Nov. 10, 1964 G. K. PARKER 3,156,372

CLOSURE FOR THE EXHAUST OPENING OF A JET ENGINE

Filed Dec. 19, 1961

Fig. 1.

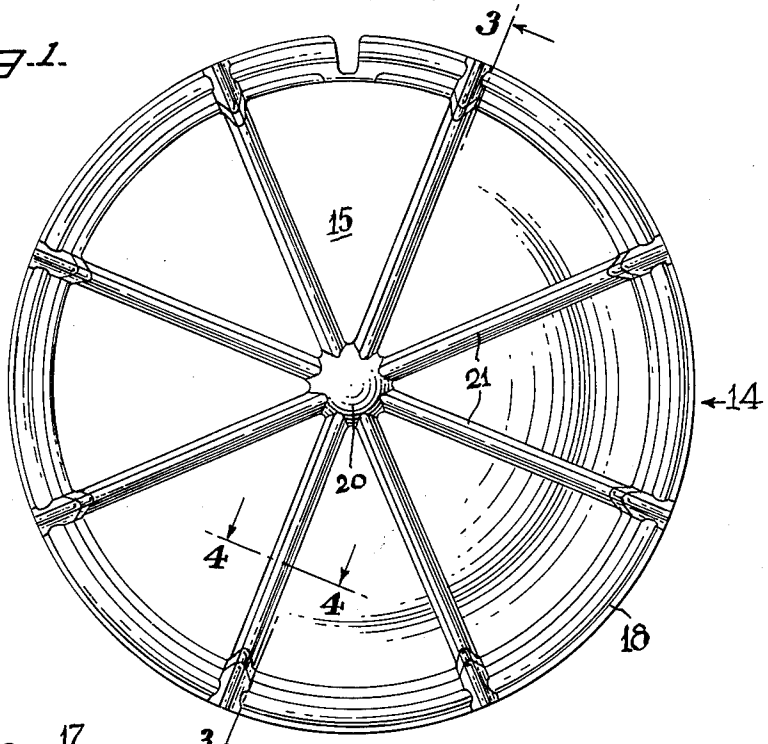
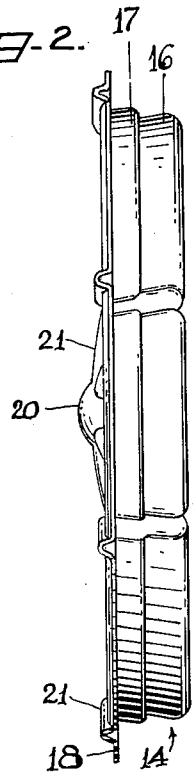


Fig. 2.



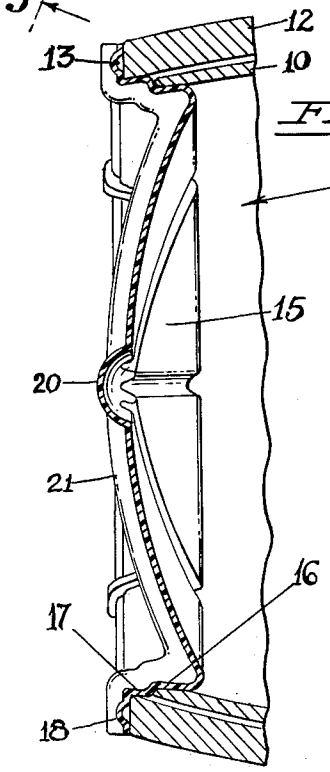
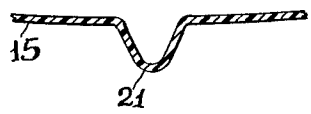


Fig. 3.

Fig. 4.



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CLOSURE FOR THE EXHAUST OPENING OF A JET ENGINE

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This invention relates to a novel closure for the exhaust opening in the rear end of a jet engine.

The efficient operation of jet engines is dependent in some measure on the exclusion of dust particles and moisture from the interior of such an engine while it is being serviced or when it is not in use. While temperature changes are apt to temporarily enlarge or contract the openings in either end of a jet opening, the normally circular exhaust opening is sometimes distorted permanently by the discharge therethrough of the high temperature exhaust gases. Such exhaust openings are apt to vary both with respect to size and shape, so for this reason it has been a problem to provide a tight-fitting cover which would readily conform to and completely close such an opening. Various devices, such as loosely fitting plastic or canvas coverings, have been used for this purpose, but none of them have been entirely satisfactory, primarily because they are apt to become detached and usually require considerable time to install and remove. In view of the large maintenance costs involved in servicing jet airplanes, airlines in particular have been interested in the availability of an inexpensive exhaust opening closure capable of fitting both normal and distorted exhaust openings, and which is adapted to be easily installed and detached with a minimum of time and effort.

The present invention satisfies these requirements by providing a novel cover or closure cap made from a suitable flexible plastic material such as polyethylene, which may be easily applied in a closing position with respect to the exhaust opening of a jet engine, and which when once installed is not apt to become displaced or detached. Polyethylene, being capable of remaining flexible over a wide range of temperature change and not deteriorating when contacted by oil and most chemicals, is particularly suitable in the manufacture and use of a cover or cap of the type embodying the present invention. Notwithstanding these desirable properties, polyethylene as well as most other plastic materials will expand and contact when subjected to changes in temperature. It is for this reason that other plastic devices intended for the same purpose as the present invention but not embodying the novel features thereof, have not been satisfactory, since covers of this kind while fitting properly when the engine is still fairly warm, will become loose fitting when the engine cools, thereby making it possible for such a cover to become detached easily. In order to make possible the utilization of a plastic material such as polyethylene in the manufacture of a satisfactory device for closing the exhaust openings of jet engines, it has become necessary to construct a cover or cap which is sufficiently expansible and contractable to insure a proper fit irrespective of whether such exhaust opening has become distorted or whether the opening has become slightly expanded or contracted due to variations in temperature.

The primary object of the present invention is to provide a novel closure for the exhaust opening in a jet engine, one which is circumferentially self-adjusting, and which is adapted to fit on and normally remain attached to the exhaust end of a jet engine even though such exhaust opening has become distorted from its normal circular shape.

Other objects of the present invention will be pointed out hereinafter or will be indicated in the appended claims

or will be obvious to one skilled in the art upon an understanding of the present disclosure. For the purpose of this application, I have elected to show herein certain forms and details of a cover or closure for use with jet engines, which is representative of my invention; it is to be understood, however, that the embodiment of my invention herein shown and described is for purposes of illustration only, and that therefore it is not to be regarded as exhaustive of the variations of the invention in the art.

In the accompanying drawing:

FIG. 1 is a plan view of a closure cap or cover for the exhaust opening of a jet engine, embodying my invention;

FIG. 2 is a side elevational view of the same;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 1; and

FIG. 4 is an enlarged sectional view taken on the line 4—4 of FIG. 1.

Referring to the drawing, **10** designates the rear circular end portion of a jet engine, **11** the exhaust opening, and **12** the rear end portion of the engine's cowling. In the particular engine shown, the cowling is formed with a rearwardly protruding annular bead **13**.

My improved closure cap or cover for an exhaust opening comprises a flexible but normally rigid disc-like body or member **14** of substantially circular shape formed in the usual manner from a resilient sheet of polyethylene or other suitable plastic material. The body **14** comprises a diaphragm or disc-like member **15** of generally concave shape which is adapted to extend across and entirely close the exhaust opening **11** in the engine. The peripheral portion of the body **14** extends rearwardly from the diaphragm **15** to provide an annular flange or wall **16** which is adapted to engage firmly with the sides of the exhaust opening **11** in the end portion **10** of the jet engine, such annular wall extending outwardly and rearwardly as at **17**, to engage annularly with the sides of the opening in the cowling **12**. The peripheral portion of the body **14** extends outwardly from **17** to provide an annular strip **18** adapted to extend over and engage with the rear end of the cowling **12**, such annular strip having a hollow annular bead **19** adapted to fit against the bead **13** of the cowling.

The diaphragm **15** is formed with a centrally disposed rearwardly bulged area or concave portion **20** which connects with a plurality of uniformly spaced radial ribs **21** that extend continuously to the outer peripheral edge of the body **14**. The ribs **21** are substantially V-shaped or U-shaped in cross-section as shown in FIG. 4, and preferably they have substantially the same uniform height throughout their lengths. While the number of radial ribs **21** may vary from the particular embodiment illustrated, it has been found that if the body **14** is formed with at least two (2) and preferably a larger number of such ribs, the normal shape of the cover may be temporarily changed so it will fit a somewhat distorted discharge opening in the jet engine. The radial ribs **21**, each having longitudinal extending converging sides and being hollow throughout their lengths, not only provide means permitting the expansion and contraction of the diaphragm **15** and the outer peripheral portion of the body **14** comprising the annular walls **16** and **17** and the strip **18**, but such ribs also make it possible for the normal shape of the cover when installed to be modified or distorted sufficiently to fit the exhaust opening in a jet engine when the normal circular shape of such opening has been permanently changed by the hot gases discharged therethrough. The walls **16** and **17** of the body **14** are of suitable size circumferentially to fit snugly inside of and against the annular sides of the rear portions of the engine and cowling, respectively. By providing the flexible diaphragm **15** with a concave shape, and by having the ribs constructed and arranged as described, it is possible for the walls **16** and

17 to be slightly larger in circumference than the openings in the rear end portions of the engine and cowling, respectively; thus when the cover is installed and the walls 16 and 17 are forced into such openings in the engine and cowling, respectively, and are thereby contracted slightly, the diaphragm will be slightly deformed and will thereby become tensioned so as to exert an outward annular pressure on the said walls to cause them to snugly engage with the end portions of the engine and cowling and thus normally prevent the displacement of the installed cover.

The present embodiment of the cover prevents dust particles and moisture from entering the exhaust opening in the engine as well as the annular opening or space between the cowling and the engine. The flexibility and self-adjusting features of the cover will normally make possible its attachment to the rear end of the engine irrespective of the minor irregularities in the shape of the discharge opening. It is to be noted that a cover of the type embodying the present invention may also be used to close the inlet opening of a jet engine.

What I claim is:

1. In combination, a jet engine having an annular jet engine outlet end and a surrounding annular cowling projecting beyond said outlet end, said outlet end being defined by an annular wall the inside surface of which tapers to and terminates at the mouth of the engine outlet, a closure comprising a circular plastic radially deformable closure having an inner annular wall insertable within said outlet end and tapered in the same direction as said

surface to resiliently bear against the surface, and an outer annular wall extension adapted to form a closure between the engine outlet and cowling and to resiliently engage against the inside of the cowling.

2. The combination of claim 1 wherein said circular closure has hollow ribs extending radially from a central area of the closure through said cowling engaging extension of the closure.

3. The combination of claim 1 wherein said wall extension has an annular flange adapted to engage against the end surface of the cowling.

4. The combination of claim 3 wherein said circular closure has hollow ribs extending radially from a central area of the closure through said annular flange.

5. The combination of claim 1 wherein said outer annular wall extension is convergently tapered toward the outer extremity of the cowling substantially in accordance with the taper of said inner annular wall.

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