July 29, 1958 B. SMITH 2,845,026

MULTIPLE BOX FIN

Filed Nov. 17, 1953 3 Sheets-Sheet 1

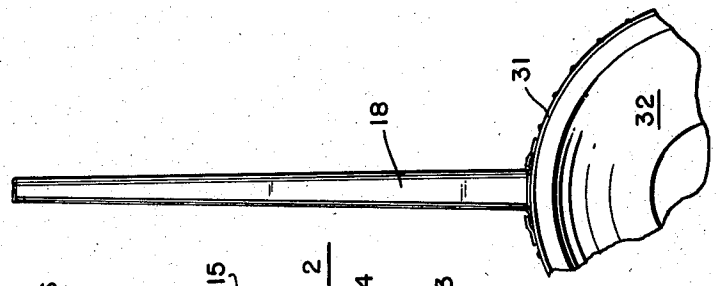


Fig. 2.

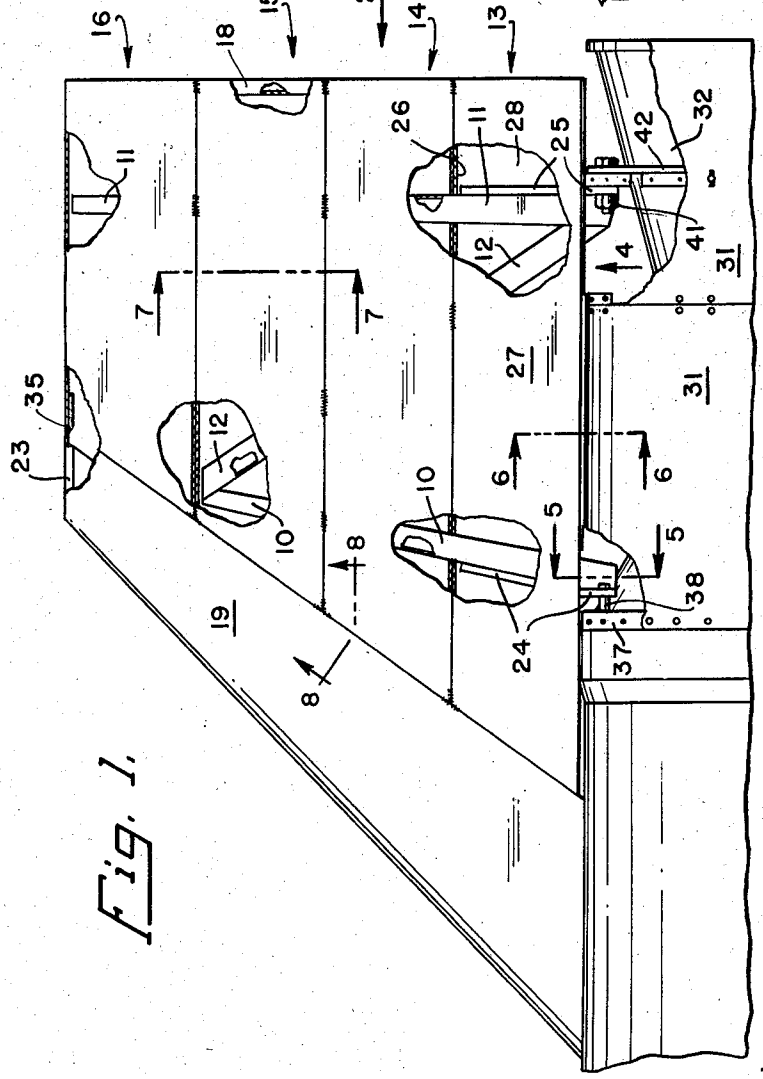


Fig. 1.

INVENTOR.
BERNARD SMITH
BY A. O'Brien
E. C. Walsh
ATTORNEYS

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MULTIPLE BOX FIN

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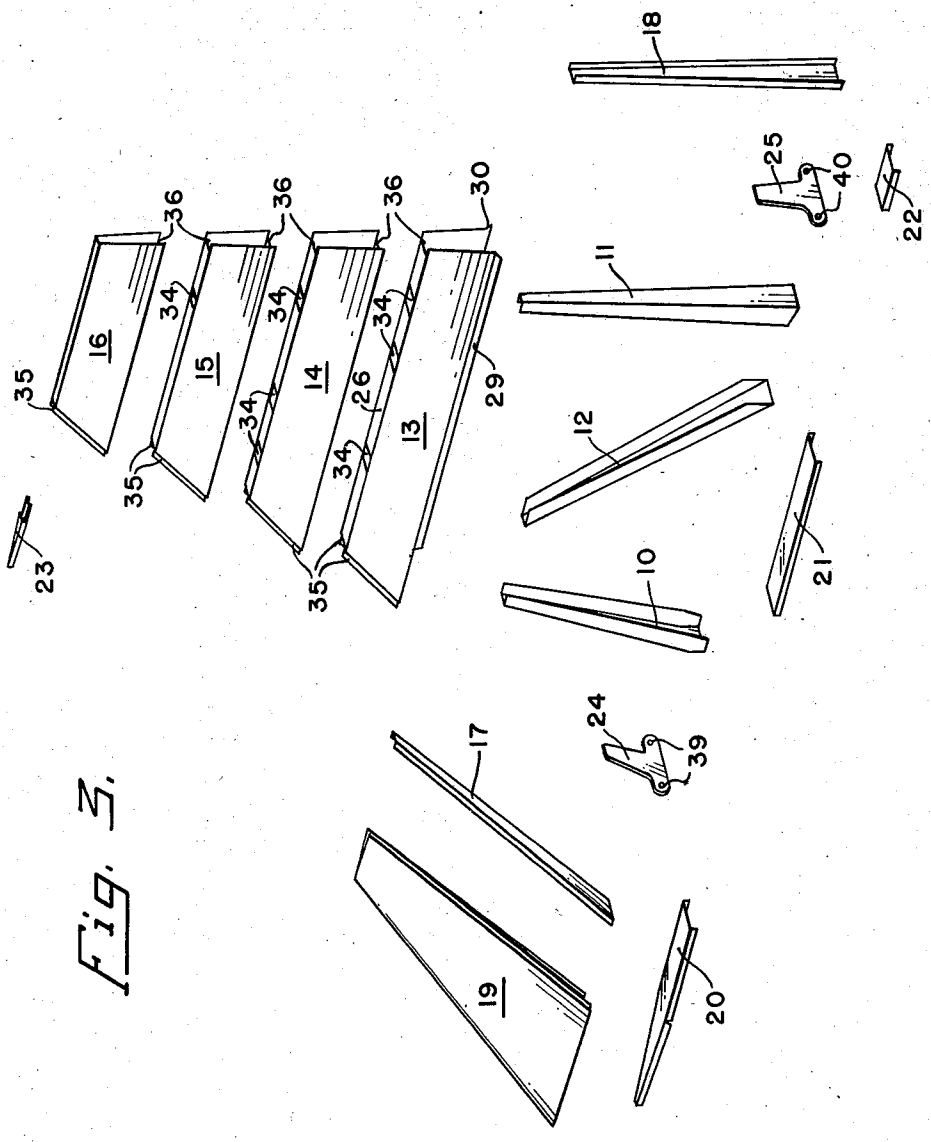


Fig. 3.

INVENTOR.
BERNARD SMITH

BY G. D. O'Brien
E. C. Walsh
ATTORNEYS

July 29, 1958 B. SMITH 2,845,026

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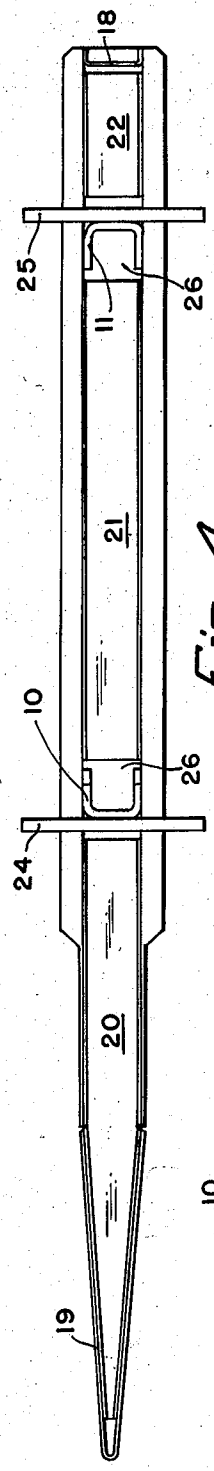


Fig. 4.

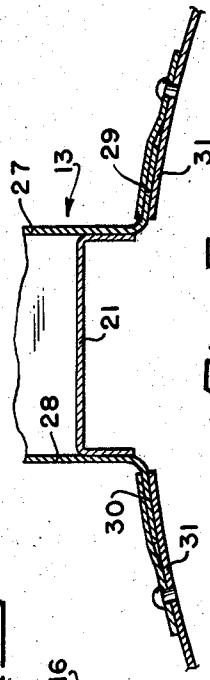


Fig. 6.

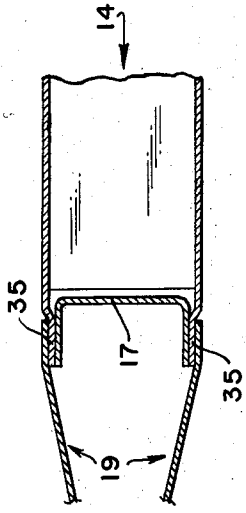


Fig. 8.

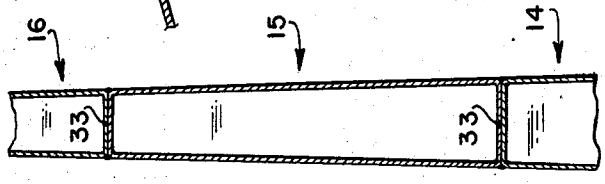


Fig. 7.

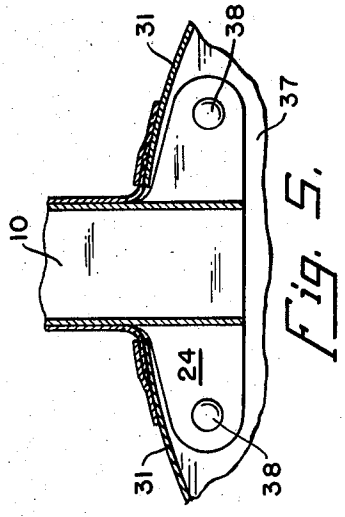


Fig. 5.

INVENTOR.
BERNARD SMITH
BY J. D. O'Brien
E. C. Walsh
ATTORNEYS

United States Patent Office 2,845,026 Patented July 29, 1958

2,845,026

MULTIPLE BOX FIN

Bernard Smith, China Lake, Calif., assignor to the United States of America as represented by the Secretary of the Navy

Application November 17, 1953, Serial No. 392,777

1 Claim. (Cl. 102—50)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to air missiles and more particularly to improvements in stabilizing fins employed on relatively large and long range rockets, and specifically, to fins employed on the booster motor of a two stage rocket.

In a missile employing the present invention, severe requirements were imposed upon its fin construction. It was required, for example, that each fin be five feet in length at its base and extend outward therefrom two and one half feet, have a 45° leading edge sweepback, withstand a transverse load of one ton, a set back load of two tons, a skin temperature of 650° F. and maintain a straightness tolerance of less than ¼°, these values being approximate. To meet these severe requirements, available fin designs would require as many as several thousand parts, such constructions, of course, being extremely complicated and expensive.

The principal object of this invention is to provide a simple and inexpensive fin which meets requirements of the order aforesaid.

Another object is to provide a fin construction, the parts of which may be readily assembled and welded together on a suitable jig adapted to maintain requisite tolerances, thus rendering same subject to mass production by relatively unskilled mechanics.

Another object is to provide a novel support construction between the base of the fin and a rocket nozzle.

Still further objects, advantages and salient features will become more apparent from the description to follow, the appended claim and the accompanying drawing, in which:

Fig. 1 is a fragmentary side elevation of the rear end of a rocket motor and a fin attached thereto, portions being broken away;

Fig. 2 is a rear elevation of Fig. 1 as viewed in the direction of arrow 2;

Fig. 3 is an exploded perspective of the various components of the fin;

Fig. 4 is an inner plan of the fin, as viewed in the direction of arrow 4, with the fin removed from the rocket motor;

Fig. 5 is an enlarged section taken on line 5—5, Fig. 1;

Fig. 6 is an enlarged section taken on line 6—6, Fig. 1;

Fig. 7 is an enlarged section taken on line 7—7, Fig. 1; and

Fig. 8 is an enlarged section taken on line 8—8, Fig. 1.

Referring in detail to the drawing, and particularly Fig. 3, the fin which forms the subject of the invention comprises, in general, a front spar **10**, a rear spar **11**, a diagonal strut **12**, a plurality of hollow sections **13**, **14**, **15**, **16** within which the spars and struts are disposed,

front and rear webs **17**, **18** for closing front and rear ends, respectively, of the hollow sections, a leading edge wedge **19**, formers **20**, **21**, **22** for closing the inner ends of wedge **19** and section **13**, a former **23** for closing the outer end of wedge **19**, and a pair of plates **24**, **25**, to which the inner ends of spars **10**, **11** are secured, respectively.

Section **13**, as best shown in Figs. 1, 4 and 6, is formed of sheet metal, bent into the form of a channel, having an outer wall **26** and tapering side walls **27**, **28**, the latter being bent outwardly in opposite directions at the inner portion of the section to provide, respectively, longitudinally extending flanges **29**, **30** which abut a cylindrical fairing **31** which surrounds exhaust nozzle **32** of the rocket motor. Channel shaped formers **21**, **22** and a rear portion of channel shaped former **20** are disposed within member **27** adjacent its inner edges or base, thus forming a box section. The forward tapering portion of former **20** closes the inner end of wedge **19**, and former **23**, which is a tapering channel, closes the outer end of wedge **19**. At the outer and inner points where formers **20**, **23** cross the joggles **35**, the latter are cut away. The outer web of former **23** is joggled inwardly to abut the inner face of the outer transverse wall of section **16**, as shown in Fig. 1.

Sections **14**, **15** and **16**, as best shown in Fig. 7, are each bent from sheet metal into box sections, adjacent edges of the inner walls of each being secured together by welds **33**. The side walls of these sections similarly taper so that the exposed surfaces of the assembled sections lie along opposite sides and the narrow outer transverse side of an isosceles trapezoid. Aligned apertures or cut-outs **34** are provided in the transverse walls of the sections through which the spars and struts extend. As best shown in Fig. 1, the outer ends of spar **10** and strut **11** terminate within section **15** and the outer end of spar **11** terminates within section **16**.

The spars and strut are channel shaped in cross section and taper in width to conform to the tapering inner surfaces of the side walls of the various sections, the inner ends of spars **10**, **11**, being welded, respectively, to plates **24**, **25**. The inner end of strut **12** is welded to the inner end of spar **11** and its outer end to the outer end of spar **10**.

As best shown in Figs. 3 and 8, the front edges of the various sections terminate in joggles **35**, front web **17** being disposed inside of same and the rear edges of V-shaped wedge member **19** disposed outside of same.

Channel shaped rear web **18** is tapered, similar to web **17**, and disposed between the side walls of the box sections adjacent their rear edges, suitable rectangular cut-outs **36** being provided in the transverse walls of the sections for receiving same.

Nozzle plate **37** is provided with a pair of rearwardly projecting pins **38** which extend through spaced apertures **39** in plate **24**, permitting relative sliding movement therebetween during temperature variations between the nozzle and fin. Plate **25** is provided with a similar pair of apertures **40** through which a pair of bolts **41** extend, rigidly securing plate **25** to an annular ring **42** rigidly affixed to the nozzle. Four equi-angularly spaced fin mountings of the type just described are provided around the nozzle plate and nozzle and four identical fins secured thereto.

In the assembly of the fin, plates **24**, **25** are rigidly affixed to a jig or fixture in the same relative positions in which they are disposed on the nozzle. Sections **13**, **14**, **15**, **16** are stacked as shown in Fig. 1 and spar **10** inserted through the cut-outs **34** for receiving same. Strut **12** is then inserted through the cut-outs for receiving same and strut **11** similarly inserted. The assembly is then disposed on the jig and the various parts moved to predetermined position, as determined by gage stops and then spot welded together. The various formers and leading

edge wedge are similarly aligned and welded. Since the sequence of assembly forms no part of the invention, per se, further detailed description is omitted in the interests of clarity, the foregoing merely being exemplary to show that the construction is subject to assembly and accurate alignment of its various components.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What I claim is:

A stabilizing fin for use on a missile, comprising; a plurality of elongated box sections formed of sheet material, each being shaped as a substantially isosceles trapezoid in cross section and of the same cross section throughout its length, and of greater height between the transverse parallel walls than in transverse thickness between the tapering side walls, adjacent sections, in a direction toward an outer edge of the fin, being of diminishing thickness and disposed in superposed relationship, with the narrower transverse wall of one section abutting the wider transverse wall of an adjacent section, aligned apertures in certain of the parallel walls, reinforcing members disposed within the sections and extending through certain of the apertures, means securing the sections and reinforcing members together to form a unitary structure, said reinforcing members including a pair of spars and a strut extending between an outer end of one of the spars to an inner end of the other spar, a plate secured to an inner end of each spar, means rigidly securing one of the plates to a rocket nozzle in a predetermined alignment, and means for slideably securing the other plate to the rocket nozzle in such manner to permit relative motion between the nozzle and fin under temperature differences between the fin and nozzle, but maintaining the fin in said alignment.

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