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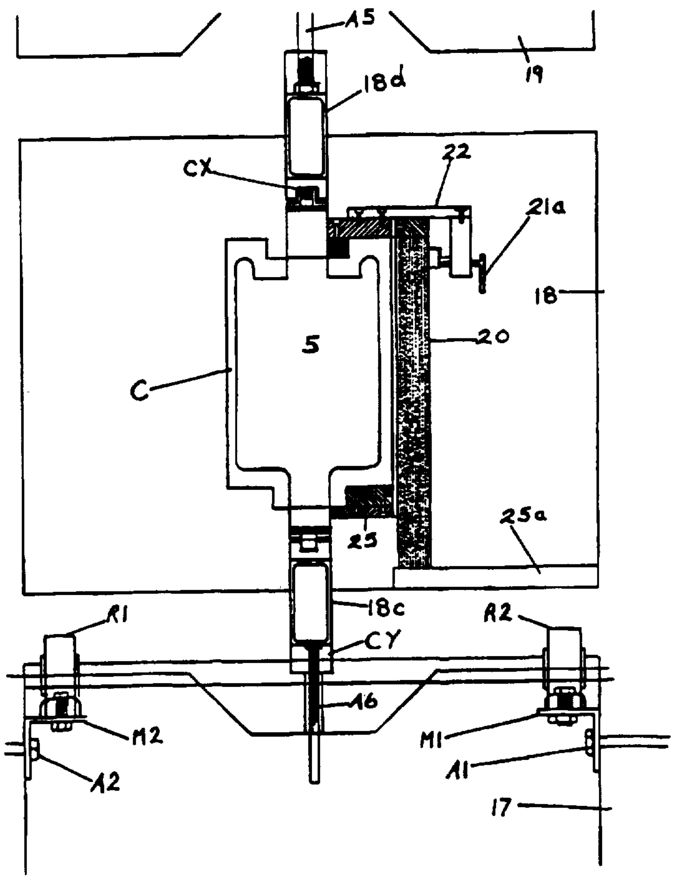
(54) Title: PROCESS AND DEVICE FOR THE MANUFACTURE OF PULTRUDED BUILDING ELEMENTS

(57) Abstract

A pultrusion process involving the insertion of a soft polymer core into a pultrusion mandrel, see figure 1. As the core (5) progresses, it is encased with a cementitious material (C), which is pumped into the top of the mandrel, thus filling the void between the outer surfaces of the core and the inner surfaces of the mandrel. The building material sets slightly in the pultrusion form and is conveyed through a curing process, consisting of adjustable concrete slabs (20) with the provision for either heating, cooling and steam inducement, or a combination of all three curing features. Furthermore, by using pressure elements (21a, 22) which compress the concrete slabs (20) against the cementitious coating, excess moisture is expelled from the building material. The finished building material emerges as a continuous single panel, which is strong enough to stand unsupported. The panel is then cut into predetermined lengths, prior to shrink wrapping, palletization and storage.



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PROCESS AND DEVICE FOR THE MANUFACTURE OF PULTRUDED BUILDING ELEMENTS

The invention relates to a novel process for the manufacture of pultruded building materials, which find particular application as embodied in a system of equipment and the particular machinery components therein. The aforementioned building materials so formed, include panels for buildings, basements, roofs, replacement panels for exterior cladding, baseboards, door frames, moldings, cornices, blocks and related products.
By way of example, the aforementioned building materials are described thus :-

Building Panels

The product is a geometrically designed panel which allows interconnection with other panels, to produce a flat, two sided fabrication for use as a wall, floor, ceiling or related structure. The core material is exposed on both edges where the panels connect, to create a thermal bridge of insulating material, which effectively insulates the two wall surfaces from each other.

The composite finished product is impervious to humidity, water, gases, cracking, rotting, abrasion, impact, weathering, fading, creaking and extremes of temperature, which range from freezing to direct flame.

Decorative Moldings.

The product is an extruded profile which consists of a concrete encasement for exterior applications, and a plaster / gypsum based encasement for interior applications.

The interior cornice molding is a lightweight, flexible product, which, while having the texture and visual resemblance of a traditional plaster cornice, also has the advantage of compatibility with modern building structures.

The exterior molding has a modified concrete encasement, which improve the characteristics to resist weathering, freezing / thawing, ultra - violet radiation and cracking. The lightweight characteristics allow the product to be fashioned to produce large details, which if made of stone or pre-cast concrete, would require assembly in several sections.

Previous manufacture of building panels utilizing an extrusion process, is referred to in part within United States Patent : 4,774,794.

Such an extrusion process however, due to the nature of the dies, requires a foam core to be pushed through a die, which incorporates a forming box containing a continuous full bore of cementitious material, which has been pumped therein.

Such material requires the use of fast setting cements which are difficult to control during an extrusion process, as they do not dry in crystalline form, but in that of strands or tube like fibers which matt with each other. These extruded materials can be made to specific requirements to meet the demands of a particular installation, however, in certain geographical locations, (the Middle East for example,) when forming various building components, sand must be imported, as hydraulic cement does not mix readily with local sand which contains salt and other minerals. The salt delays the setting time of the fast drying cement and as a consequence, the process is impossible to control. Such cements are prone to contaminate the dies, and under these circumstances the entire process must be shut down, in order that the dies may be removed and replaced. Once this has been completed, the line can be restarted, however continuity of production has been interrupted. The constituents of such fast drying hydraulic cements also include fairly expensive additives which consequently increase the cost of manufacture.

It has since been discovered however, that when sand containing salt is mixed with Portland cement, the setting process is accelerated. Initially, an extrusion system was contemplated, to manufacture a product using fast drying hydraulic cement. This product was demonstrated to various interested parties to determine market response. It soon became apparent however, that extrusion was an excessively costly process for manufacturing the aforementioned building materials, and all research in that particular field was abandoned in favor of a pultruded process which is heretofore unknown, as is the process machinery and equipment required with which to manufacture the finished product. It is therefore, the primary objective of this invention to provide a process which forms pultruded building materials, such a process as embodied in a system of equipment and the particular machinery components therein. This and other objects of the invention, will become apparent to a person skilled in the art, when considering the following summary and detailed description of the preferred embodiments illustrated therein.

According to the present invention, there is provided a process for the manufacture of pultruded building materials including panels for building, basements, roofs, replacement panels for exterior cladding, baseboards, door frames, moldings, cornices, blocks and related products. Said process is achieved via particular applications as embodied in the system of equipment and the particular machinery components so incorporated. Said process comprising a production line assembly consisting of inlet guiding channel, roller chain, conveyor assembly, core feed section, mixing equipment, distribution reservoir, pumping equipment, pultrusion mandrel and curing line. Said conveyor assembly comprising upper and lower belt sections, drive motors, drive pulleys, drive belts, rollers and tensioning device, all of which operate in conjunction to establish a means for transporting said building materials along said production line assembly. Said production line assembly incorporating an adjustable steel beam and steel supporting framework. A cutting, wrapping and palletizing section at the end of said process consists of a water bathed, carbide tipped traveling " wet saw "arrangement, an orbital shrink wrapping machine and a palletizing facility.

The specific embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, in which :-

Figure 1 shows a cross - sectional view of a pultrusion process for coating a foam core with a cementitious material and is illustrated in a preferred embodiment of the invention.

Figure 2 shows a close up view of the adjustable mandrel section of Figure 1, and is illustrated in a preferred embodiment of the invention.

Figure 2A shows a close up view of the adjustment mechanism of Figure 2 and is illustrated in a preferred embodiment of the invention.

Figure 3 shows a cross - sectional view of the bottom section of the pultrusion mandrel and is illustrated in a preferred embodiment of the invention.

Figures 3A, 3B and 3C show respectively, side view, front elevation and plan view of the roller assembly used to provide tension on the top belt section of the pultrusion process, and are illustrated in a preferred embodiment of the invention.

Figures 4, 4A and 4B respectively show close up cross - sectional views of the separable wall which constitutes the side of the pultrusion mandrel, and are illustrated in a preferred embodiment of the invention.

Figure 5 shows a plan view of the process clarifying the adjustment mechanism of Figure 2A and is illustrated in a preferred embodiment of the invention.

Figure 6 shows a cross - sectional view of the foam core material within the process and is illustrated in a preferred embodiment of the invention.

Figure 7 shows a side view of the cutting section of the process and is illustrated in a preferred embodiment of the invention.

Figure 8 shows a schematic view of the shrink wrapping process for protecting the finished product and is illustrated in a preferred embodiment of the invention.

Figures 9 and 9A show cross - sectional views of the preferred panels formed by the pultrusion process and are illustrated in a preferred embodiment of the invention.

The process involves the insertion of a foam core **5** into a guiding channel, which aligns said foam core **5** to be carried from the underside by a roller chain **CX/CY** which itself is to travel on a thick walled tube steel beam. Dimensions of said steel beam to be stated as 51mm wide x 102mm long x 4.7mm thick with the uppermost face showing 51mm. Upon said uppermost face of said steel beam to be placed a continuous strip of HDPE plastic material, to act as a running surface and guide for said roller chain **CX/CY**. Dimensions of said continuous strip of HDPE plastic material to be 13mm thick x 27mm wide. Said steel beam to be supported by a steel frame and to be vertically adjustable on said steel frame, said vertical adjustment being achieved by a remote laser which ensures the degree of accuracy required as an essential part of said process. On the top side of said roller chain **CX** at every pitch, to be welded an inverted "U" channel to have a PVC (or equal) plastic plate fixed to the surface. Said PVC plastic plates, when said roller chain **CX** is lying flat and level, to have no more than a 0.5mm gap between their end edges. Said individual PVC plastic plates to have fastened to them, a laminated rubber gripping surface. The result of this configuration to produce gripping pads which adhere to the exposed surface of said foam core **5** and to convey said foam core **5** along the length of said process. The PVC portion of said gripping pads to extend 13mm laterally from each side of said "U" channel at intervals of approximately 305mm, to serve as outriggers on which said roller chain **CX** is conveyed on the underside of said production line. The drive mechanism for said roller chain **CX/CY** to consist of two sprockets to be located at either end of a drive section with 32mm diameter bored shaft centers, with dimensions of said sprockets to be 305mm diameter. The ends of said shafts to be supported by pillow block bearings which are to be fastened to two angle iron sections mounted to said steel support frame. Dimensions for each of said angle iron to be 6m long x 102mm. To said 102mm angle iron at 1.2mm centres, five of said steel frames to be bolted to form a 6m long section. Two of said sections to be connected to form a still larger section of 12m in length, to which a continuous length of said roller chain **CX/CY** to be installed to create one drive section. Two of these said drive sections to be connected via a slave chain drive link to be powered by a 1.5 horse power motor.

In another preferred method for creating a drive section, there can be provided one continuous length of said roller chain **CX/CY** from one end of said production line to the other, the extent of which not to exceed 50m in length.

A typical embodiment of the process to consist of four of said drive sections to be powered by two of said motors, to serve a 50m length of said production line. The speed of said motors being determined by AC inverter speed controllers, to monitor and adjust the running speed of said production line via digitally recording the rotation speed of calibrated timing wheels which are mounted on the shafts of said drive sections.

Referring to the conveyor system, the top portion thereof to consist of a gripping surface conveyor belt **B1** which is pulled and guided by a specified number of pulleys, each to be 305mm in diameter. Spring loaded 77mm diameter adjustable rubber rollers **34** to be located inside the loop of said belt **B1** at 154mm intervals along the lower part of said belt **B1** thereof. Said rollers **34** to incorporate needle bearing centres for smooth accuracy and operation, and to ensure that the pressure which said conveyor belt **B1** exerts upon the exposed surface of said foam core **5** is as prescribed. Said rollers **34** to be mounted in two parallel arms, and to form part of an assembly which includes a pair of spring tensioning adjustments. Said assembly to be mounted on the underside of a thick walled square steel tube, via a bolt penetrating the sides of said steel tube and the top part of said parallel arms in such a manner to allow said assembly to pivot upon said bolt. Dimensions for said steel tube to be 51mm x 51mm x 5mm. Said spring tensioning adjustment to consist of a threaded rod with nut **31**, and coiled spring **32** on each side of said parallel arms, being mounted on said square steel beam in a pivoting manner. Said square steel beam to provide therein, a common base against which, said springs **32** can act in conjunction with the overall pivot point of said parallel arm assembly. The tensioning apparatus so described, to have the capability to allow a maximum adjustment of 64mm, away from said square steel beam. A typical drive section of said upper belt **B1** to be 6m in length instead of 12m, due to the inherent sag and stretch which is a typical feature of such said belts. Preferably, four upper drive sections to be powered by one x 1.5 horse power motor, and to be linked via slave chain drives and sprockets of identical size. Alternatively, eight 6m drive sections powered by two 1.5 horse power motors, would constitute a typical 50m long production line. The speed of said motors to be determined by AC inverter speed controllers, which monitor and adjust the running speed of said production line via digitally recording the rotation speed of calibrated timing wheels to be mounted on the shafts of said drive sections. As an essential part of said process, identical calibrated timing wheels to be mounted on each of said upper and lower sections to ensure that said upper and lower drive speeds are perfectly synchronized. Said foam core **5** to be placed into said guiding channel between said upper and lower drive sections, said tension on said upper drive belt **B1** to be firmly set to hold and pull said foam core **5** into said production line. Four feet into said production line, said foam core **5** to be pulled through a plastic seal plate which, depending on the density of said foam core **5**, to be slightly smaller than said foam core **5** itself, to create a perfect seal. The front of said seal plate on each side of the core opening being attached to a cementitious material distribution reservoir, delivery to be from the top via lines from a progressive cavity pump, itself to be supplied from a continuous mixing arrangement. Said seal plate to be attached to concrete side slabs **20**, each to measure 38mm thick x 1.2m long and between 305mm and 380mm high. Said concrete slabs **20** to be manufactured from high density concrete **21** for added strength, and to incorporate inserts on the outer surface to allow connection of lateral position adjustment mechanisms. As a preferred method for curing said building material, said concrete slabs **20** to incorporate pre-formed depressions on the inner surface, to accommodate therein silicon heating elements **24**.

Said silicon heating elements **24** in each of said concrete slabs **20**, to be controlled independently via thermostatic temperature controls being located adjacent to each of said concrete slabs **20**. The extent of said control to be in a range from 40°C to 100°C, with provision for an integral overload protection facility. Teflon coated **23a**, 6.35mm thick aluminum forming side plates **23** to be hung and secured over the surface of said silicon heating elements **24**, to extend to the edges of each of said concrete slabs **20**. A lower profile former to be permanently fixed on the bottom of said side plates **23**. Affixed to the top of the said side plates **23** to be a profile former which is to be mechanically fastened in such a way as to be removable, to allow retraction of said side plates **23** when said pultrusion mandrel is full of cementitious coating **C**.

In another preferred method for curing of said cementitious coating **C**, at a later stage in said curing process, cooling elements may be inserted in place of said silicon heating elements **24**.

In yet another preferred method for curing said cementitious coating **C**, pressurizing elements can operate in conjunction with said cooling elements, to compress said concrete slab **20** against the said cementitious coating **C**, at a sufficient pressure to expel the moisture from said cementitious coating **C**.

Alternatively or in addition, yet another preferred method for curing said cementitious coating **C** involves the connection of steam lines to a pre-formed penetration in said concrete slabs **20**. Said steam lines themselves connect to remote steam generation equipment, which would be familiar to a person skilled in the art. Said steam lines to consist of a main steam header to distribute above said production line, from which smaller branch lines drop to connect to penetrations in said concrete slabs **20**, to provide a moist source of heat to further promote the curing of said cementitious material **C**.

By way of example, the initial 40 ft section of said production line may contain five equal sections of 8 ft in length, the first of those sections with said concrete slabs **20** incorporating therein, said silicon heating elements **24**. The remaining sections may contain said cooling elements and said pressurizing elements, as integral components of said curing process.

As an alternative or in addition to said example, the initial 40ft section of said production line may contain therein, another preferred method for curing said cementitious coating **C**, involving the connection of said steam lines to said pre-formed penetrations in said concrete slab **20**.

The complete inner forming assembly to be adjustable in the vertical plane on said concrete slab **20** and to be interchangeable to allow for different profiles. Said concrete slab **20** to be fastened to a "U" channel which rests upon a plastic runner, thus allowing a horizontal adjustment of up to 204mm for said concrete slab **20** and its' attachments thereon. Said plastic runners to be supported by two thick walled steel tubes, dimensions of which to be 51mm x 102mm x 4.7mm with the uppermost face showing 51mm at right angles to said roller chain support beam. Said plastic runner supports to be positioned to said steel frame at the frame centres and to be adjustable at both ends in the vertical plane. The outer end being adjustable, the inner end being adjustable in conjunction with said roller chain support beam. In order to adjust the position of each of said concrete slabs **20**, a centered screw drive **H1** and manually operated hand wheel **H** is fastened to said angle iron attached to said steel frame. Once the adjustments have been made to said slabs **20**, a locking device **21a** to be engaged to secure the position. The length of the left side brace **Br(a)** on the rear of each said concrete slab **20** is adjustable to allow accurate parallel alignment of said concrete slab **20** to said building material. Said concrete slabs **20** and all said supports and adjustments therein on either side of said production line are identical and permanently fixed, and to these all said profile formers to be fitted.

After said building material passes beyond the first said 6m drive section, said building material will not require top forming support, and from this point forth, said top formers are to be removed. After said building material passes beyond the second said drive section, said silicon heating elements **24** will no longer be required. At the end of said typical 50m production line, operating at a speed ranging from 2.5m to 3m per minute, said building material will be sufficiently cured to allow it to be cut to a predetermined length, via an automatic traveling carbide tipped, wet bathed saw **3**, operation of which to be synchronized with the speed of said production line conveyor belts.

Referring to the drawings, Figure 1 illustrates a cross sectional view of said supporting steel frame, which comprises segments **11, 12, 13, 14a, 14b** and **14c** for supporting therein, 51mm HDPE tie rods **A1, A2, A3, A4, A5** and **A6** which support within said steel frame, items of equipment referred to hereafter. At the top of said steel frame, a supporting frame **19** is positioned to accommodate an upper belt drive as indicated in Figure 5. The mid - mandrel section **18** referred to hereafter, accommodates a lower belt drive support **17**, which is secured via said 51mm HDPE rods **A5** and **A6**. The lower section **17**, middle section **18** and upper section **19**, constitute respectively, a lower belt track, an upper belt track and a supporting frame for the mandrel section of the pultrusion process. The entire said steel frame incorporates therein, parallel locator blocks **11a, 11b, 13a, 13b, 17a, 17b, 18a, 18b, 19a and 19b**, to " square " said steel frame and so ensure that belts and adjustments are uniform and consistent thus eliminating manufacturing blemishes or defects from the finished building material. Said locator blocks, preferably of aluminum construction, are leveled via use of a remote laser beam which is projected onto each of said locator blocks to establish uniformity.

In order therefore to assure the integrity of said finished building material, this procedure to be adopted when the pultrusion process equipment referred to hereafter, is initially arranged. Said laser beam to be projected along the entire length and width of the equipment therein, between the nearest and furthermost upper corners, to ensure that all machinery and equipment therein is square and level. As a consequence therefore, continuous regularity of said finished building material will be achieved, by minimizing variations in length, height and width thereof. Said production line to be assembled in four equal sections of 40 feet in length, to provide a total length of 160 feet. As said production line operates at a rate of 10 feet per minute, it is to be finely balanced to coordinate between the process time and the curing time for the eventual said finished building material. Should there be an end requirement for the installation of cable in said finished building material, preferred penetrations may be made to the said finished building material, at predetermined locations. Said foam core **5** to be pulled into said process as it is inserted between said upper and lower conveyor belt sections. Said upper belt section to incorporate therein, adjustable spring loaded rollers **34** which are to exert the correct pressure upon said upper belt section as it pulls on said foam core **5**, as indicated in Figures 3, 3A and 3B. In this respect , at the top and on the underside of said foam core **5**, an exposed area to be employed to pull said foam core **5** through said process. At this stage of said process, the adjustable pultrusion mandrel plates are to be fixed in position, the progressive cavity pumps are to be enabled, and the coating of preferred cementitious material **C** is to be delivered into a sealing box, as said foam core **5** is pulled through said pultrusion mandrel. In the event that a bridging of materials occurs, said cavity pumps will be disabled, and said plates can be removed and replaced with clean plates whilst said production line remains operational. This particular facility is unlike any other known art process.

Referring to Figure 2, there is illustrated frame portions **18c** and **18d** upon which roller chain portions **CX** and **CY** are carried. Each of said roller chains **CX** and **CY** to sustain a belt which pulls against the exposed surface of said foam core **5**, as supported by frame portions **18c** and **18d** and held against said foam core 5, via belts carried therein by chain portions **CX** and **CY**. As indicated, although not shown, said belts to be carried proximate to the bottom of said pultrusion mandrel, by rollers **R1** and **R2**. An adjustable concrete side wall **20** to be provided on each side of said foam core **5**. The bottom portion **25**, to move on an HDPE track **25a**, to allow horizontal adjustment as illustrated in Figure 2A, as said concrete wall **20**, moves in the direction shown. Said bottom portion **25** to connect with a flange piece as illustrated in Figure 4B, via fasteners **25b** and an adjustment pin **26a** to be attached to said concrete slab **20** to allow ease of separation of the components in use. The top portion **22** of said adjustable concrete wall **20**, to incorporate therein, dowel portions as shown in Figure 4, Figure 4A and Figure 4B, which, while said process is operational, to be removable and replaceable, to allow machinery to be cleaned quickly and with minimum disruptive consequence to said process. This particular facility is unlike any other existing art process.

Said adjustable concrete wall **20**, to incorporate therein, a locking device **21a**, as illustrated in Figure 4. As shown in figure 2A, a handle portion **H**, to provide adjustment of said concrete wall **20**, via a threaded opening **H2** and a screw **H1** thus connected to said concrete wall **20** and said mandrel portion. In a preferred embodiment of such an assembly, said concrete wall **20**, to provide for the initial 8 feet and up to 40 feet of a typical production line, upper and lower abutments to support the as yet uncured said cementitious coating **C** on said foam core **5**. The internal face of said concrete wall **20** to incorporate an aluminum sheet **23** coated with Teflon **23a**, to ensure manufacture of a smooth finished building material. Mounting portions **M1** and **M2** to be provided for rollers **R1** and **R2** which carry said bottom conveyor belt. Said conveyor belt being manufactured according to those skilled in the art, the exception being that on the underside of said conveyor belt, and attached to each of said chains, to be paddle portions separated by approximately 25mm. Said paddle portions to butt up against said conveyor belt and so press against said foam core **5** for improved conveyance of said foam core **5** through said process.

Referring to Figure 3, said roller chain **CX** to be mounted against an HDPE block, adjacent to said supporting frame **18c**. Said roller chain **CX** to carry a belt **B1** above a layer of PVC to be fastened to said roller chain **CX** as indicated. Said belt **B1** is therefore able to grip the exposed surface of said foam core **5** as illustrated. Should said foam core **5** be larger than illustrated, said concrete slab **20** to be adjustable at both sides on the said track **25**, to center the exposed area of said foam core **5** upon said belt **B1**. In order to facilitate the return of said roller chain **CY** , outriggers **O1** and **O2** to be installed at 305mm intervals on the underside of said supporting steel frame. Figure 3, Figure 3A and Figure 3B illustrate a roller assembly for applying tension and exerting pressure upon the exposed surface of said foam core **5**. In a preferred embodiment of the invention, said roller **34** presses down on said upper belt as shown. Control of the amount of tension placed on said upper belt by the roller **34**, to be determined by a tensioning threaded nut **31**, which engages a biasing spring **32**, as indicated in Figure 3B. As said upper belt tensions, said lower belt will reciprocate to provide gripping pressure on said foam core **5** as it is pulled through said pultrusion mandrel. Said roller **34** to be supported by a shaft **35** which extends to twin adjustments, both of which to be supported between frame portion **33** to said roller portion **34**, inclusive of the components indicated in Figure 3C.

Figure 4, Figure 4A and Figure 4B illustrate said concrete slab portion **20** inclusive of said heating elements **24** and top portion **22** with said dowel portions **22a, 22b, 23c** and **23b** which allow smooth and efficient removal of the top of said concrete slab **20** for cleaning and replacement while said process is operational. This particular facility is unlike any other known art process.

Figure 5 illustrates said adjustment handle **H**, said screw **H1** and said threaded opening **H2**. Bracing arms **BR** and **BR(a)** allow the bracing tension to be adjusted. Said handle **H** to be adjusted automatically or manually by hand, to slowly press out moisture from said cementitious coating portion **C** of the finished building material. This particular facility is unlike any other known art process.

Said upper belt chain portion **CX** is indicated, but not shown in normal position against said exposed surface of said foam core **5**. The drive roller assembly **TB** for said upper belt is shown via supporting frame position **19**.

In another example of a preferred method for producing a pultruded building material, said building material can be formed slightly undersized, and so may be built up by the addition of a very thin water resistant outer covering, which forms a protective skin over said cementitious coating **C**.

The foregoing examples of preferred methods for producing said building material illustrate the unique features of the invention, by elimination of the curing chamber normally required by a typical extrusion process. By provision of adjustable plates which squeeze moisture from said cementitious coating **C**, in conjunction with said heating, said cooling and said steam inducement sections, said curing time is improved to such an extent, that at the end of the second 40 feet section of said production line, said building material is capable of standing unsupported.

Figure 6 illustrates a cross sectional view of said foam core **5** within said pultrusion process, showing a typical arrangement of said of said foam core **5**, with exposed upper and lower surfaces as shown for transportation by said conveyor belts. As indicated, but not identified, on either side of the foam core **5**, concrete slabs **20** showing silicon heating elements **24** therein with Teflon coated **23a** aluminum side plates **23** incorporated on the internal face of said concrete slab **20**. Adjustment pin **26a** and fasteners **25b** are also shown at the bottom portion of said concrete slab **20** with top portion **22** showing said dowel portions **22a, 23a and 23b**, with adjustable screw **22c** nut **22d** and handle **22h**.

Figure 7 illustrates a cutting assembly which comprises cutting table **4**, saw blade **3**, and associated drive motor **2**. After said curing, the finished product to emerge from said pultrusion process as a single continuous building panel **1**, being strong enough to stand unsupported. Said building panel **1** to be cut into sections **1a**, on said cutting table **4**, via the action of said saw blade **3** pressing down across the cutting surface **1b**, as said saw blade **3** so penetrates. The resulting building panel sections **1a** to be typically 8ft in length. The entire building panel **1** and section **1a** to be carried by rollers **6**. For those skilled in the art, this procedure would not be novel.

Figure 8 shows a schematic illustration of a system for shrink wrapping and palletizing said panel sections **1a**. Said panel sections **1a** to be stacked as indicated, and in the direction of travel shown, to be separated by plastic sheets at the sheet dispenser **40** before being protectively wrapped by an orbital wrapper **50**. Said shrink wrapping process to provide therein, optimum temperature and humidity conditions, to allow said cementitious material **C** to further cure for a period of 14 to 28 days, to ameliorate the strength of said panel section **1a** by approximately 10% overall. Said panel section **1a** once wrapped, to be lifted by a load lift **70** for palletization by a pallet feed **60**, and to be strapped securely for storage by a strapping machine **80**. The load once wrapped, to be removed by forklift for storage and shipping. To a person skilled in the art this process would not be novel.

Figure 9 and Figure 9A illustrate cross sectional views of said panel sections **1a** with differing dimensions and having therein, tie portions manufactured from HDPE. Said tie portions to reinforce the adjacent cladding areas where no other reinforcement is available, to so assist during said curing process. The penetrations shown in said foam core **5**, are so provided to accommodate future service pipes, electrical conduit or the like. Furthermore, said penetrations accommodate any thermal expansion which, if not allowed for, may crack and so damage said panel sections **1a**. As illustrated in Figure 9A, said HDPE tie to have a cut out portion **Cr**, with additional reinforcement achieved by cut out portion **Cp** for the wider panel.

- CLAIMS -

1. A process for the manufacture of pultruded building materials including panels for buildings, basements, roofs, replacement panels for exterior cladding, baseboards, door frames, moldings, cornices, blocks and related products, where said process is to be achieved via particular applications as embodied in the system of equipment and the particular machinery components so incorporated, said process to comprise a production line assembly to consist of inlet guiding channel, core feed section, roller chain, conveyor assembly, mixing equipment, distribution reservoir, pumping equipment, pultrusion mandrel and curing line, said conveyor assembly to comprise upper and lower belt sections, drive motors, drive pulleys, drive belts, rollers and tensioning devices, all of which to operate in conjunction to establish a means for transporting said building materials along said production line assembly, said production line assembly to incorporate therein, an adjustable steel beam and steel supporting framework, furthermore, a cutting, wrapping and palletizing section at the end of said process to consist of a water bathed, carbide tipped traveling " wet saw "arrangement, an orbital shrink wrapping machine and a palletizing section, said "wet saw" arrangement to operate in a manner which is synchronous with the speed of said production line to facilitate the accurate penetration of the preferred building material thereby to produce a product of specified uniform length.

2. A process for the manufacture of pultruded building materials as claimed in Claim 1, wherein the inlet guiding channel as a specific embodiment of said process to be located at the entry point of said production line assembly, to allow alignment of said foam core between said upper and lower drive sections.

3. A process for the manufacture of pultruded building materials as claimed in Claim 2, wherein the conveyor assembly as a specific embodiment of said process to consist of distinct upper and lower sections, each of said sections to be driven by a belt and pulley arrangement supplied with power from a suitably sized motor, said upper belt section to include a tensioning device for adjustment of the force which said conveyor belt assembly exerts upon said foam core, said upper and lower belt sections each to incorporate a specially designed surface, which grips the exposed areas of said foam core throughout the length of said process, said upper belt section to incorporate therein, adjustable rubber rollers to be located along the lower part thereof, within the loop of said upper belt section, each of said rubber rollers to incorporate needle bearing centres to facilitate accuracy and operation and to ensure that the pressure which said upper belt exerts upon the exposed surface of said foam core is as prescribed, said rubber rollers therefore to form part of an assembly which is to include spring tensioning adjustments each of which to consist of a threaded rod with nut and coiled spring to provide the capability to allow maximum specified adjustment of said rubber rollers.

4. A process for the manufacture of pultruded building materials as claimed in Claim 3, wherein the pultrusion mandrel as a specific embodiment of said process to be adjustable in the horizontal and vertical planes, with top, bottom and two sides therein, where said pultrusion mandrel to provide with said building product, a closed box arrangement via use of a plastic plate with a tapered opening which is by design, slightly undersized to create an improved seal to achieve same, said pultrusion mandrel to incorporate the facility to receive a preferred cementitious material via appropriately sized connection or connections from a continuous mixing arrangement.

5. A process for the manufacture of pultruded building materials as claimed in Claim 4, wherein the curing line as a specific embodiment of said process to consist of a specified number of sections of said production line assembly, each of which to comprise specially designed concrete slabs which are to be located at fixed positions on either side of said conveyor belt assembly, each of said concrete slabs to incorporate pre - formed depressions which accommodate therein, silicon heating elements, wherein said heating elements to be controlled independently via local thermostatic temperature controls which are to incorporate an overload protection facility, furthermore, Teflon coated aluminum forming side plates to be suspended over the surface of said silicon heating elements, to extend to the edges of said concrete slabs along the height and width thereof, said side plates to include a fixed profile former on the lower section, and a mechanically fastened profile former on the upper section, thus allowing ease of removal of said side plates from said pultrusion process.

6. A process for the manufacture of pultruded building materials as claimed in Claim 5, wherein the method of speed control for the aforementioned drive motors as a specific embodiment of said process to consist of AC inverter speed controllers, which determine the speed of said drive motors serving said upper and lower conveyor belt sections, each of said AC inverter speed controllers to monitor and adjust the operating speed of said production line by digitally recording the rotational speed of calibrated timing wheels which are located on the shaft of said drive motors, said control settings to be manually selected to suit specified requirements.

7. A process for the manufacture of pultruded building materials as claimed in Claim6, wherein the method of synchronizing the speed of the upper and lower belt sections as a specific embodiment of said process is to be achieved via identically calibrated timing wheels which are located on the shaft of said drive motors.

8. A process for the manufacture of pultruded building materials as claimed in Claim 7, wherein the method of vertical adjustment of the steel beam as a specific embodiment of said process is to be achieved via a laser beam device, which is located remote from said production line, to provide the degree of accuracy required by said process.

9. A process for the manufacture of pultruded building materials as claimed in Claim 8, wherein the method of adjustment of the concrete slabs as a specific embodiment of said process to consist of lateral adjustment mechanisms to facilitate regulation of said concrete slab in the horizontal plane, said adjustment to be achieved by fixing said concrete slab to a "U" channel facility which rests upon a plastic runner, to allow horizontal adjustment as specified for said concrete slab and its' attachments thereon, said plastic runners to be supported by two thick walled steel tubes, with the uppermost face showing at right angles to said roller chain support beam, said plastic runner supports to be positioned to said steel frame at the frame centres and to be adjustable at both ends in the vertical plane, the outer end to be adjustable, the inner end to be adjustable in conjunction with said roller chain support beam, whereby, in order to adjust the position of each of said concrete slabs a centered screw drive and manually operated hand wheel to be fastened to said angle iron attached to said steel frame, thereafter, when said adjustments have been made to said concrete slabs, the length of said side brace on the rear of each said concrete slab therefore to be adjustable to allow accurate parallel alignment of said concrete slab to said building material, wherein said concrete slabs and all said supports and adjustments therein on either side of said production line to be identical and permanently fixed.

10. A process for the manufacture of pultruded building materials as claimed in Claim 9, wherein the method of securing said adjustment as a specific embodiment of said process to be achieved via use of a one and one half turn locking device, operation of which to maintain the position of said concrete slabs, once said adjustment has been made, thereby to prevent further movement of said concrete slab in the horizontal plane.

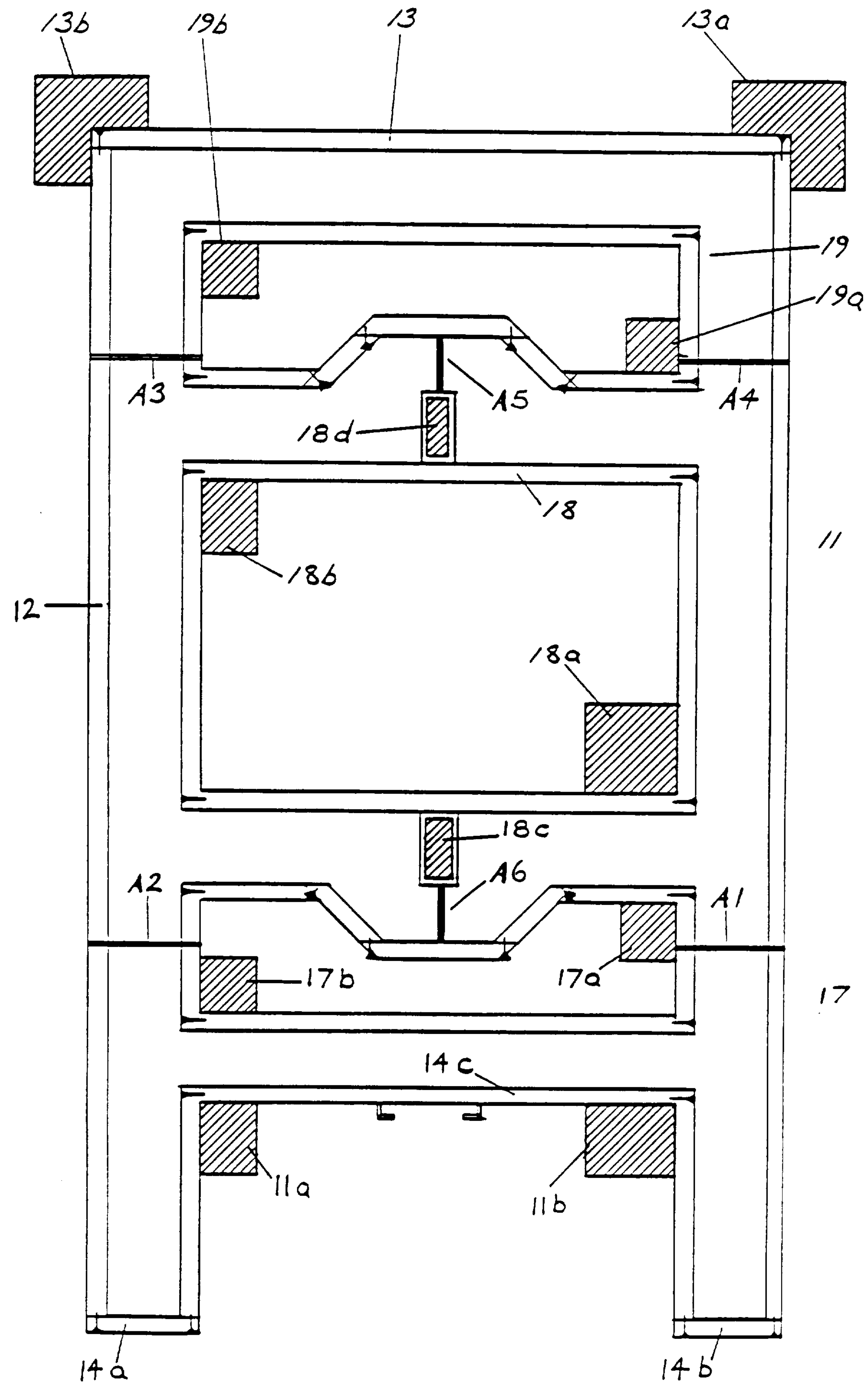
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FIGURE 1

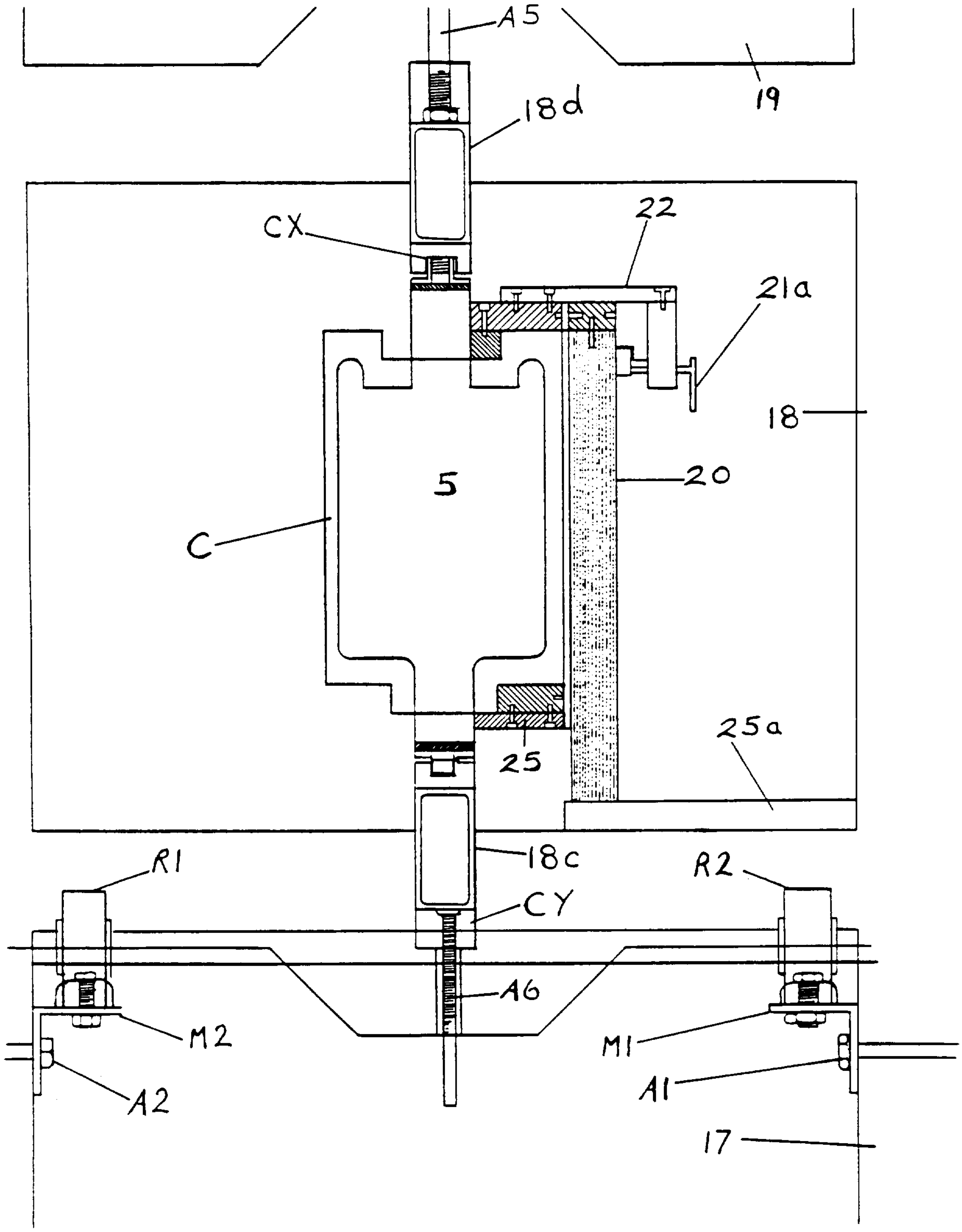

FIGURE 2

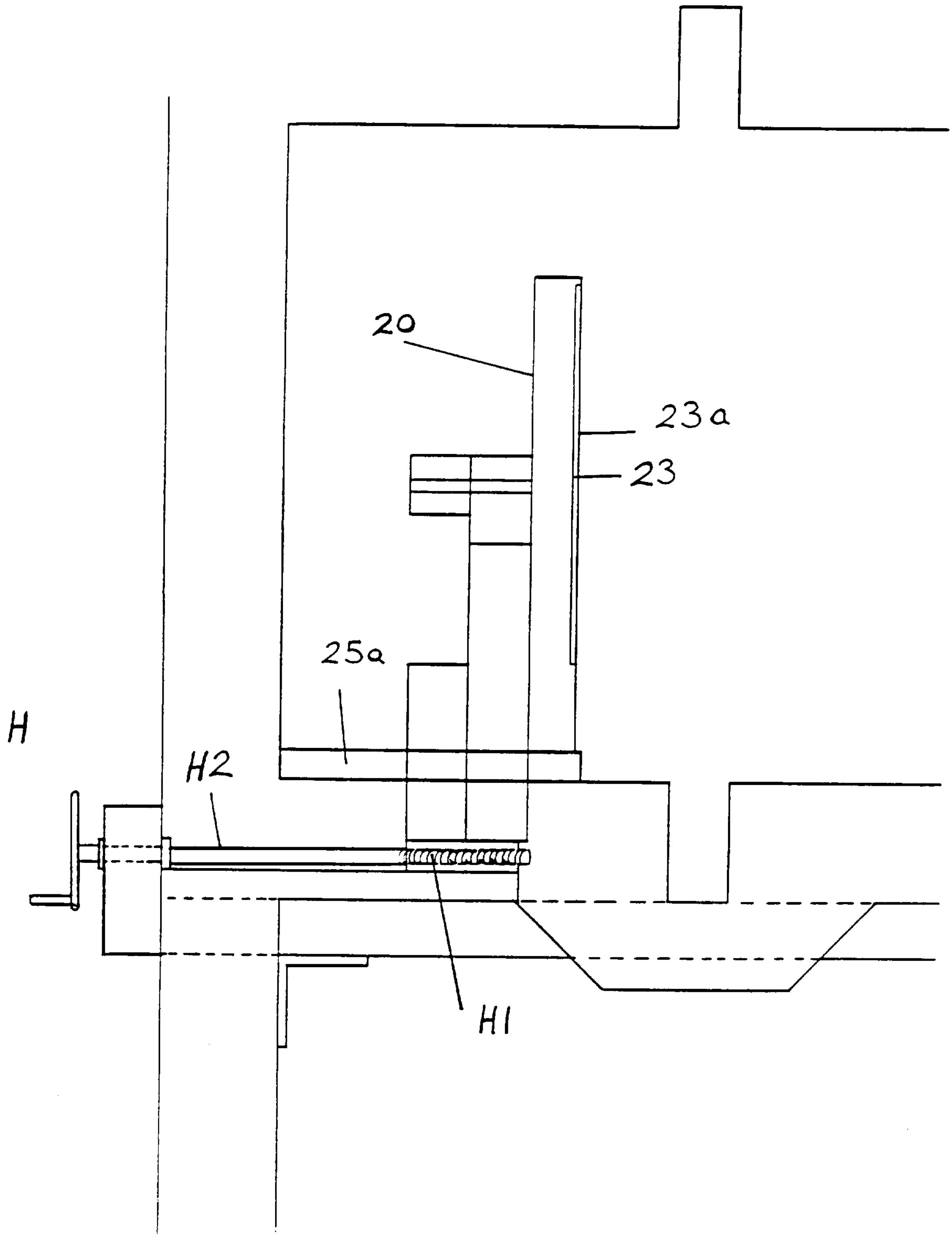

FIGURE 2A

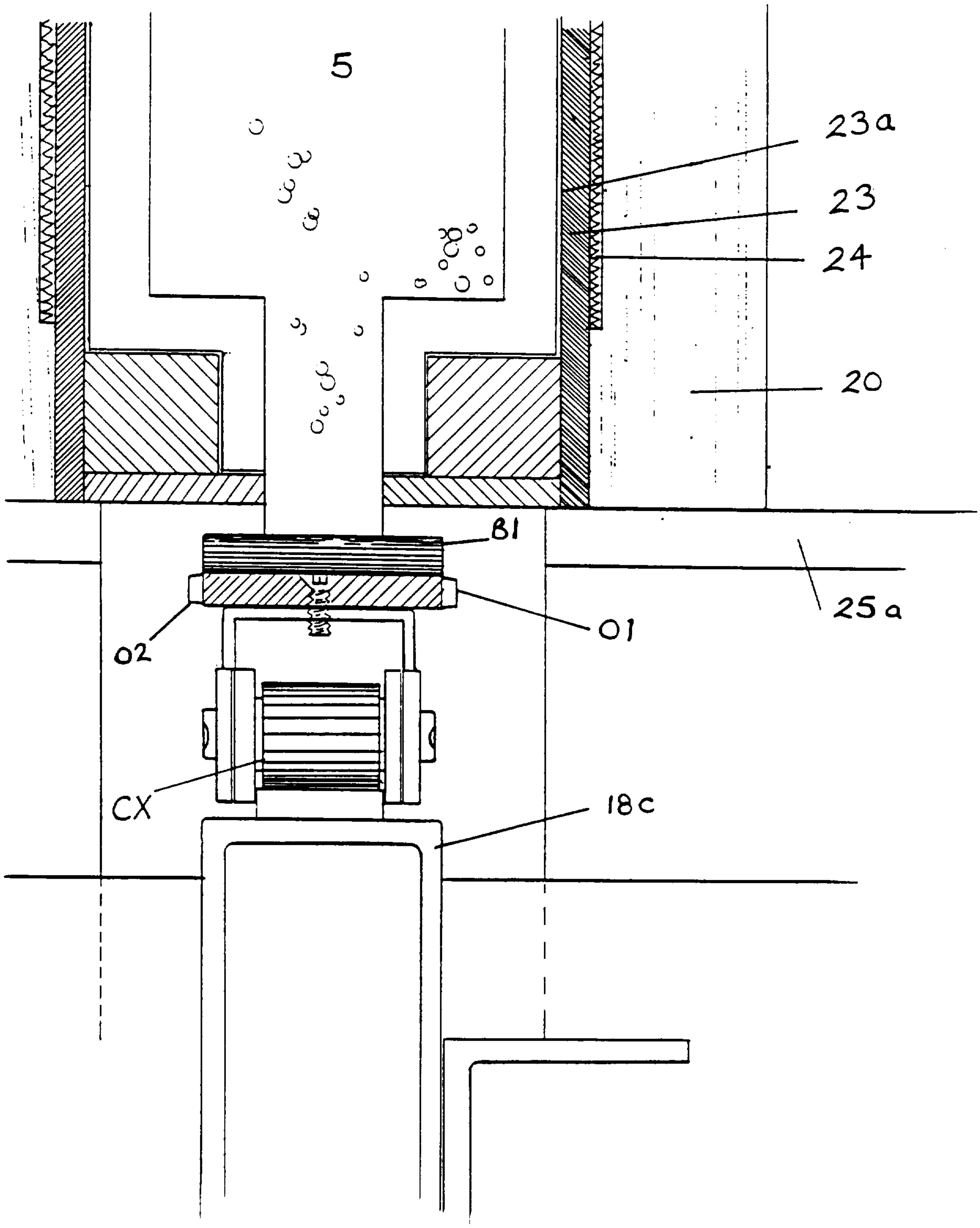

FIGURE 3

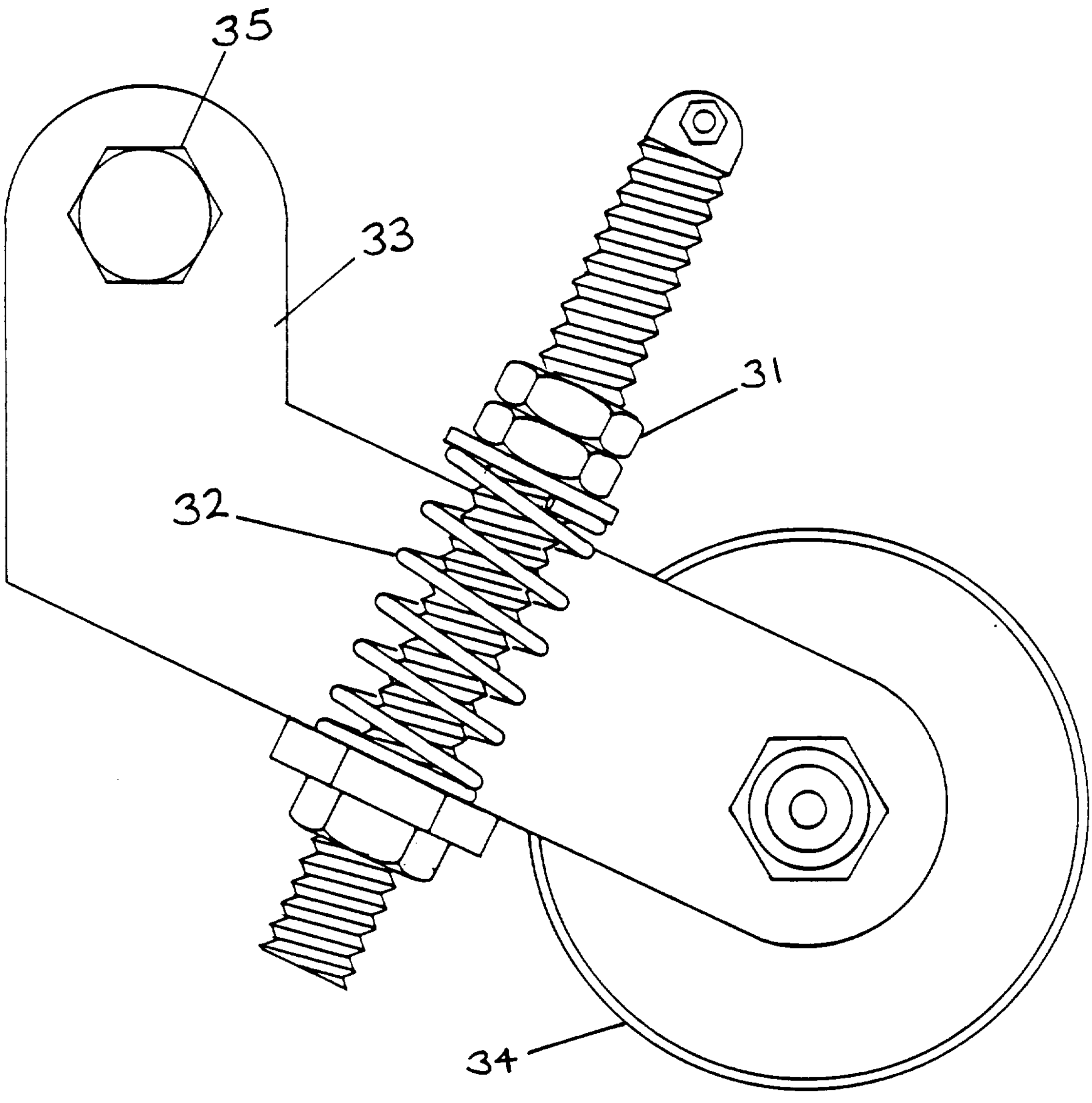

FIGURE 3A

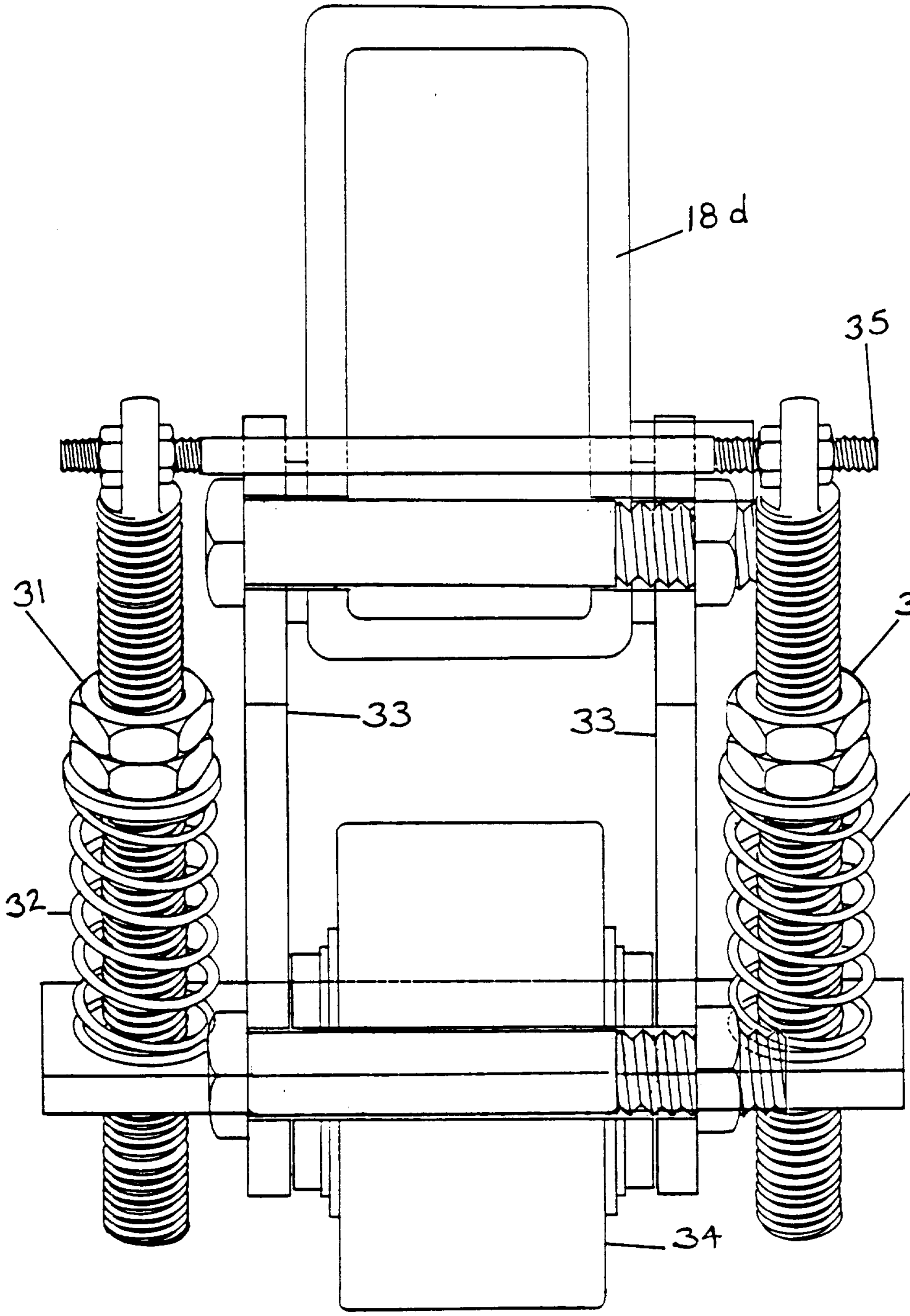

FIGURE 3B

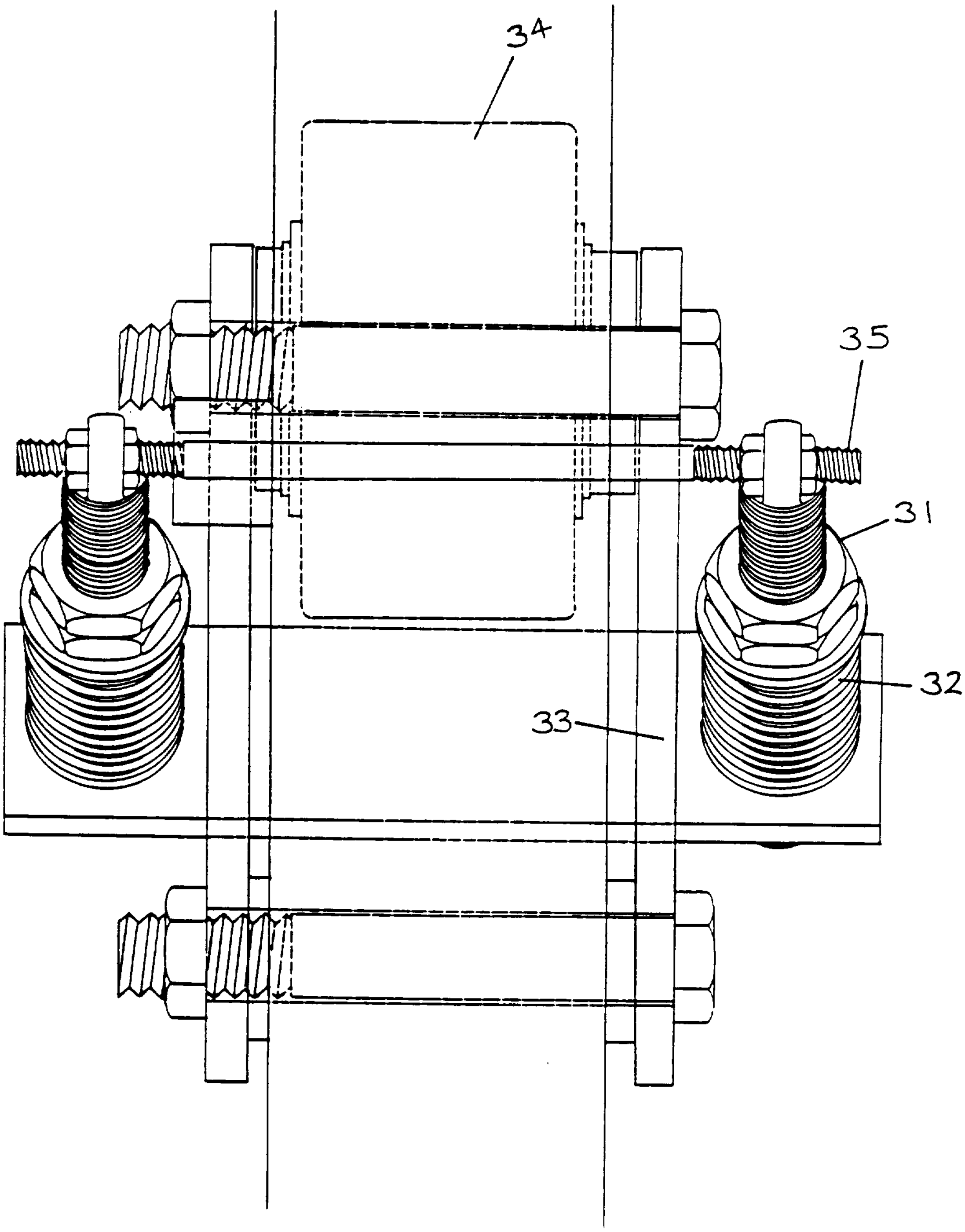

FIGURE 3C

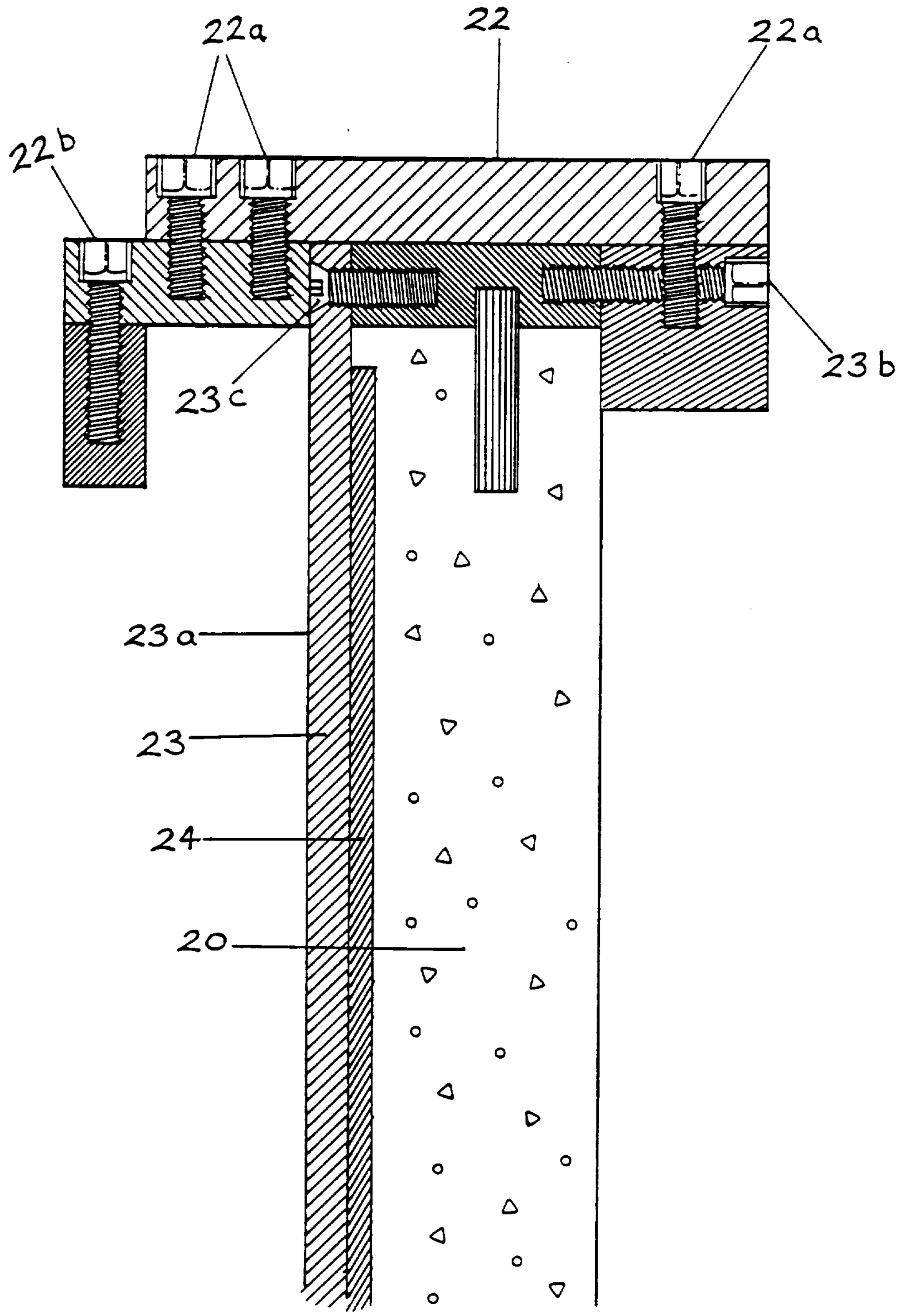

FIGURE 4

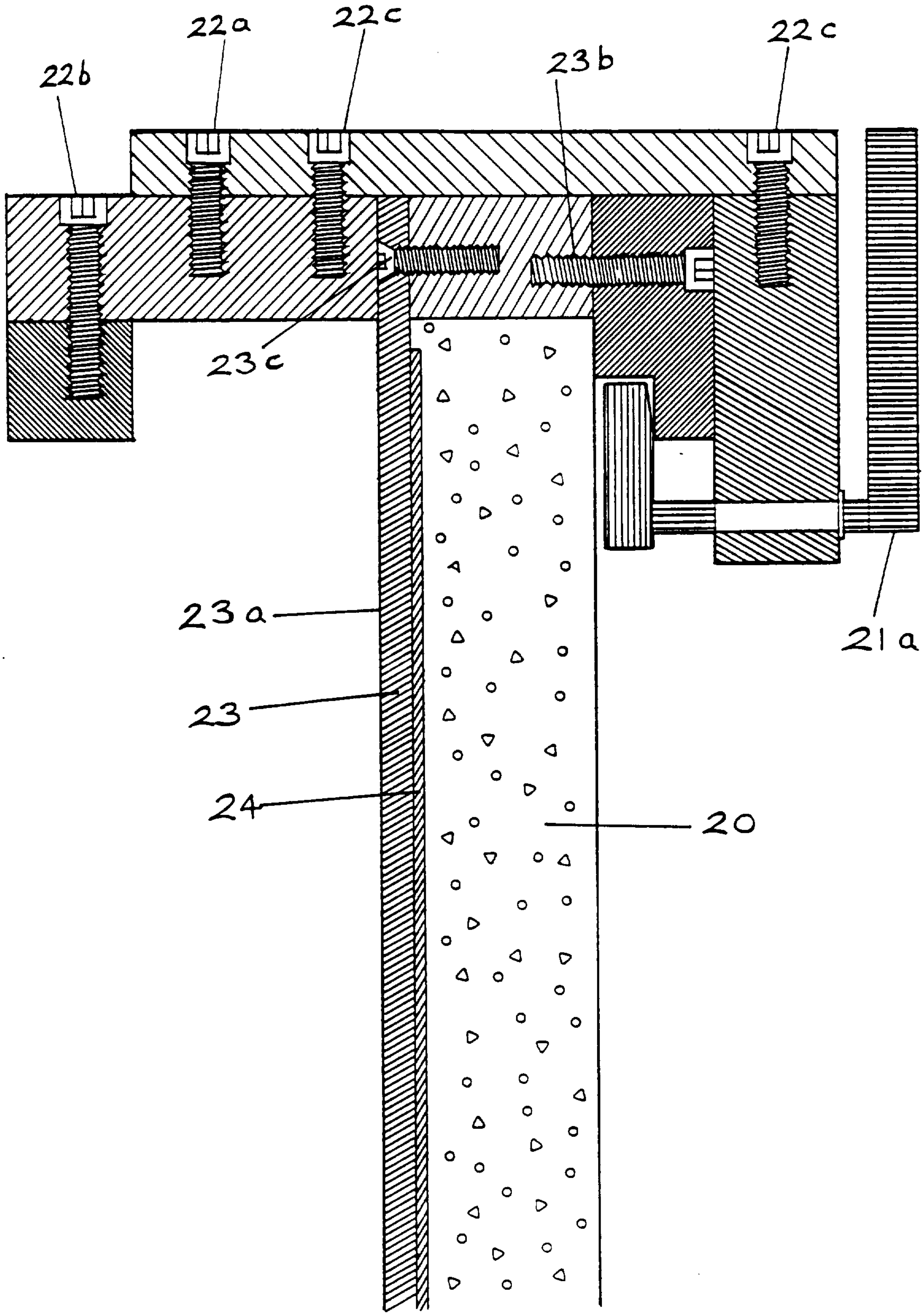

FIGURE 4A

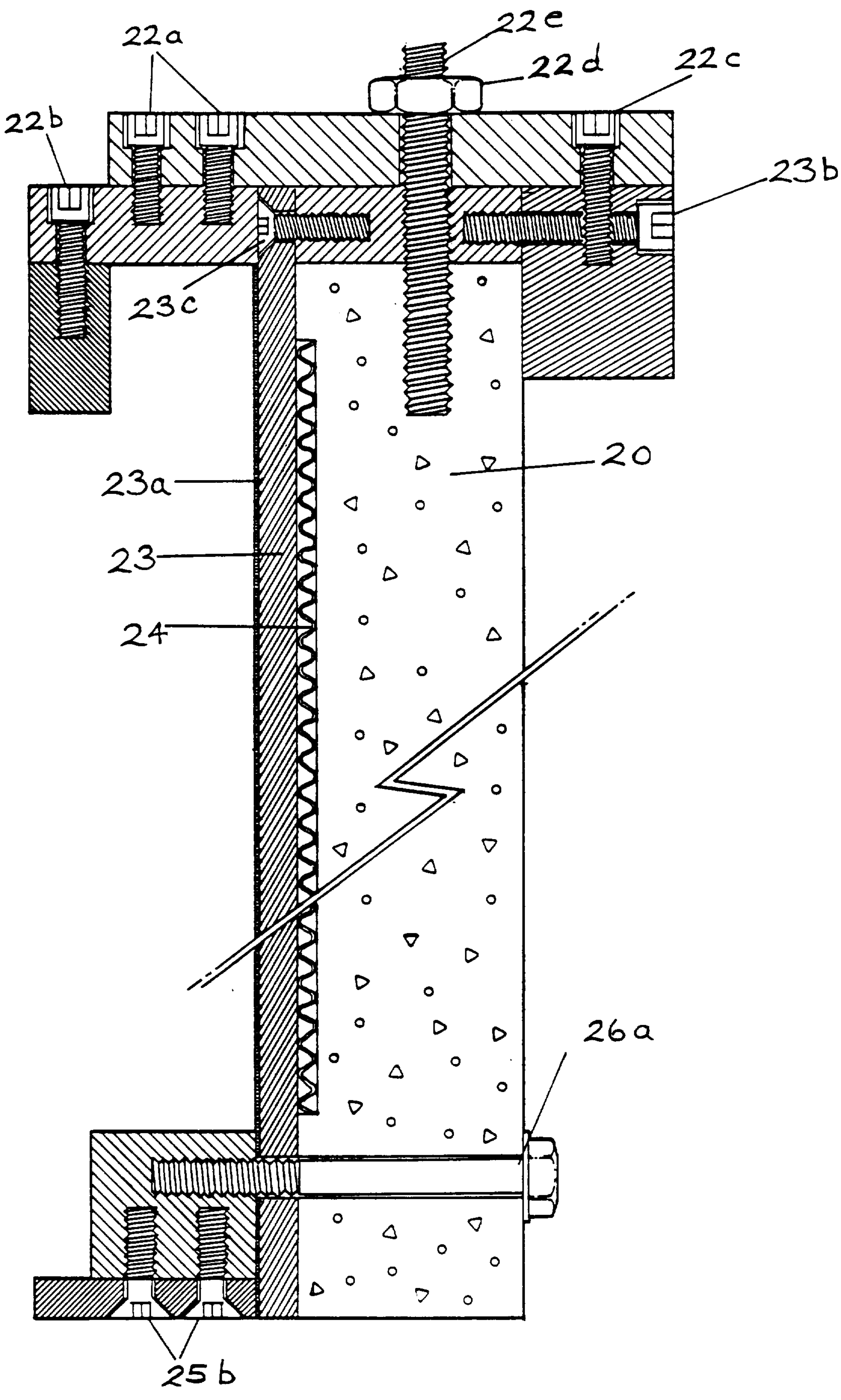

FIGURE 4B

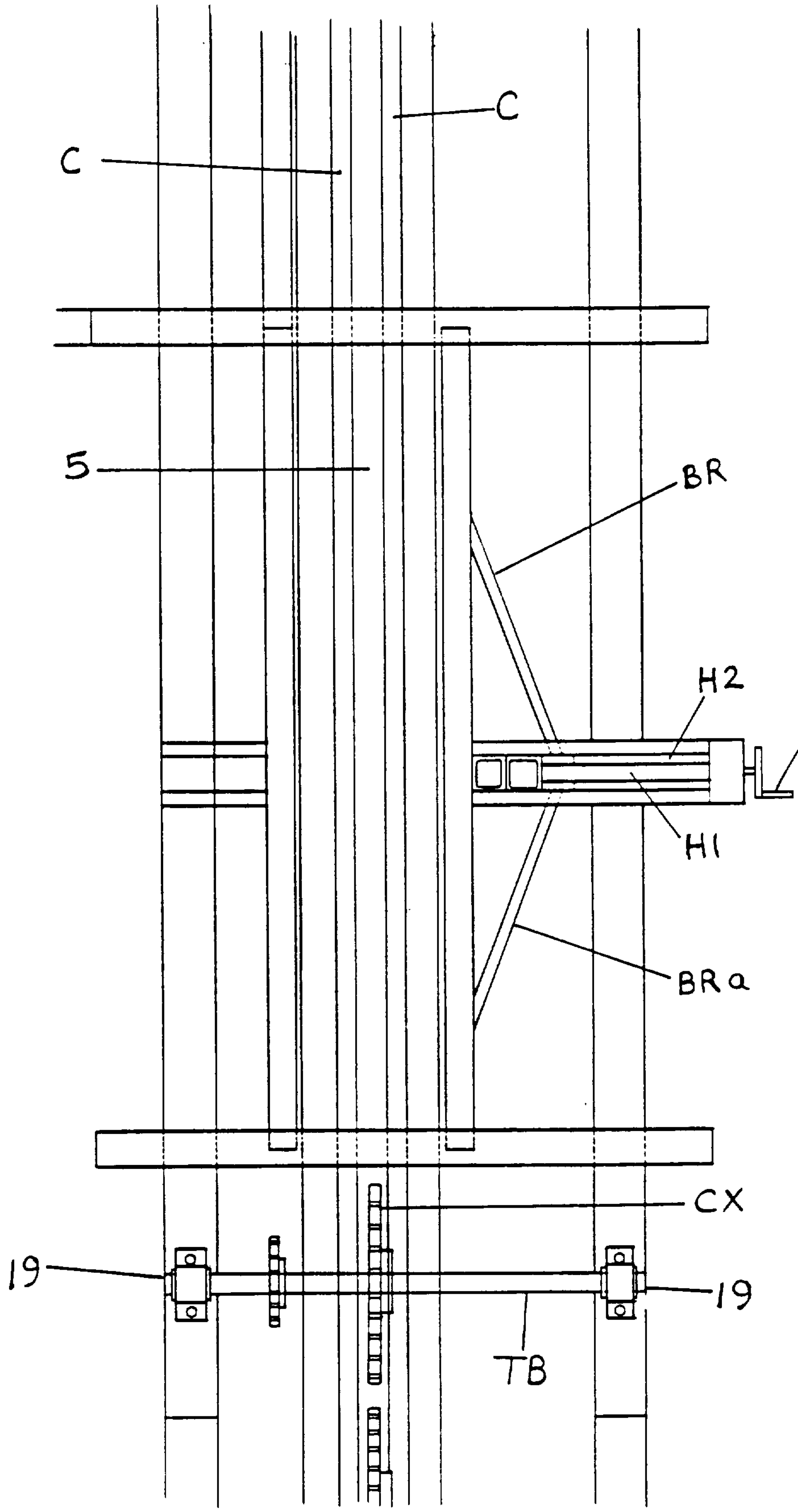

FIGURE 5

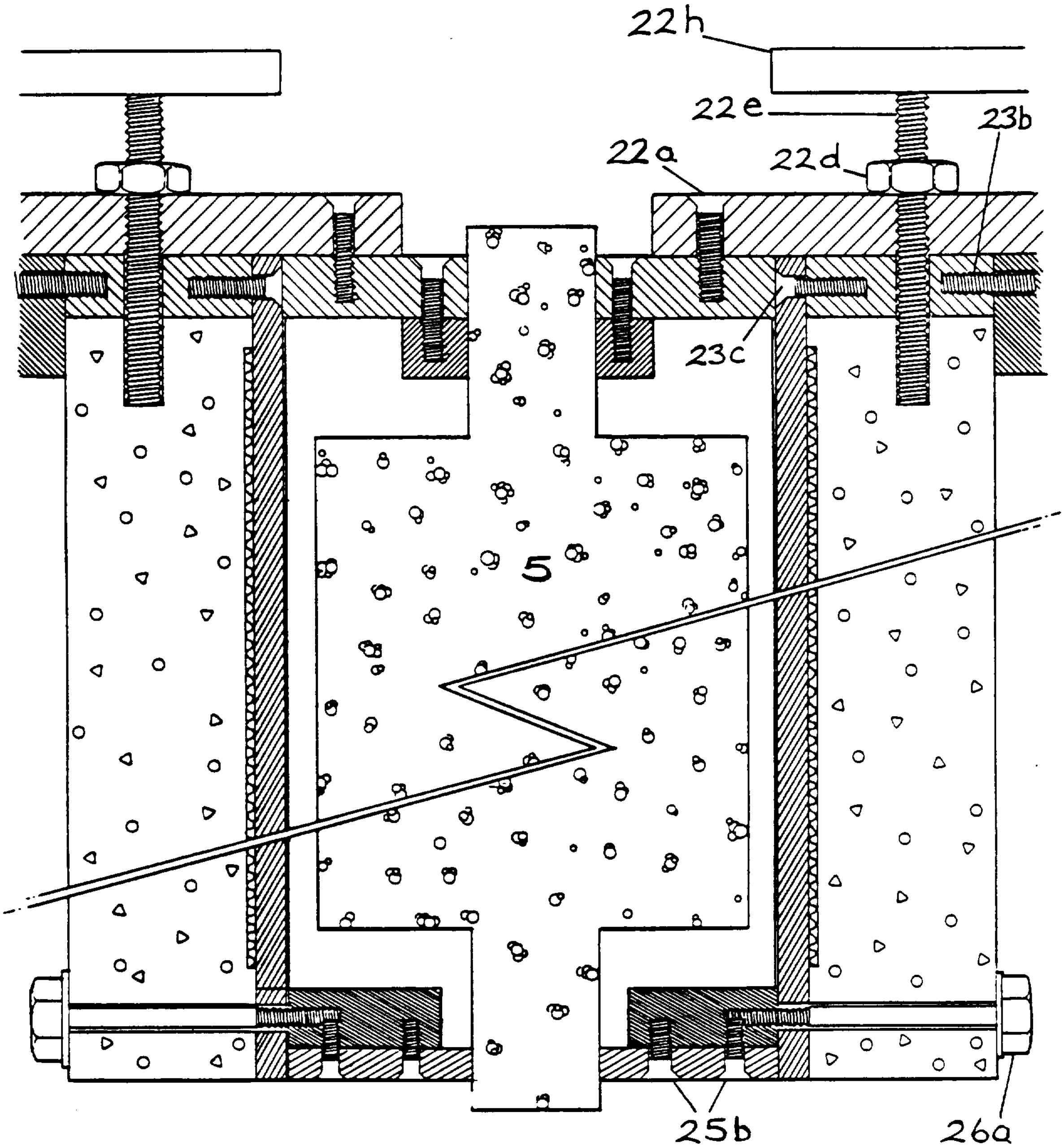

FIGURE 6

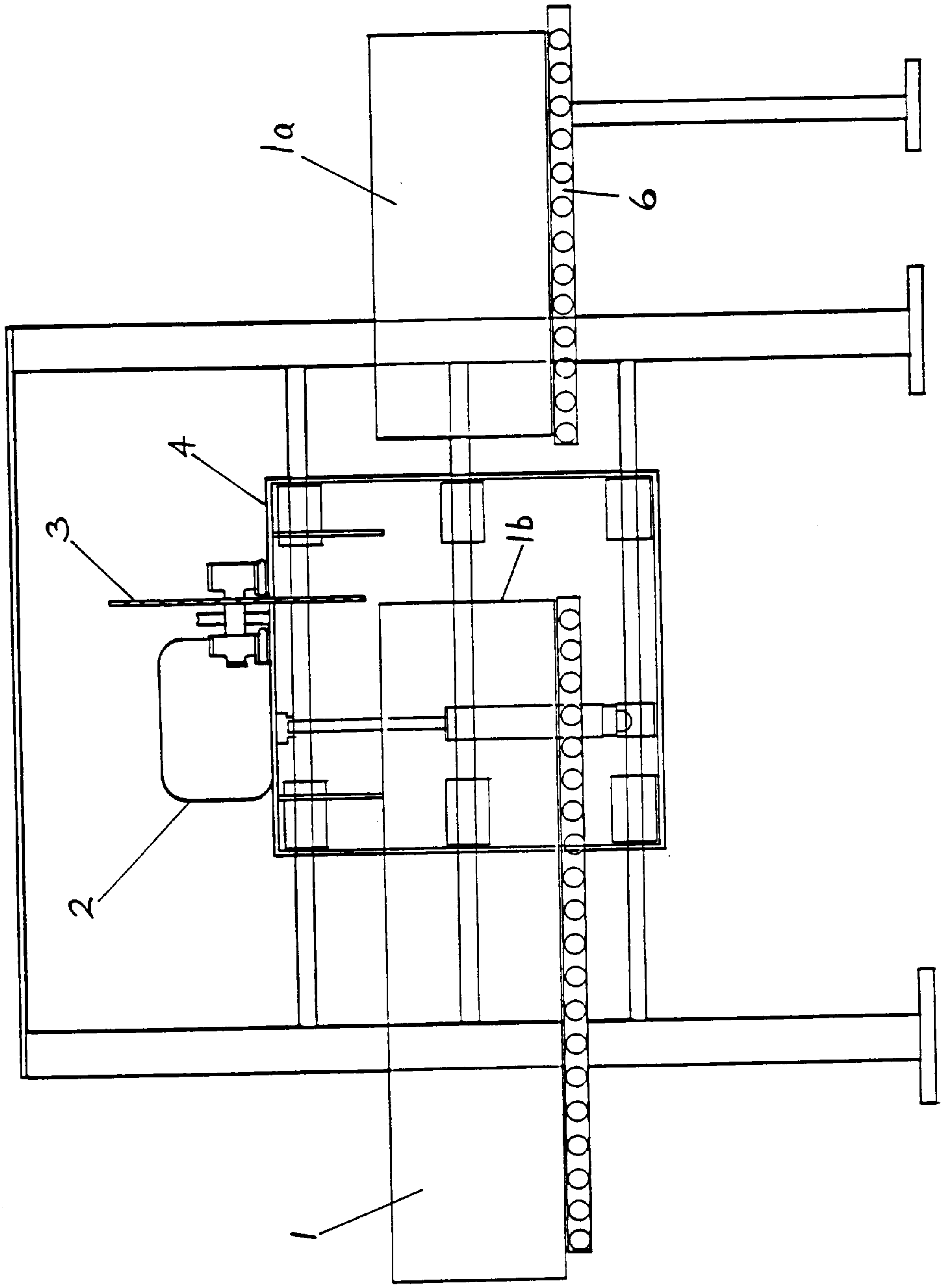

FIGURE 7

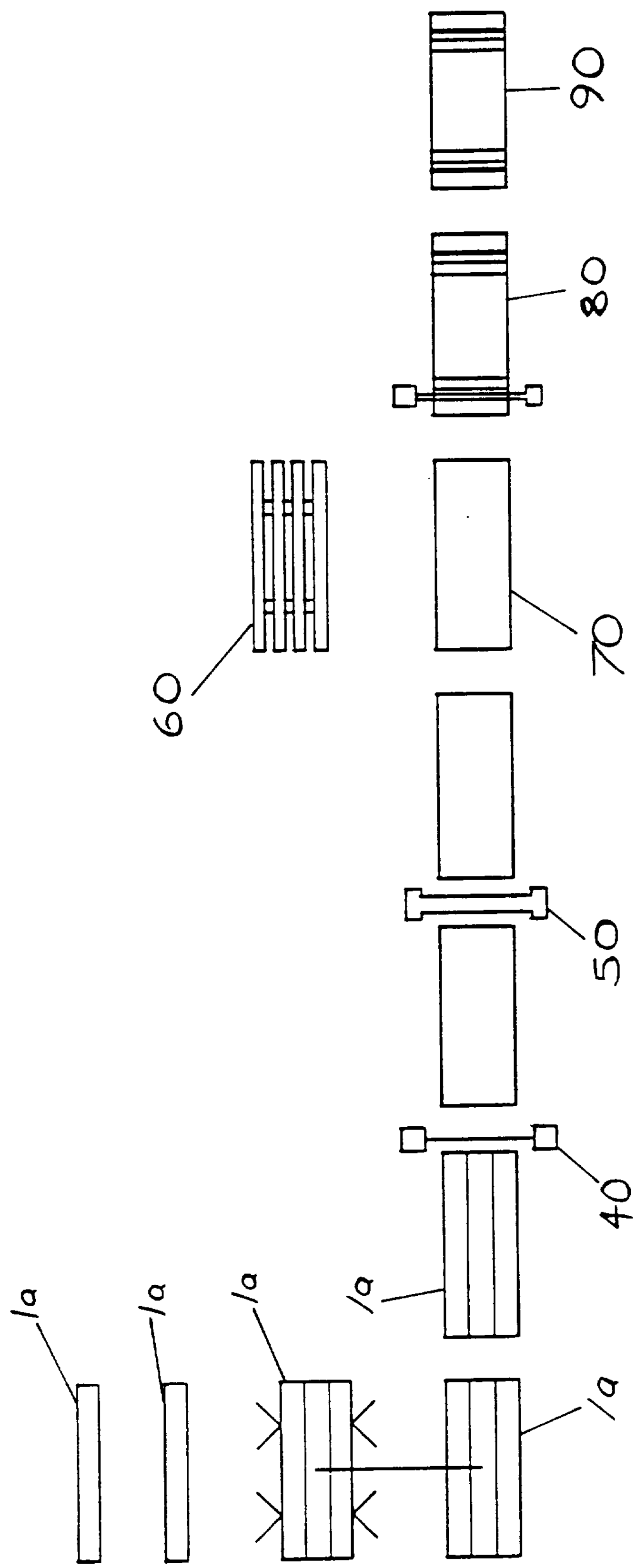

FIGURE 8

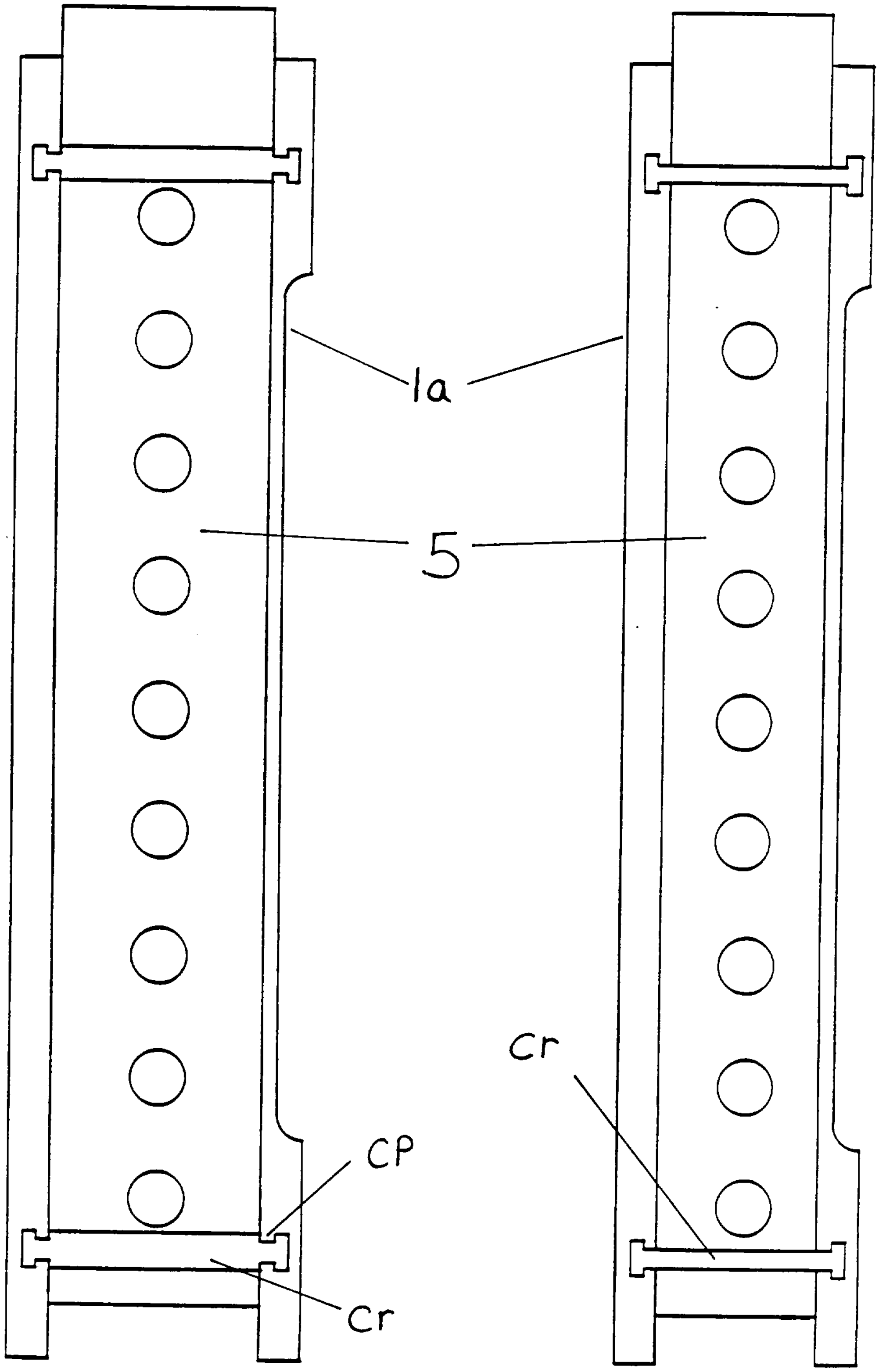

FIGURE 9

FIGURE 9A

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 96/00188

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B28B19/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B29C B28B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 152 (M-953), 23 March 1990 & JP,A,02 014105 (MATSUSHITA ELECTRIC WORKS LTD), 18 January 1990, see abstract	1
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 458 (C-766), 3 October 1990 & JP,A,02 184582 (SEKISUI CHEM CO LTD), 19 July 1990, see abstract	1,2
A	US,A,4 681 722 (N. A. CARTER) 21 July 1987 see the whole document	1-7
A	WO,A,94 07682 (OWENS-CORNING FIBERGLAS CORPORATION) 14 April 1994 see the whole document	1-7

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
19 July 1996	- 7. 08. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gourier, P

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 96/00188

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB,A,1 338 536 (SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ) 28 November 1973 see the whole document ---	1
A	US,A,5 127 980 (M. G. CAVIN) 7 July 1992 see the whole document see column 5, line 15 - column 7, line 4; figures 5,6 -----	1,5

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Int   ıonal Application No
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		EP-A-	0239588	07-10-87
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