July 21, 1964 J. J. SHIELDS 3,141,297

DISPOSABLE JET NOZZLE

Filed Aug. 21, 1961 2 Sheets-Sheet 1

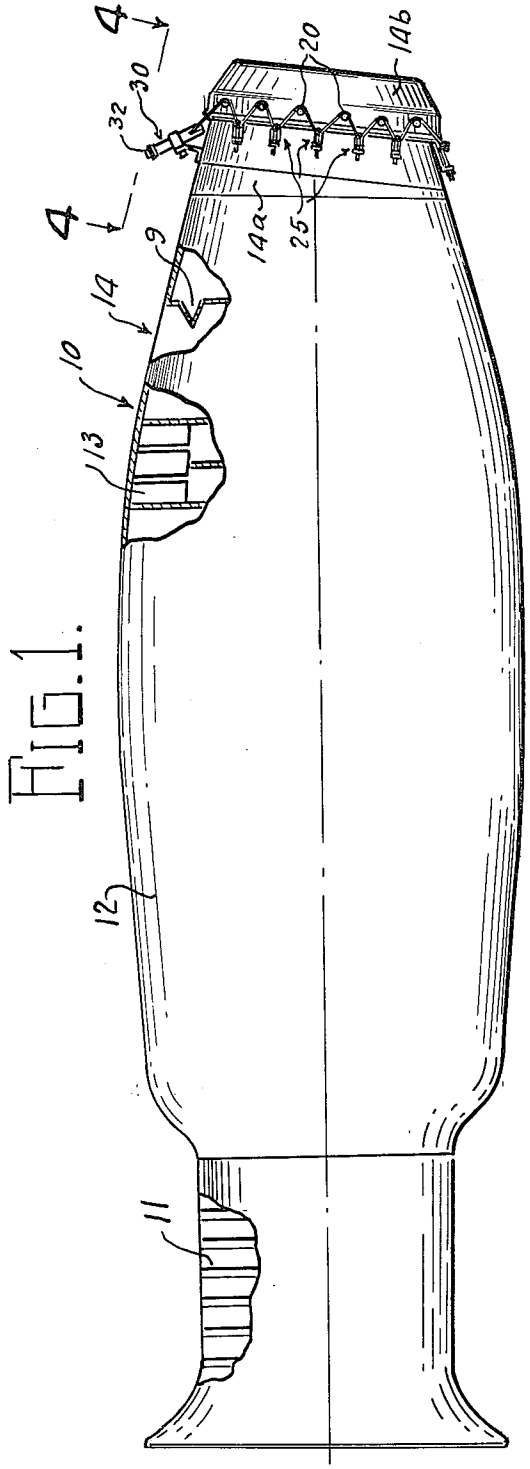
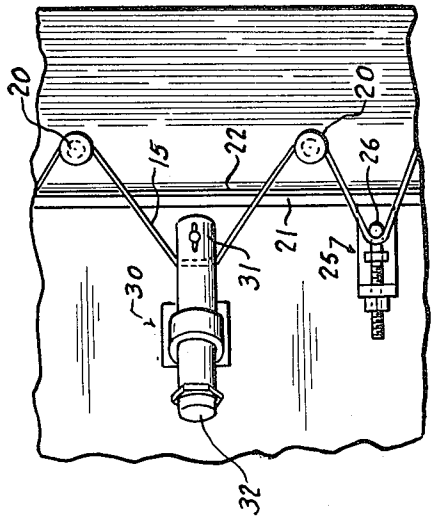


FIG. 1.

FIG. 4.



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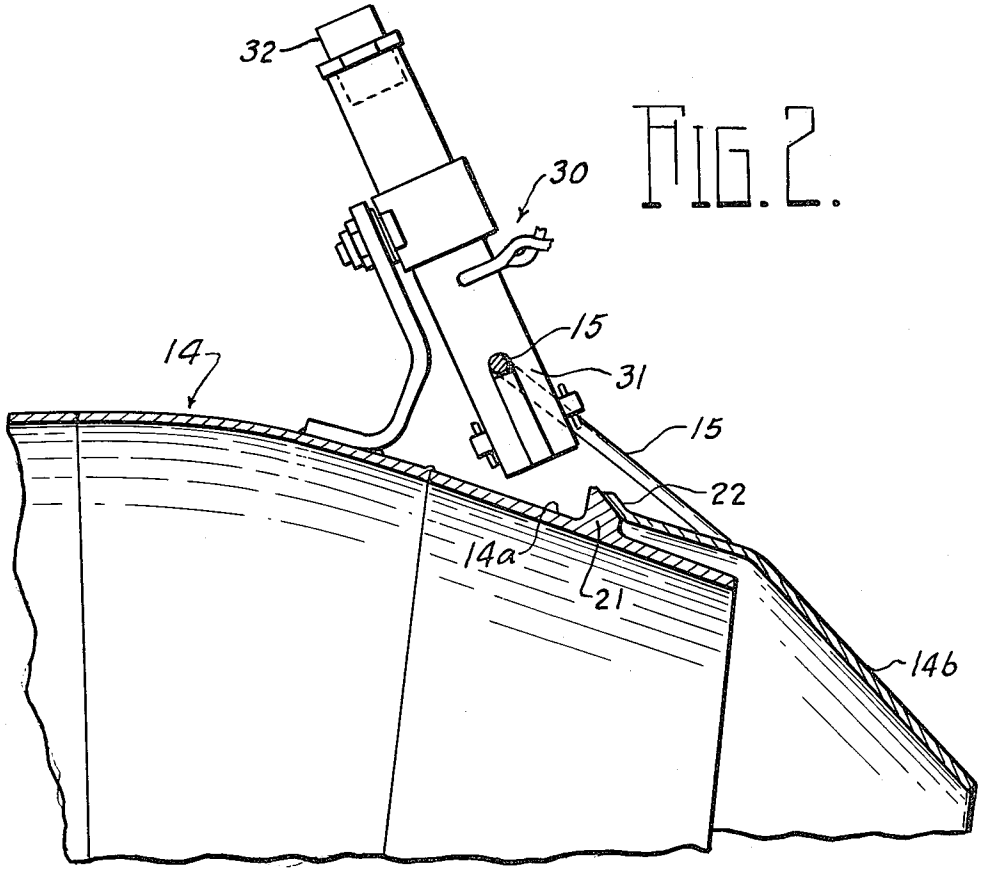

FIG. 2.

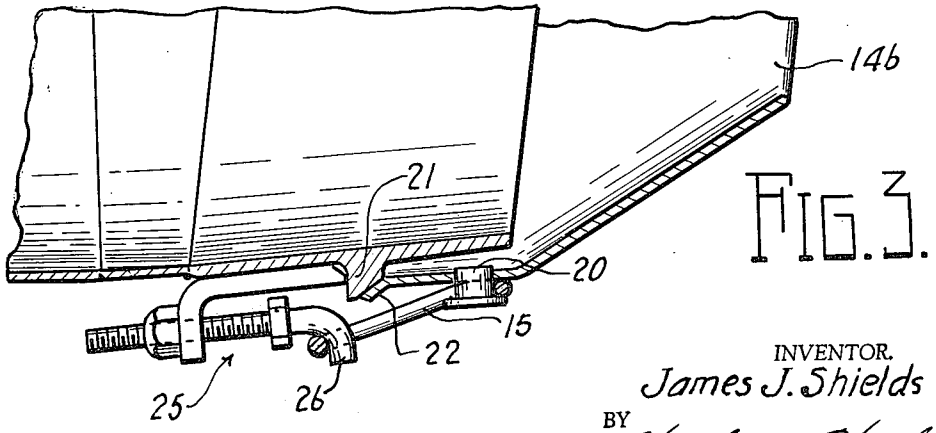

FIG. 3.

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DISPOSABLE JET NOZZLE

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My invention relates to jet engines and more particularly to an improved jet nozzle structure having a readily disposable jet nozzle part. In order to obtain maximum engine efficiency in power plants of the type aforesaid equipped with an afterburner, it is generally the practice to provide adjustable nozzles for increasing the exhaust jet area on operation of the afterburner to avoid back pressure and the resulting compressor surge. Such structures entail considerable complicated control and operating mechanisms as well as a complex mounting for the adjustable nozzle part.

It is an object of my present invention to improve the operating characteristics of a jet engine of the aforesaid type equipped with an afterburner by providing a multistage control of the jet nozzle area, and more particularly to incorporate a disposable jet nozzle, thereby providing for initial operation of the engine on take-off and at relatively lower altitudes and subsequently for maximum jet engine operating efficiency when the afterburner is turned on upon reaching relatively higher altitudes, the jet nozzle having a smaller discharge area and being discarded or disposed of when the afterburner is turned on, thus avoiding the creation of back pressure which would be detrimental to engine operation, as such back pressure effects the efficiency of the turbine as well as causing compressor surge.

A further object of my invention is facilitating jet engine operational control by providing a readily disposable jet nozzle, and means for quickly and easily releasing the jet nozzle, so that same falls free from the main jet nozzle section, more particularly by providing means which lace the disposable jet nozzle to the main jet nozzle body, and means for cutting or severing the lacing to quickly release same.

For a more detailed understanding of my invention, reference may be had to the accompanying drawing illustrating a preferred embodiment of my invention in which like parts are referred to by like characters throughout the several views, and in which

FIG. 1 is an elevational view of the nozzle structure of a conventional jet engine equipped with an afterburner,

FIG. 2 is an enlarged sectional view of a jet nozzle structure showing the anvil wire cutter,

FIG. 3 is an enlarged similar sectional view showing the cable slack take-up fixture, and

FIG. 4 is an enlarged fragmentary elevational view of the means securing the disposable jet nozzle to the main jet nozzle and showing the cable severing means.

The accompanying drawing illustrates a turbine jet engine in which the engine indicated as a whole by reference character **10** is provided with a compressor **11**, a combuster **12**, a turbine **13** and a nozzle structure **14** provided with an after-burner **9** downstream of said turbine, the aforesaid elements comprising substantially conventional structures excepting said nozzle structure which is herein illustrated as comprising a two part structure hereinafter identified as a main jet nozzle **14***a* and a disposable jet nozzle **14***b*.

In the operation of a turbine jet engine having an afterburner, it is generally operated with the after-burner ineffective until the plane powered with said engine has attained a predetermined altitude, at which time the disposable jet nozzle is detached and allowed to fall free and said after-burner is turned "on."

Both said jet nozzles are provided with cable anchoring means such as posts or hooks about which a flexible steel cable **15** may be laced to detachably secure the disposable jet nozzle to said main jet nozzle. More particularly, the disposable jet nozzle is provided with a plurality of annularly spaced posts **20**, the said nozzle having an inwardly tapered portion terminating in an outlet having an area less than the outlet area of the main jet nozzle. Said main jet nozzle is provided with an external rib or annular abutment **21** against which the outwardly tapered flange **22** at the inlet end of said disposable jet nozzle is engaged.

The flexible steel cable **15** is laced around the posts **20** and the anchoring means, such as the hook **26** carried by the main jet nozzle. At least one and preferably some of the hooks **26** are adjustably mounted and comprise a cable slack take-up device **25** for tightening the laced cable and tightly holding the flange **22** against the annular abutment **21**.

Preferably disposed intermediate a couple of the cable anchoring devices on said main jet nozzle is a cable, severing device **31**, said device having an explosive charge device **32** for actuating the cutter to sever the taut wire cable. On severing the cable the disposable jet nozzle is released from attachment to said main jet nozzle and falls off, permitting the continued operation of the turbine jet with an operating afterburner, the larger area jet effecting continued operation at optimum efficiency, with no detrimental back pressure and no compressor surge.

Although I have described only one preferred embodiment of the invention, it will be apparent to one skilled in the art to which the invention pertains that various changes and modifications may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A nozzle structure for use in a jet engine having a turbine and an afterburner positioned downstream from said turbine, said nozzle structure comprising

(*a*) a main jet nozzle structure having an outlet of a predetermined area designed for the most efficient operation of said engine during operation of said afterburner,

(*b*) a disposable jet nozzle having an outlet of a predetermined area designed for the most efficient operation of said engine without operation of said afterburner,

(*c*) means for detachably securing said disposable jet nozzle to said main jet nozzle, said means comprising a flexible steel cable laced between said main jet nozzle and said disposable jet nozzle,

(*d*) means selectively operable to detach said disposable jet nozzle from said main jet nozzle, said means comprising an anvil wire cutter operable to sever said cable, and

(*e*) a cable slack take up device carried by said main jet nozzle and being operable to engage said cable and to tighten the laced cable to securely attach said disposable nozzle to said main jet nozzle.

2. In a jet engine having a turbine and an afterburner positioned downstream of said turbine, a nozzle structure comprising

(*a*) a main jet nozzle having an outlet and being positioned downstream of said afterburner,

(*b*) a disposable jet nozzle having an outlet with a cross sectional area less than the cross sectional area of the outlet of said main jet nozzle,

(*c*) a flexible cable laced between said nozzles and detachably securing said disposable jet nozzle to said main jet nozzle whereby exhaust gases from

said engine will be directed through the outlet of said disposable jet nozzle,

(*d*) means for selectively severing said cable to detach said disposable jet nozzle from said main jet nozzle whereby the cross sectional area of said nozzle structure can be increased for operation of said engine with operation of said afterburner, and

(*e*) a cable slack take up device carried by said main jet nozzle and being operable to engage said cable and to tighten the laced cable to securely attach said disposable nozzle to said main jet nozzle.

3. The nozzle structure as defined in claim 2 and in which said severing means comprises an anvil cutter and an explosive charge for actuating said cutter.

4. In a jet engine having a turbine and an afterburner positioned downstream of said turbine, a nozzle structure comprising

(*a*) a main jet nozzle positioned downstream of said afterburner and having an outlet,

(*b*) a disposable jet nozzle having an outlet with a cross sectional area smaller than the cross sectional outlet of said main jet nozzle,

(*c*) said main jet nozzle comprising a housing structure having an external annular rib,

(*d*) said disposable jet nozzle comprising a housing structure having an inlet end fitting over said housing structure of said main jet nozzle and engaging said rib,

(*e*) a plurality of annularly spaced posts being provided on said housing structure of said disposable jet nozzle,

(*f*) a plurality of anchoring means carried by said main jet nozzle, each of said anchoring means being positioned intermediate a pair of adjacent posts,

(*g*) a cable encompassing said housing structures and being laced alternately between said posts and said anchoring means whereby said disposable jet nozzle is secured to said anchoring means, and

(*h*) means selectively operable to sever said cable whereby said disposable jet nozzle may be detached from said main jet nozzle.

5. The nozzle structure as defined in claim 4 and in which said cable severing means comprises

(*a*) an anvil cutter carried in a position to engage said cable, and

(*b*) an explosive charge for actuating said cutter.

6. The nozzle structure as defined in claim 5 and in which at least one of said anchoring means comprises a cable slack take up device operable to tighten the laced cable to securely attach said disposable jet nozzle to said main jet nozzle.

7. The nozzle structure as defined in claim 1, wherein a plurality of cable anchoring means are carried respectively by said jet nozzles in staggered relation, and in which at least one of said anchoring means carried by said main jet nozzle comprises a cable slack-take-up device.

8. The nozzle structure as defined in claim 7 wherein said main jet nozzle is provided with an annular abutment and said disposable jet nozzle has a flange portion tightly engaged with said abutment by said taut laced cable and securely attached thereto.

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