CROSS REFERENCE SEARCH ROOM

Oct. 17, 1961 J. E. RADFORD 3,004,734

HYDRAULIC POWER SUPPLY

Filed Feb. 27, 1959

3 Sheets-Sheet 1

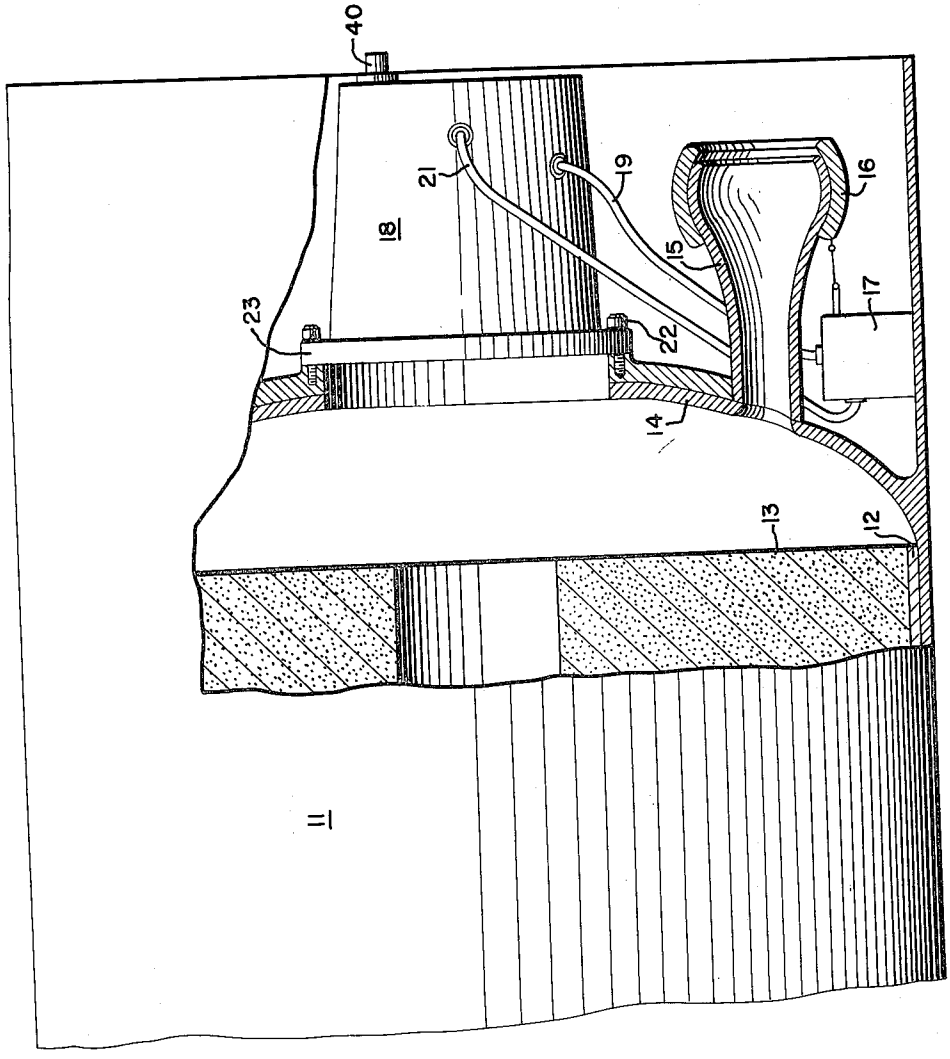


FIG. 1.

INVENTOR.
JAMES E. RADFORD

BY Baxter Warner & Hodges
ATTORNEYS.

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FIG.3.

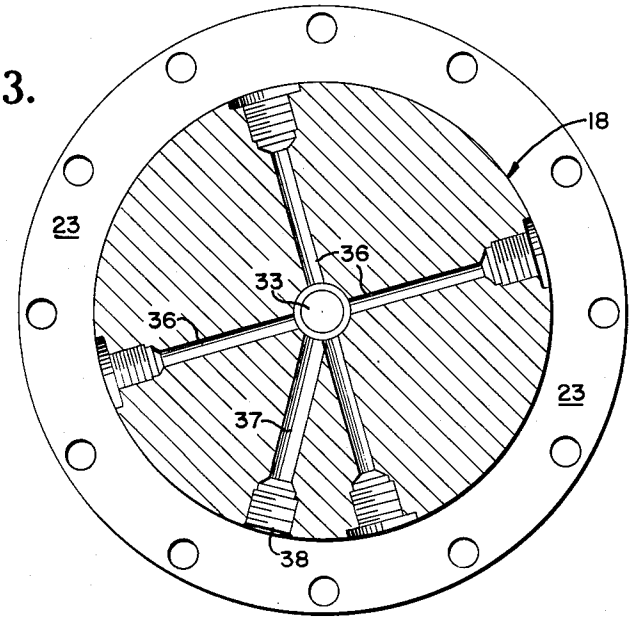
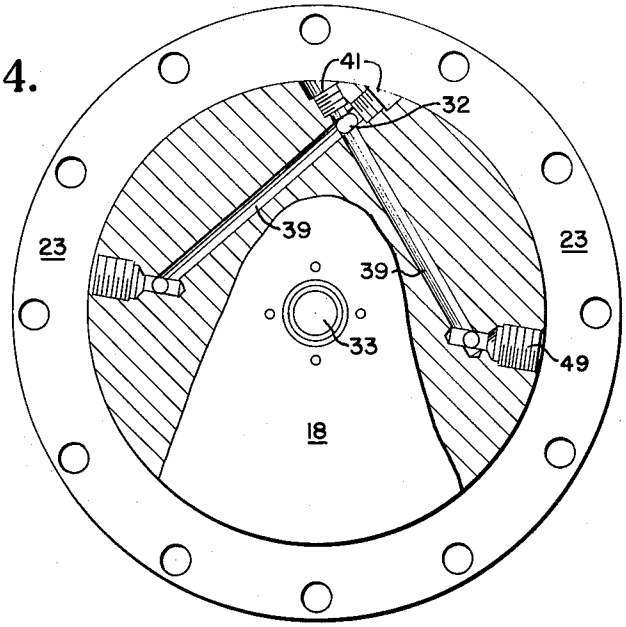


FIG.4.



INVENTOR.
JAMES E. RADFORD

BY Q. Baxter Warner
O. Hodges
ATTORNEYS.

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HYDRAULIC POWER SUPPLY

James E. Radford, Silver Spring, Md., assignor to the United States of America as represented by the Secretary of the Navy

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2 Claims. (Cl. 244—14)
(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 is concerned with an hydraulic power supply and is more particularly concerned with a new and improved power supply for operating the hydraulically controlled actuators in a missile or rocket or the like.

It is common practice in the missile art to steer a guided missile by means of thrust vectoring or by aerodynamic controls. In the latter case, the missile is usually steered by fins which are depressed or elevated in a certain manner to stabilize the missile in roll, pitch and azimuth. Thrust vectoring is accomplished by means of vanes disposed in the stream of propulsive gases discharged from the rocket motor, by swivel nozzles, or by jetavators. Generally, the fins, vanes, jetavators or swivel nozzles are powered by an hydraulic actuator or a D.C. motor which operates in response to input signals generated by the guidance section of the missile. In the past, it has been the practice to power the electric motors by hydraulic powered alternators, and to power the alternators by means of high pressure fluid. Both of these systems require an auxiliary hydraulic power unit for generating the necessary high pressure fluid. In the past, this has been accomplished by a motor-pump arrangement wherein the motor is powered by an electrical power supply or by a turbine-pump arrangement powered by high energy gases such for example as those generated by a cartridge containing a propellant.

Both of these systems add to the complexity of an already complex missile and tend to slightly decrease reliability since there is always a danger of malfunctioning of the turbine or the motor which drives the pump.

It is therefore an object of this invention to provide a new and improved auxiliary power supply for a rocket propelled vehicle which power supply derives its energy from the main propulsive gases of the rocket motor.

It is another object of this invention to provide a simple efficient and rugged hydraulic power supply suitable for use in a rocket or missile.

These and many other objects will become more readily apparent to those skilled in the art when the following specification is read and considered along with the attendant drawings wherein like numerals designate like or similar parts throughout the various views and in which:

FIG. 1 is a simplified drawing of the rearward portion of a missile having a hydraulic power supply embodying the principles of this invention;

FIG. 2 is a horizontal section of the hydraulic power supply of this invention;

FIG. 3 is a section taken along line 3—3 of FIG. 2; and

FIG. 4 is a section taken along line 4—4 of FIG. 2.

Referring now with greater particularity to FIG. 1 wherein the hydraulic power supply embodying principles of this invention is shown in a typical missile having a jetavator thrust vectoring system. It is to be understood, of course, that the particular type of thrust vectoring system or aerodynamic control system is a matter of choice and forms no part of this invention per se. Disposed within the missile body 11 is a rocket liner 12 containing a solid propellant rocket motor 13 therein. An internal bulkhead 14, bowed slightly away from rocket motor 13, is formed within the missile casing 11 and contains a plurality of thrust nozzles 15 which are in communication with the rocket motor 13 for producing the necessary propulsive thrust. At the ends of each of these nozzles is a jetavator 16 operated by one of a plurality of hydraulic actuators 17. It will be noted that the bulkhead 14 has a central aperture formed therein to receive the forward portion of the housing 18 of the hydraulic power supply unit. This housing contains the hydraulic fluid which is pumped to actuators 17 via lines 19. The return flow from the actuator is discharged through line 21 as described in greater detail hereinafter.

Housing 18 is mounted to bulkhead 14 by means of a plurality of bolts 22 which pass through the mounting flange 23 formed on the housing and thread into appropriate holes in bulkhead 14. Threaded into the open end of housing 18 is a baffle plate 44 (FIG. 2) having a plurality of bleed ports 26 therein. This baffle plate may be constructed of any material such for example as 10/20 steel. However, a rather thick slab 27 of heat and corrosion insulation material is bonded to the baffle plate to prevent rapid overheating of plate or erosion thereof by the rocket motor gases which may be of a temperature up to about 5,000 F. Slab 27 may be constructed of graphite, ceramic, or heat resistant glass. It will be noted that the slab 27 also has a plurality of bleed ports 25 which are in alignment with ports 26 in baffle plate 44.

Since there is relatively little flow of gases past the outside edge of the housing 18 an O ring 28 made of conventional material such as Neoprene or Buna-N may be used to seal the housing to the bulkhead 14.

A quantity of hydraulic fluid partially fills the interior of casing 18 as indicated at 29 while a free piston 31 is disposed within the casing, normally adjacent the baffle plate 44 for actuation by the hot rocket motor gases as they bleed through ports 26 against the piston. Since the hydraulic actuator is in operation only for a very short period, it has been found unnecessary to fabricate piston 31 from special high heat resistant material; and O ring 32 like O ring 28 may be constructed of conventional rubber.

It should be noted that the piston 31 is constructed in a manner contrary to the generally accepted practice; that is, the l/d ratio is much smaller than normal design practice. This permits the use of a casing of smaller exterior size containing a rather large interior volume of fluid 29. That is to say, the low length/diameter ratio permits a proportionately large volume of fluid to be contained within a given housing. In tests, the piston did not cock or bind as it moved to the right as seen in FIG. 2 under the influence of the high pressure rocket gases. This result is contrary to what would normally be predicted.

A stepped bore 33 is formed at the end of casing 18 opposite from the baffle plate 44. Disposed within this bore is a spring loaded valve 34 having an O ring 35 sealingly disposed against the smaller diameter of bore 33 and supported by spider 24. When valve 34 is moved to the right by pressurized fluid 29, and the seal 35 clears the smaller diameter portion of bore 33, high pressure fluid is allowed to flow by this seal and into passageways 36.

Passageways 36 run radially out from a bore 33 at 90° intervals and deliver high pressure fluid to one of the servo actuators 17 shown in FIG. 1. For the sake of convenience, and simplicity these actuators are not shown in FIGS. 2–4. An auxiliary port 37 (FIG. 3) is also connected to the bore 34 and terminates in a self-sealing connector 38 which may be any available commercial type suitable for the purpose such as a "Roylyn connector." Port 37 and valve 38 make it possible to check the opera-

tion of the servo valve actuators by applying a high pressure fluid through port 37 and out channels 36 without necessitating the actuation of piston 31 by the rocket motor, thereby making it possible to test the missile control section periodically during storage. When the missile is launched, the self-sealing connector 38 prevents loss of high pressure fluid. The return flow from the servo actuator 17 is provided by ports 39; each port accommodating two actuators. As is apparent from FIG. 4, these ports are formed by drilling straight holes through the body of casing 19 and fitting one end of each of the holes with a connector 49 while the other end is plugged by suitable plugs 41. An exhaust port 32 is formed at the intersection of the ports 39 and rejects the excess and spent pressure fluid from the casing. Port 32 is sealed by a low pressure poppet valve 40 (FIG. 1) to prevent accidental loss of fluid prior to ignition of motor 12.

By thus forming the pressure delivery ports and the exhaust ports in two distinct layers as it were one above the other in the wall of casing 18, it is possible to conserve space without sacrifice of ruggedness.

It should be apparent to those skilled in the art upon reading this specification that this invention provides apparatus for powering the auxiliary power supply unit of a missile directly from the hot exhaust gases of the rocket motor while achieving simplicity of design and dependability of operation.

Having thus described this invention with reference to but a single preferred embodiment, it is to be understood that this invention may be practiced otherwise than as specifically delineated and is susceptible of many alterations and modifications without departing from the spirit and scope thereof. Accordingly, this invention is not to be construed as limited only by the terms of the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a missile having a plurality of hydraulic actuators for effecting control of the missile in flight, an hydraulic power supply comprising; a rocket motor for generating propulsive gases, an open ended casing disposed against one end of said motor to receive a portion of the propulsive gases and partially filled with hydraulic fluid, a baffle plate closing the open end of said casing, and having a plurality of bleed holes to admit a portion of the propulsive gases into the casing, heat and corrosion resistant shield means bonded to said plate to protect it from erosion by said propulsive gases, a piston slideably disposed within said casing and operated by a portion of the propulsive gases from the rocket motor to pressurize the fluid in said casing, a plurality of bores in the wall of said casing, hydraulically connected to said actuators, normally closed spring biased valve means in said bores and opened by pressurized fluid to permit pressurized fluid to flow to said hydraulic actuators when said valve is open, and channel means in the walls of said casing to receive spent hydraulic fluid from said actuators, and port means connected to said channel means for discarding spent fluid.

2. The hydraulic power supply of claim 1 further comprising; a normally closed port accessible from without the power supply to permit injections of a quantity of testing pressurized fluid thereby providing for periodic testing of said hydraulic actuators in storage without actuation of said piston.

References Cited in the file of this patent

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