

April 30, 1957

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2,790,489

MULTIPLE-TUBE PRESSURIZED TANK FOR MISSILE

Filed June 1, 1954

2 Sheets-Sheet 1

Fig. 1.

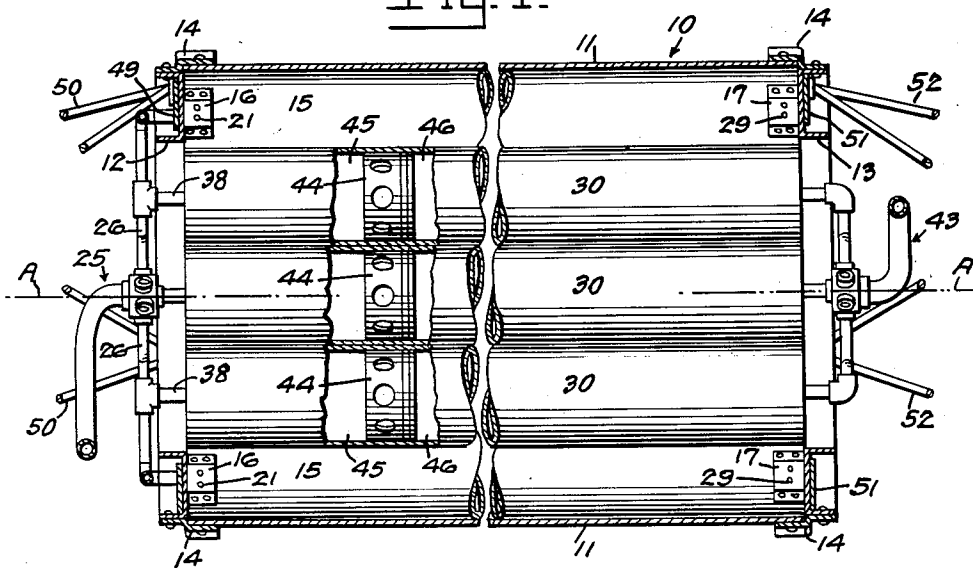


Fig. 2.

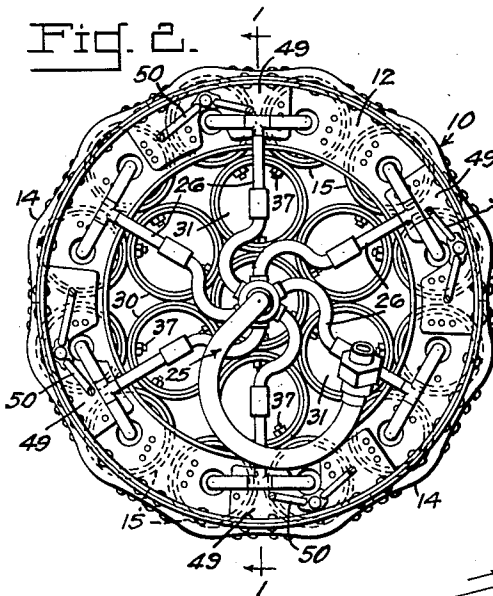


Fig. 3.

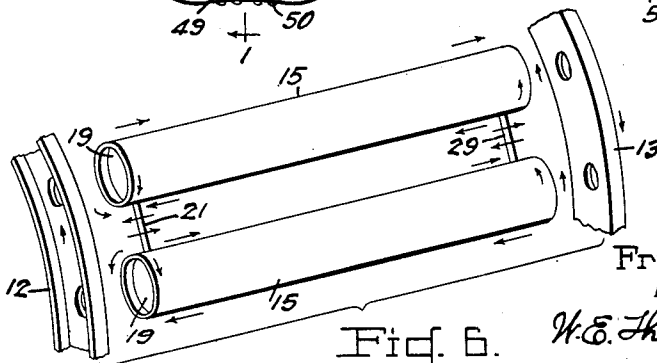
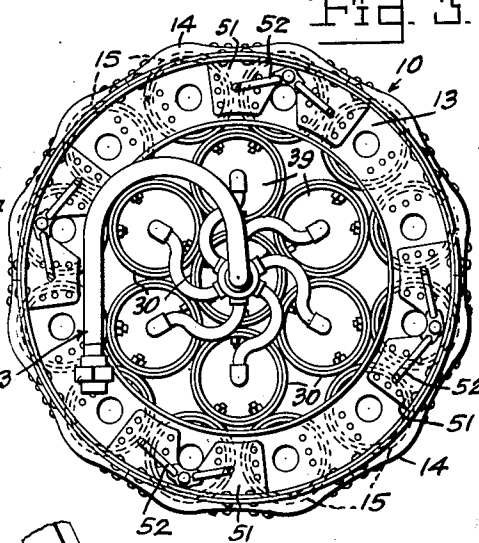


Fig. 6.

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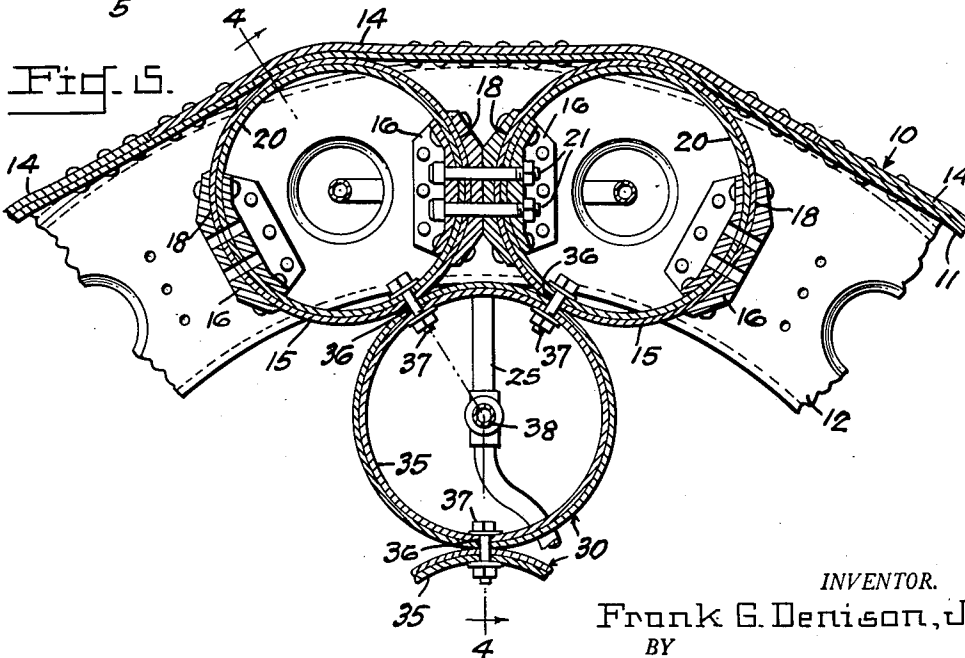
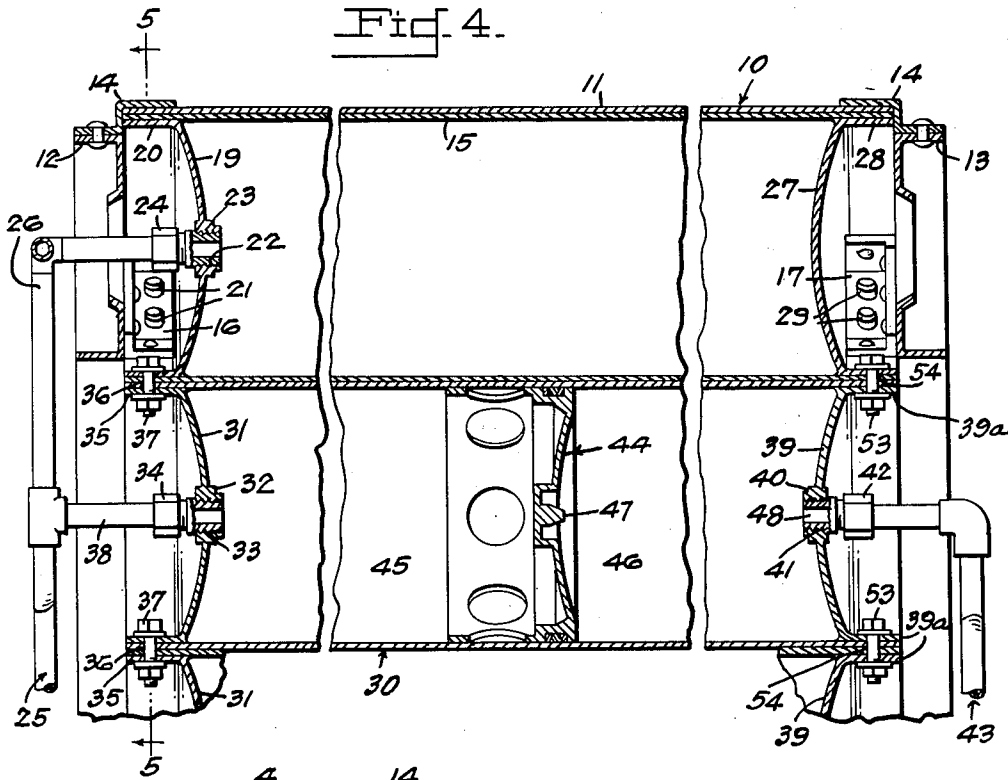
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MULTIPLE-TUBE PRESSURIZED TANK FOR MISSILE

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Application June 1, 1954, Serial No. 433,853

12 Claims. (Cl. 158—50.1)

This invention is a multiple-tube fuel storage tank for self-propelled missiles.

An object of the invention is to provide a multiple-tube storage tank for storing liquids or gas under pressure.

Another object of the invention is to provide an assembly for bearing major internal structural loads when assembled with the motor and warhead of a self-propelled missile.

Another object of the invention is to provide an assembly in which the airframe and tubes are assembled to absorb stresses imparted thereto in flight of the missile.

Other objects and advantages will be apparent from the following detailed description and the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view of the multiple-tube tank taken on the line 1—1 of Figure 2 and showing parts in elevation,

Figure 2 is an end view of the tank as viewed from the left-hand side of Figure 1,

Figure 3 is an end view of the tank as viewed from the right-hand side of Figure 1,

Figure 4 is an enlarged sectional view of parts of the tank taken on the line 4—4 of Figure 5,

Figure 5 is sectional view of the parts shown in Figure 4 taken on the line 5—5 of Figure 4, and

Figure 6 is a diagrammatic view showing the direction of transferral of loads from the mounting rings of the tubes and from one tube to another, during flight, in a self-propelled spin type missile into which the fuel tank is assembled.

In the drawings, wherein for the purpose of illustration, is shown one form of the invention, the reference character 10 indicates an airframe having a longitudinal axis A—A. The airframe comprises a cylindrical sheet metal casing 11 reinforced at its ends by rings 12 and 13. For the sake of clarity the end of airframe 10 carrying ring 12 will be called the forward end of the airframe and the end carrying ring 13 will be called the rearward end. Overlying sectional brackets 14 secure the rings 12 and 13 to the casing 11 by rivets or other suitable means.

An outer layer of tubes 15 are held in parallel relationship each with the other and with the longitudinal axis of the casing 11. The tubes 15 are securely held at their forward ends in hangers 16 and at their rearward ends in hangers 17. Each hanger has an arcuate seat 18 for receiving the forward and rearward ends, respectively, of tubes or tanks 15. Each tank is sealed at its forward end by a head 19. The heads 19 are formed with forwardly extending flanges 20 which are also received in the seats 18 of forward hangers 16 and secured therein by bolts 21. In the present application of the invention the tanks 15 will receive gas under pressure and therefore the bulkheads 19 are provided with screw threaded openings 22 formed in bosses 23 to which a screw threaded pipe coupling 24 is attached. A manifold 25, see Fig-

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conducts gas pressure to the tanks 15 from a source (not shown). Radially extending from the manifold 25 are branches 26 which serve to uniformly distribute to the tubes 15 gas pressure and uniformly deliver the gas pressure to a liquid fuel reservoir, to be later described, during flight of a self-propelled missile in which the tank is installed. When used solely as a storage tank additional valves (not shown) are installed in the branches 26 so that individual tanks may be depleted as desired. The rearward ends of tanks 15 are sealed by bulkheads 27 which also have flanges 28 held in the arcuate seats of rear hangers 17 together with the rear ends of tanks 15 and secured by bolts 29 extending through the hangers 17.

An inner bank of tubes 30, in parallel relationship and close contact with tubes 15, completely fills the area inside the outer tubes 15 and each tube 30 is sealed at its forward end by a bulkhead 31. Each bulkhead 31 is formed with a central boss 32 having a screw threaded opening 33 for screw threadedly receiving a pipe coupling 34. Formed with bulkheads 31 and extending forwardly therefrom are flanges 35. Bolt holes 36, near the forward ends of tubes 15 and 30 extend therethrough and through the flanges 20 and 35 at points of surface contact or tangency of adjacent tubes. Bolts 37 pass through the holes 36 and securely bind the forward ends of the tubes together. At their rearward ends each tube 30 is closed by a bulkhead 39 formed with a central boss 40 in which a screw threaded opening 41 is formed. Formed with the heads 39 and extending rearwardly therefrom are flanges 39a. Bolt holes 54, near the rearward ends of tubes 30 extend therethrough and through the flanges 28 and 39a at points similar to the bolt holes 36 in the forward end of the tubes. Bolts 53 pass through the holes 54 and securely bind the rearward ends of the tubes together. In fluid communication with the pipe fitting 34 and the manifold 25 are short pipe couplings 38 for admitting pressure to the inner bank of tubes 30 for a purpose to be later pointed out. A screw threaded pipe coupling 42 is secured in the boss 40 and to a branch of a manifold 43. The manifolds 25 and 43 may be of any configuration as best suited to the particular use to which the tank is put, whether for gas storage or as a fuel supply reservoir for a rocket missile. In the present illustration each tube 30 of the central bank of tubes has slidably received therein a piston 44 which will divide its interior into two discrete compartments 45 and 46 of reciprocally variable volume. In use the compartments 46 are filled with a liquid fuel through the openings 41 in bosses 40 and the pistons are thereby moved to the forward ends of tanks 30, thereafter the manifold 43 is attached. Gas pressure is applied to the tanks 15 and subsequently to the compartments 45 as the liquid fuel in compartments 46 is consumed in a motor (not shown). When the fuel in compartments 45 is exhausted and gas pressure from tubes forces pistons 44 rearwardly a tapered plug 47 formed centrally of each piston 44 will close the outlet opening 48 formed in the coupling 42 to seal the compartment 46.

Reinforcing plates 49 are rivetted to the forward ring 12 and carry truss rods 50 for securing the forward end of airframe 10 to a warhead (not shown) and a similar structure comprising reinforcing plates 51 and truss rods 52 secure the air frame to a rocket motor (not shown).

Figure 6 is an exploded fragmentary view of parts of the assembly to illustrate the direction of stresses to which the assembly is subjected as will now be discussed.

In flight, torsional stress generated outside the multi-cell tank is transferred through the mounting rings 12 and 13 and the bolts 21 and 29 to the individual tubes. The tubes absorb this stress by undergoing torsional and differ-

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sorbed by the tubes according to their individual displacement from the neutral axis of the airframe through development within individual tubes of simple compression or tension, differential bending and associated vertical shear.

In assembly and operation the pistons 44 are moved to the forward ends of tanks 30 and the compartments are filled with liquid fuel. The manifold 43 then is connected to the heads 39 by means of the pipe couplings 42, after which the free end of the manifold is connected to a rocket motor. The tubes 15 can be pressurized at any desired time before flight of the missile and the free end of the manifold 25 sealed. Gas pressure in the tubes 15 is then applied to the compartment 45 by way of the manifold 25 and the short couplings 38 through the bulkheads 31 into the forward ends of tubes 30. Any well known means for releasing the liquid fuel to the rocket motor may be employed.

It is to be understood that the form of the invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention, or the scope of the subjoined claims.

Having now fully disclosed the invention, what I claim and desire to secure by Letters Patent is:

1. In a pressure tank assembly for a self-propelled vehicle, a pair of cylindrical tanks each having an outwardly-flanged head integrally secured within an end to define circular rims, a pair of duplicate hangers each having an arcuate slot to embrace the rim of a respective tank, said hangers having generally flattened contacting surfaces, and bolts passing through aligned holes in said rims and hangers to rigidly secure said tanks in contiguous spaced parallel relation with said surfaces in contact.

2. In a pressure tank assembly, first and second cylindrical tanks each having a pair of flanged heads secured within the respective ends to form circular rims, first and second pairs of duplicate hangers each hanger having an arcuate slot receiving and embracing the rim of a respective tank, each hanger having generally parallel flat external and internal faces in planes parallel with the axis of its tanks, and a pair of bolts extending through the flat surfaces of a respective pair of hangers and the rims of the tanks embraced thereby, said bolts acting to clamp the external faces of each pair in contacting relation and to rigidly secure said tanks in spaced parallel relation.

3. In a pressure tank assembly for a self-propelled missile, a pair of cylindrical tanks having inwardly flanged heads secured within the respective ends thereof to form circular rims, first and second pairs of hangers each having an arcuate slot to receive and embrace the rim of a respective tank, and external and internal flats in respective radially spaced planes parallel with the axis of its tank, and bolts passing through aligned holes in the flats of each pair of hangers and the rims embraced thereby, whereby to rigidly unite said tanks in spaced, parallel, side by side relation.

4. An assembly as recited in claim 3, said hangers each having a generally flat attaching flange at its end exteriorly of the tanks and lying in a plane normal to the axis of the tanks, a pair of flat supporting rings, and means rigidly attaching each flange in surface-to-surface contact with a corresponding one of said rings.

5. In a pressure tank assembly for a self-propelled missile, a first plurality of cylindrical tanks each having an outwardly flanged head secured within a respective end to form therewith a circular rim, a plurality of pairs of hangers each arcuately slotted to receive the rim of a respective tank and having a generally flat exterior surface, bolts passing through aligned holes in the rims and surfaces of the respective pairs of hangers and rims to rigidly unite the tanks with the surfaces of each pair of hangers in contact whereby said tanks are united in parallel relation circumferentially about a common central axis, each

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said hanger having an attaching flange externally of the tanks, first and second flat rings overlying the corresponding ends of all said tanks, and means securing each said flange to a corresponding ring whereby all said tanks and rims are united into a rigid assembly.

6. An assembly as recited in claim 5, a second plurality of like tanks mounted within said first plurality, each of said tanks of said second plurality being in tangential contact with a pair of tanks of said first plurality, and bolt means passing through the rims of each of said tanks of said second plurality and the corresponding tanks of said first plurality at the points of tangency.

7. An assembly of storage tanks for self-propelled missiles comprising a frame having a longitudinal rotational axis, a first circumferentially disposed group of tanks within said frame each said tank being sealed at its forward and rearward ends, means securing said tanks to said frame and to each other in parallel relationship to each other and to the longitudinal axis of said frame to resist relative displacement due to torsional and axial stresses in the assembly during flight of the missile, a second group of tanks positioned centrally of said frame and said first group of tanks in parallel relationship with each other and with said first group of tanks each said tank being sealed at its forward and rearward ends, means securing all of said tanks to each other and to said first group of tanks at contiguous points to distribute and absorb said stresses, inlet manifold means connected to the forward ends of all of said tanks for admitting fluid under pressure, and outlet manifold means connected to the rearward ends of said second group of tanks.

8. An assembly of storage tanks for self-propelled missiles comprising a frame, a first group of tanks within said frame, first and second reinforcing means secured to said frame at opposite ends thereof, pin and bracket means carried by said first and second reinforcing means to secure said group of tanks thereto and to each other to resist relative displacement due to torsional and axial stresses during flight of the missile, a second group of tanks positioned adjacent and in parallel relationship to said first group of tanks, and pin means connecting said first and second groups of tanks at contiguous points on their outer surfaces to distribute and absorb said stresses.

9. An assembly of storage tanks for self-propelled missiles comprising a frame including a first reinforcing means secured to one end of said frame, a second reinforcing means secured to the opposite end of said frame, a first plurality of tanks supported at their opposite ends to said first and second reinforcing means and to each other, a second plurality of tanks secured to said first plurality of tanks and to each other to provide a single rigid assembly, inlet manifold means connected to the inlet ends of all of said tanks for admitting fluid under pressure, and outlet manifold means connected to the outlet ends of said second plurality of tanks.

10. An assembly of storage tanks for self-propelled missiles comprising a hollow cylindrical frame including a first reinforcing ring secured to one end of said frame, a second reinforcing ring secured to the opposite end of said frame, a first group of tanks circumferentially disposed within said cylindrical frame in surface contact with the inner circumference thereof and having their longitudinal axes parallel with the rotational axis of said cylindrical frame to form a central longitudinally extending cavity, bracket means having an arcuate seat secured to both said reinforcing rings for receiving the respective ends of each said tank, a second group of tanks in said central longitudinal cavity having their longitudinal axes parallel with the longitudinal axes of said first group of tanks, separate pin means for securing adjacent tanks together at contiguous points, means for supplying pressurized fluid into the tanks, at one end

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thereof, and outlet means connected to the opposite ends of said second group of tanks.

11. An assembly of storage tanks for self-propelled missiles comprising a frame, a first group of tanks within said frame to receive fluid pressure, first and second reinforcing means secured to said frame at opposite ends thereof, pin and bracket means carried by said first and second reinforcing means to secure said first group of tanks thereto and to each other, a second group of tanks to receive liquid fuel positioned within and in parallel relationship to said first group of tanks, a piston slidable in each said tank to separate the fluid pressure from the liquid fuel and provide a separate chamber for said liquid fuel, pin means connecting said first and second groups of tanks at contiguous points on their outer surfaces, an inlet manifold structure connected to all of the tanks at one end of the assembly whereby all of said tanks are pressurized, and an outlet manifold structure connected to said second group of tanks at the opposite end of the assembly whereby the liquid fuel contained therein is led to a point of usage when fluid pressure from said first groups of tanks is applied to said pistons.

12. An assembly of storage tanks for self-propelled missiles comprising a frame, a first group of tanks within said frame to receive fluid pressure, first and second reinforcing means secured to said frame at opposite ends thereof, pin and bracket means carried by said first and

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second reinforcing means to secure said first group of tanks thereto and to each other, a second group of tanks to receive liquid fuel positioned within and in parallel relationship to said first group of tanks each tank at its outlet end carrying a bulkhead having an outlet opening, a valve seat positioned in said opening, a piston slidable in each said second group of tanks to separate said fluid pressure from said liquid fuel, a tapered valve member carried by said piston engageable with said valve seat to seal the outlet opening when said tank is empty, pin means connecting said first and second groups of tanks at contiguous points on their circumferences, an inlet manifold structure connected to all tanks at the pressure inlet ends thereof whereby all of said tanks are pressurized, and an outlet manifold structure connected to said second group of tanks at the outlet ends thereof to conduct said liquid fuel to a point of usage when fluid pressure from said first group of tanks is directed to said pistons.

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