

SPECIFICATION

Boat having a wind-powered propulsion system

The present invention relates to improvements to propulsion systems for water-carried vessels of all kinds, whether these are large ships or small fishing or pleasure boats, or lifeboats.

The term "boat" is used in this specification to embrace all such vessels.

The energy crisis affecting all countries has called attention to the need to achieve the greatest possible saving of fuels derived from petroleum and to replace them by using other types of energy, which in the case of ships may be wind energy.

The present invention does not seek to make it possible to replace completely conventional engines using petrol or similar fuels, but one object is to permit maximum economy in the use of such fuels by utilising the energy of the wind when the latter is favourable.

The invention consists typically in providing a mast, near the prow of the boat and at least one sail which may comprise a top portion of great concavity with a contour approximately in the shape of a quarter of a sphere. At the north pole of this portion is provided attachment means, e.g. a halyard clew tied to the truck of the mast, while the lateral ends of this top part of the sail extend downwards to respective clews tied by means of sheets to the sides of the ship. From the equator of this top part of the sail, there is suspended a second, non-spherical but slightly baggy portion at whose bottom central apex is situated a clew tied to the stempost or adjacent the prow of the ship at a certain height in order to permit visibility below its edge. The sail makes it possible to receive stern winds from quarter to quarter, with the centre of the sail for instance situated at one-third of the height of the mast, so that the force of the wind develops a power of which for instance about 80% is converted into driving force and the remaining 20% into lifting force tending to raise the prow of the vessel.

Preferably over a large central zone of the sail there are a plurality of nozzles open at the rear face and directed at the front face towards the deck, these nozzles channel part of the air received by the sail and direct it downwards in the form of jets, thus producing by reaction a lifting force which tends to raise the prow of the ship and at the same time reduces the intensity of the effect of the wind on the sail when the wind is blowing with great force.

Preferably the sail is separable into two symmetrical twin sails of triangular contour, joined together along the central edge in a detachable manner, so that it is possible to use the pair of sails together as a single sail, or else to use either part by itself, in order to

take advantage of the port or starboard wind as the case may be.

In the latter case provision may be made for the boat, if it is of large tonnage, to be equipped with additional masts making it possible to hoist half-sails after the style of jibs in order to supplement the action of the first sail.

The improvements provided by the invention do not assume a simple return to navigation by sail, but entail the rational utilisation of the wind with the aid of sails of a completely new configuration, which can be adapted to large ships and to smaller craft, with maximum exploitation of the wind.

For the better understanding of the invention, the preferred embodiments of the invention will now be described by way of non-limitative example with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a boat embodying the invention having a hoisted, wind-filled sail, viewed from the front on the port side;

Figure 2 is a perspective view of the sail of *Figure 1*, viewed from the rear;

Figure 3 is a view in perspective very similar to *Figure 2* but relates to a boat embodying the invention having a sail consisting of two triangular half-sails joined at a central dividing line;

Figure 4 shows a detail in longitudinal section and on a larger scale of central wind orienting nozzles in the sails of *Figures 1* to *3*;

Figure 5 is a plan view of a boat having a sail as shown in *Figure 3*;

Figure 6 is a view in side elevation of a boat embodying the invention propelled with the aid of a prow half-sail and other rear triangular sails supplementing the action of the first sail; and

Figure 7 is a plan view of the boat of *Figure 6*.

In *Figures 1* and *2* of the drawings is shown a boat having a sail 1, with a top part 2 having very pronounced concavity and with a parabolic profile, whose curvature extends towards the bottom part in the form of a quarter of a sphere, and which is equipped with attachment means in the form of a halyard clew 3 tied to a line which passes over a truck of a mast 4 which is situated near the prow 5 of a ship 6.

This upper zone 2 of the sail extends laterally to attachment means in the form of two clews 7 tied by sheets 8 secured on the port and starboard sides of the ship.

The bottom part of the sail 1 is formed by a zone 9 of smaller curvature, but slightly baggy, with a bottom central clew 10 tied to a stempost 5a of the prow 5, and at a certain height from the same in order to permit visibility under the edge.

The centre of the sail is approximately in a zone 11 at one-third of the height of the mast 4, thus imparting great stability to the ship.

The sail 1 has a plurality of apertures or nozzles 12 (see Fig. 4) which occupy a wide central zone of the sail, these nozzles are equipped with an upper inlet 13 at the rear side of the sail and with a lower outlet mouth 14, directed towards the deck, at the front side of the sail. The nozzles serve two very useful functions at one and the same time; one function is to regulate the wind pressure, which at any moment because of a gust of wind may jeopardise the stability of the ship, while their second function is to ensure that the ship will always be stable and will not list however strong a wind may blow. The nozzles, by reason of their downward direction, give the sail an upward thrust which is dependent on the wind pressure. Thus, with increasing wind or pressure the ship, is given additional lifting force. The thrust and power of the sail are thus displaced and increasingly concentrated at the bow clew 10, and since this force is at the same time distributed by the two sheets 8 the ship remains completely stable without listing of any kind, and in addition the prow of the ship is lifted, giving further protection against the waves or seas.

It is possible for the sail 1 already described to be in the form of two triangular half-sails 1a and 1b (Fig. 3) joined together detachably along the central edge 15, which lies in a vertical plane, in such a manner that they can be used together or else independently.

In the embodiments of Figs. 1 to 5, the sail 1, or assembly comprising the sails 1a and 1b, makes it possible to take advantage of stern winds from quarter to quarter. When it is desired to utilise the winds of one quarter or the other, only one of the half-sails is hoisted (Figs. 6 and 7), and in the case of ships of large tonnage the propulsion may be supplemented by means of other, triangular sails 16 after the style of jibs, which are hoisted on other, additional masts 17.

The above-described improvements in propulsion systems make it possible to supplement conventional propulsion by means of engines by using the force of the wind, provided that the latter is suitably directed. The efficiency thus achieved is great while navigational safety is ensured. It is possible to apply these improvements to any type of ship or other boat, whatever its tonnage.

Preferably the height of the mast on which the sail is hoisted is equal to one-third of the length of the ship, if the length of the ship is greater than 150 metres, so that masting of reduced height is obtained.

These improvements permit the saving of a considerable amount of conventional fuel by using the force of the wind whenever this is possible, without entailing any substantial slowing-down of the ship because, as has been emphasised above, the power supplied by the sail can be very high.

Preferably two or more longitudinal brails,

internal and external, extend from the halyard clew 3 to the foot of the sail and pass through small rings, attached to the sail, the sail sliding along the brails when being hauled down, to prevent it from falling into the sea.

Though the invention has been described by reference to preferred embodiments, many modifications and variations are possible within the spirit and scope of the following claims.

CLAIMS

1. A boat having a wind-powered propulsion system, said propulsion system having (a) a mast attached to and extending upwardly from said boat,

(b) a sail having, when filled with wind, a substantial curvature and having two lateral corners and an upper and a lower edge, two lateral corners being situated in use respectively to port and starboard sides of the boat, and

(c) at least four attachment means for attaching said sail, in use thereof, to said boat, first and second of said attachment means attaching said two lateral corners of said sail to said boat, a third of said attachment means attaching said lower edge of said sail at a central region of said lower edge to said boat at a point on the boat which is forward of said mast and of said first and second attachment means, and a fourth attachment means attaching said upper edge of said sail at a central region of said upper edge to said mast,

whereby said lower edge of the sail is spaced above the boat to allow vision forward and said sail under the action of the wind provides a force acting on the boat having both a horizontal and a vertical component.

2. A boat according to claim 1 wherein said sail comprises an upper portion which when filled with wind is generally in the shape of a quarter sphere whose concavity opens downwards and a lower portion which has a lesser degree of curvature than said upper portion, the sail having a general centre which is located at about one-third of the height of the position on said mast of said fourth attachment means.

3. A boat according to claim 1 or 2 wherein the ratio of said vertical component to said horizontal component of said force acting on said boat is about 20:80.

4. A boat according to any one of claims 1 to 3 wherein said attachment means distribute said force acting on said boat such that said vertical component of said force acts so as to lift the forward part of said boat and stabilize said boat.

5. A boat according to any one of claims 1 to 6 wherein said sail is separable along a central vertical plane into two symmetrical component sails such that said component sails may be used separately or together.



The sail 1 has a plurality of apertures or nozzles 12 (see Fig. 4) which occupy a wide central zone of the sail, these nozzles are equipped with an upper inlet 13 at the rear side of the sail and with a lower outlet mouth 14, directed towards the deck, at the front side of the sail. The nozzles serve two very useful functions at one and the same time; one function is to regulate the wind pressure, which at any moment because of a gust of wind may jeopardise the stability of the ship, while their second function is to ensure that the ship will always be stable and will not list however strong a wind may blow. The nozzles, by reason of their downward direction, give the sail an upward thrust which is dependent on the wind pressure. Thus, with increasing wind or pressure the ship, is given additional lifting force. The thrust and power of the sail are thus displaced and increasingly concentrated at the bow clew 10, and since this force is at the same time distributed by the two sheets 8 the ship remains completely stable without listing of any kind, and in addition the prow of the ship is lifted, giving further protection against the waves or seas.

It is possible for the sail 1 already described to be in the form of two triangular half-sails 1a and 1b (Fig. 3) joined together detachably along the central edge 15, which lies in a vertical plane, in such a manner that they can be used together or else independently.

In the embodiments of Figs. 1 to 5, the sail 1, or assembly comprising the sails 1a and 1b, makes it possible to take advantage of stern winds from quarter to quarter. When it is desired to utilise the winds of one quarter or the other, only one of the half-sails is hoisted (Figs. 6 and 7), and in the case of ships of large tonnage the propulsion may be supplemented by means of other, triangular sails 16 after the style of jibs, which are hoisted on other, additional masts 17.

The above-described improvements in propulsion systems make it possible to supplement conventional propulsion by means of engines by using the force of the wind, provided that the latter is suitably directed. The efficiency thus achieved is great while navigational safety is ensured. It is possible to apply these improvements to any type of ship or other boat, whatever its tonnage.

Preferably the height of the mast on which the sail is hoisted is equal to one-third of the length of the ship, if the length of the ship is greater than 150 metres, so that masting of reduced height is obtained.

These improvements permit the saving of a considerable amount of conventional fuel by using the force of the wind whenever this is possible, without entailing any substantial slowing-down of the ship because, as has been emphasised above, the power supplied by the sail can be very high.

Preferably two or more longitudinal brails,

internal and external, extend from the halyard clew 3 to the foot of the sail and pass through small rings, attached to the sail, the sail sliding along the brails when being hauled down, to prevent it from falling into the sea.

Though the invention has been described by reference to preferred embodiments, many modifications and variations are possible within the spirit and scope of the following claims.

CLAIMS

1. A boat having a wind-powered propulsion system, said propulsion system having
(a) a mast attached to and extending upwards from said boat,
(b) a sail having, when filled with wind, a substantial curvature and having two lateral corners and an upper and a lower edge, two lateral corners being situated in use respectively to port and starboard sides of the boat, and
(c) at least four attachment means for attaching said sail, in use thereof, to said boat, first and second of said attachment means attaching said two lateral corners of said sail to said boat, a third of said attachment means attaching said lower edge of said sail at a central region of said lower edge to said boat at a point on the boat which is forward of said mast and of said first and second attachment means, and a fourth attachment means attaching said upper edge of said sail at a central region of said upper edge to said mast,
whereby said lower edge of the sail is spaced above the boat to allow vision forward and said sail under the action of the wind provides a force acting on the boat having both a horizontal and a vertical component.

2. A boat according to claim 1 wherein said sail comprises an upper portion which when filled with wind is generally in the shape of a quarter sphere whose concavity opens downwards and a lower portion which has a lesser degree of curvature than said upper portion, the sail having a general centre which is located at about one-third of the height of the position on said mast of said fourth attachment means.

3. A boat according to claim 1 or 2 wherein the ratio of said vertical component to said horizontal component of said force acting on said boat is about 20:80.

4. A boat according to any one of claims 1 to 3 wherein said attachment means distribute said force acting on said boat such that said vertical component of said force acts so as to lift the forward part of said boat and stabilize said boat.

5. A boat according to any one of claims 1 to 6 wherein said sail is separable along a central vertical plane into two symmetrical component sails such that said component sails may be used separately or together.



- 3
6. A boat according to any one of claims 1 to 5 wherein the height of said mast is approximately one third the length of said boat, said boat being longer than about 150 metres.
- 5
7. A boat according to any one of claims 1 to 6 wherein said sail has a plurality of openings through it such that at least a part of the wind striking said sail may pass through said sail, and means associated with each of said openings to deflect said wind passing through said openings such that the reaction of the deflected wind produces a force on the sail having an upward vertical component.
- 10
8. A boat according to any one of claims 1 to 7 having, supplementary to said mast and said sail, at least one further mast and at least one further sail adapted for mounting thereon.
- 15
9. A boat according to any one of claims 1 to 8 further having two or more longitudinally arranged brails which extend from said fourth attachment means attaching said sail to said mast at least to the lower edge of said sail, means attached to said sails and to said brails such that said sail may slide along said brails when being lowered.
- 20
10. A boat substantially as any herein described with reference to and as shown in the accompanying drawings.
- 25
- 30