

Jan. 28, 1958

J. SMURIK

2,821,350

JET AIRPLANE CONSTRUCTION

Filed June 11, 1953

3 Sheets-Sheet 1

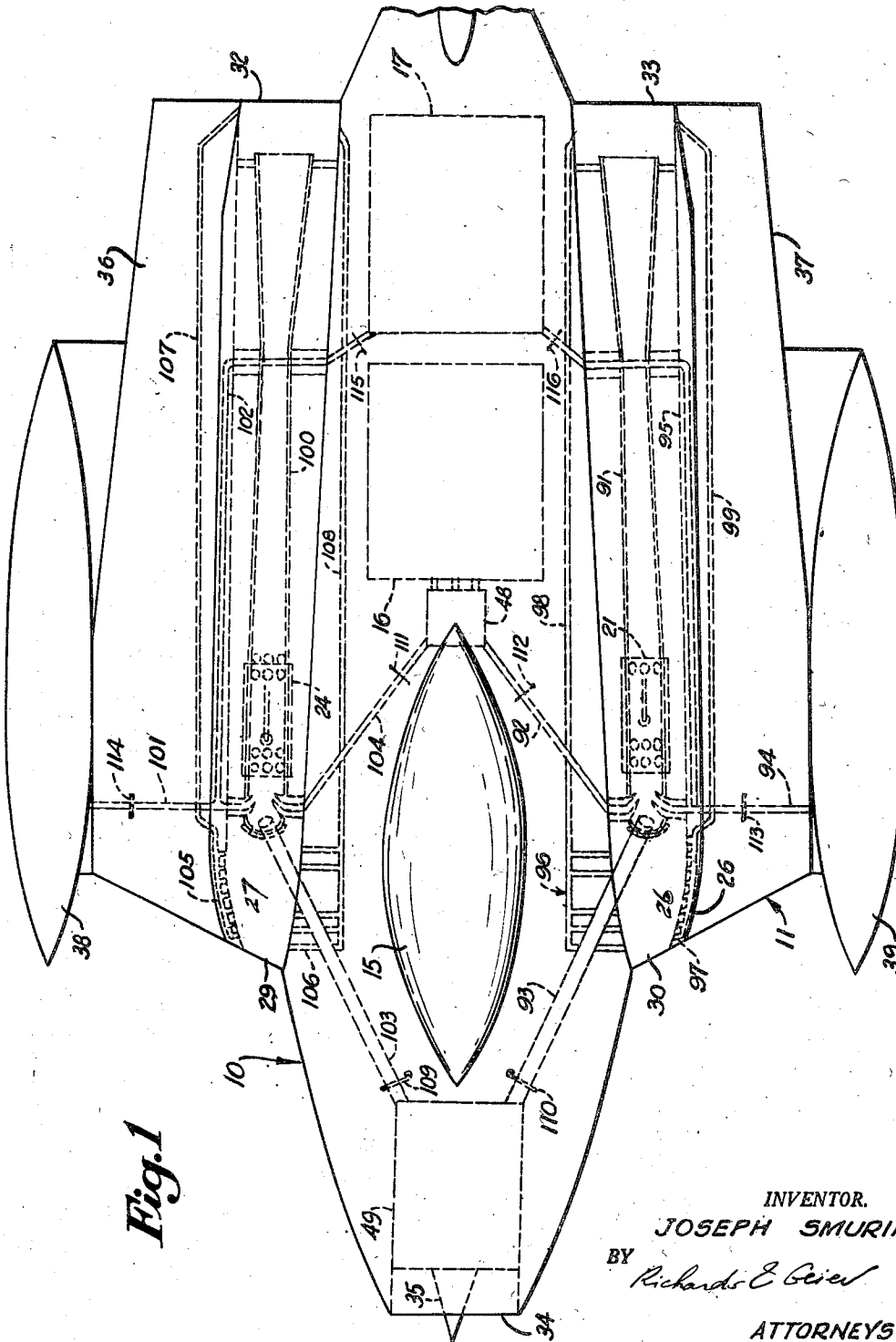


Fig. 1

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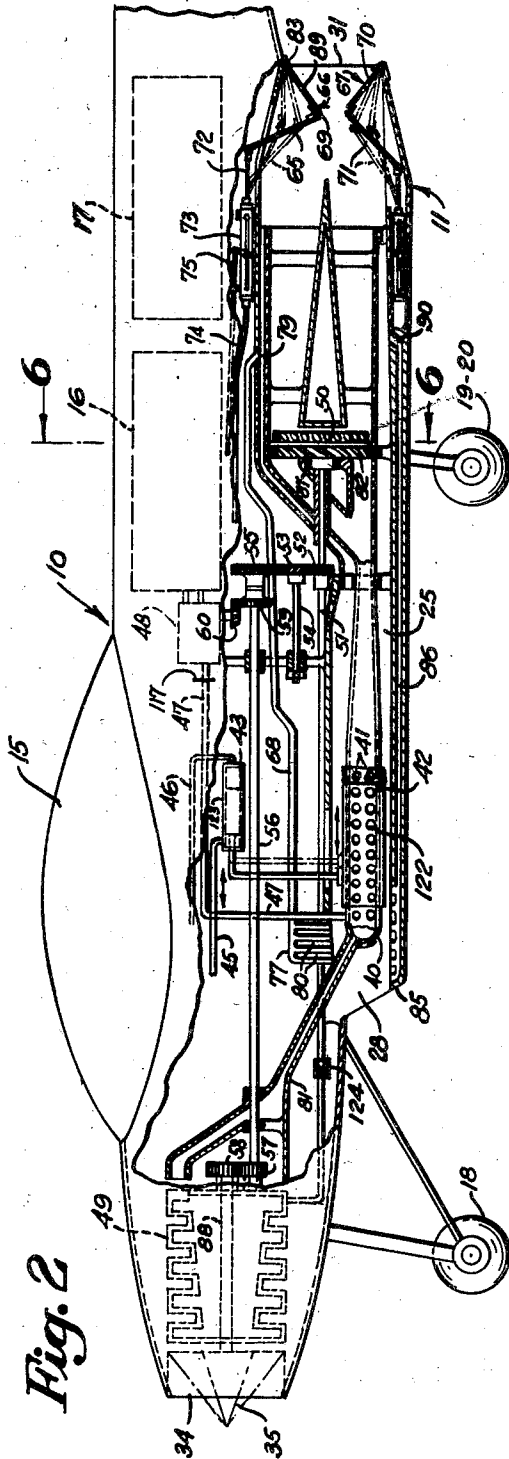


Fig. 4

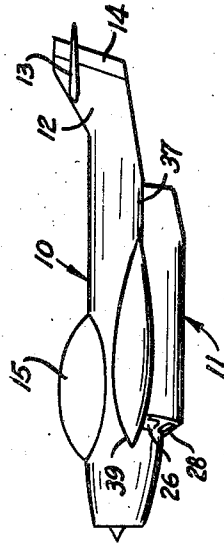
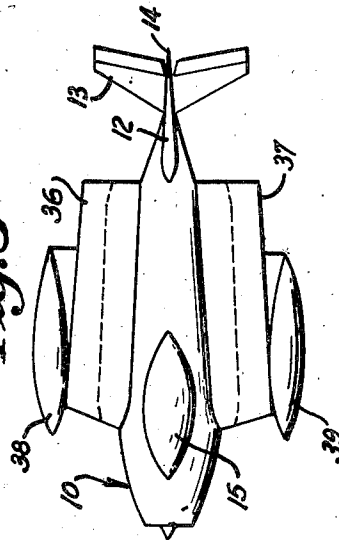


Fig. 3



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3 Sheets-Sheet 3

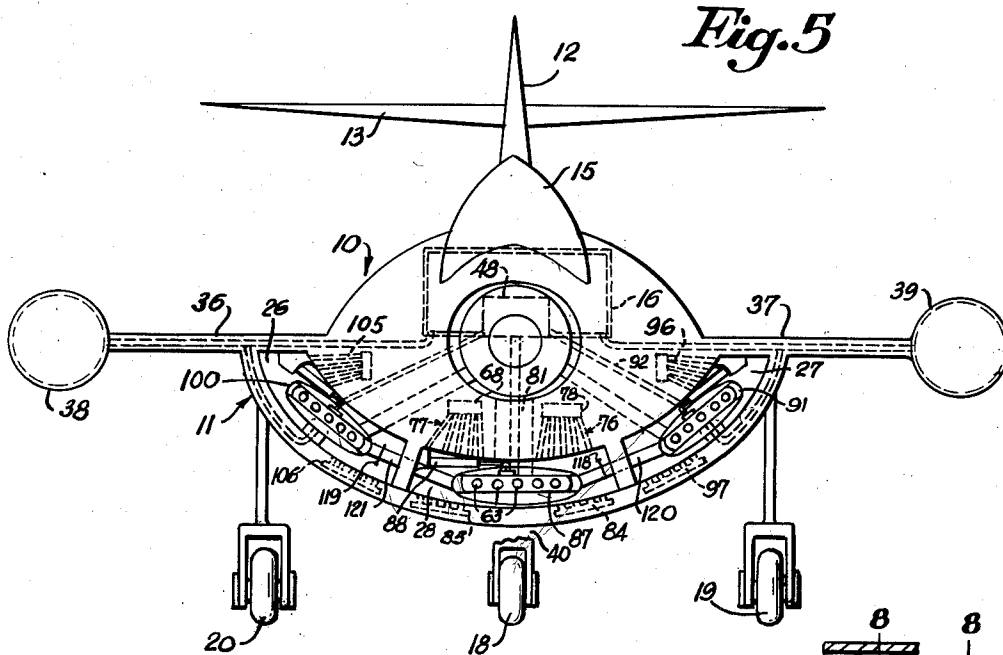
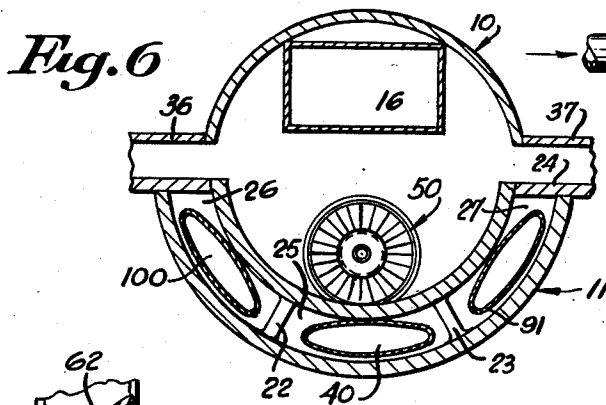
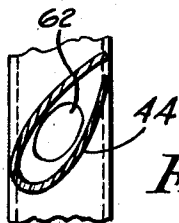


Fig. 8

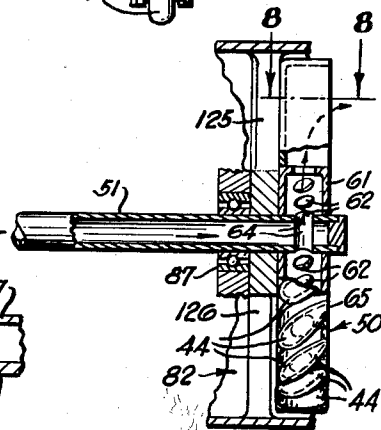


Fig. 7

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JET AIRPLANE CONSTRUCTION

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2 Claims. (Cl. 244—15)

This invention relates to improvements in airplane construction and, more particularly, to improvements in jet airplane construction.

Jet airplanes may be classified as turbojets or ramjets, the distinction being that in turbojets a mechanical compressor is used, while in ramjets there is no mechanical compressor. Turbojets are limited by the temperature capable of being withstood by the blades of the turbine operating the mechanical compressor. While known ramjets without a compressor and a turbine for driving the compressor are not so limited, it is necessary to place known ramjets in motion by another source of power. When ramjets are equipped with the entire propellant for operation, they may be designated as rockets. However, the consumption of propellant in known rockets is so great that the duration of flight is greatly limited.

It is an object of the instant invention to disclose jet airplane construction in which many of the advantages of the turbojet, ramjet, and rocket types of construction have been so combined that the airplane can be started in flight as a turbojet and then converted into a ramjet, and finally into a rocket.

A further object is to disclose jet airplane construction in which a portion of the lifting surface is channeled around the bottom and the sides of the body to overcome the tendency of the wings of known jet airplanes to buckle and break at transonic speeds.

Another object is to disclose jet airplane construction in which the quantity of air supplied to the burner can be regulated.

An additional object is to disclose jet airplane construction in which the magnitude of the exhaust nozzle of any burner can be varied.

It is also an object of the instant invention to disclose jet airplane construction in which the turbulence of the surface adhering air currents of the air supplied to the burners is substantially removed.

Still another object is to disclose a means for cooling the turbine driving the compressor used in turbojet construction.

Additional objects, including the location of the center of gravity under the pilot, will become apparent in the course of the following specification.

In the attainment of the aforesaid objectives, subject jet airplane is constituted of an elongated body having outwardly directed fins on each side. Depending from the fins is an arcuate member in spaced relationship with the bottom and contiguous side surface portions of the body. The space between the arcuate member and the body is longitudinally divided into a central channel and a side channel on each side of the central channel. The central channel has at the front a lower central air intake and at the back a central exhaust nozzle in which mechanism is provided for varying the magnitude thereof. Each side channel has an air intake at the front and an exhaust nozzle at the back. In the central channel is a central burner and in each side channel a side burner, each burner being in spaced relationship with the channel

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to provide an air passageway therebetween. Each burner is interconnected with a fuel supply and the side burners are also interconnected with an oxygen supply. Each burner further has two sets of air inlets formed therein for the admission of air to support combustion and is further equipped with means for varying the magnitude of the air inlets. In the nose of the body and above the lower central air intake is an upper central air intake and adjacent the intake is a compressor, the outlet of which is interconnected with each of the burners at the front. A turbine operated by the exhaust of the central burner actuates the compressor. The blades of the turbine are air cooled and the sides of the channels are so designed at the front that the turbulence of the surface adhering air along the inner surface of each channel is removed in order to furnish a highly desirable steady air volume to the burners. Part of the exhaust of the central burner can be diverted to the side burners as an aid in the firing thereof. Subject jet airplane is started in motion as a turbojet using the central burner which is fired by the known starter motor, ignition system, and igniter plugs. As the speed of the airplane increases, the fuel lines to the side burners are opened and part of the exhaust from the central burner diverted into the side burners which fire for the operation of the airplane as a turbojet on all three burners or as a combined turbojet and ramjet when the compressed air to the side burners is cut off or as a combined turbojet and ramjet when the compressed air to the central burner is cut off or as a ramjet when the compressed air to all three burners is cut off. As the oxygen in the air becomes thin, the central burner is shut down and the pipe lines from the oxygen supply to the side burners opened for rocket operation. By spacing the burners from the channels, selecting the contour of the burners to give the maximum cooling surface relative to the volume of air passing between each burner and channel, and providing air cooled blades for the turbine, the operating temperature of the burners has been substantially increased over known burners.

The invention will appear more clearly from the following detailed description when taken in conjunction with the accompanying drawings showing by way of example a preferred embodiment of the inventive concept.

In the drawings:

Figure 1 is a fragmentary plan view of the improved jet airplane constructed in accordance with the principles of this invention;

Figure 2 is a side view of the airplane shown in Figure 1 in part section to more clearly show the internal construction;

Figure 3 is a plan view of the airplane shown in Figure 1 but on a reduced scale;

Figure 4 is a side view of the improved airplane shown in Figure 3 with the wheels removed;

Figure 5 is a front view of the airplane shown in Figure 1;

Figure 6 is a sectional view along 6—6 of Figure 2;

Figure 7 is an enlarged fragmentary view of the turbine shown in Figure 2 in part section; and

Figure 8 is a sectional view along 8—8 of Figure 7, enlarged.

Referring now in greater detail to the drawings where like reference numerals indicate like parts, reference numeral 10 indicates the body of the airplane, and 11 the upwardly directed arcuate portion of the lifting surface in spaced relationship with the body.

The body 10 is an elongated structure having at the back the usual vertical stabilizer 12 (Figs. 3, 4 and 5), the horizontal stabilizer 13, and the rudder 14 operably secured at the back of the vertical stabilizer. On each side of the body and intermediate the ends thereof are

the outwardly directed fins 36 and 37. A cockpit 15 is situated adjacent the front of the body. In rearwardly spaced arrangement with the cockpit 15 is a fuel tank 16, and in rearwardly spaced arrangement with the fuel tank 16 is the main oxygen supply tank 17 (Fig. 1). A front wheel 18 (Figs. 2 and 5), a rear wheel 19, and another rear wheel 20 on the side opposite the rear wheel 19 are rotatably secured to the bottom of the airplane in the usual manner. It will be noted that with the fins 36 and 37 only protruding from the sides of the body the use of subject airplane along highways in the manner of an automobile is quite feasible.

The upwardly directed arcuate portion 11 of the lifting surface on both sides of the body 10 is secured to the bottom surfaces of the fins in spaced arrangement with the bottom and the contiguous side surface portions of the body 10 (Fig. 6) and intermediate the front and the back thereof. Fastened to the outer edges of the fins 36 and 37 are the auxiliary oxygen supply tanks 38 and 39, respectively.

Further maintaining the arcuate portion 11 of the lifting surface in spaced arrangement with the body and under the fins, are the longitudinally spaced projections 22 and 23 (Fig. 6) which may be integrally formed with or otherwise secured to the body and with the arcuate portion of the lifting surface fastened in a known manner to the outer edges of the projections. By virtue of such construction there is formed between the body and the arcuate member a longitudinally directed central channel 25 (Fig. 1), and the side channels 26 and 27 on opposite sides of the central channel. Each channel is open at the front, the open front of the central channel being designated as the lower central air intake 28 (Fig. 5), and the open fronts of the side channels being designated as the side air intakes 29 and 30 (Fig. 1). Each channel is further open at the back to provide the central exhaust nozzle 31 (Fig. 2) for the central channel and the side exhaust nozzles 32 and 33 (Fig. 1) for each side channel.

An upper central air intake 34 (Figs. 1 and 2) is made in the nose of the body 10 with the opening and the closing thereof controlled by the known shutter 35 shown in the closed position by the dot-dash lines (Fig. 2) and in the open position by the full lines.

In spaced arrangement with the inner surface of the central channel 25 is the central burner 40 (Figs. 2, 5, and 6). The burner 40 is preferably of arcuate cross section other than circular since for a given area a circle will have a minimum perimeter and an arcuate surface of maximum cross section will usually provide a surface having the greatest heat transfer area. In the sides of the central burner 40 adjacent the front are the spaced air inlets 41 (Fig. 2) for the introduction of air therein. Slidably inserted over the burner and designed to vary the magnitude of the air inlets 41 is a sleeve 42 with the air inlets 122 thereof coacting with the air inlets in the burner. The sleeve is reciprocated in a known manner by a piston 123 in a cylinder 43 which may be interconnected with the later described compressor 49 or with an independent compressed air source as desired. Valves, not shown, but of well known type can be inserted in the pipe lines 45 and 46 from the compressed air source for the reciprocable manipulation of the piston. A pipe line 47 from the fuel pump 48, interconnected with the fuel tank 16, is used to introduce fuel into the central burner. Obviously, similar sleeves can be used with the later described side burners 91 and 100 as later shown.

Forwardly of the central exhaust nozzle 31 of the central burner 40 is the rotor 50 of the turbine coacting with the well known stator or turbine nozzle diaphragm 82. The rotor 50 is keyed to a hollow shaft 51 which is rotatably passed through the axis of the stationary stator, the shaft being rotatably supported forwardly thereof by any suitable bearing 87. The hollow shaft 51 is extended forwardly of the bearing 87 toward the com-

pressor 49 with which it is interconnected for the introduction of air from the compressor through the hollow shaft. Adjacent the compressor and on the side thereof, the hollow shaft may be stationary while a known swivel joint 124 interconnects the rotatable portion of the shaft 51 with the stationary portion thereof. A gear 52 keyed to the shaft 51 engages a gear 53 keyed to a rotatably supported shaft 54. The gear 53 engages a gear 55 keyed to the shaft 56 which is rotatably mounted by any suitable means and extended forwardly toward the compressor 49 for the driving thereof by the engagement of the gear 57, keyed to the shaft 56, with the gear 58 keyed to the drive shaft 88 of the compressor. The shaft 56 may also have keyed thereto a gear 59 in engagement with a gear 60 which drives the fuel pump 48. In addition, the shaft 56 may be used for driving other auxiliary equipment not shown in the drawings.

The blades 44 (Figs. 7 and 8) of the rotor 50 are hollow formed in spaced circumferential arrangement around the rim of a hollow disc 61 which is, in turn, fixed to the shaft 51. Spaced openings 62 in the rim of the hollow disc form a passageway between each hollow blade 44 and the interior of the hollow shaft 51 through the openings 62 and 64. The end of each blade on the side of the exhaust nozzle 31 is open, as shown in Fig. 8, and communicates with the interior of the burner forwardly of the nozzle, so that air at a relatively low temperature from the compressor 49 is forced through the hollow blades 44 to maintain the temperature thereof at a lower point than heretofore possible. The products of combustion of the burner are directed by the blades 125 and 126 of the known stator 82 against the hollow blades of the rotor at a high temperature and at the angle of maximum efficiency, but the use of the air cooled blades permits the operation of the burner at a higher temperature than heretofore considered possible. Obviously, the rotor is operable without the known stator.

When the airplane is started in flight, the magnitude of the central exhaust nozzle 31 (Fig. 2) needs to be at a minimum, while in full flight a wide open nozzle is preferable. To vary the magnitude of the nozzle 31, there is provided an upper closure 66 (Fig. 2) coacting with a lower closure 67. The nozzle 31 may be of rectangular cross section and the closures 66 and 67 of coacting shape but in any event of any shape that will substantially vary the magnitude of a nozzle of similar shape. The upper closure 66 is constituted of the outer member 89 and the inner member 65. The outer edge of a side of the outer member 89, the side being equal to the width of the nozzle, is hingedly secured to the top of the nozzle by any suitable means 83 and the outer edge of the side of the inner member 65 is hingedly secured to the edge of the inner side of the outer member 89 by any known means 69. Any suitable means (not shown) may be used for preventing the products of combustion from entering the body of the airplane when the magnitude of the nozzle is restricted. For example, a shell could be placed around the outer surface of the nozzle with the later described piston rod for operating each closure slidably inserted through the shell. The lower closure 67 is likewise constituted of the outer member 70 and the inner member 71 hingedly secured to each other and to the bottom edge of the nozzle. The outer edges of the upper and lower closures, of course, are substantially aligned. In the operation of the closures, the inwardly directed hinged movement of the upper closure 66 is controlled by pivotally securing the outer end of the piston rod 72 to the inner member 65, as shown in Figure 2. The piston rod 72 is reciprocable in a cylinder 73 which is designed in a well known manner, so that compressed air from a pipe line 74 can be introduced into the cylinder on opposite sides of the piston and exhausted therefrom at the will of the operator by the manipulation of the lever 75. The lower closure 67 is operated

in a similar manner and both may be interconnected to operate simultaneously. Since only the central burner is used in starting the airplane, no similar closures are proposed for the side nozzles 32 and 33 but could be used.

A steady or non-turbulent air stream for the support of combustion in each burner is desirable. To remove the undesirable turbulence caused by the friction of the surface of the air, entering the lower central air intake 28, against the inner surface of the channel, there is provided at the top of the channel and adjacent the front of the central burner 40, the boundary layer controls 76 and 77 (Figs. 2 and 5) each of which is formed with the spaced tubes 80 (Fig. 2), as illustrated, one end of each tube being flush with the surface of the channel and the opposite end interconnected with a duct 78 or 68 leading toward the central exhaust nozzle 31 and reconnected with the central burner 25 at the point 79 (Fig. 2) forwardly of the nozzle in the case of the duct 68. The exhaust of the burner will draw by venturi action the turbulent surface adhering air through the spaced tubes 80 of the boundary layer controls 76 and 77 to leave a non-turbulent stream of air for introduction into the burner through the air inlets 122 and 63. Similar boundary layer controls 84 and 85 are placed at the bottom of the central channel, the boundary layer control 85 interconnecting with a duct 86 (Fig. 2) leading toward the rear of the burner and interconnected therewith at the point 90. The boundary layer control 84 is likewise interconnected with the central exhaust burner.

In the side channel 26 (Fig. 1) is the spaced side burner 91. Like the previously described central burner 40, the side burner 91 has formed therethrough adjacent the front a plurality of spaced air inlets for the introduction of air flowing into the side air intake 30 (Fig. 1). A sleeve 21 similar in all respects to the previously described sleeve 42 of the central burner and operated in the same manner is provided for varying the magnitude of the spaced air inlets adjacent the front of the side burner 91. A fuel line 92 (Fig. 1) from the fuel pump 48 conducts fuel from the fuel tank 16 to the side burner 91 while a duct 93 connects the outlet of the compressor 49 into the front of the burner 91. Another pipe line 94 conducts oxygen from the auxiliary tank 39, while a pipe line 95 conducts oxygen from the main oxygen tank 17 to interconnect with the previously mentioned pipe line 94. The boundary layer controls 96 and 97 (Fig. 1) similar to the previously described boundary layer controls of the central channel 25, remove the turbulent surface adhering air through the pipe lines 98 and 99, respectively.

In the side channel 27 (Fig. 1) is the spaced side burner 100 similar in all respects to the previously described side burner 91. A pipe line 101 conducts oxygen from the auxiliary tank 38 to the side burner 100. Another pipe line 102 conducts oxygen from the main oxygen tank 17 to interconnect with the pipe line 101. A duct 103 interconnects the compressor 49 with the side burner 100 and a pipe line 104 interconnects the fuel pump 48 with the side burner. The boundary layer controls 105 and 106, interconnected by the pipe lines 107 and 108 (Fig. 1), respectively, conduct the turbulent surface adhering air from the air stream to the rear of the side burner 100, as illustrated, and in the same manner as the boundary layer controls of the other channels previously described. Of course, the side burner 100, like the central burner, and the side burner 91 is provided with a sleeve 24 for varying the magnitude of the air inlets adjacent the front of the burner, the sleeve being operated in the same manner as the sleeve of the central burner described ante. Sleeves are, of course, necessary when the side burners are being operated as rockets or only on air from the compressor.

As thus far described and illustrated, there is a tendency

for the air stream entering each of the burners through the openings adjacent the front to leave a vacuum in the extreme front of the burner. To overcome such contingency, there is formed through the front end extremity of the central burner 40 a plurality of spaced front openings 63 (Fig. 5) and over which is slidably attached a shutter 87 which is provided with openings designed to be aligned with or moved out of alignment with the front openings in the burner when reciprocally moved by a piston 88. Similar front openings, a shutter, and a piston are provided for each side burner as illustrated in Figure 5.

In operation:

Subject jet airplane is started with the usual starter motor (not shown) and with the valves 109, 110, 111, 112, 113, 114, 115, and 116 (Fig. 1) and 118 and 119 (Fig. 5) in the closed position and the valve 117 (Fig. 2) in the open position. The sleeve 42 is preferably moved to the open position, that is, with the air inlets in the sleeve substantially aligned with the air inlets 41 and the shutter 87 moved to the open position of the front openings in the burner, to allow the maximum admittance of air, since the compressor is idle and there is no forced volume of air through the lower central air intake 28. When the central burner fires, the products of combustion will be directed by the blades of the stator 82 against the hollow blades 44 for the rotation of the rotor 50 which will turn the hollow shaft 51 and through the previously described gear train and shafts the compressor 49. Air from the compressor through the hollow shaft 51 will tend to maintain the blades of the rotor at a reasonably low temperature. At the start, the upper and lower closures 66 and 67 are moved to the solid line position shown in Figure 2 to reduce the magnitude of the central exhaust nozzle 31. The exhaust forces the airplane forward and the sleeve 42 and shutter 87 may be moved to restrict the magnitude of the air inlets for the desired mixture of air in the support of combustion. The upper and lower closures 66 and 67 may also be moved to the dot-dash position shown in Figure 2 to increase the magnitude of the central exhaust nozzle as the speed of the airplane increases. As thus far described and illustrated, subject airplane is operating as a turbojet on the central burner. By opening the valves 118 and 119 (Fig. 5), controlling the opening and closing of the ducts 120 and 121, respectively, which interconnect the central burner with the side burners some of the products of combustion of the central burner are diverted into the side burners so that when the valves 111 and 112 (Fig. 1) of the fuel lines 104 and 92, respectively, are opened, as well as the valves 109 and 110 in the ducts 103 and 93, respectively, from the compressor 49, the airplane will operate as a turbojet using all three burners. By closing the valves 109 and 110, the side burners will operate as ramjets while the central burner will operate as a turbojet. By closing the valve 117 (Fig. 2) to cut off the fuel supply to the central burner, the airplane will operate as a ramjet on the side burners. As the oxygen in the air becomes thin, the valves 115 and 116 and/or 114 and 113, controlling the oxygen supply in the main oxygen tank 17 and the auxiliary oxygen tanks 38 and 39, are opened and the airplane will operate as a rocket using the side burners only. It will be noted that subject jet airplane is designed to give desirable aerodynamic configuration, that is, the pilot is located substantially above the point of the center of gravity of the airplane. Such result is attained by placing the compressor 49 in front of the pilot and the turbine in back of the pilot. Hence, when maneuvering, the pilot is located substantially at the pivot position of the airplane and experiences no violent gyrations as occurs in known jet airplanes.

While there are above disclosed but a limited number of embodiments of the structure herein presented, it is

possible to produce still other embodiments without departing from the inventive concept herein disclosed.

What is claimed is:

1. A jet airplane comprising an elongated body, an outwardly directed fin disposed on each side of the body substantially for the length thereof, an arcuate member in spaced relationship with the bottom and contiguous side surface portions of the body depending from the fins, means for longitudinally dividing the space intermediate the body and the arcuate member into a central channel and a side channel on each side of the central channel, a burner for each channel in spaced relationship therewith, and means for conducting products of combustion of the central burner to each side burner whereby the temperature is raised to facilitate starting the side burners.

2. A jet airplane according to claim 1 in which each burner is in spaced relationship with the inner surface of its channel and extends substantially for the length of said channel whereby a stream of cool air substantially surrounds the outer surface of the burner.

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