Title: APPARATUS FOR THE COMBUSTION OF VARIOUS TYPES OF OIL

Abstract: Apparatus for the combustion of various types of oil where the apparatus comprises - a nozzle creating an oil mist, - ignition means arranged adjacent the nozzle for igniting the oil mist, - combustion air supply means in which the combustion air supply means comprises an air flow channel in the shape of a cylinder, said cylinder having an air inlet opening and an outlet opening arranged in opposite ends of said cylinder, and where inside of the cylinder the nozzle and ignition means are arranged, and where in or adjacent the outlet opening, air and/or mist distribution means in the shape of a non-rotatable disc having an outer and inner diameter is arranged, wherein the disc has a conical section shape, such that the inner diameter of the disc is closer to the cylinder's air inlet opening and the outer diameter of the disc is arranged proximate the outlet opening of the cylinder, and where a plurality of wings are arranged radially around the disc, for directing the airflow leaving the cylinder.
Apparatus for the combustion of various types of oil

Field of the Invention
The present invention relates to an apparatus for the combustion of various types of oil of the type typically used in heating installations and the like.

Background of the Invention
It is generally known to use apparatuses for the combustion of oil, for example refined fuel oils.

It is furthermore known in the art to provide apparatuses which are suitable to combust other types of oil such as for example oils derived from vegetables or a vegetable matter such as for example oils derived from rape, sunflowers and other plants having a relatively high oil content. Also waste oils or used oils may be used in certain apparatuses for combustion where the waste oil may be derived from used engine oils and the like.

Typically these apparatuses from the art are constructed by providing a burning unit mounted or connected to a boiler or cauldron. In order to be able to use other types of oils than the oil which the burning unit is designed for a pre-treatment unit may be provided in order to treat the alternative oil in such a manner that it becomes suitable to be used in the apparatus for the combustion of oils. Such a pre-treatment unit is typically arranged outside the oil combustion unit and will typically comprise means for heating the oil in order to increase the viscosity whereby an improved combustion of the vegetable or waste oil is achieved.

The known types of apparatus for combustion of other types of oil apart from the hydrocarbon based oils are traditionally used in relatively large boiler plants such as central heating plants, due to the fact that the high viscosity oils are normally cheaper than the normal oils used for heating having a lower viscosity, but where the high viscosity cheaper oils usually require special pre-treatment installations which for private use
may be too expensive compared to the savings which are achievable for a normal private house unit.

The ever increasing oil prices in combination with environmental aspects which also in some regions lead to special levies imposed on more polluting installations have created a market and a need for the use of alternative oils in private installations at affordable prices.

This need has been addressed by various devices which all up to now incorporate one or more disadvantages relating to the feasibility of combusting these alternative oils.

One of the main disadvantages with the prior art devices is the fact that depending on the oil used they all have a tendency to develop relatively high amounts of soot. The sooting up causes a number of problems. First of all the efficiency with which the burning unit was designed may not be maintained over time in that the soot will diminish the efficient burning of the oils and thereby the efficiency, i.e. the energy output, of the oil per unit over time. This requires that the unit be stopped and cleaned at regular intervals such that the desired efficiency without pollution may be achieved during combustion of oil. Typically, when oil from rape is used it is necessary to clean the nozzles and the interior of the burner, in particular the combustion chamber, every 100-150 litres of spent oil, and in case of light fuel oils typically 5-800 kilos of oil may be burnt before the need to clean the combustion apparatus or the boiler arises. The rapid deterioration of energy output leads to a waste of potential energy in that the oil spent could have been utilized to a higher degree, i.e. more heating energy could have been derived from the amount of spent oil. In addition, service costs are relatively high.

**Object of the Invention**

It is consequently an object of the present invention to overcome these advantages and in turn provide an apparatus where the energy output is greatly increased and at the same time the cleanliness of the combustion process is improved such that the environmental impact of the oil burning process is minimized and at the same time the
need to clean the combustion apparatus and/or the boiler is only necessary at much longer intervals.

**Description of the Invention**

The present invention addresses this by providing an apparatus for the combustion of various types of oil where the apparatus comprises:

- a nozzle creating an oil mist;
- ignition means arranged adjacent the nozzle for igniting the oil mist;
- combustion air supply means

wherein the combustion air supply means comprises an air flow channel in the shape of a cylinder, said cylinder having an air inlet opening and an outlet opening arranged in opposite ends of said cylinder, and where inside of the cylinder the nozzle and ignition means are arranged, and where in or adjacent the outlet opening, air and/or mist distribution means in the shape of a non-rotatable disc having an outer and inner diameter is arranged, wherein the disc has a conical section shape, such that the inner diameter of the disc is closer to the cylinder's air inlet opening and the outer diameter of the disc is arranged proximate the outlet opening of the cylinder, and where a plurality of wings are arranged radially around the disc, for directing the airflow leaving the cylinder.

By guiding the combustion air inside the cylinder past the oil emitting nozzle and ignition means it is very easy to control the amount of combustion air being lead to the oil such that the optimum amount of air may be provided in relation to the amount of oil being issued by the nozzle. Furthermore, by providing air and/or mist distribution means in the shape of a disc where the disc is supplied with a plurality of wings, the airflow during combustion of the oil is optimized such that substantially all mist particles, i.e. oils suspended in the combustion air, is ignited whereby the maximum energy output is achieved and at the same time sooting is dramatically reduced.

In comparison to the numbers mentioned above relating to prior art devices sooting up of the device the present apparatus has burnt 20-30 of tonnes of light fuels for example without the necessity to clean neither the nozzle, the ignition means, the disc nor
the boiler, whereas the prior art devices after approximately 5-800 kilos of the same
type of oil needed a thorough cleaning. In the case where the oil is derived from rape
as mentioned above 1000-1500 litres of spent oil require a cleaning, whereas with the
present device due to the inventive air and/or mist distribution means more than 1,500
litres may be burnt before it is necessary to clean the nozzle and the disc.

In a further advantageous embodiment the angle between a longitudinal axis through
the air flow channel and the air distribution means is between 60° and 80°, more pre-
ferred approximately 70°. The conical section shape having the angle between 60° and
80° in combination with the wings creates a turbulent and agitated airflow in the im-
mediate vicinity where the atomised oil particles are introduced into the air stream and
ignited.

Prior art blowers arranged in connection with an oil nozzle creates a substantially
laminar air stream creating a long flame where the oil particles are ignited. The present
invention on the other hand creates a turbulent airflow for combustion wherein the
flame will tend to have a shape corresponding to a well-known candle flame shape
such that the combustion of the oil mist is very close to 100% and at the same time the
direction of the energy is towards the boiler, whereby the wasted energy due to heat
going off in other directions is minimised.

In addition to the angle of the conical section shape the number of wings is very im-
portant such that in a further advantageous embodiment of the invention the number of
wings is selected between 7 and 14 wings more preferred between 8 and 12, and most
preferred 10 wings are arranged radially around the disc.

The number of wings is a balance between air resistance and the ability of the disc to
create a homogenous turbulent flow pattern of the mist when it is ignited immediately
following issuing of oil by the nozzle. Thorough testing has indicated that for most
burners the combination of 10 wings provides for a substantially homogenous mist
downstream whereas the air resistance of the disc remains as little as possible. It is
clear that the combustion air supply means needs to force the air through the cylinder
towards the combustion zone, and the less energy is wasted forcing the air past the
disc, the less energy is used in order to run the installation. In this connection measurements on test equipment have indicated that the air pressure necessary in order to create the homogenous mist may be as low as 0.5 bar whereas other types of units for combusting different types of oil may use up to 20 bar air pressure in order to create a relatively satisfactory combustion.

In a further advantageous embodiment the disc is made from a plate material where each wing in cross section has first and second bent portions, where said first portion is at an angle relative to the disc, and where the second portion is parallel to the disc. In this manner a relative simple and reliable process of manufacture is deviced, and at the same time by having the second bent portion parallel to the disc, i.e. the cone section shape, and the distance between the disc and the second portion relatively shallow a relatively violent impact is imparted on the combustion air during its passage through the disc in order to create a very well-distributed oil mist in front of the nozzle such that the thorough combustion of the atomized oil is achieved.

In the art it is well known to arrange some kind of disc rotatably in the combustion air flow path. The disc is often arranged such that it is forced to rotate, for example by being coupled to motor means. The purpose of this rotatable disc is to create turbulence, and disperse and possibly minimise the drop sizes in the oil unit dispensed through the nozzle. It is desirable to create as small droplets as possible in that the smaller droplets the leaner and more efficient combustion is achieved.

An additional further advantageous aspect of the present invention is the provision of a pre-treatment unit where the oils are treated such that as they enter the burning unit, i.e. the nozzle and the ignition means, the oil will have the optimum viscosity. For this purpose the apparatus in a further advantageous embodiment comprises an oil receiving tank which tank comprises an inlet and an outlet, where the inlet is arranged adjacent the bottom of said tank and the outlet is arranged above said inlet, and where further a heating element is placed in the tank at a level above the inlet but below the outlet.
It is known in the art to provide oil receiving tanks prior to letting the oil into the combustion apparatus and also supplying the oil receiving tank with heating means. Usually, in prior art devices the oil inlet and the oil outlet from said tank are provided adjacent the top of the tank and a suitable heating element is arranged substantially in the bottom of the tank such that as the oil is heated it will, due to the temperature difference between the colder oil entered into the tank, rise and be able to be guide through the outlet towards the combustion chamber. This oil movement, however, is very unstable and requires a certain size of tank in order to ensure that the distance between the oil inlet and the oil outlet is sufficient in order to ensure that only pre-heated oil enters the oil outlet. At the same time the mix of the oil as it is moving upwards respectively downwards due to temperature differences and thereby density differences requires that the oil be heated to a substantially higher temperature in order to ensure that the oil taken out at the outlet has the desired exit temperature.

With the present invention having the oil inlet adjacent the bottom of the tank and the oil heating element adjacent the bottom, but above the inlet, a one dimensional liquid flow will arise in the heating tank such that all oil will travel in the same direction whereby the colder part of the oil will be adjacent the bottom and the warmer having the desired exit temperature will be present at the top of the tank. This is further improved by using a tank size having a relatively small size, for example between 0.5-1 litre, more preferred between 0.65-0.75 litre. In order to heat such a small amount of oil whereby a relatively homogenous heating of the combustion oil is achieved, only a relatively small amount of energy is necessary. Also, only small amounts of oil are in the apparatus at any one time, again limiting the amount of energy needed in order to operate the apparatus, and if an accident should occur, for example self-ignition or the like, the damage is limited to the limited amount of oil.

In a further advantageous embodiment the tank is provided with a lid. In this manner it is achieved that evaporation of oils is kept at a minimum such that any bad smelling odours is reduced. Furthermore, the provision of a lid substantially reduces the risk of igniting the oil by accident and furthermore reduces the amount of energy which is needed in order to heat the oil in that the lid will also provide a certain thermal insulation. The spreading of malodours is particularly undesirable in private installations.
such as housings and the like. As the oil is heated, the amount of volatile bad smelling gasses increases and thereby the risk of malodours greatly increases. By applying the lid to the tank, where the heating of the oil occurs, a substantial reduction of volatile gasses which may escape the oil tank is reduced.

In a further advantageous embodiment of the invention the distance from the tank’s outlet to the nozzle is as short as possible, such that the distance between the tank outlet and the nozzle is less than 250 mm, more preferred less than 200 mm and most preferred less than 150 mm, and that the difference in elevation between the outlet and the nozzle is between 10 mm and 50 mm preferably less than 25 mm, and further that the pipeline connecting the tank with the nozzle and/or the tank optionally may be insulated.

By arranging the tank very close to the nozzle, i.e. the place where the oil from the tank is atomized and combusted, the cooling between the storage and the nozzle is greatly reduced such that a higher nozzle temperature may be achieved with less heating energy used in order to bring the oil in the tank up to the desired temperature. With prior art devices it is necessary to heat the oil in the tank to an over-temperature in that cooling during the transport of the oil to the nozzle may result in a lower temperature whereby the combustion of the oil is less than optimal. Therefore, by reducing the distance between the tank’s outlet and the nozzle as much as possible, the overall energy consumption in particular for heating the oil may be reduced without risking bringing oil to the nozzle at a too low temperature. Quite the contrary is actually the case in that it becomes easier to control the temperature at the nozzle where the atomizing effect is to take place and also the combustion such that an optimal combustion condition in or immediately adjacent the nozzle may be ensured.

In a further advantageous embodiment the apparatus as well as the pre-treatment unit is arranged inside the same housing, where said housing only is provided with one opening in the shape of an air inlet for the supply of air to the combustion air supply means. By arranging a housing covering the pre-treatment unit as well as the apparatus as such a number of advantages are achieved. Firstly, the volatile gasses and malodours arising from heating and even pre-heating of the oil prior to combustion is re-
duced to a minimum or altogether alleviated in that the combustion care supply means will create an under-pressure inside the housing such that all gasses in other volatile fractions of the oils are transported with the combustion air into the combustion chamber. Even in situations where no combustion is taking place, but a small amount of oil is present in the tank, firstly the Hd on the tank will diminish the evaporation of the volatile gasses and fractions of the oil, and furthermore due to the natural draft in the chimney connected to the apparatus via the boiler, the substances giving rise to malodours will be carried away due to the draft in the chimney into the combustion chamber and further op the chimney due to the natural and well recognized functioning of chimneys.

Although it has not been specifically stated above it is clear that the apparatus according to the invention is provided with a number of safety measures. In the tank in the pre-heating unit a thermo fuse is installed such that in case the oil overheats, all circuits are shut down including the combustion parts of the apparatus. This is done in order not to run the risk that ignition of volatile fragments of the oil in particular from the overheated oil may inadvertently ignite inside the housing and thereby create an explosion. The overall construction of the apparatus is such that the energy consumption by the apparatus is substantially less than other comparable apparatuses whereby the risk of overheating or creating situations where the use of excess energy creates malfunction is reduced. The relatively small size of the tank furthermore provides for a very limited amount of ignitable and volatile materials such that should the safety devices built into the apparatus for one reason or the other fail to shut down the apparatus, the amount of flammable liquid is very limited.

In order to also reduce the noise created by the apparatus the components are designed to correspond to each other such that no mismatch of components creates noises from e.g. vibrations or air flow which are unnecessary in relation to the general running of the apparatus.

With a design as explained above it is possible to provide apparatuses which may produce an effect of between 70 and 250 kilowatts, but normally for household use the effect will be between 70 and 120 kilowatts. In order to ensure proper running of the
apparatus it is very important to adjust the air supply means such that it is suitable for
the selected nozzle and the selected boiler. Again the boiler and the nozzle will be
selected according to circumstances depending on the desired energy output and regu-
larising the air supply means is carried out by simply adjusting a baffle built into the
ventilator such that the desired air flow and air pressure particularly around 0.5 bar is
achieved. Due to the provision of the air and/or mist distribution disc alterations in the
air flow may be accepted in that the air distribution disc provides for a very homoge-


neous creation of an oil particle mist such that a substantially complete combustion of
all oil particles suspended in the mist is achieved substantially regardless of the air
pressure. By furthermore heating the oil in the pre-treatment unit to a desirable viscos-
ity a substantially clean and thorough combustion of the oil components is achieved.
Although pollution inside the apparatus occurs, it is relatively easy to open the unit
and clean the air distribution disc in order to achieve the optimal conditions for com-
busting the air/oil mixture.

The arrangement of the disc in relation to the nozzle and ignition means shall under
ideal conditions be such that the inner diameter of the disc is close to the outlet of the
nozzle. The ignition means usually comprises two electrodes between which a spank is
generated. In order to avoid the spark going elsewhere, i.e. to maintain the spark be-
tween the two electrodes, the distance between the electrodes and the disc shall be
approx. 3 mm or more.

Tests have indicated that the shape of the resulting flame, i.e. when the oil/air mist is
ignited, is comparable in shape to the natural flame occurring on for example a candle,
and furthermore temperature measurements across the flame indicate that a relatively
homogenous temperature is achieved across the flame indicating that the air/mist dis-
tribution means achieves a substantially homogenous distribution of the oil particles in
the mist whereby an optimum combustion of the oil is achieved. This has in compari-
son to prior art devices resulted in a 20% reduced oil consumption with the present
device in comparison to prior art devices for the same energy effect. In addition to the
output energy effect there is also a reduction in the energy consumption by the appara-
tus due to the inventive features as mentioned above.
Description of the Drawing

The invention will now be explained with reference to the accompanying drawing wherein

5 Figure 1 illustrates an apparatus according to the invention,
Figure 2 illustrates a section of an apparatus according to the invention where the housing has been removed;
Figure 3 illustrates a section as seen from above with the housing removed;
Figure 4 illustrates a section of the apparatus seen from the side;
Figure 5 illustrates a perspective of the pre-treatment unit;
Figure 6 illustrates a side-view of the pre-treatment unit;
Figure 7 illustrates a safety measure arranged inside the pre-treatment unit;
Figure 8 illustrates the air and/or mist distribution means;
Figure 9 illustrates a schematic side-view of the air and/or mist distribution means;
Figure 10 illustrates the principle of an apparatus comprising a nozzle pre-treatment unit and safety measures.

In figure 1 is illustrated an apparatus according to the invention where the parts of the apparatus is covered by a housing 1 as well as an air flow channel in the shape of a cylinder 7. The air flow channel 7 is suitable to be mounted for example on an existing boiler unit such that the apparatus according to the invention may use an already existing boiler. Furthermore, a regulator 2 is provided such that any desired temperature may be selected to which the oil type being used as combustion media should be pre-heated in the tank.

Furthermore, an air intake 6 as well as an oil inlet 5 is provided on the front of the unit. In addition, the unit may be provided with an electrical outlet 4 in order to provide a power outlet for an air compressor if such is needed in connection with increasing the energy output of the unit by forcing more air through the apparatus.

When removing the housing 1 the interior of the apparatus becomes exposed as illustrated in figure 2. In this view the pre-treatment unit 8 is clearly visible, in the pre-
treatment unit an oil inlet 9 is arranged which oil inlet 9 is connected to the oil inlet 5 on the exterior of the housing such that any type of oil suitable to be used in the device is lead into the lower section of the pre-treatment 8.

Above the oil inlet 9 is arranged a heating element 10 such that the cooler oil entered through the oil inlet 9 will be heated before it moves upwards towards the oil outlet 12 where the oil is further piped to the nozzle and thereby the combustion chamber.

The pre-treatment unit 8 consists of a tank 27 and a lid 28. The lid is specifically provided for a number of reasons but mainly in order to avoid the evaporation of volatile fractions of the oil being used for combustion and at the same time in order to minimize the heat loss in order to save energy during the heating of the oil in the tank 27. In the lid 28 is arranged a liquid level gauge 11 which level gauge is used in order to activate the oil pump in order to let more oil into the tank 8 through the inlet 9. hi this manner it is possible at all times to have the optimal amount of oil preheated in the tank ready for combustion in the apparatus.

Also the air supply means 13 in the shape of a blower may be seen in the right hand part of figure 2. As the blower is arranged under the housing 1, it will during use create an under-pressure inside the housing whereby volatile gasses cannot escape the housing but will be forced with the combustion air into the boiler chamber.

hi figure 3 is illustrated a view of the apparatus seen from above with the housing removed. The air channel 7 is in this embodiment mounted on a pivotal arm 14 such that a flange member 29 connected to the pivotal arm and fastened to the air channel 7 may be mounted on the boiler as such. The rest of the apparatus according to the present invention may then be pivoted away from the air channel 7 in order to carry out maintenance as illustrated in figure 4.

The air channel 7 and the flange plate 29 will, when the apparatus is mounted on a boiler (not illustrated), be such that by means of the pivotal arm 14 the apparatus according to the invention may be pivoted away in order to expose the nozzle, the ignition means 15 as well as the air and/or mist distribution means 16. hi the assembled
situation, i.e. corresponding to configuration of figure 3 the disc 16 will be substantially flush with the end of the air channel 7 and as illustrated with reference to figure 4 the disc 16 is mounted immediately adjacent the outlet of the nozzle immediately adjacent the ignition means 15.

The pre-heated oil from the tank 8 is by means of the oil outlet pipe 12 (see figure 2) lead to the nozzle and will be introduced into the nozzle means by the coupling 17 as illustrated with reference to figure 4. From here on the pre-heated oil will be atomized in the nozzle and due to the air flow through the air and/or mist distribution means in the shape of the disc 16 will be formed into an oil mist which will be ignited by the ignition means 15.

Turning to the depiction of the tank as illustrated with reference to figures 5 and 6 the tank 8 comprises an oil inlet 16 as already explained above as well as an oil outlet 12 arranged respectively with the oil inlet at a low portion of the tank 8 and the oil outlet at an upper portion of the tank 8. In between the inlet 9 and the outlet 12 is provided a heating element 10 for heating the oil which is lead into the tank 8.

Additionally, as may be seen with reference to figure 6 the tank may be provided with a slanted bottom 20 such that any residue and particles will be collected at the lowermost point of the tank 8, where during maintenance the valve 18 may be opened in order to empty the tank for residue, foreign objects etc. hi the illustrated configuration of the tank 8 according to figures 5 and 6 the lid 28 as illustrated in figure 2 has been removed. It is, however, contemplated that the lid is able to completely seal the tank 8 such that malodours are not able to escape the tank as such.

Turning to figure 7 the bottom of the housing 1 is illustrated where it is provided with a tray 21 for collecting possible leaking oils. Furthermore, the leak tray 21 is provided with a level gauge 22 which is connected by means of wires 23 to a shut-down mechanism such that if any oil is collected in the leak tray 21, up to a certain level decided by the level gauge 22, the level gauge will send a signal to a control unit whereby the entire apparatus will be shut down until the fault is detected, i.e. the fault that lead to the oil being collected in the leak tray.
The control unit of the apparatus is connected to the sensors, i.e. the level gauge both in the leak tray 21 as well as in the tank such that as combustion of oil uses oil from the tank 8 the level gauge mounted in the lid as described above will detect that the level is lowering and thereby allow more oil to enter the pre-heating tank 8 and thereby become ready for combustion in the air channel.

As already discussed above, the preheating of the oil in the tank will be decided according to the particular properties of that oil being used for combustion, and the regulator 2, see figure 1, is used in order to preset the heating element 10 in the tank to the desired temperature such that the preheating in the tank 8 is carried out according to the optimal temperature depending on the oil used for combustion.

Turning to figure 8 a central key element in order to achieve the advantages with the present invention is illustrated in the shape of the means for air and mist distribution in the shape of a disc. The disc has a basically conical section shape such that the conical section shape is defined by an outer and an inner diameter and the inner diameter is closer to the nozzle means than the outer diameter. The disc 16 is provided with a central aperture 25 in which the nozzle and ignition means are placed such that the atomized oil particles will be introduced into the air flow in the air channel which due to the provision of the wings 26 will create an air pattern whereby the combustion air and the minuscule oil particles in the shape of a mist will be so effectively mixed that a thorough and complete combustion of the oil due to the inventive disc is accomplished. One of the special features about the disc is the way the wings 26 are shaped.

Turning briefly to figure 11 a cross section through one wing is illustrated. The wing comprises a bent portion 35 arranged in between two substantially straight portions 36, 37. The first section 36 is in the same plane as the conical section shape of the disc, i.e. in the plane of the disc, whereas the first bent section 35 is at an angle to this disc shape. The second bent portion 37 is bent relative to the first bent portion 35 such that the second section 37 is substantially parallel to the disc shape 37. By furthermore flaring the wings slightly towards the centre, the combustion air will be distributed around the atomized oil particles in such a manner that a complete mixture of oil and air is achieved whereby complete and pure combustion is facilitated.
Turning back to figure 9 a principle sketch of the disc is illustrated where the disc 16 with its wings 26 are arranged at an angle 27 relative to a longitudinal axis of symmetry 30. The angle is typically chosen between 60 and 80° and an angle of approximately 70° has in practice shown very good results relating to the quality of combustion for a wide spectre of different oils, hi figure 9 a flange 24 is provided in order to attach the disc 16 to the nozzle, but in other embodiments of the invention it is foreseen that the disc is made as an integral part of the air channel 7, for example by attaching the disc in the outlet end of the air channel, whereby the flange member 24 being attached to the nozzle is avoided. A further advantage by attaching the disc 16 to the air channel is the fact that when the apparatus according to the invention is provided with a pivotal arm 14 as explained with reference to figures 3 and 4 the disc by swinging the apparatus away becomes fully accessible as do the nozzle and ignition means which in the embodiment according to figure 4 is partly enclosed by the disc 16. By separating the disc and the nozzle and the ignition means it becomes easier to clean the part, so from that perspective the configuration where the disc 16 is attached to the air channel 7 provides some cleaning advantages.

Turning to figure 10 the principle behind the oil installation in the apparatus according to the invention will be explained. The oil is by means of the oil inlet 9 force into the tank 8. The heating element will heat the oil such that pre-heated oil will exit the tank 8 by means of the outlet 12 and be guided into the nozzle inlet 17 for combustion. The air supply means will supply air inside the unit in the direction 31 such that as the oil and air enters the nozzle 28 a mist will be created whereby the ignition means (not illustrated) will ignite the mist and create a substantially complete combustion of the atomized oil particles. Should a leakage occur in some of the connections between the tank, the inlet, the outlet or otherwise, the leakage tray 21 will collect the oil spillage, and after a certain amount of oil has been collected in the leakage tray 21, the level gauge 22 will be activated sending out a signal by wire means 23 to the control unit after which the entire unit will be shut down. The control unit will furthermore issue a warning signal such that appropriate maintenance and service may be carried out in response to the generated signal.
A further important aspect of the invention is the fact that the distance 29 between the nozzle 28 and the outlet of the tank 12 is kept at a minimum such that the pre-heated oil in the tank 8 through its passage of the outlet pipe 12 towards the nozzle is not cooled which will lead to an inferior combustion when ignited upon leaving the nozzle. This is due to the fact that it is more difficult to create a very fine atomized mist with low viscosity oils as compared to high viscosity oils at lower air pressures such that by maintaining a relatively high and preset temperature in the oil corresponding to the optimum temperature of that particular oil type the mist formation and thereby the resulting combustion may be optimized. In practice the distance 29 for practical reasons has been set in a vertical direction to be between 1 and 5 cm, more preferable around 3 centimetres. The total distance from the outlet of the tank 8 to the inlet in the nozzle should also be kept as short as possible, but will for practical reasons due to the other components in the unit be around 20 cm or more preferable down to approx 12.5 cm. At these distances tests indicate that no significant cooling influencing the mist formation in the nozzle occurs such that optimum combustion results in combination with a minimum of energy consumption in the preheating unit is achieved.

According to the invention the apparatus may be designed to have a so-called boiler effect of between 15 and 40 kilowatts where the air in the air channel is provided with a pressure of 0.5 bar in comparison to the ambient air pressure. The oil types usable with the present invention are very varied and all known energy oils may be used with the present apparatus such as environmental friendly non-fossil oils deriving from vegetables or animals may be used as also fossil fuel are usable with the present invention.

Although different embodiments of the invention have been described above, the invention as such should not be limited by the examples described, but should only be limited by the scope of protection afforded by the appended claims.
CLAIMS

1. Apparatus for the combustion of various types of oil where the apparatus comprises:
- a nozzle creating an oil mist;
- ignition means arranged adjacent the nozzle for igniting the oil mist;
- combustion air supply means characterised in that the combustion air supply means comprises an air flow channel in the shape of a cylinder, said cylinder having an air inlet opening and an outlet opening arranged in opposite ends of said cylinder, and where inside of the cylinder the nozzle and ignition means are arranged, and where in or adjacent the outlet opening, air and/or mist distribution means in the shape of a non-rotatable disc having an outer and inner diameter is arranged, wherein the disc has a conical section shape, such that the inner diameter of the disc is closer to the cylinder's air inlet opening and the outer diameter of the disc is arranged proximate the outlet opening of the cylinder, and where a plurality of wings are arranged radially around the disc, for directing the airflow leaving the cylinder.

2. Apparatus according to claim 1 characterised in that the angle between a longitudinal axis through the air flow channel and the air distribution means is between 60° and 80°, more preferred approximately 70°.

3. Apparatus according to claim 1, characterised in that between 7 and 14 wings, more preferred between 8 and 12, and most preferred 10 wings are arranged radially around the disc.

4. Apparatus according to claim 3, characterised in that the disc is made from a plate material where each wing in cross section has first and second bent portions, where said first portion is at an angle relative to the disc, and where the second portion is parallel to the disc.
5. Apparatus according to claim 1, characterised in that the apparatus comprises a pre-
treatment unit which unit comprises an oil receiving tank, which tank comprises an in-
let and an outlet, where the inlet is arranged adjacent the bottom of said tank and the outlet is arranged above said inlet, and where further a heating element is placed in the tank at a level above the inlet but below the outlet.

6. Apparatus according to claim 5 wherein the tank has a volume of between 0,5 l to 1,0 l, more preferred between 0,65 l to 0,75 l.

7. Apparatus according to claim 5 wherein the tank is provided with a lid

8. Apparatus according to claim 5 wherein the distance from the tank's outlet to the nozzle is as short as possible, such that the distance between the tank outlet and the nozzle is less than 250 mm, more preferred less than 200 mm and most preferred less than 150 mm, and that the difference in elevation between the outlet and the nozzle is between 10 mm and 50 mm preferably less than 25 mm, and further that the pipeline connecting the tank with the nozzle and/or the tank optionally may be insulated.

9. Apparatus according to any preceding claim characterised in that the apparatus as well as the pre-treatment unit is arranged inside the same housing, where said housing only is provided with an opening in the shape of an air inlet for the supply of air to the combustion air supply means.
**A. CLASSIFICATION OF SUBJECT MATTER**

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

**B. FIELDS SEARCHED**

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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* Special categories of cited documents

- **A**: document defining the general state of the art which is not considered to be of particular relevance
- **E**: earlier document but published on or after the international filing date
- **L**: document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another document, or a special reason (as specified)
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"A": document member of the same patent family

Date of the actual completion of the international search: 19 February 2008

Date of mailing of the international search report: 26/02/2008

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

Authorized officer:
Coi, Enrico
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INTERNATIONAL SEARCH REPORT

Box No II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos ______ because they relate to subject matter not required to be searched by this Authority, namely ______

2. Claims Nos ______ because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically ______

3. Claims Nos ______ because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6(4)(a)

Box No III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ______ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2. ______ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of additional fees

3. ______ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos ______

4. ______ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims, it is covered by claims Nos ______

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation
- No protest accompanied the payment of additional search fees
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4

   Apparatus for the combustion of various types of oil, provided with an air-fuel mixture swirler whose wings show a preferred inclination to the air flow channel central axis

2. claims: 5-9

   Apparatus for the combustion of various types of oil, provided with an improved fuel pre-heater
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