forward movement of the insertion device provides the energy required to laterally compress the sealing strip as well as to guide the sealing strip into its insertion position within the slot (102). The presence the sealing strip between the two metallic discs (51,51') as well as the fact that both support wheels travel the same distance along the upper slab surface, means that the support wheels (53,56) and their respective metallic discs (51,51') are in effect rotationally locked relative to one another.

[0095] Also illustrated in Figure 2 is a "slipper" (7), which is illustrated in greater detail in Figures 3a and 3b. The slipper (7) provides a leading edge (72) which contacts the radially inner surface of sealing strip as it approaches the slot (102). The leading edge (72) acts to divert or "peel" the laterally compressed sealing strip (10c) from between the discs (51,51') at a position where the sealing strip is already at least partially inside the slot, as illustrated in Figure 2. After being diverted initially by the leading edge (72) of the slipper, the sealing strip, in use, will normally make contact with the underside surface (76) of the slipper. In the region where the diversion of the sealing strip takes place, the sealing strip starts to expand to fill the slot (102) as it exits from between the discs (51,51') in response to the action of the slipper (7).

[0096] As illustrated in Figure 3a, the slipper is a substantially plate shaped device which is attachable to a suitable element of the frame of the insertion device by means of a bore (75) within a boss (74) which forms part of the slipper. The slipper is furthermore provided with a height adjustment mechanism (71) which acts to raise or lower the slipper and therefore the leading edge (72) relative to the rest of the insertion device, in particular the disc assembly (5). Height adjustment of the slipper therefore has an influence on the depth of the sealing strip (10c) within the slot (102) as it expands to seal the slot. This is therefore a useful adjustment which makes the insertion device more versatile and adaptable to local conditions. The height adjustment is achieved by a threaded bolt or screw attached to either the frame of the device or the slipper and by which the distance between frame and slipper can be adjusted.

[0097] Figure 4 illustrates a slot (102) in the joint (104) between two slabs (100,100'). The slot is of substantially dovetail, tapered or isosceles trapezium cross sectional shape. The slot (102) is substantially symmetrical about the centreline of the joint (104) and includes two tapered walls (102,102') which are substantially flat and which are closer together at the surface of the slabs and further apart where they meet the bottom of the slot (103). The bottom of the slot (103) is substantially parallel to the surface of the slabs, although this will inevitably vary in practice since rigid slabs used in applications such as roads will very rarely be precisely level. A sealing strip (10) of substantially isosceles trapezium cross sectional shape is illustrated schematically for insertion under compression into the slot (102).

[0098] Figure 5 illustrates a cross sectional view of a sealing strip which has a substantially isosceles trapezium cross sectional shape whereby the longest of the "parallel" walls (106') has a slightly concave form in cross section. The sealing strip (10) has a micro-cellular core (107) which consists of a cellular structure of elastomeric walls which surround interstices in order to produce a core which is resilient and more compressible than a solid core of the same material. The core is surrounded by an outer skin of elastomeric material (106) which have both been extruded together as one component. The outer skin (106) provides a fuel and flame resistant protective outer layer to the sealing strip which makes it particularly suitable for hazardous environments such as aircraft movement surfaces and such like.

[0099] Fig.6a illustrates a cross-sectional view of a conventional slot cutting device with a vertically disposed circular saw blade and which is suitable for cutting a vertically sided slot in the slab on which the device is positioned, the slot being substantially the same width as the width of the circular saw blade.

[0100] Fig.6b illustrates a cross-sectional view of a slot cutting device according to one embodiment of the present invention. The device comprising a body or chassis (200), a pair of axles (203), each of which respectively carries two wheels of different sizes (201,202). The pair of wheels (201,202) on an axle (203) defining, as illustrated, the tilt of the chassis (200) and also the tilt of the axle (204) of the cutting disc (210) relative to the upper surface of the slab (100) on which the slot cutting device is positioned.

[0101] The device in its position illustrated in Fig.6b is capable of cutting a part of the intended slot, including one of the opposing walls of the finished slot, when the device is moving in a first direction. In order to complete the slot the device is turned around and moved along the slot in the opposite direction, thus cutting the remainder of the slot cross-section and in particular, the second of the opposing walls of the slot. This arrangement can, but need not, be used for cutting a slot into an existing joint between two adjacent slabs. The device can be used to cut a tapered slot into a slab which does not have any joint as such.

[0102] A device, as illustrated in Fig.6b can be realised in practice with a minimum amount of modification by the addition of pairs of differently sized wheels (201,202) sharing respective axles (203) to a conventional sawing machine as illustrated in Fig.6a. The outer circumference of the wheels are tapered relative to the axle by substantially the same angle as the angle between the axle and the slab surface so that the wheels present a substantially flat contact surface to the upper surface of the slab. The result is a quick and convenient solution which permits the adaptation of existing devices to the requirement for cutting tapered slots.

[0103] When the saw blade is first introduced into the slab material to start cutting a slot, it may be introduced at the same angle as that of one of the (intended) finished opposing walls of the slot and this can be achieved by a special adaptation of the device illustrated in Fig. 6b.

[0104] Figure 7 illustrates an end view of the joint between two adjacent slabs (100,100') and in this view a slot (102,102:105) is illustrated which has been longitudinally cut into the joint (104) which extends right the way through the thickness of the slabs (100,100') by a saw blade having a first position (120) as the slot cutting device moves in a first direction (first pass) along the intended cutting line of the slot and a second position (121) which is inclined relative to the first position, as the slot cutting device is moved in the opposite direction, after rotation through 180 degrees at the end of the first pass, to cut the opposing walls of the slot (102',102) respectively. As can be seen from Figure 7, the resulting cross sectional shape of the slot is narrower near to the surface of the slabs and gets wider with increasing depth into the joint (104) up to a point where the side walls (102) meet the bottom of the slot (105). As illustrated, the bottom of the slot (105) is neither planar, nor is it parallel to the slab surface and this is a consequence of using an inclined saw blade as described. The method of cutting the slot furthermore also includes the step of guiding the circular saw blade (or grinding disc) by means of guide wheels or fins in order to keep them centred on the joint (104) as it travels along the joint cutting the slot. The circular saw blade, drive means, the guide wheels or fins being included as part of a slot cutting device which is capable of rolling (or sliding) along the slab surface as the slot is cut.

[0105] Fig.8a and 8b illustrate a slot cutting device comprising a body or chassis (300) which is carried on a set of wheels (301) at two axles (302) respectively. The body of the device includes means by which two circular saw blades (303,304) are inclined relative to a vertical plane substantially perpendicular to the slab (100) on which the slot cutting device is positioned. The saw blades are mounted on two axles (303',304') which are inclined relative to one another as illustrated. The circular saw blades (or grinding discs) project beneath the body of the device and into the slab (100) so as to be capable of cutting a tapered slot in the slab. As can be seen from Fig.8a, the saw blades are not only inclined relative to one another, but they are disposed one behind the other relative to the direction of movement (from left to right in Fig.8a) of the slot cutting device. As illustrated in Fig.8b, the upper facing side of one of the saw blades (303) produces one of the opposing walls of the finished slot, the upper facing side of the other saw blade (304) producing the other opposing wall of the finished slot. Also illustrated is a guide means (305) which is intended for insertion in a joint between adjacent slabs and this gives lateral stability to the device, assisting the operator to cut a slot which is symmetrical on either side of the existing joint line. The slot cutting device is furthermore also provided with a pair of handles (306) which permit the operator to steer and/or push the device along a cutting line. The use of this device means that the need to machine the tapered slot in two passes may not therefore be necessary. Once again it should be understood that the saw blades should be introduced, i.e. individually, into the slab and retracted from it at the angle at which they are inclined when cutting the slot. Furthermore, although not illustrated, both the blades of the machine need to be powered either independently, using two separate sources, or together from one source using a power division arrangement.

[0106] Also illustrated in Figures 9a and 9b is an alternative method for cutting a slot wherein the axis, where single circular saw blade (400) is mounted, is tiltingly oscillated or "see-sawed" which causes the circular saw blade to rock from one wall of the slot to the other, between the end positions (400', 400") illustrated and generally in the direction of the arrows shown. The periphery of the saw is therefore rocked as it rotates and causes, when confronting a material to be cut, a band of material to be cut which is of greater width than if the saw blade had been axially fixed. This results in a tapered or substantially dovetail or substantially isosceles trapezium cross-sectionally shaped slot of greater width at greater depth within the joint i.e. at the base of the slot, as illustrated.

[0107] The scanned saw blade (400) is suitable for insertion into the existing joint between the peripheral walls of adjacent slabs and is moved along the joint to cut away the slab material on either side of the joint to produce respectively each of the opposing walls of the slot.

[0108] This requires only one rotating saw blade to produce a tapered slot of the desired shape and dimensions for a sealing strip of tapered, dovetail or isosceles trapezium shaped cross section. The result is a particularly simple, light, reliable and compact version of the invention.

[0109] Figs.9a and 9b illustrate alternative positions for the pivoting axis of the blade, in Fig.9a the pivoting axis is at the intersection of the slab surface and the proposed slot centreline and this is capable of producing a tapered slot, the opening of which is substantially the same width as the width of the saw blade. It has been found that by reducing the width of the saw blade for a given slot width, the pivot point can be raised above the slab surface, as illustrated in Fig.9b, in practice this means about 40mm above the surface for a 350mm diameter blade when the saw blade cutting width is less than about 6mm for a top slot width of 13mm. Thinner blades could have effects on the cutting accuracy due to blade flex, which is due in turn to the side forces involved. For practical reasons the pivot point pivoting axis needs to be some distance above the substrate, however blade ware will influence the blade centre height and bring it closer to the substrate.

[0110] At a typical cutting rate of 1 metre per minute, the scanning speed will be in the order of 500-600 cycles per minute or about 10Hz, in order to limit the blade side cutting zone to less than 1mm.

[0111] Fig.11 illustrates the linkages and pivots which define the movement of the saw blade (400), the axis of rotation of which is arranged to be in parallel with linkage E illustrated.

[0112] If the crank radius G is increased or decreased, the amplitude of the motion through points 1 to 3 and 1a to 3a is increased or decreased thus increasing or decreasing the slot width. Should however non-symmetrical slot geometries be required, then only one pivot point (401 or 402 or A or B) should be moved to affect the change.

[0113] As illustrated in Fig.11, an adjustable three link i.e. trapezoidal arrangement of control links is employed, the linkages C, E and D of which are substantially symmetrical about the cutting axis, in which the pivot points A and B are mounted on the sawing machine frame and pivot points (401) and (402) are attached to a transverse member E which is attached to the blade via its rotating axle. Either or both sets of pivot points can be adjusted transversely on the sawing machine frame and/or transverse member and symmetrically.

[0114] By selecting the length of linkages C, E and D and pivot point positions A and B, then by moving (by drive mechanism E', F, G, 410) links C and D through point 1 to 3 and 1a to 3a respectively, the blade will be controlled to describe the desired cutting action, i.e. of generally isosceles trapezium cross-sectional shape.

[0115] To enable this speed to be achieved whilst maintaining the necessary accuracy, the movement of the axis of the saw blade will be determined by a set of linkages C,D,E and F, attached at fixed points A and B to the slot cutting device, the linkages being interconnected at pivoting points (401,402) which define the tilting oscillation path of the saw blade relative to the slot cutting device. The movement of the saw blade is powered and controlled by a crank (410,404) carrying a pivot (404) to which a connecting rod F is connected. The connecting rod F is furthermore also attached to an extension E^1 of the lateral linkage E, which connects to the ends of the upright linkages C and D. The opposite ends of linkages C and D are in turn connected to respective pivoting points A and B on either side respectively of the saw blade at fixed points on the device. By varying the crank stroke, the width of slot can be varied.

[0116] Fig.10 illustrates how a system of linkages and pivots, by varying the length of upright linkages C, D and/or the distance between points A and B, enables the path and movement of the saw blade and the position of pivoting axis to be controlled. This means that the pivot point of the saw blade can be moved upwards and downwards relative to the rotational axis of the saw blade. Such an arrangement permits a variation in the path and movement of the blade so that the slot cross-section which is cut by the saw blade can be changed from a tapered slot, generally trapezium shaped, whose narrowest parallel side is at the top, i.e. proximate the slab surface (10a), through to a parallel sided slot (10b) and then to a tapered slot, i.e. generally trapezium shaped, whose widest parallel side is approximate the slab surface (10c).

[0117] As the lower pivot points A and B are moved further apart, the pivoting axis X of the blade will move upwards until it reaches infinity (therefore not shown) at which the distance between A and B, and 2 and 2a will be equal, and the saw blade together with the linkages will describe parallel motion, as illustrated in Fig.10b, resulting in a parallel sided slot.

[0118] By making linkages C and D longer, as illustrated in Fig.10c the vertical pivot point can be moved downwards resulting in a slot as shown in Fig.10c which is wider at the slab surface than at the bottom of the slot.

[0119] This adjustment means, i.e. movable pivots 401, 402 and/or points A and/or B and/or an adjustable scanning amplitude (crank stroke) is of significant benefit to practitioners, permitting the width of the slot being cut to be varied, and enabling a variety of slot shapes and widths to be produced using a single width of blade.

[0120] Fig.12 illustrates how an appropriate selection of an appropriate saw blade width and disposition of 1) the saw blade of the sawing machine having a single inclined saw blade i.e. the two pass machine of Fig.6b and 7, 2) the pair of saw blades of the sawing machine having two inclined saw blades i.e. the single pass machine of Fig.8a and Fig.8b, and 3) the saw blade of the sawing machine having a tiltingly oscillatable saw blade of Figs.9-11 i.e. the selection of the pivoting point for the saw blade, i.e. below the surface of the slab into which a slot is being cut can be used to chamfer the corners where the sides of the slot meet the slab surface in order to reduce the sharpness of the edges at the top of the slot which may be a source of weakness.

[0121] As illustrated, the face of the chamfered edge B is then substantially inclined at the same angle as the angle of inclination of the saw blade.

Claims

1. Device for applying a strip (10) of sealing material to a slot (102) provided between slabs (100,100') of structural material during relative movement of the device along the slot, said device including a guide means (9) and a strip compression and insertion means (5), the guide means being arranged to guide successive portions of a sealing strip (10) into the sealing strip compression and insertion means (5), which is arranged to apply a compressive force across the sealing strip, and to insert the compressed sealing strip into the slot.

2. A device according to claim 1 wherein said compression and insertion means (5) is adapted to project at least partially between the opposing walls of the slot and further includes means (7) to extricate, within the slot, the sealing strip, whereafter the sealing strip is free to expand and make contact with the opposing walls thereby sealing the slot.

3. A device according to claim 2 wherein a position setting means (71) is provided for setting the depth within the slot at which said sealing strip is extricated from the compression and insertion means.

4. A device according to claim 3 wherein said position setting means provided for setting the depth at which the sealing strip is extricated is capable of manual adjustment.

5. A device according to any preceding claim which is provided with means for applying adhesive to the slot before the sealing strip is inserted into the slot.

6. A device according to any preceding claim which is provided with means for applying adhesive to the sealing strip before it is inserted into the slot.

7. A device according to any preceding claim which includes means for applying longitudinal compression to the sealing strip.

8. A device according to any preceding claim wherein the compression and insertion means comprises a disc assembly including a pair of rotatable discs which face one another and which lie in respective planes inclined relative to one another, so that the discs are further apart at a region which serves to receive the sealant strip from the guide means than at a region which is capable of projecting into the slot for insertion of the sealant strip.

9. A device according to claim 8 wherein a support wheel is provided, the support wheel being capable of rolling contact with the slab surface at the side of the slot into which the discs project thereby setting the depth of the sealing strip within the slot before it is extricated.

10. A device according to any one of claims 8 to 10 including extrication means as defined in claim 2 which is provided with a leading edge substantially fixed in position relative to the disc assembly, the leading edge facing in the direction of movement of the device during sealing strip insertion and cooperating with the disc assembly as it rotates to divert the sealing strip from between the discs and into its insertion position within the slot.

11. A device according to any preceding claim, the device including mechanically driving means capable of propelling the device along the slot as well as providing the motive force to guide, compress and insert the sealing strip.

12. Method of applying a sealing strip to a slot provided between slabs of structural material comprising the steps of applying a compressive force across the sealing strip, directing the sealing strip to the space between the opposing walls of the slot and releasing, within the slot, the sealing strip from the compressive force so that the sealing strip is then free to expand and make contact with the opposing walls and thereby seal the slot.

13. Method of applying a sealing strip according to claim 12 wherein a sealing strip of substantially isosceles trapezium cross sectional shape is inserted into the slot, the broadest parallel wall of which is located at the base of the slot.

14. Method of applying a sealing strip according to either of claims 12 and 13 wherein adhesive is applied to the slot before the sealant strip is inserted into the slot.

15. Method of applying a sealing strip according to any one of claims 12 to 14 wherein adhesive is applied to the sealing strip before the sealing strip is inserted into the slot.

16. Method of applying a sealing strip according to any one of claims 12 to 15 wherein longitudinal compression is applied to the sealing strip before or during extrication from the compression means so that the sealing strip remains under longitudinal compression after insertion into the slot.

17. A slab assembly comprising a plurality of slabs of structural material provided with one or more joints where peripheral walls of the respective slabs are adjacent one another, at least one said joint including a slot extending from the slab face a predetermined depth into the joint, the opposing walls of the slot being closer at the slab face than at said predetermined depth in the joint, and a sealing material retained in said slot.

18. An assembly according to claim 17 wherein the opposing walls of the slot taper away from the centre line of the joint with increasing depth from the slab face.

19. An assembly of slabs according to claims 17 or 18 wherein the slot retains a sealing strip of substantially isosceles trapezium shaped cross section the broadest parallel wall of which is located at the base of the slot.

20. A sealing strip for use in an assembly according to claim 19.

21. A sealing strip according to claim 20 wherein the sealing strip comprises elastomeric material and preferably comprises a micro-cellular core surrounded by a solid outer skin layer.

22. A sealing strip according to claim 20 or 21 wherein the sealing strip includes an additional layer of protective elastomeric material at the narrower of the two parallel outer walls and which, after insertion, is capable of protecting the remainder of the sealing strip from damage due to aggressive agents at the slab surface.

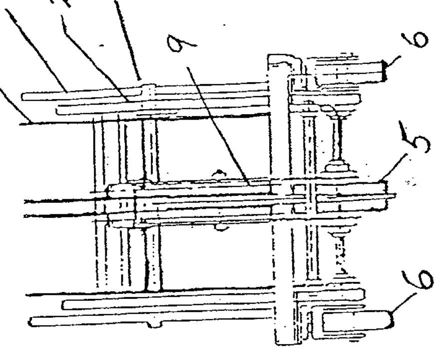


Fig 1b

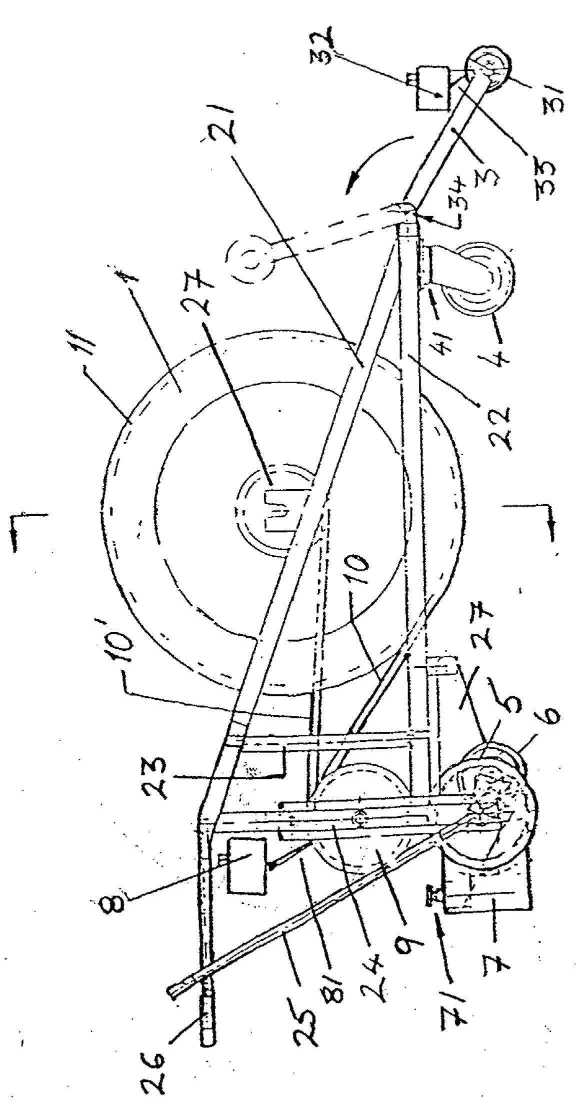


Fig 1a

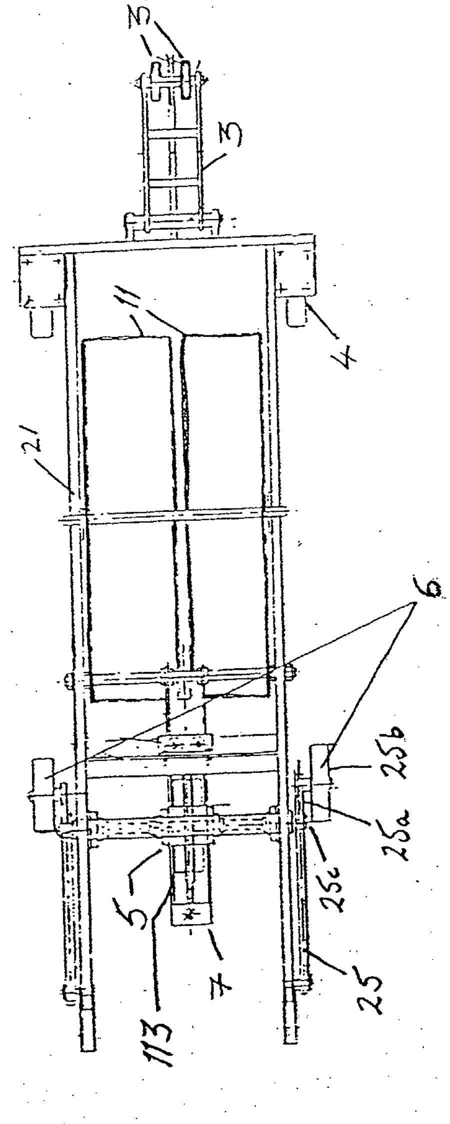


Fig 1c

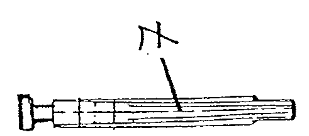


Fig 3b

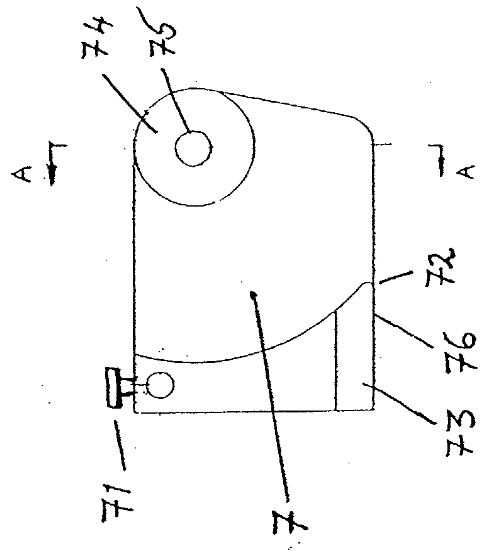


Fig 3a

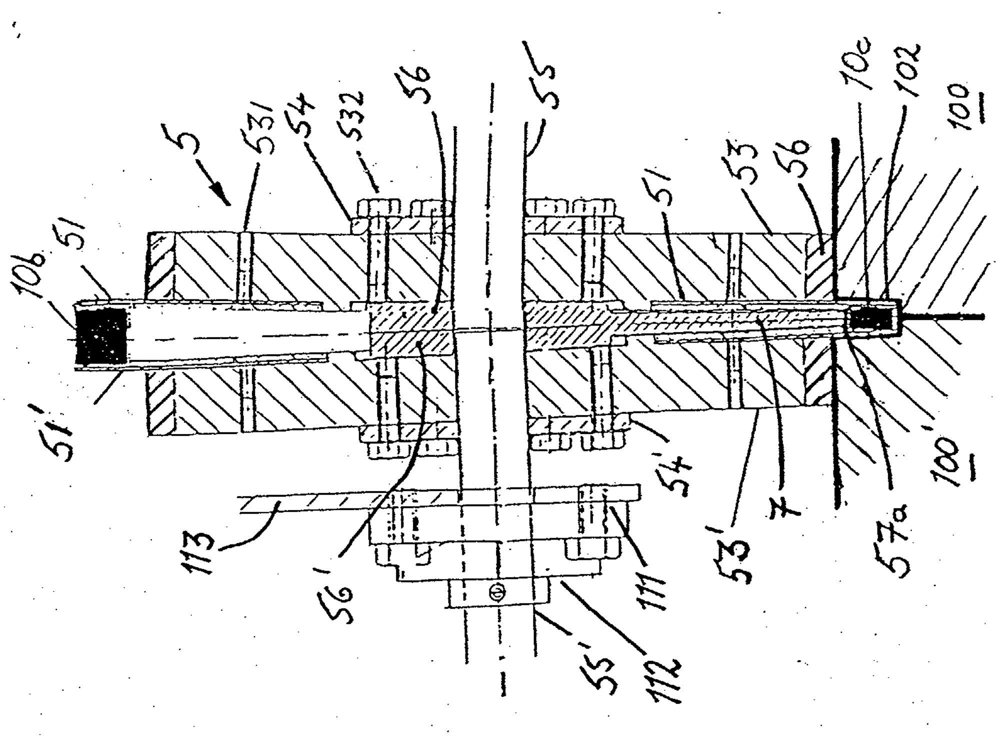


Fig 2

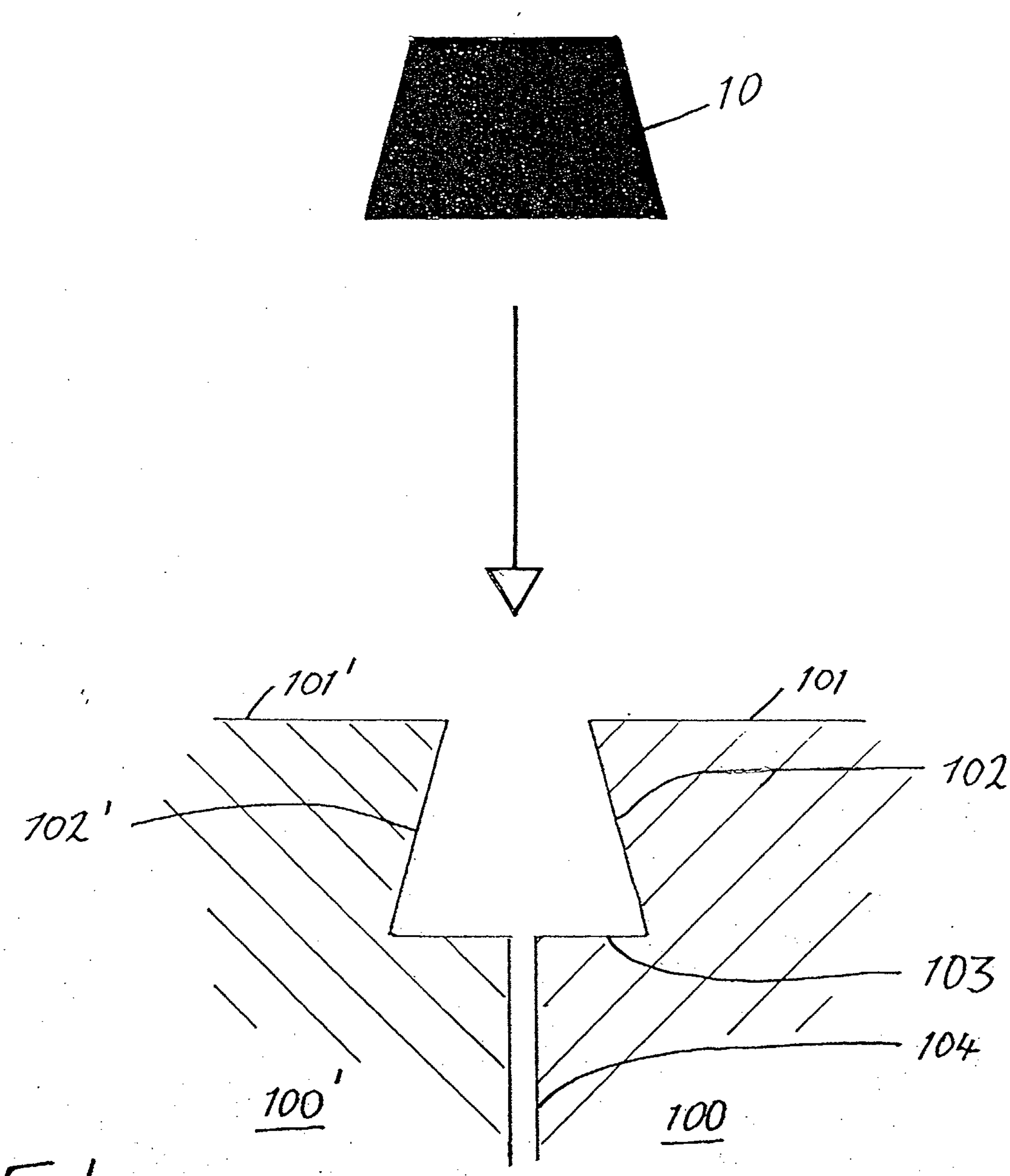


Fig. 4

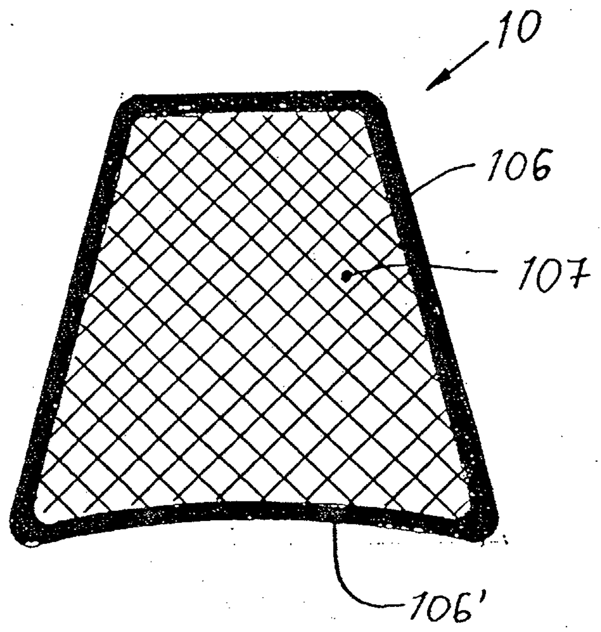


Fig. 5

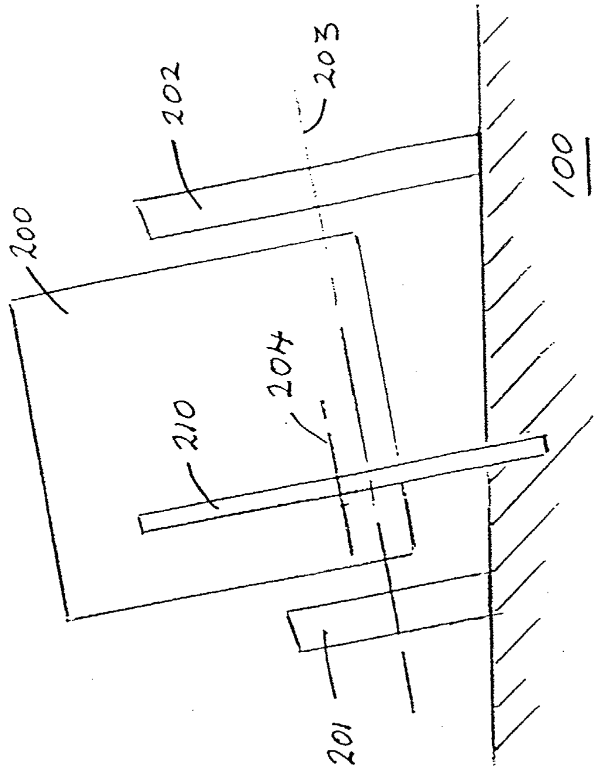


Fig. 6b

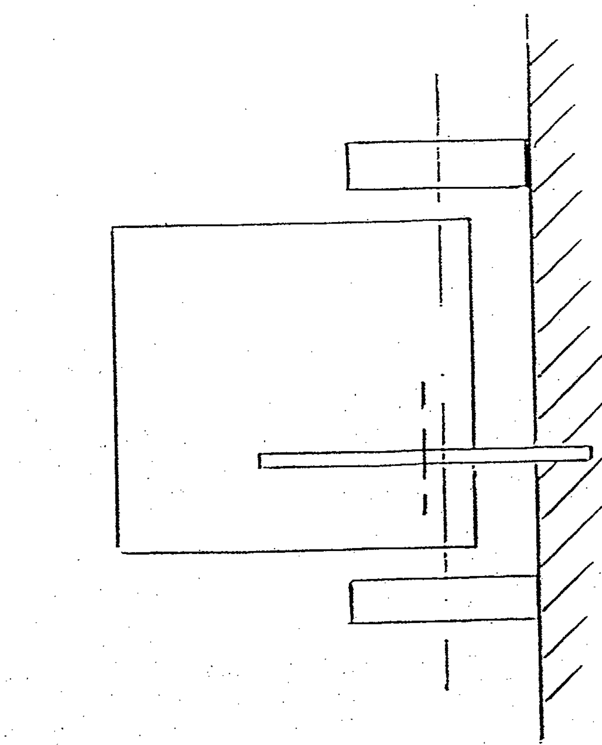


Fig 6a

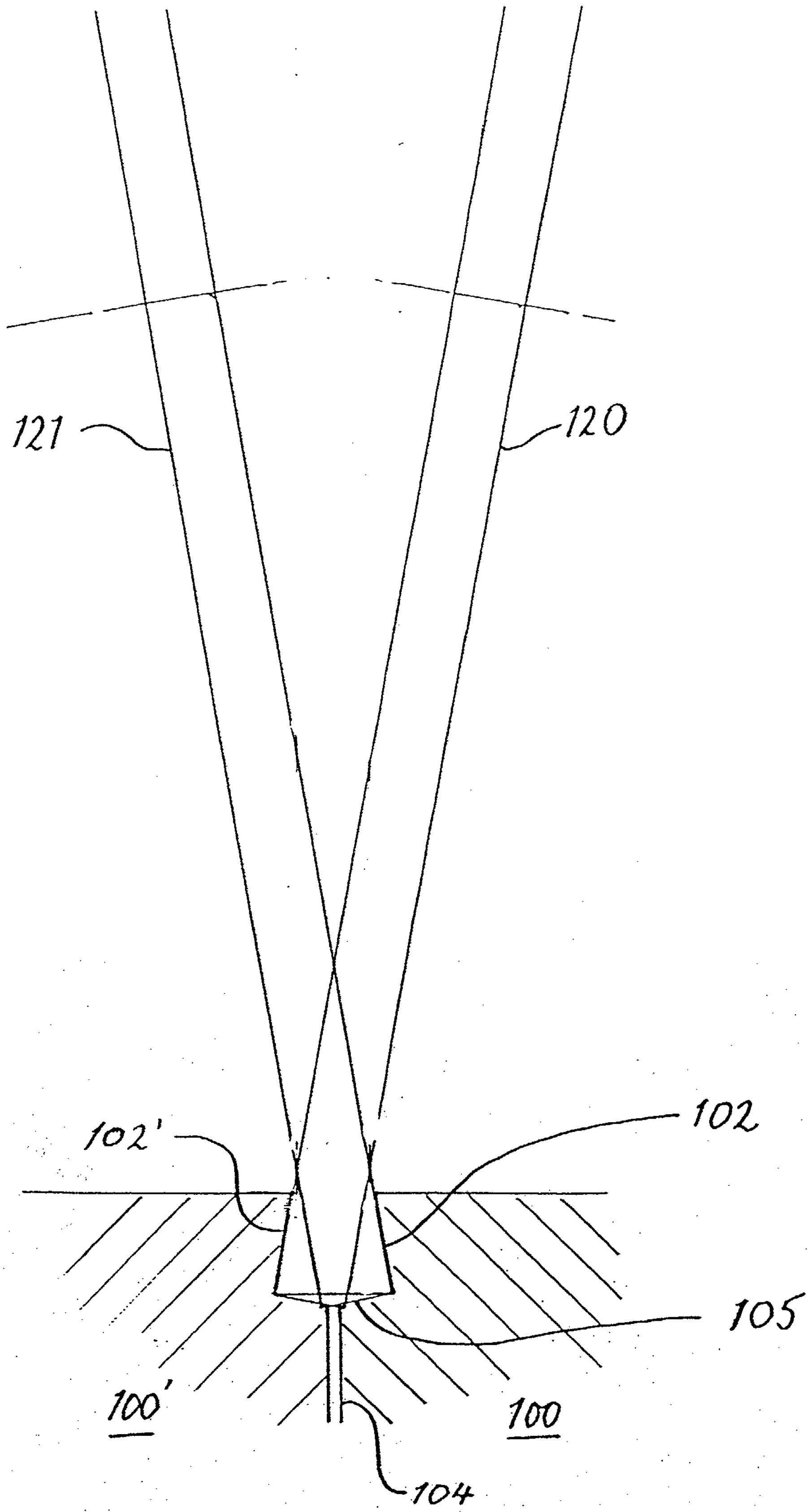


Fig. 7

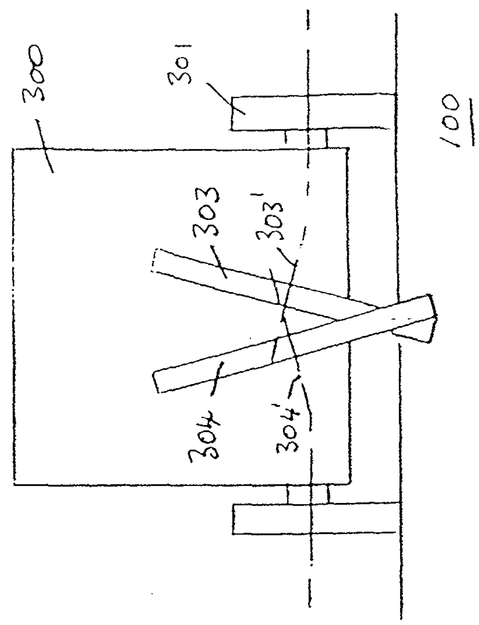


Fig. 8b

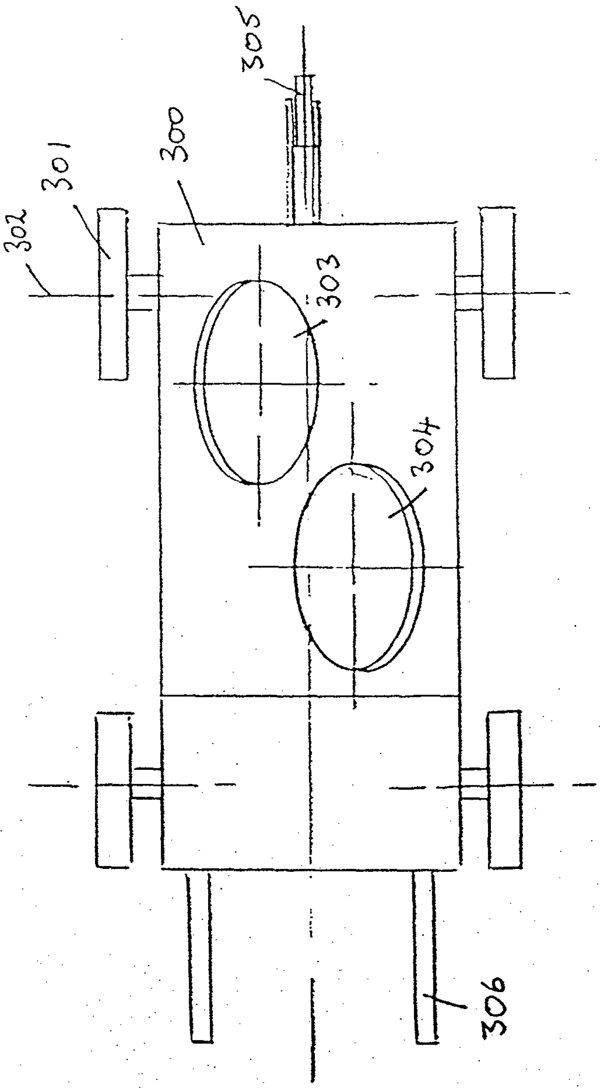


Fig. 8a

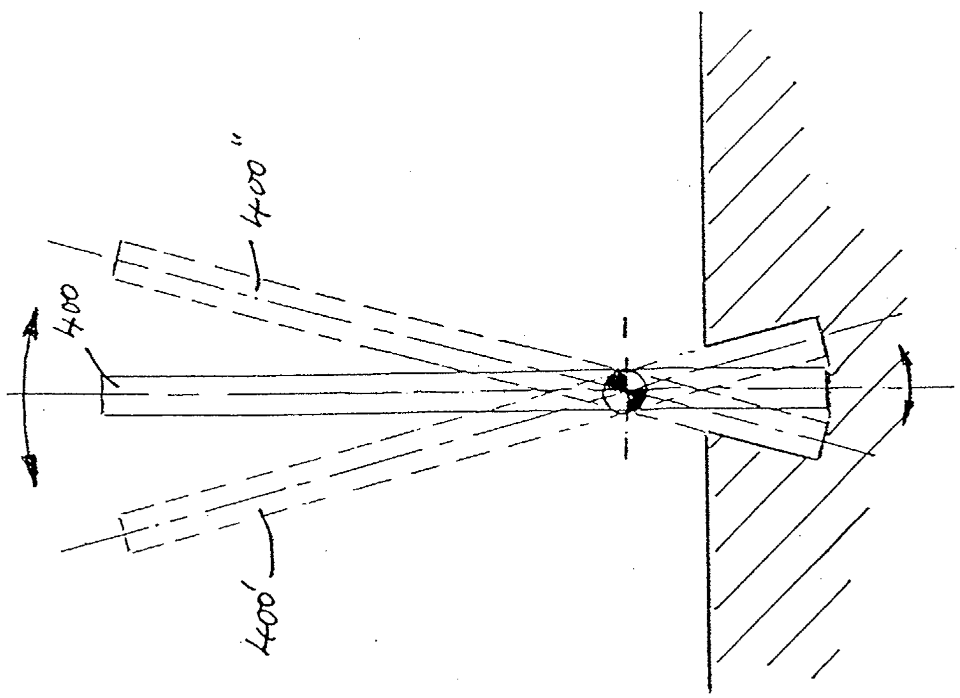


Fig 9b

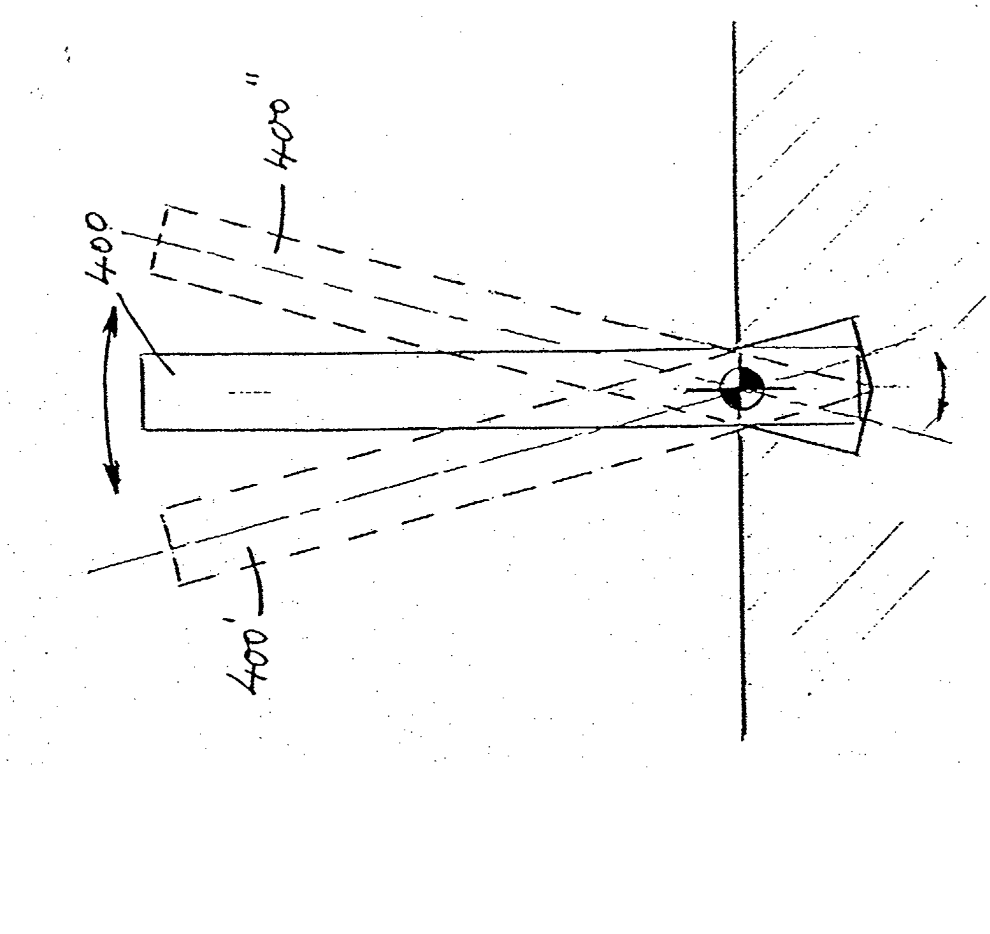


Fig 9a

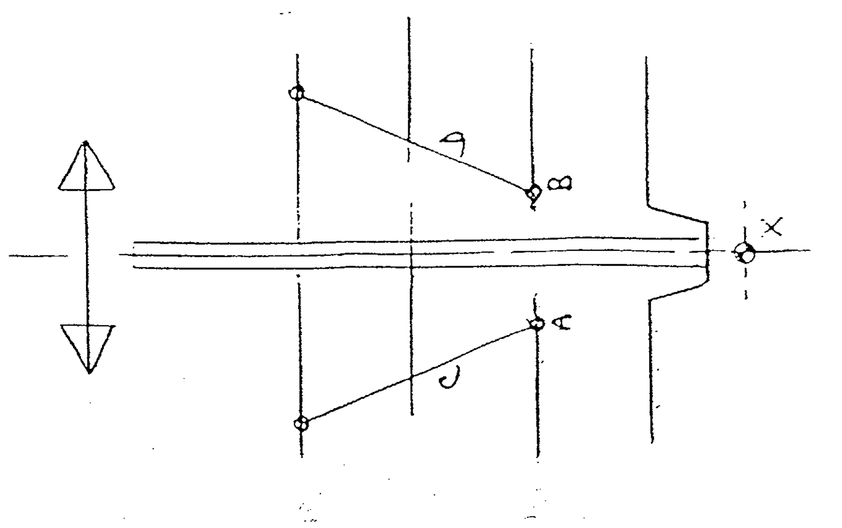


Fig. 10c

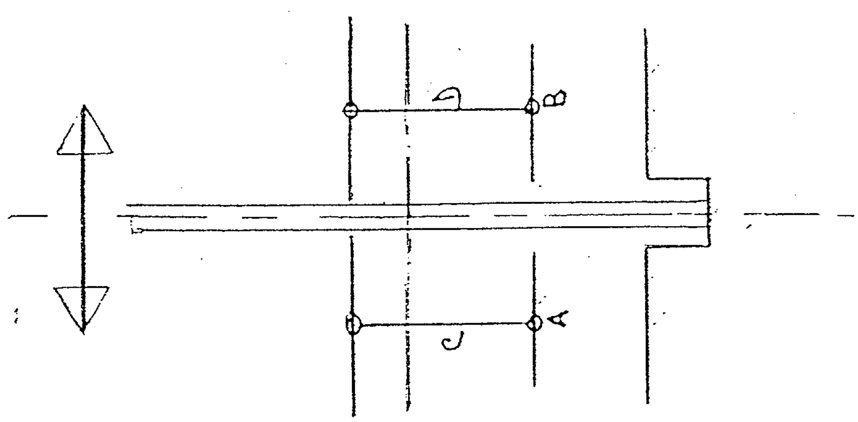


Fig. 10b

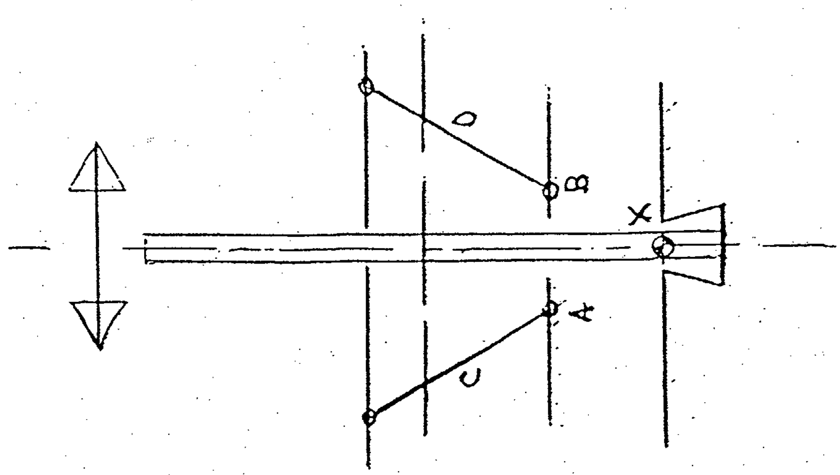


Fig. 10a

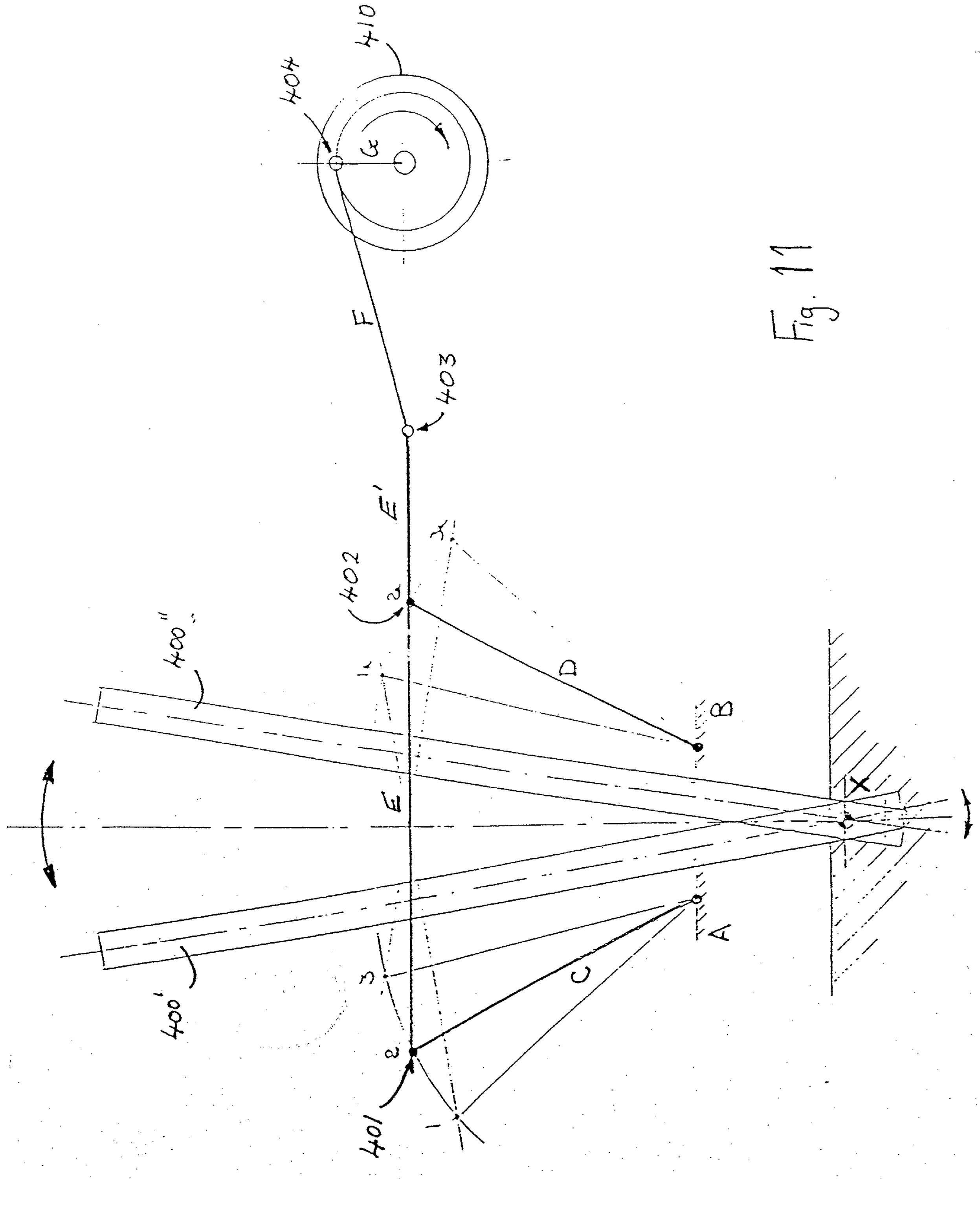


Fig. 11

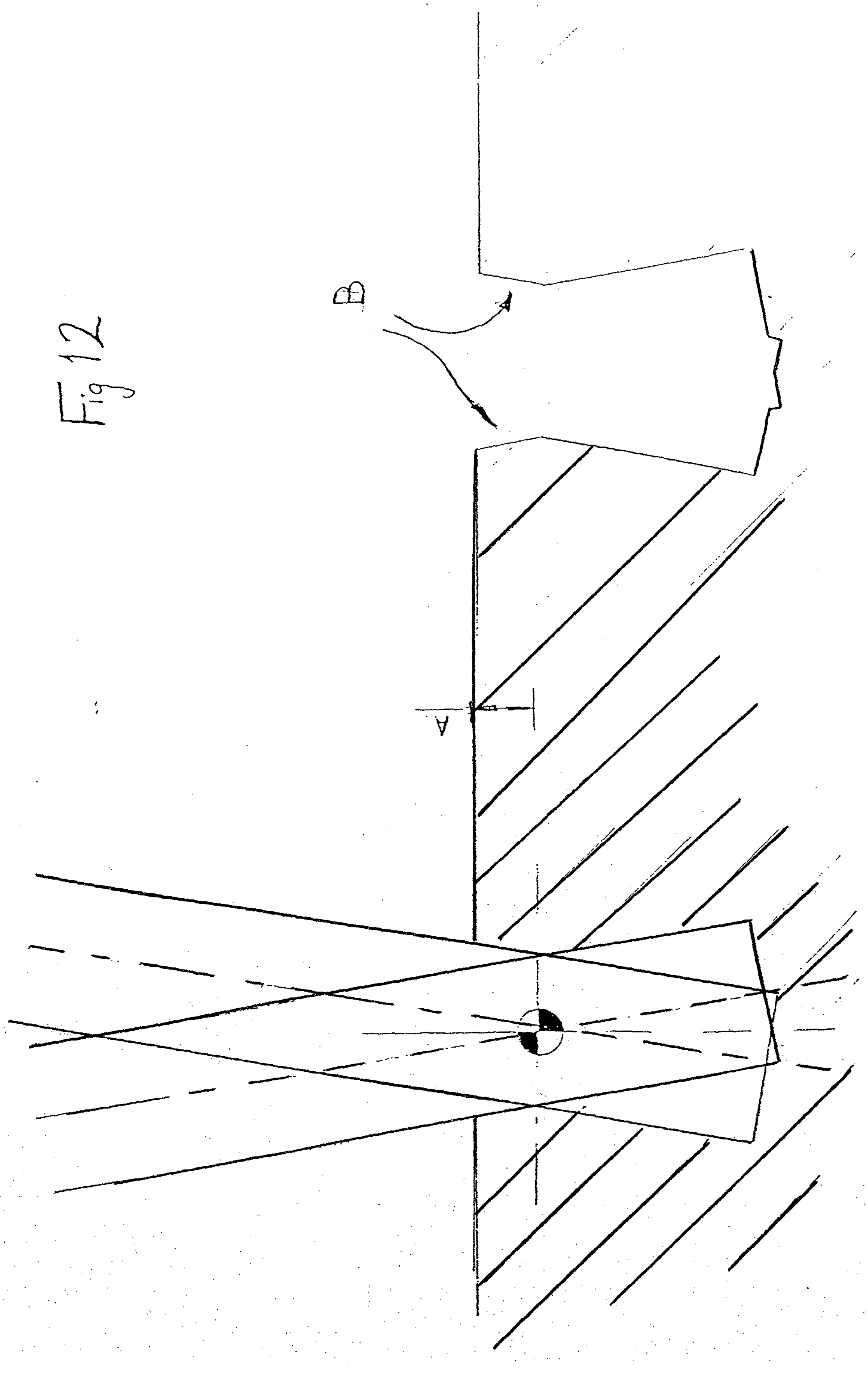


Fig 12