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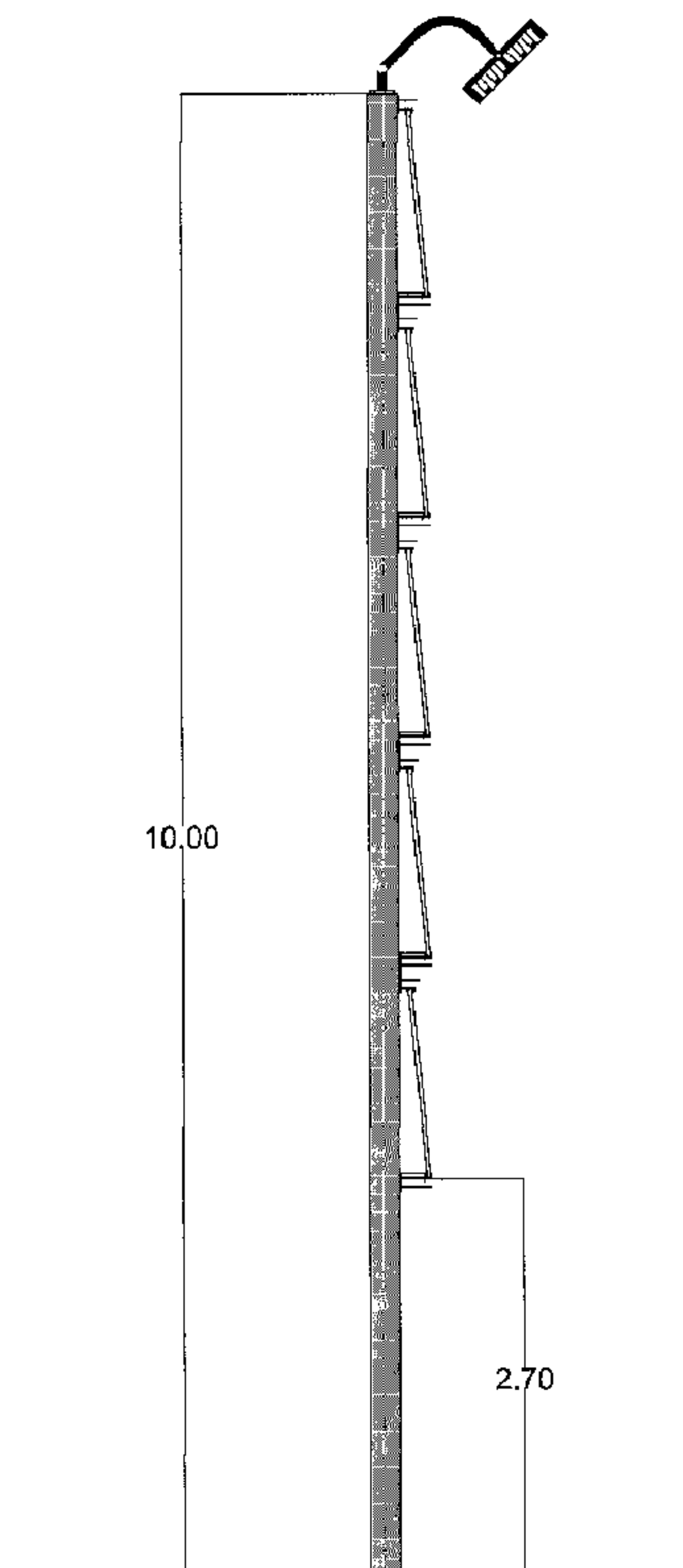
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(54) Title: NEW OUTDOOR SOLAR LIGHTING SYSTEM



(57) Abrégé/Abstract:

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(57) **Abrégé(suite)/Abstract(continued):**

includes also a storage battery and a charge controller. The lighting pole includes an angular adjusting ring at the base to allow maximum solar light harvesting. Shape of the pole and available surface area are also optimized to maximize solar electricity output. The pole may have a triangular, rectangular, square, trapezoidal, octagonal or hexagonal horizontal cross-section. Proposed design may accommodate tilt and azimuthal angles optimization. Additional surface area could be available for integrating solar powered digital display. Proposed solar lighting may also provide support for motion sensing and telecommunication communication. Both crystalline and thin film based solar modules are suitable for this new solar powered lighting system.

New outdoor solar lighting system

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Abstract

A new outdoor solar lighting pole powered including conventional photovoltaic solar panels is described. These photovoltaic panels are attached to at least to one of the vertical flat surfaces of the lighting pole. Besides photovoltaic panels, the lighting system includes also a storage battery and a charge controller. The lighting pole includes an angular adjusting ring at the base to allow maximum solar light harvesting. Shape of the pole and available surface area are also optimized to maximize solar electricity output. The pole may have a triangular, rectangular, square, trapezoidal, octagonal or hexagonal horizontal cross-section. Proposed design may accommodate tilt and azimuthal angles optimization. Additional surface area could be available for integrating solar powered digital display. Proposed solar lighting may also provide support for motion sensing and telecommunication communication. Both crystalline and thin film based solar modules are suitable for this new solar powered lighting system.

Description

Several renewable and non-renewable energy sources are available to match specificity of local energy needs. Abundance of free solar energy has spurred technology and commercial developments for innovative solutions to address specific energy and heat requirements. The success of feed-in-tariff programs helped the photovoltaic power generation to become a major contributor to the overall energy mix. The development of large-scale manufacturing and efficient logistics has helped the reduction of the capital cost of solar modules and other balance-of-system components. The focus on the integration of these solar modules into standardized grid-connected power generator has reduced the interest into innovative energy solutions that could address important challenges within a sustainable scheme. For example, instead of upgrading grid to accommodate increasing intermittent renewables, development of appropriate integrated solar power generation for local consumption is a better option in some cases.

Solar powered lighting system may provide a sustainable solution to increasing electricity demand. In some areas with high solar radiation, excess electricity production could be even used for other applications particularly during peak load hours. Often this peak load occurs during daytime when outdoor lighting is not required.

Lighting represents more than 20% of the overall electricity in developed countries. Street lighting contribute significantly to this overall electricity demand. High installed cost of solar powered lighting systems is a significant hurdle. This is particularly the case for remote areas with no electric grid and/or expensive electricity sources. Maintenance of these lighting systems is also expensive for local communities. For some municipalities, it's the most important budget item.

Several patents have been published in the area of solar lighting. US patent 4,200,904 filed in 1978 describes a standalone solar powered street lighting system including a maintenance-free battery with sufficient storage capacity to power street lights and/or traffic signals. Additional auxiliary generator could be needed to provide energy when sufficient sunlight is not available for an extended period of time.

US patent 6,120,165 filed in 1998 describes a solar powered outdoor lamp with a stand supporting a solar module. Incandescent lamp and a halogen lamp are also included along with

passive infrared motion detector. The halogen is used for intruder detection in security applications.

US patent 7,832,892 B2 filed in 2008 describes a two LED lamps solar powered lighting assembly. Each LED lamp includes a photovoltaic panel installed on the top of the lamp frame.

Previously mentioned patents are mostly based on standard photovoltaic module mounted on top of a post. These designs provide electricity output to low lighting requirements. Large solar panel up to around 10 m^2 may be required to satisfy electric power requirements for high flux lighting system. High surface area solar panel may raise issues related to mechanical stability and cost of integration. This is particularly the case in highways and remote places where high intensity lighting systems are required. Higher surface area is needed even in areas of high solar radiations. Furthermore, design of the solar lighting should provide high surface area and high solar-to-electricity conversion efficiency. To avoid additional capital and operation costs, we need to use simple and standard fabrication and integration processes. For example, using solar cells or solar modules produced by custom-made manufacturing processes and machinery increases the overall cost.

The surface area of the pole may provide large area for integrating large numbers of solar panels. For example, with a square base pole having 25 cm each side and 10 m high, available surface area for integrating solar cells or solar modules is estimated at 10 m^2 . Potentially this could provide around 1000 W installed electric power capacity. However, the efficiency of solar collection will be reduced because of potential shading and non-tilted solar panel. Furthermore all the faces do not have the optimal azimuthal angle. Solar panel with standard length will be used. For example, solar module around 120 cm long is suitable. Solar panels containing one row of solar cells could be obtained using conventional back-end manufacturing processes and machinery. Modules with different size could be also used depending on the power requirements and the geometrical dimensions of the lighting pole.

US patent 2014/0041714 A1 describes a tubular solar system laminate for integration into solar lighting system. Requirement for flexible solar cell and tubular high quality glass makes this solution very expensive. Furthermore, around 50% of solar cell will not be exposed to direct solar radiation. Furthermore, the vertical position of the solar module will reduce significantly

the solar radiation collection efficiency. This design will make the overall energy efficiency of the system even lower.

We propose solar lighting pole with triangular, square or trapezoidal, octagonal or hexagonal cross-section base to provide maximum surface area exposed to direct solar radiation. Other non-circular cross-section shapes could be also used. Depending on the cross-section, the pole will provide 3, 4, 5 or 6 faces to accommodate solar panels. Lighting poles having different cross-section shapes could be also used depending on the application and local requirements. For example, these different shapes may provide architectural and design flexibility. Local requirements may dictate the choice. These requirements may include installed capacity, mechanical and style needs.

Properly designed solar panel placed on the different faces of the pole will allow production of electricity of sufficient amount even in low solar radiation sites. South-east and south-west facing panels will have a reduction of electricity output of around 10% when compared to true south rated power. However, the multitude faces with different azimuthal angles will give raise to high power capacity during longer hours of the day. This will allow utilisation of the excess solar power in peak load management. This is particularly the case when the battery is 100% charged.

Figure 1 shows a schematic representation of a 10 m height solar powered lighting pole. This pole could be made of a single unit or multiple sub-units. Each pole face may contain at least 5 inclined photovoltaic solar panels around 120 cm long. Longer or shorter solar modules could be also used. This will affect the overall number of modules per lighting pole. Depending on the pole cross-section dimensions, at least one row of solar cells could fit on each pole face. Solar panel tilt orientation will help optimize solar-to-electricity conversion. Additional components of the lighting system include battery storage, motion sensor and charge controller.

The pole should be oriented properly by different means before permanently fixed to the ground. Note shown in Figure 1, is the possibility to rotate de pole before permanent fixing. An angular adjusting ring at the pole base allows optimization of the azimuthal angle. This will help optimize further the solar-to-electricity conversion efficiency.

Both crystalline silicon and thin-film based solar modules are suitable. Thin film based solar modules may provide an advantage in some specific applications. For example, in addition to

using an optimal tilt and azimuthal angle for the solar panel, $\text{CuIn}_x\text{G}_{1-x}\text{S}_y\text{Se}_{1-y}$ could provide help reduce glare. This option could be for example used in highway and near metropolitan areas. In addition to this, solar panels are attached around 2.70 m or higher. In some cases the clearance height could be even bigger. The final clearance height could be dictated by other local requirements. The pole height and the number of solar modules will be adjusted accordingly.

Figure 2 provide a schematic representation how the bottom and top of each photovoltaic panel are fixed to a single metallic piece. This metallic piece is fixed to the pole before solar module integration. This reduces time and cost of solar module installation. Different means could be used to fix the metallic piece to the lighting pole. Preferable position of holes with appropriate sizes are shown in Figure 2. This facilitates fixing the metallic piece to the pole. Dimensions of this piece are provided in cm units. Additional mean could be added to provide mechanical stability for the solar module. For example, one or more screws could be used to attach the solar module and the metallic piece together.

Figure 3 provides a horizontal cross-section of the pole including the solar panel in the case of trapezoidal shape. The regular trapezoidal cross-section provides one face, around 34 cm and up to 10m long, for display or other applications. The other three faces are used in this example as support of solar panels. These three faces are 21 cm wide.

The metallic piece is not shown in Figure 3. This piece could be fixed against one or multiples faces of the poles. Fixing against multiple faces of the poles could provide additional stability. Three holes to help installer fixing the metallic piece, before module integration, are shown. Each hole is positioned at the center of each face.

Claims

What is claimed is:

1. A solar lighting assembly comprising of single unit or plurality sub-units. Each sub-unit consists of non-circular horizontal cross-section.
2. A solar lighting assembly of claim 1, wherein each sub-unit provides anchoring to the adjacent sub-unit.
3. A solar lighting assembly of claim 1, wherein a solar panel with appropriate geometry is attached to the single unit or plurality sub-units.
4. A solar lighting assembly of claim 1, wherein a solar panel with appropriate geometry is attached to one face of the lighting pole.
5. A solar lighting assembly of claim 1, wherein the solar module tilt angle is optimized to maximize solar collection and reduce shading.
6. A solar lighting assembly of claim 1, wherein thin film based solar module such as $\text{CuIn}_x\text{G}_{1-x}\text{S}_y\text{Se}_{1-y}$ is used to reduce glare.
7. The solar lighting assembly of claim 1, wherein the sub-unit has a triangular shape with three faces.
8. The solar lighting assembly of claim 1, wherein the sub-unit has a rectangular shape with four faces.
9. The solar lighting assembly of claim 1, wherein the sub-unit has a squared shape with four faces.
10. The solar lighting assembly of claim 1, wherein the sub-unit has a trapezoidal shape with four faces.
11. The solar lighting assembly of claim 1, wherein the sub-unit has an octagonal shape with five faces.
12. The solar lighting assembly of claim 1, wherein the sub-unit has a hexagonal shape with six faces.
13. A solar lighting assembly of claim 1, wherein the lighting pole includes an angular adjusting ring at the base to allow azimuthal orientation of the pole.
14. The solar lighting assembly of claim 1, wherein a single metallic piece is used to fix the bottom and top of two adjacent solar panels on the same face of the pole.

15. The solar lighting assembly of claim 14, wherein a mean is provided to fix the metallic pierce to the single unit or sub-unit.
16. The solar lighting assembly of claim 14, wherein holes are provided to facilitate fixing the metallic pierce to the single unit or the sub-unit.
17. The solar lighting assembly of claim 14, wherein the dimensions of the metallic piece is adjusted to optimize solar panel tilt angle.

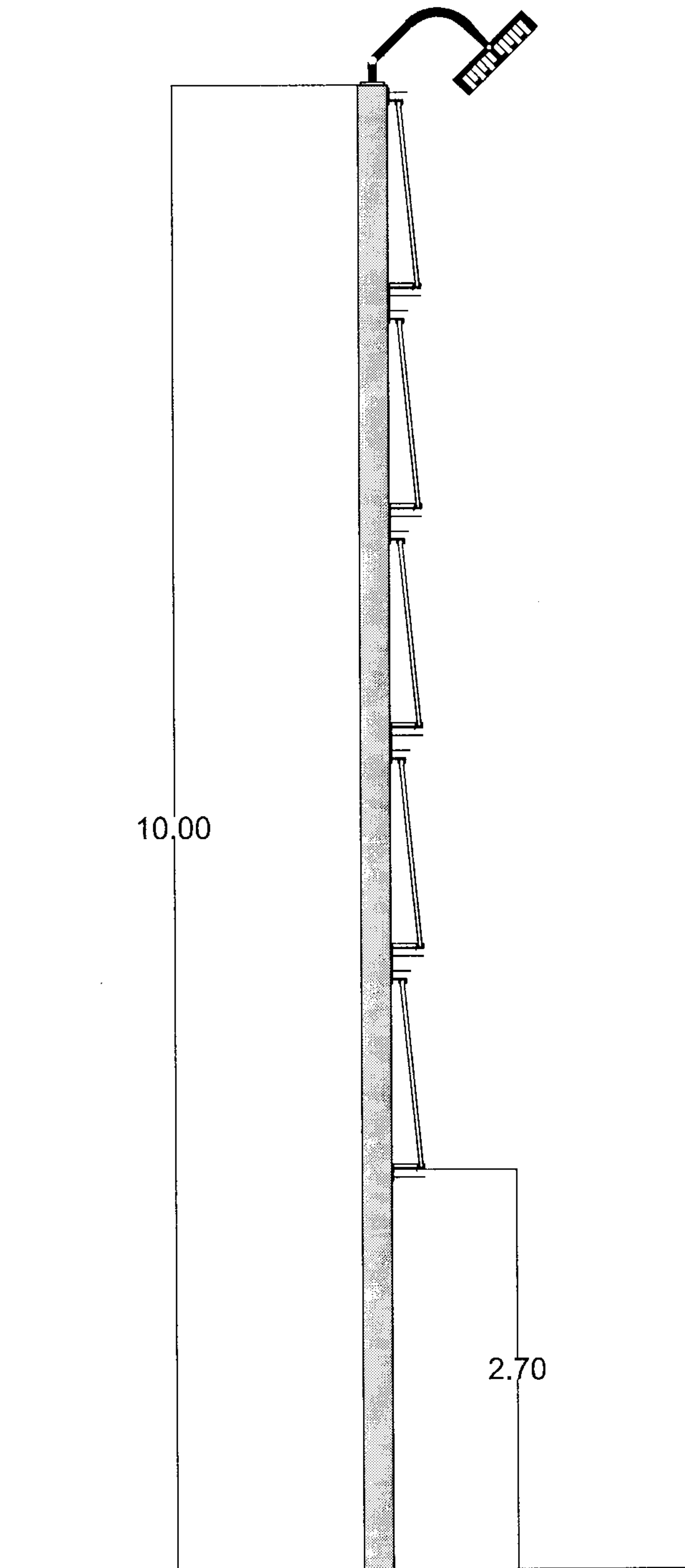


Fig. 1

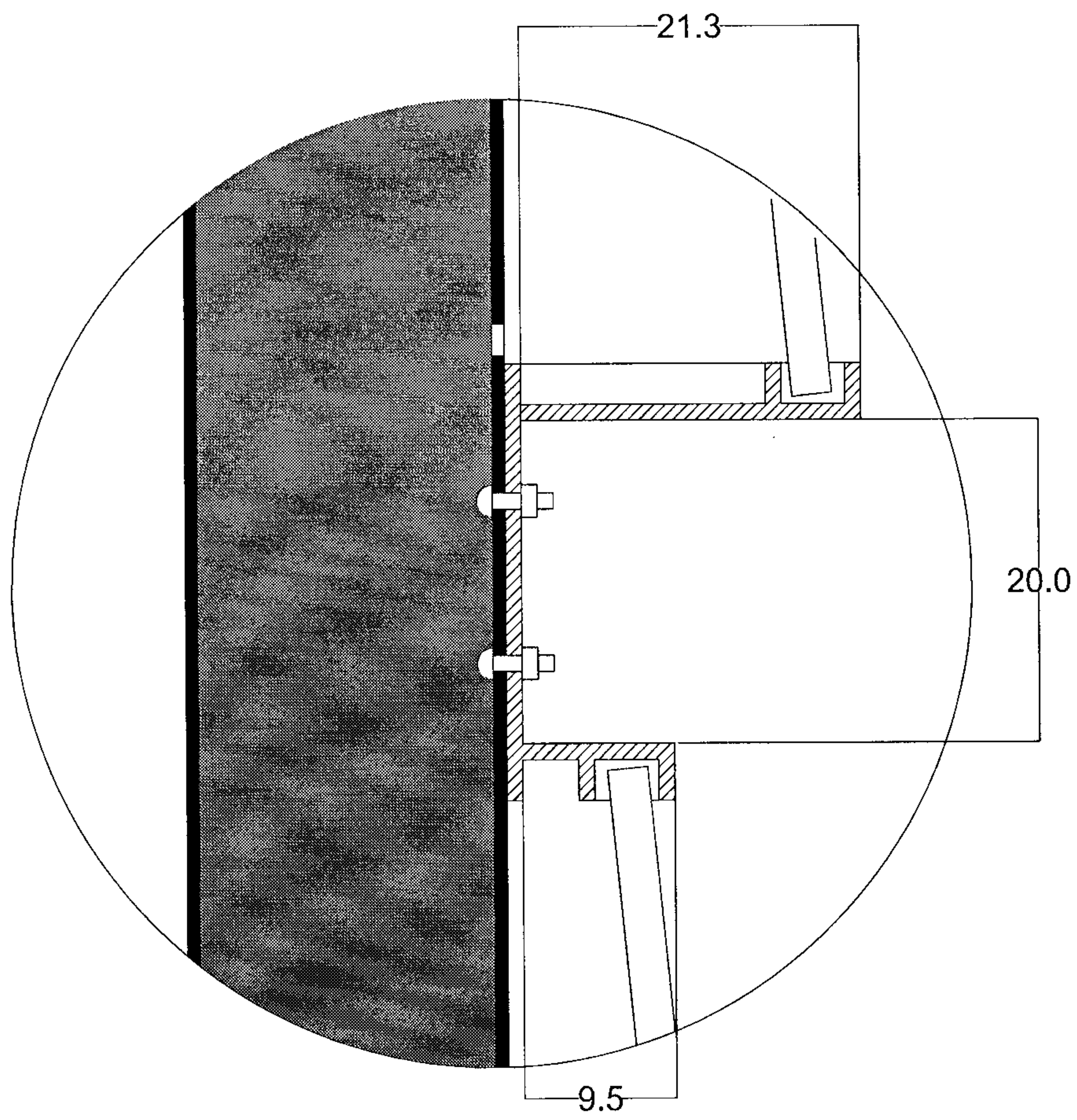


Fig. 2

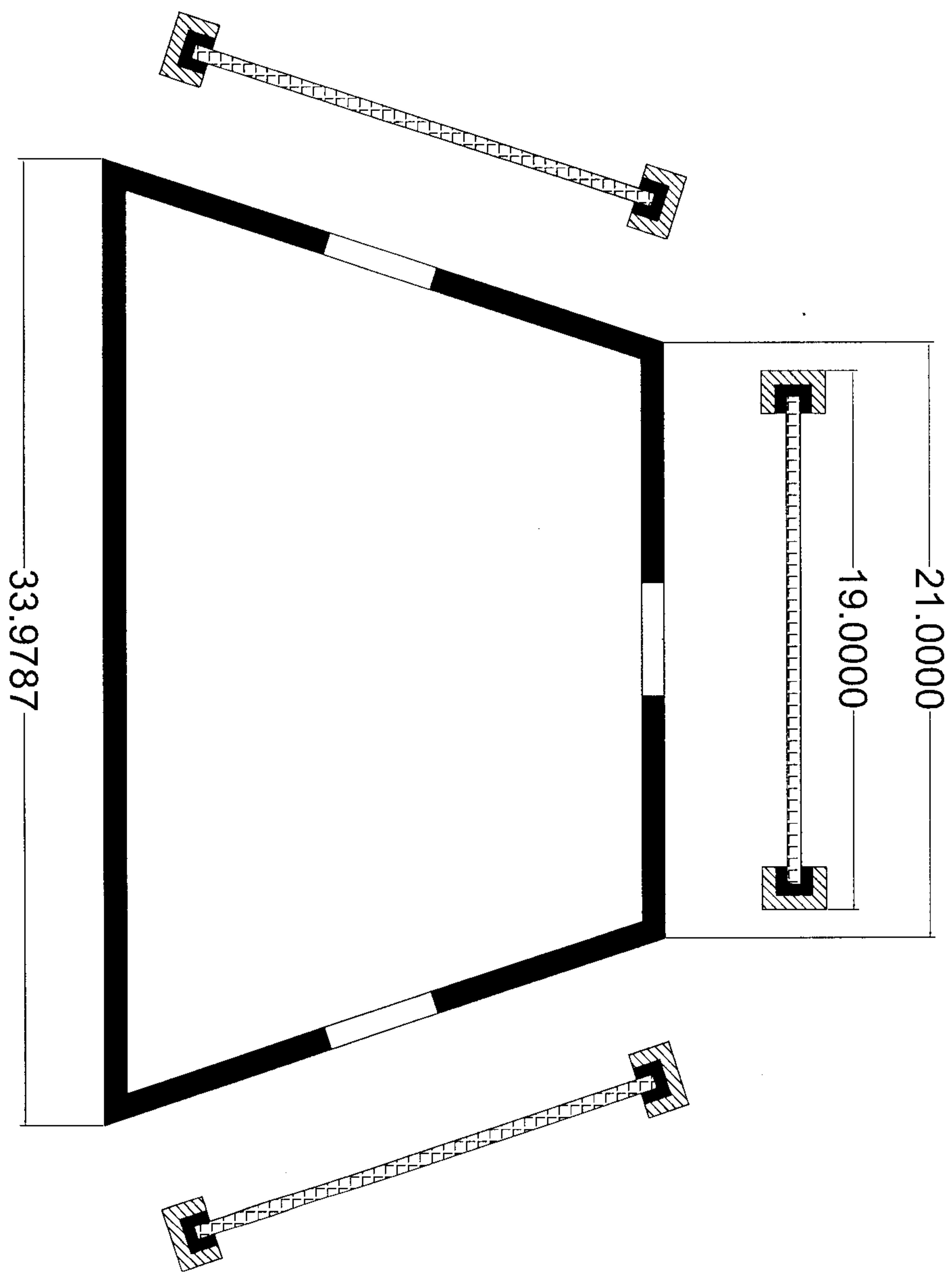


Fig .3

