A Spark Plug Retainer For An Engine

FIELD OF INVENTION

The invention relates broadly to a spark plug retainer for an engine. In particular, the invention relates to a spark plug retainer for an engine of a remote controlled aircraft.

BACKGROUND

Conventionally, a spark plug 101 of an engine is centrally mounted on a cylinder head 109 made of cast aluminium (refer Figure 1). The cylinder head 109 has an array of radiators 111 for cooling the engine. A spark plug cap 103 (herein referred to as plug cap 103) is plugged on to the spark plug 101. A cable 105 attached to the plug cap 103 connects a high voltage to the spark plug 101. The plug cap 103 is usually a thin shell made of tin and consists of a ring spring 107 to keep the plug cap 103 in contact with the base of the spark plug 101.

Often, the plug cap 103 loses its grip after a few usages. Furthermore, in the existing designs, the plug cap 103 swings horizontally and vertically when the engine of a remote controlled (RC) aircraft is subjected to vibrations during a flight thereby causing the plug cap 103 to disengage from the spark plug 101 resulting in a "quit engine" condition.

The plug cap 103 is also a grounding surface for arresting any electrical noise that is generated when the spark plug 101 is fired. Improper grounding will lead to leakage of the electrical noise causing a "RC link loss" which, in turn, causes an aerial platform of the RC aircraft to go to a "fail safe mode".

Furthermore, since ignition involves high voltages, any intermittent contact between the spark plug 101 and the spark plug cap 103 will lead to arcing between the surfaces of the spark plug 101 and the plug cap 103, which in turn, generates heat that may melt the insulation of the plug cap 103. As a result, a short circuit occurs, thereby leading to a failure of an ignition unit of the engine.

In view of the above problems, presently available ignition units of an engine do not last longer than a few hours. In worst cases, an ignition unit lasts only for a few minutes.

There is thus a need to provide a spark plug retainer that seek to address one or more of the above disadvantages.

SUMMARY

According to a first aspect of the present invention, there is provided a retainer to connect a spark plug cap and a cylinder head of an engine, said retainer comprising a retaining ring operable to be positioned around the outer surface of the plug cap to engage and lock the movement of the plug cap relative to the cylinder head.

The retaining ring may comprise a first and a second substantially half rings co-operating with each other and accommodating the outer surface of the plug cap.

The first half ring may comprise one or more L-shaped clamps located underneath the first half ring, each clamp facing the centre of the ring and enclosing a channel.

The first half ring may comprise two opposing L-shaped clamps, one on each opposing end of the first half ring.

The opposing end of the first half ring may further comprise a rectangular recess to accommodate a pair of central linings of the spark plug cap.

Each opposing end of the first half ring may further comprise an arcuate recess adjacent the rectangular recess.

Each opposing end of the second half ring may be arcuate in order to fit into the arcuate recess of the first half ring.

Each end of the first half ring may comprise a through hole and each end the second half ring comprise a threaded hole for inserting and fastening the two half rings and the plug cap with a screw.

The inner surface of the first half and second half rings may comprise an arcuate kerbed portion and a plurality of vertical side walls separating a plurality of hollow chambers, wherein the inner edges of the side walls may be inclined to accommodate a outer surface of the spark plug cap.

The cylinder head may have a substantially hemispherical structure comprising a plurality of circular radiating plates whose top and bottom surfaces are parallel, said plurality of radiating plates include a base plate, a top plate and one or more intermediate plates.

The base plate may comprise a plurality of through holes for fastening the cylinder head to the chassis of the engine.

The top plate may comprise a centrally located threaded hole for inserting and holding a spark plug.

The top plate may comprise one or more projections mounted on a centrally positioned cylindrical wall, wherein the top and bottom surfaces of the projections may be parallel to those of the radiating plates. The number of projections may be two.

The projections may be operable to engage with the channels of the L-shaped clamps. Each of the projections may have a threaded hole for fastening a screw.

The outer edges of each of the plurality of radiating plates may negotiate a curve so as to follow the outer surface of a hemisphere.

The cylinder head may be made of an aluminium alloy. The aluminium alloy may be preferably a 7075 aluminium alloy.

The cylinder head may be machined from a computer numerical control (CNC) machine.

According to a second aspect of the present invention, there is provided an assembly comprising: a cylinder head of an engine; a spark plug; a spark plug cap; and a retainer comprising a retaining ring operable to be positioned around the outer surface of the plug cap to connect the spark plug cap and the cylinder head of the engine, said retainer is operable to engage and lock the movement of the plug cap relative to the cylinder head.

According to a third aspect of the present invention, there is provided a cylinder head for co-operation with a retainer comprising a retaining ring operable to be positioned around the outer surface of the plug cap to connect a spark plug cap to the cylinder head, the cylinder head having a substantially hemispherical structure comprising a plurality of circular radiating plates whose top and bottom surfaces are parallel, said plurality of radiating plates include a base plate, a top plate and one or more intermediate plates.

The base plate may comprise a plurality of through holes for fastening the cylinder head to the chassis of the engine.

The top plate may comprise a centrally located threaded hole for inserting and holding a spark plug.

The top plate may comprise one or more projections mounted on a centrally positioned cylindrical wall, wherein the top and bottom surfaces of the projections are parallel to those of the radiating plates.

The number of projections may be two. The projections may be operable to engage with the channels of L-shaped clamps of the retainer. Each of the projections may have a threaded hole for fastening a screw.

The outer edges of each of the plurality of radiating plates may negotiate a curve so as to follow the outer surface of a hemisphere.

The cylinder head may be made of an aluminium alloy. The aluminium alloy may be a 7075 aluminium alloy.

The cylinder head may be machined from a computer numerical control (CNC) machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better-understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 is a perspective view illustrating a conventional way of attaching a plug cap to a cylinder head of an engine;

Figure 2 is a perspective view of an assembly of a plug cap, a retaining ring, a cylinder head and an engine in accordance with an embodiment of the present invention;

Figure 3 is an exploded view showing the plug cap, the retaining ring, the spark plug and the cylinder head in accordance with an embodiment of the present invention;

Figure 4 is a perspective view of an assembly of the plug cap, the retaining ring and the cylinder head in accordance with an embodiment of the present invention;

Figure 5 is another perspective view of Figure 4;

Figure 6 is a perspective view of an assembly of the plug cap and the retaining ring in accordance with an embodiment of the present invention;

Figure 7 is an exploded view of Figure 6;

Figure 8 is a perspective view of an assembly of the retaining ring in accordance with an embodiment of the present invention;

Figure 9 is an exploded view of Figure 8;

Figure 10 is a bottom view of Figure 8;

Figure 11 is a top view of Figure 8;

Figure 12 is a front view of Figure 8;

Figure 13 is an inner perspective view of a first half ring in accordance with an embodiment of the present invention;

Figure 14 is outer perspective view of Figure 13;

Figure 15 is an inner perspective view of a second half ring in accordance with an embodiment of the present invention;

Figure 16 is a perspective view of the cylinder head in accordance with an embodiment of the present invention;

Figure 17 is a top view of the Figure 16; and

Figure 18 is a front view of Figure 16.

DETAILED DESCRIPTION

Embodiments of the present invention are aimed to restrict the movement of a plug cap relative to the cylinder head.

Embodiments of the present invention are also aimed to establish a permanent contact between a spark plug and a plug cap so as to prevent:

1. the disengagement of the plug cap during the flight of a RC aircraft,
2. the loss of RC link during the flight of a RC aircraft, and
3. the melting of the spark plug insulation that may arise when a short circuit occurs in an ignition unit.

Embodiments off the present invention are also aimed to improve the heat radiation capacity of an engine by providing a cylinder head with a larger cooling area.

Figure 2 is a perspective view of an assembly of a plug cap 103, a retaining ring 209, a cylinder head 207 and an engine 201 in accordance with an embodiment of the present invention. The engine 201 has an engine chassis 205 and an exhaust pipe 203.

A substantially hemispherical cylinder head 207 is attached to the top part of the engine chassis 205 by a plurality of mounting screws 211. Along its axis, the cylinder head 207 has thin layers of substantially circular radiating plates, including a base plate 208, a top plate 210 and a plurality of intermediate plates 215. The radius of each of the radiating plates 208, 210, 215 diminish from the base plate 208 to the top plate 210. The top and bottom surfaces of each radiating plates 208, 210, 215 are parallel. The upper surface of the top plate has a pair of opposing projections 219 positioned on top of a centrally mounted cylindrical wall 212. The top and bottom surfaces of the projections 219 are parallel to the radiating plates 208, 210, 215. The peripheral portion of each of the radiating plate 208, 210, 215 has an equal number of arcuate cut-outs 217, the cut-outs 217 of each radiating plate 208, 210, 215 are positioned equidistant around the periphery of the radiating plate 208, 210, 215 such that a plurality of through-holes (e.g. refer Fig 16) that are equal in numbers to the number of cut-outs 217 are formed in the base plate 208 in order to fasten the cylinder head 207 to the engine chassis 205.

A retaining ring 209 having a pair of opposing L-shaped clamps 221 is operable to accommodate the plug cap 103 and engage with the projections 219. A pair of screws 213 is fastened to restrict the vertical movement of the plug cap 103. The projections 209 and the L-shaped clamps 221 helps in restricting the vertical movement of the plug cap103.

Figure 3 is an exploded view showing the plug cap 103, the retaining ring 209, the spark plug 101 and the cylinder head 207 in accordance with an embodiment of the present invention.

The retaining ring 209 consists of two substantially half rings 307, 309 that can be attached to each other. The two half rings 307, 309 are die-casted from a material

suitable for mass production (e.g. an aluminium alloy) and having sufficient mechanical strength and electrical conductivity.

The base plate 208 has of a plurality of holes 301 through which screws 311 are inserted to fasten the cylinder head 207 to the engine chassis 205 (refer Figure 2). A pair of threaded holes 305 is provided on the cylindrical wall, one on each of the opposing projections 219, for fastening the screws 311 in order to arrest the horizontal movement of the plug cap 103. The top plate 210 of the engine chassis 205 has a mounting hole 303 at the centre. The mounting hole 303 has internal threads so as to fasten the base 102 of the spark plug 101.

Figure 4 is a perspective view (in a direction of the first half ring 309) of an assembly of the plug cap 103, the retaining ring 209 and the cylinder head 207. The two half rings 307,309 are attached to each other around the plug cap 103 and fastened by a pair of screws 213. The two opposing clamps 221 are engaged and locked to the projections 219.

Figure 5 is another perspective view (in a direction of the second half ring 307) of an assembly of the plug cap 103, the retaining ring 209, and the cylinder head 207. A pair of screws 311 is fastened to the projections 219 so as to arrest the movement of the plug cap 103 in the horizontal direction.

Figure 6 is a perspective view (in a direction of the first half ring 309) of an assembly of the plug cap 103 with the two half rings 307, 309 fastened to each other, without the cylinder head 207.

Figure 7 is an exploded view of Figure 6 showing that the two half rings 307,309 are spaced apart.

The two outer edges of the first half ring 309 and second half ring 307 are upright and have equal widths. The first half ring 309 has a c-shaped portion 720 and two arms 701 extending away from the centre of the c-shaped portion 720. A pair of opposing L-shaped clamps 221 is formed orthogonal to the extended arms 701. The junction 715 of each of the L- shaped clamp 221 and the arm 701 is rounded. In addition, the terminal portion 719 of each clamp 221 is rounded so as to easily engage with the projections 219 found on the cylinder head 207 (refer Fig 2). A pair of through holes 702 is formed laterally on either side of the first half ring 307, at the

junction of the c-shaped portion 720 and the arms 701. The inner surface of the c-shaped portion 720 has a pair of rectangular recesses 709, one on either ends, each accommodating a central lining 708 of the plug cap 103. The inner portion of each of the two arms has an arcuate recess 711 immediately adjacent to the rectangular recess 709.

The second half ring 307 has a c-shaped portion 730 and two arms 703 extending away from the centre of the c-shaped portion 730. The inner surface 717 of each of the two arms 703 is arcuate so as to fit into the arcuate recess 711 of the first half ring 309. A pair of threaded holes 705 is formed laterally on either arms 703 at the junction of the c-shaped portion 730 and the arms 703.

The inner surface of the two half rings 307, 309 has an arcuate kerbed portion 708 with a plurality of vertical side walls 710 that are equidistant from each other. The side walls 710 separate a plurality of hollow chambers 707. The inner edges of the side walls 710 are inclined in order to accommodate an inclined part 704 of the plug cap 103.

Before assembling the two half rings 307, 309, a spark plug is inserted and fastened to the mounting hole of the cylinder head. After this, the two half rings 307, 309 are placed around the inclined portion 704 of the plug cap 103 so that the central lining 708 of the plug cap 103 fits into the recesses 709 while the arms 701, 703 of the two half rings 307, 309 fits into each other to form the retaining ring 209 around the plug cap 103. The two clamps 221 are then manually pushed in between the projections 219 (Figure 4) and turned clockwise or anticlockwise so that the channels 805 (Figure 8) of the clamps 221 engage and lock to the projections 219 (Figure 4). A pair of screws 213 are inserted into the through holes 702 and fastened to the threaded hole 705 so that the two half rings 307, 309 are attached to each other with the plug cap 103. After this, another pair of screws 311 (Figure 5) is fastened to the projections 219 (Figure 5).

Figure 8 is a perspective view of an assembly (without the plug cap) of the retaining ring 209 clearly showing how the two half rings 307, 309 are attached by the screws 213. Each clamp 221 has a hollow channel 805, which is operable to engage with a projection 219 (refer Figure 4).

Figure 9 is an exploded view of Figure 8. The side walls 710 of the inner surface of the retainer ring 307 are inclined to accommodate the inclined part 704 of the plug cap 103.

Figure 10 is the bottom view of Figure 8 showing *inter alia* the two half rings 307, 309, the chambers 707, the kerbed portion 708, the side walls 710, the rectangular recesses 709 and the clamps 221.

Figure 11 is the top view of Figure 8 showing *inter alia* the two half rings 307, 309, and the rectangular recesses 709.

Figure 12 is a front view of Figure 8 (in the direction of one half ring 309) showing the clamps 221, the hollow channels 805 and the screws 213.

Figure 13 and Figure 14 are respectively the inner and outer perspective views of a first half ring 309 showing *inter alia* the chambers 707, the kerbed portion 708, the side walls 710, the clamps 221 and the hollow channels 805.

Figure 15 is an inner perspective view of the second half ring 307 of the retaining ring 209 showing *inter alia* the chambers 707, the kerbed portion 708, the side walls 710, the threaded holes 705 and the arcuate terminal portions 703.

Figure 16, Figure 17 and Figure 18 are respectively the perspective, top and front views of the cylinder head 207 showing *inter alia* the base plate 208, the top plate 210, the intermediate plates 215, the cut-outs 217, the projections 219, the through-holes 301, the mounting hole 303 and the threaded hole 305.

The outer edges of the radiating plates 208, 210, 215 are appropriately inclined so as to negotiate a curve corresponding to the outer surface of the hemispherical cylinder head 207. In the embodiment, the cylinder head is machined out of an alloy steel (e.g. 7075 aluminium alloy) by a computer numerical control (CNC) machine. The above cylinder head 207 has superior heat radiating capacity when compared to the conventional cylinder head.

Experiments conducted on a RC engine employing the above retainer ring 209 have indicated that the ignition unit of the RC engine was seen in good operating conditions even after 50 hours of usage.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS

1. A retainer to connect a spark plug cap and a cylinder head of an engine, said retainer comprising a retaining ring operable to be positioned around the outer surface of the plug cap to engage and lock the movement of the plug cap relative to the cylinder head.

2. The retainer of claim 1, wherein the retaining ring comprises a first and a second substantially half rings co-operating with each other and accommodating the outer surface of the plug cap.

3. The retainer of claim 2, wherein the first half ring comprises one or more L-shaped clamps located underneath the first half ring, each clamp facing the centre of the ring and enclosing a channel.

4. The retainer of claim 3, wherein the first half ring comprises two opposing L-shaped clamps, one on each opposing end of the first half ring.

5. The retainer of any one of claims 2 to 4, wherein opposing end of the first half ring further comprises a rectangular recess to accommodate a pair of central linings of the spark plug cap.

6. The retainer of claim 5, wherein each opposing end of the first half ring further comprises an arcuate recess adjacent the rectangular recess.

7. The retainer of any one of claims 2 to 6, wherein each opposing end of the second half ring is arcuate in order to fit into the arcuate recess of the first half ring.

8. The retainer of any one of claims 2 to 7, wherein each end of the first half ring comprises a through hole and each end the second half ring comprises a threaded hole for inserting and fastening the two half rings and the plug cap with a screw.

9. The retainer of any one of the preceding claims , wherein the inner surface of the first half and second half rings comprise an arcuate kerbed portion and a plurality of vertical side walls separating a plurality of hollow chambers, wherein the inner

edges of the side walls are inclined to accommodate a outer surface of the spark plug cap.

10. The retainer of any one of the preceding claims, wherein the cylinder head has a substantially hemispherical structure comprising a plurality of circular radiating plates whose top and bottom surfaces are parallel, said plurality of radiating plates include a base plate, a top plate and one or more intermediate plates.

11. The retainer of claim 10, wherein the base plate comprises a plurality of through holes for fastening the cylinder head to the chassis of the engine.

12. The retainer of claim 10 or 11, wherein the top plate comprises a centrally located threaded hole for inserting and holding a spark plug.

13. The retainer of any one of claims 10 to 12, wherein the top plate comprises one or more projections mounted on a centrally positioned cylindrical wall, wherein the top and bottom surfaces of the projections are parallel to those of the radiating plates.

14. The retainer of any one of claims 10 to 13, wherein the number of projections is two.

15. The retainer of 13 or 14, wherein the projections are operable to engage with the channels of the L-shaped clamps.

16. The retainer of any one of claims 13 to 15, wherein each of the projections has a threaded hole for fastening a screw.

17. The retainer of any one of claims 10 to 16, wherein the outer edges of each of the plurality of radiating plates negotiate a curve so as to follow the outer surface of a hemisphere.

18. The retainer of any one of claims 10 to 17, wherein the cylinder head is made of an aluminium alloy.

19. The retainer of any one of claims 18, wherein the aluminium alloy is preferably a 7075 aluminium alloy.

20. The retainer of any one of claims 10 to 19, wherein the cylinder head is machined from a computer numerical control (CNC) machine.

21. An assembly comprising:

a cylinder head of an engine;

a spark plug;

a spark plug cap; and

a retainer comprising a retaining ring operable to be positioned around the outer surface of the plug cap to connect the spark plug cap and the cylinder head of the engine, said retainer is operable to engage and lock the movement of the plug cap relative to the cylinder head.

22. A cylinder head for co-operation with a retainer comprising a retaining ring operable to be positioned around the outer surface of the plug cap to connect a spark plug cap to the cylinder head, the cylinder head having a substantially hemispherical structure comprising a plurality of circular radiating plates whose top and bottom surfaces are parallel, said plurality of radiating plates include a base plate, a top plate and one or more intermediate plates.

23. The cylinder head of claim 22, wherein the base plate comprises a plurality of through holes for fastening the cylinder head to the chassis of the engine.

24. The cylinder head of claim 22 or 23, wherein the top plate comprises a centrally located threaded hole for inserting and holding a spark plug.

25. The cylinder head of any one of claims 22 to 24, wherein the top plate comprises one or more projections mounted on a centrally positioned cylindrical wall, wherein the top and bottom surfaces of the projections are parallel to those of the radiating plates.

26. The cylinder head of any one of claim 25, wherein the number of projections is two.

27. The cylinder head of claims 25 or 26, wherein the projections are operable to engage with the channels of L-shaped clamps of the retainer.

28. The cylinder head of any one of claims 25 to 27, wherein each of the projections has a threaded hole for fastening a screw.

29. The cylinder head of any one of claims 22 to 28, wherein the outer edges of each of the plurality of radiating plates negotiate a curve so as to follow the outer surface of a hemisphere.

30. The cylinder head of any one of claims 22 to 29, wherein the cylinder head is made of an aluminium alloy.

31. The cylinder head of any one of claims 30, wherein the aluminium alloy is preferably a 7075 aluminium alloy.

32. The cylinder head of any one of claims 22 to 31, wherein the cylinder head is machined from a computer numerical control (CNC) machine.