Urban wind turbine

By :

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U.S. patent pending.: 61/245 461

Abstract

This presentation is a specific application based on the principle of the patent pending 'Wind turbine with wind concentrator'.

An urban wind turbine must satisfy at best the following requirements:

- It should supply all the energy required by a household of a small family, including the energy required by an electrical car; or produce electricity for 2 or 3 smalls apartments.
- It must be very quiet, the sound level should be lost within the natural noise of wind.
- It must not generate any vibration, even with gust of wind.
- It should not need an important base, ideally it should be sit on the roof of an existing house without any change on infrastructure.
- Visual aspect should not be awkward; ideally apparatus will show no movement.

The design principles detailed in the presentation of the patent pending **'Wind turbine with wind concentrator'** can be used to achieve all those objectives.[(1)]

(1) We suggest the reader has read the patent pending presentation before this document.

Context

Installing wind turbine in urban area is ideal as the energy produces and used in same location. That will both reduce the lost of energy in the distribution network and the cost of additional electric network require to reach far away wind farms.

There is actually no deployment of wind turbine in urban areas as it would face too many obstacles.

As the energy available in the wind is not very concentrated; to produce enough electricity for the requirement of a family, we must harnessed from 10 to 20 squares meters of wind. This mean that equivalent tri-blades wind turbine with have a diameter of 4 to 5 meters, which is unacceptable in residential areas in regards of the noise and the visual impact.

There are other wind turbines that are designeds to produce less noise, but their efficiency is so low that it is necessary to increase their size even more to provide the same power.

The following presentation shows alternatives viable solutions for the implantation of wind turbines in urban site.

Cubic wind turbine

Fig. 6 represents a side view cut of an urban wind turbine having dimensions of 4m x 4m x 4m and which is mounted on a frame placed on a flat roof of a two or three story building.

To favour a laminar compression of air, several conduits are superimposed and direct the concentrated wind to several small turbines. The development of the shape of canalization favours the run-off of water, sand, or snow so as to prevent unnecessary stoppage of the apparatus. The choice of a cubic form is simply aesthetic, as other forms could be used, including a cylindrical design that would also eliminate all appearance of movement to face the wind or a triangular design that favours the flow of residual wind.

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Fig. 7 is a top view of the design for one of the stages of the wind concentrator. While this scheme suggests that the stator and the rotor are mounted within the interior of the blades of the turbine, other configurations are possible. To absorb all vibrations produced by the apparatus, the turbine will be enclosed within a metal structure which itself will be enclosed within a rubber casing, which is finally deposited and laminated in the polystyrene structure.

Fig. 6 and **7** show that the surface attributed to the expulsion of air is approximately 50% more important than the one allotted to the incidental wind. We see in **Fig. 6** that the base evacuates a part of the air and in **Fig. 7** there is evacuation on either side. The deflectors **6** are installed on all faces to favour a reduction in pressure around the zone of expulsion.

Still referring to **Fig. 6**, the urban wind turbine is mounted on a rotating plate **10** that mechanically positions the wind turbine to face the wind. The mechanism's movement will be intentionally slow as to not generate pressure surges and to not visually draw attention. The supporting structure **11** will spread the weight on the roof over a large surface with contacts points positioned directly over the support walls.

Fig. 8 show diverse deflectors that could be added in a manner to improve:

- **50** Laminar flow of the concentrated wind.
- **51** To eliminate all direct noise produced at the output of the wind turbine. Here the distance **L2** was increased as to not hinder the expulsion of air.

Fig. 9 shows the exterior appearance of an urban wind turbine. In particular, two wind turbines of 4 meters on each side situated on the roof of two duplexes having 12 m of frontage are illustrated. The first urban wind turbine is positioned as a frontal view **12** and the second from a side view **13**. The enclosed parts of each side of the cube wind turbine can be decorated or used to generate advertising revenue.

Notes on efficiency:

If we apply the surface area of our urban wind turbine (16 square meters) to that of a standard wind turbine, it would have a nominal power of 7.5 kilowatts with a yield between 10 to 40% depending on the site. With a compression rate of 6 over a distance of 3 meters, the present invention will produce a higher nominal power value with an enhanced yield(2). For example, for an urban site having an average wind speed ranging between 10 and 15 kph and resulting in a yield of 15% from a traditional wind turbine, we estimate that when a wind concentrator is employed the total equivalent yield(3) will be between 20 and 25%. This yield is attributable to an improved use of wind and a superior efficiency at lower wind speeds that will render this low wind site economically viable. The increase in the performance will be less significant for sites that experience higher wind speeds, but return on investment will be more significant and other urban elements of our wind turbine will remain essential to their deployment in a residential area.

There is only one way to produce electric energy from wind and it is by harnessing a large surface. The implantation of a tri-blade wind turbine of four or five meters in diameter is unthinkable in an urban environment. The present invention in the form of a cube of four meters or more is necessary to produce significant energy. In addition, since the generation of energy through the harnessing of the wind is naturally irregular, the deployment of a wind turbine has to be used in conjunction with an energy management system as described in patent application no. 61/228,742 for example.

(2) : The nominal power of a wind turbine is the maximum power you can reach with it. For example a tri-blades machine of 1 megawatt will reach this power with a wind of 45 km/h. This is a mechanical efficiency of 40% in regards of the energy included in the wind at that speed. In general when it is question of the efficiency of a wind turbine, this relates to the efficiency of a site in regards of the nominal power of the engine. In a field where the average wind speed is 20 km/h. our 1 megawatt wind turbine will have an efficiency of 30%, this mean that generator will supply an average of 300 kilowatts in continuous, or more precisely 2.6 millions kilowatts-hour per year.

(3) : We estimate that the mechanical efficiency of our machine with wind concentrator will be better than the one of a tri-blades wind turbine. We expect to harness more then 45% of the energy include in the wind, where the theoretical maximum is 59%. Our overall efficiency, the amount of kilowatt-hour we can produce per year, will then be enhanced by two factors; a better harnessing of wind and a wider span of wind that will be used.

Depending on the various conditions such as the average wind speed, the cost of basic energy, the possibility of recharging a car, etc. the energy savings can justify an investment ranging between $25,000 and $50,000 excluding the consideration of the ecological impact on this source of clean energy, the potential for advertising revenues and eventual refunds resulting from government subsidies.

Similarly, an enterprise occupying a building of 300 or 400 square meters could install up to four cubes of ten meters on each side on the top of its roof. By generating on average 60 to 75 kilowatts of continuous power, the overall installation could justify an investment between $500,000 and $750,000, even more when done in the context of a carbon emission reduction exchange and the sale of advertisement space on the closed faces of the cubes.

Trapezoidal wind turbine

Fig. 22 shows a top view cut of the trapezoidal wind turbine. The input is 4m. x 4m. as the cubic one, length is also 4m. but exhaust side is 4m. x 5m. The side view is quite the same as the cubic design, **fig.6**, except that there is no need for bottom and side exhaust.

The trapezoidal wind turbine has a less clean look than the simple cubic shape, but it has few significant technical advantages:

- Incoming winds are compressed in only one axe, which reduces the potential of turbulence with strong wind.
- The ejection of wind flow is also more linear, which increases the potential efficiency of the apparatus.
- As the size of the output is 25% larger than the size of incoming wind, the turbine may extract up to 50% of the wind energy in respect with fluid mechanical principles following Betz law.
- The positioning tray (part **10** of **fig. 6**) may be moved to the back of the structure, or enlarge, as there is no more need for bottom outflow. This will spread weight and strength more efficiently and simplify the access for maintenance of the machine.

- Finally both sides offer a larger surfaces for advertising sale.

Cylindrical wind turbine

Fig. 23 shows a top view cut of a cylindrical wind turbine of 4 meters in diameter.

As show, the input of wind flow is 3.5 meters wide, to keep the same surface of harnessed wind, the height must be changed to 4.5 meters. To keep the same potential of energy transformation, the output must be 4.5 meters wide, as per the example.

The cylindrical wind turbine has 3 notables advantages over the cubic design.

- It is more esthetical and more discrete, only an attentive observation can show movement.
- Whatever the dimension of the apparatus, it only uses 2 turbines, compared to the 4 or more that may result from designs inspireds by the cube.
- The vertical axis of the turbine make it less vulnerable in regards of snow or sand.

Cylindrical wind turbine has also some weakness:

- There is more change of wind direction compare to airflow in cubical machine, especially in the 2 centre channels. This may produce more turbulence in high wind and then reduced efficiency.
- The wind engage the turbines from 3 different channels. To avoid resistance or turbulence in outsides channels, the turbines have an open centre. As airflow does not come to the pales of the turbines in perpendicular way, especially for air incoming from centre channels, we will speak of apparent compression factor for this kind of arrangement.
- There is no longer potential revenue from advertising.

As airflow is not 100% harnessed by the turbine, the apparent compression factor can be higher to standard one describe earlier. In **fig.23** we show two different apparent compressions levels. The sides **37** show a design that will produce an apparent compression of 6, this should be appropriate for mid and high average speed of wind. On sides **38** the proportions of the components will produce an apparent compression of 10, this design will be more efficient for average low wind site.

Triangular wind turbine

Fig. 24 shows a top view cut of a triangular wind turbine, each faces having 5 meters of length.

This design harnesses the wind 4 meters wide, so it will be equivalent to our 4 meters cubic machine with the same 4 meters in height. With an outflow side of 5 meters, the law of fluid mechanic is respected. In fact, the triangular shape pushes the outside wind in a way that will enhance the efficiency of the outgoing airflow.

Triangle wind apparatus will be less esthetical compared to the cylindrical machine, but it will be more efficient. The improvement comes mainly from the fact that wind will be deviated in a smoother way as the centre channels are longer. Efficiency will also grow from the easier exhaust of airflow.

Fig. 24 shows two different apparent airflow compression. On side **39** we have a compression of 7, on sides **40** it is 12.

As for trapezoidal apparatus, the supporting structure can be moved to the back of the machine, for a better distribution of static and dynamic charge. This also eases access for maintenance of the turbines.

Synergy of wind turbine and solar energy

Fig. 25 shows a top view of the supporting structure **41** of a cubic wind turbine of 4 meters on a roof of a house of 12 x 14 meters.

The structure **41** spread the weight of the apparatus on the entire roof. We can see a central cross-section that joins the rectangle structure on the perimeter. Some extra profiles are added over the supporting wall to increase the efficiency of the weight distribution.

The structure allows also the installation of solar panels **42** all around the roof. On our example, we have 30 panels of 1.5 square meters that can be install and adjusted to face the sun in the most efficient angle.

The photovoltaic energy is not yet a profitable way to produce electricity, solar panel are still too expensive in regards to the energy yielded.

Prior installation of a an efficient wind turbine will favour further installation of solar panel as their implantation cost will be reduced by sharing the use of already installed equipments like:

- The installation structure.
- The energy management system and the related wiring.
- The modular energy accumulation system.
- The transformer, rectifier and other apparatus required to interface with the electricity network.

Conclusions

The creation of a family of urban wind turbine that can be accepted without restriction by the population will represent a major advancement in our urgent fight to produce cleaner renewable energy.

The energy required by our society will continue to increase whatever we do but even if we all know the important damage that can come from an increased use of fossil energy, very few will accept the installation of larges tri-blades wind turbines in their community.

With according investment, the designs proposed here can change the world of clean energy in a very short period.

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Fig. 6

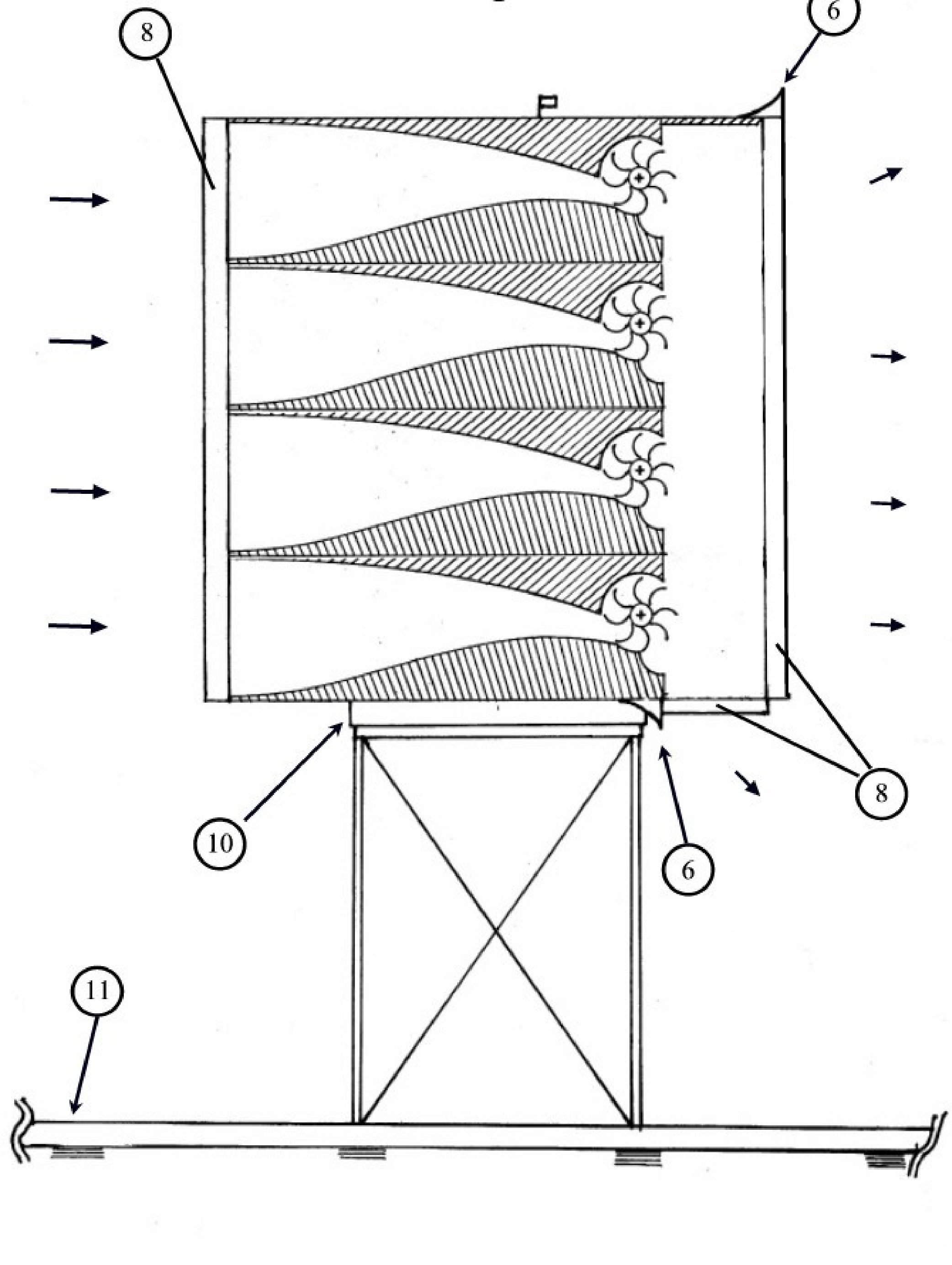

Fig. 7

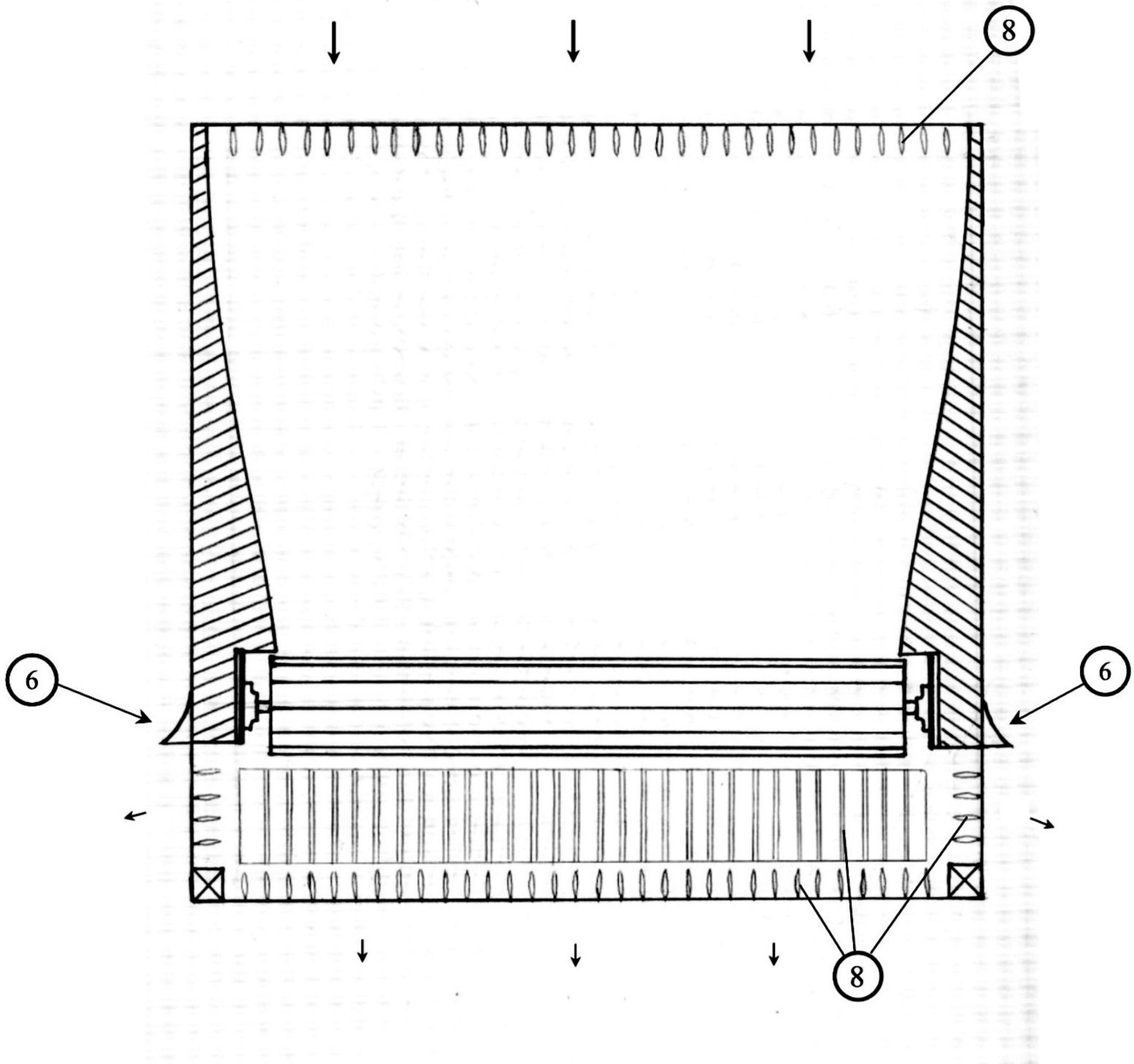

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Fig. 8

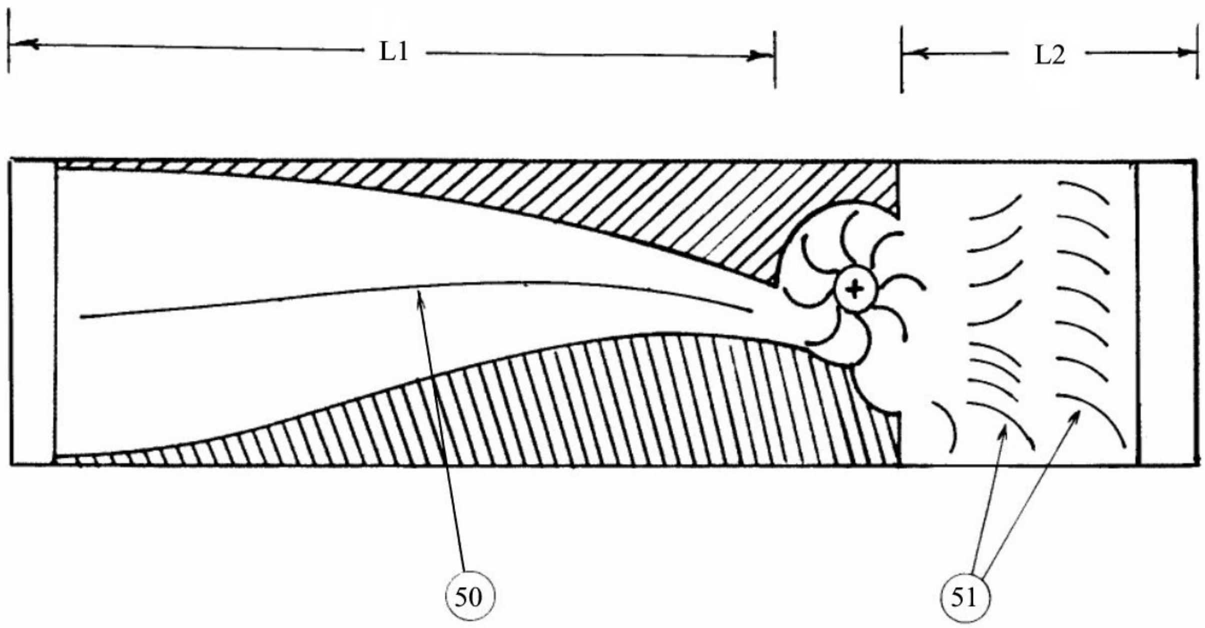

Fig. 9

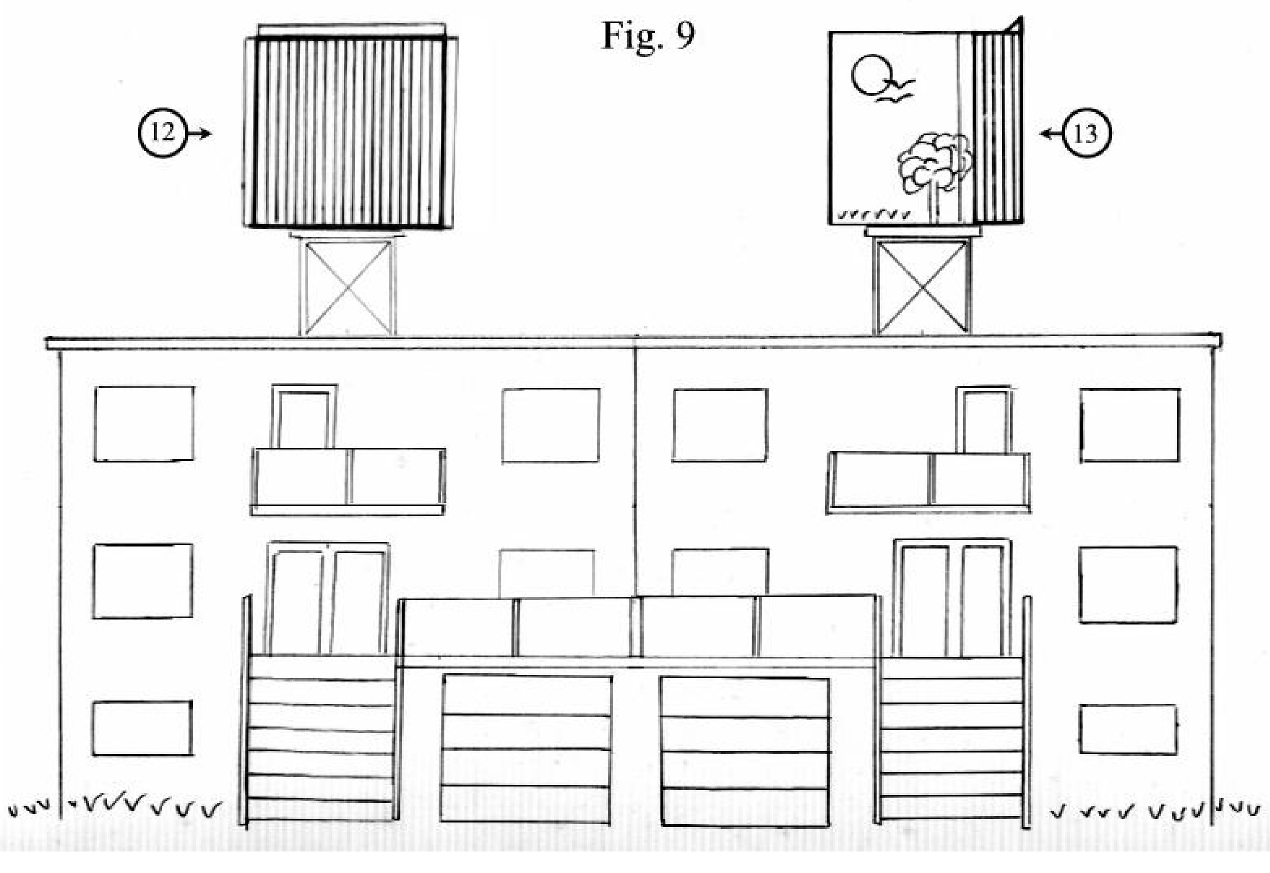

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Figure 22

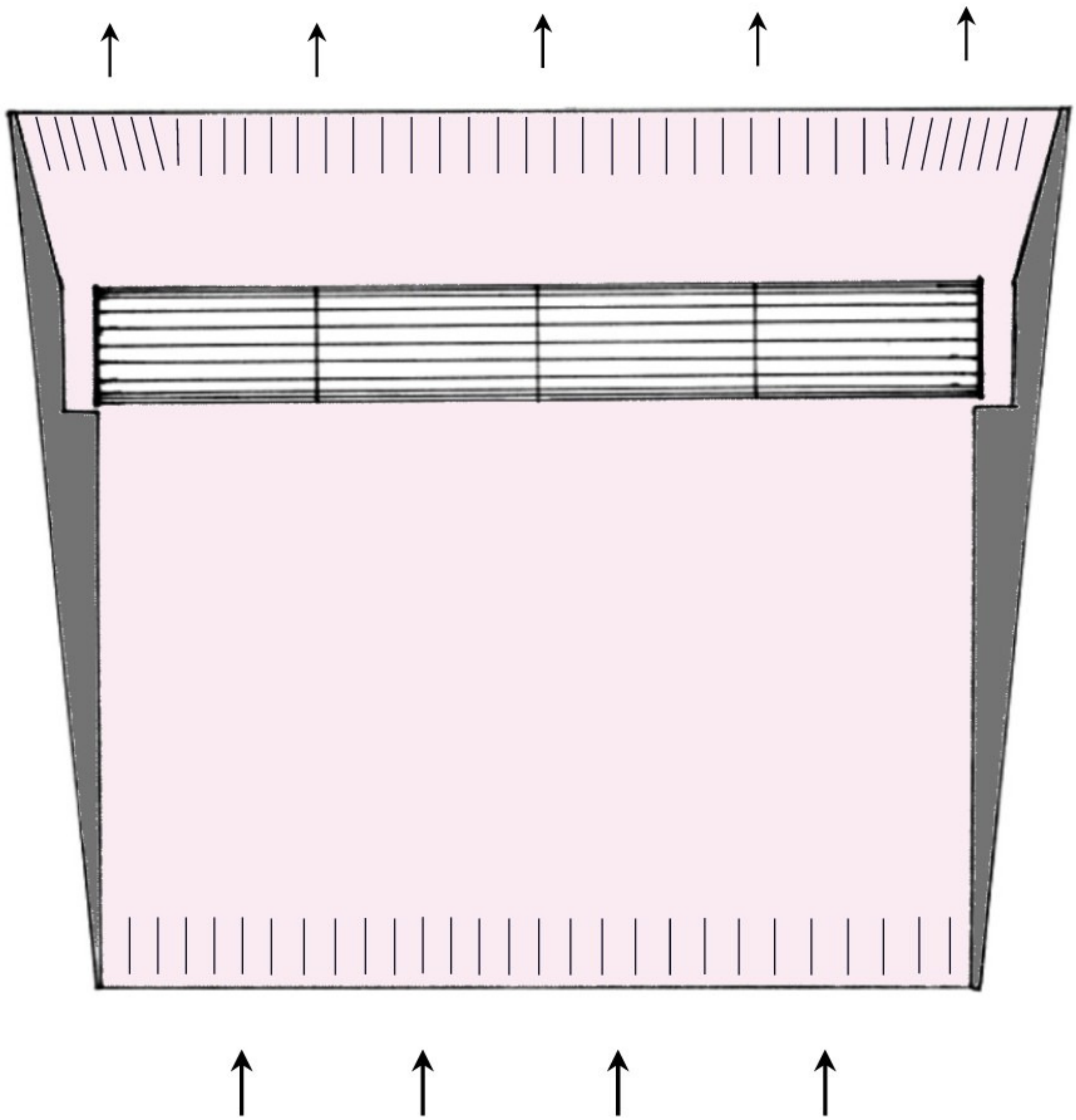

Fig. 23

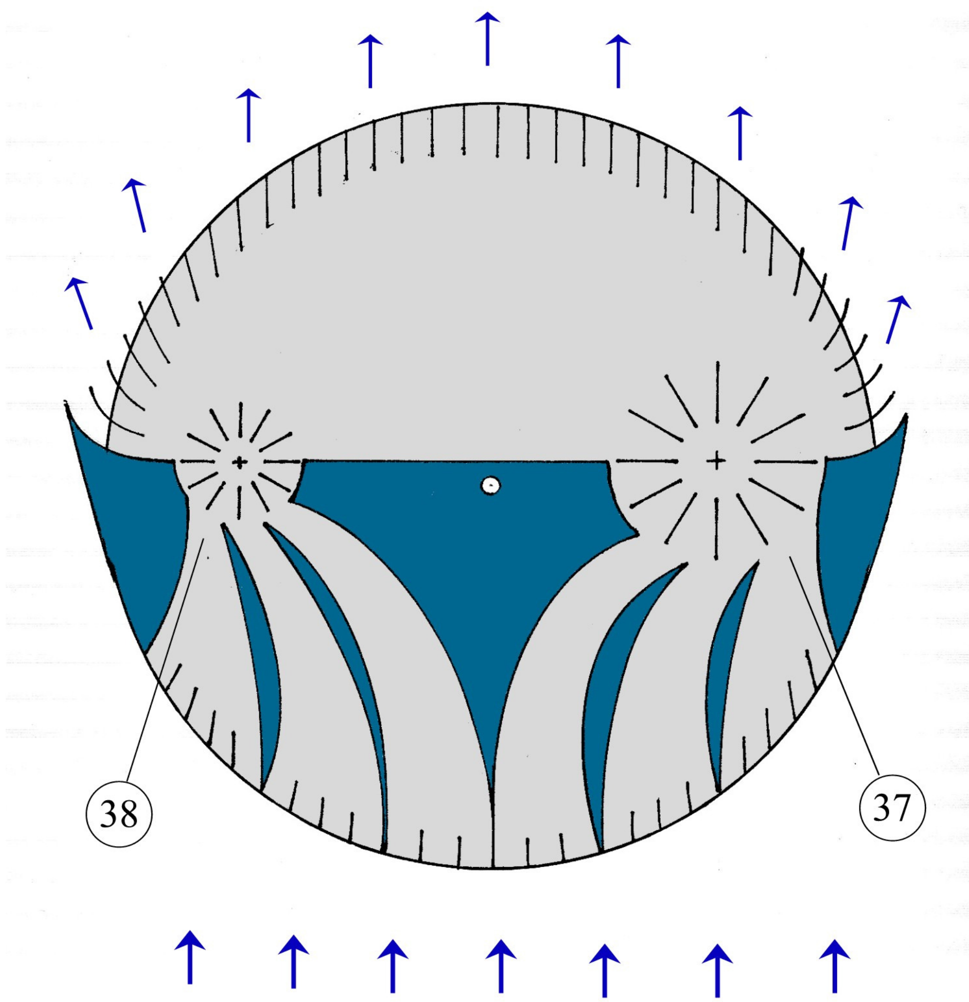

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Fig. 24

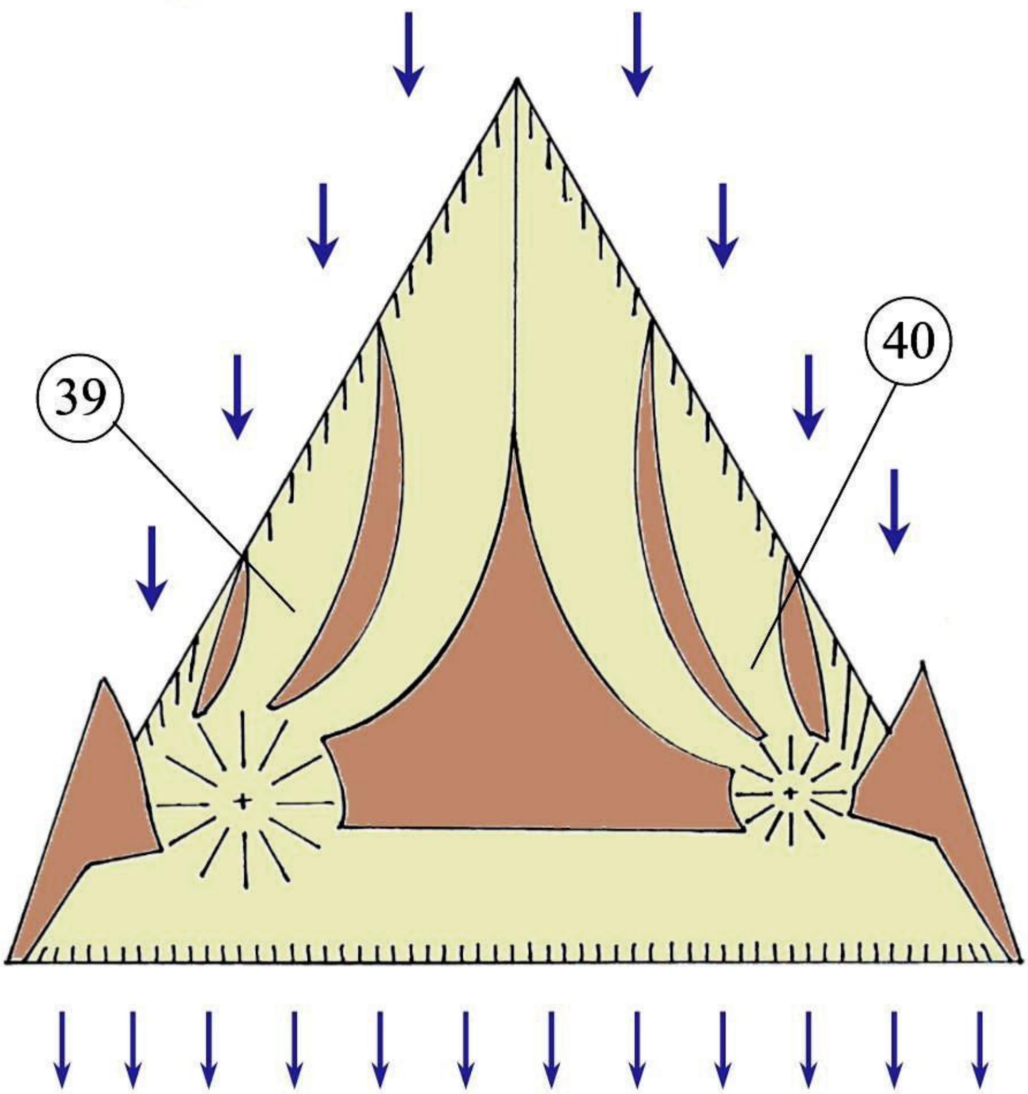

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Fig.25