Dec. 3, 1963 J. E. WEBB, ADMINISTRATOR OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION 3,112,672

UMBILICAL SEPARATOR FOR ROCKETS

Filed March 7, 1962 2 Sheets-Sheet 1

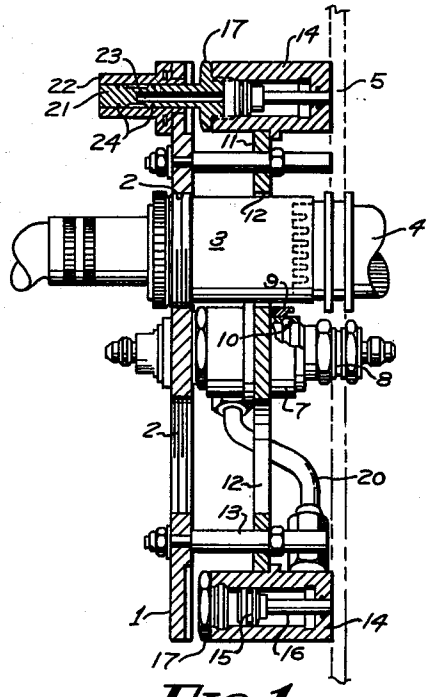


FIG. 1

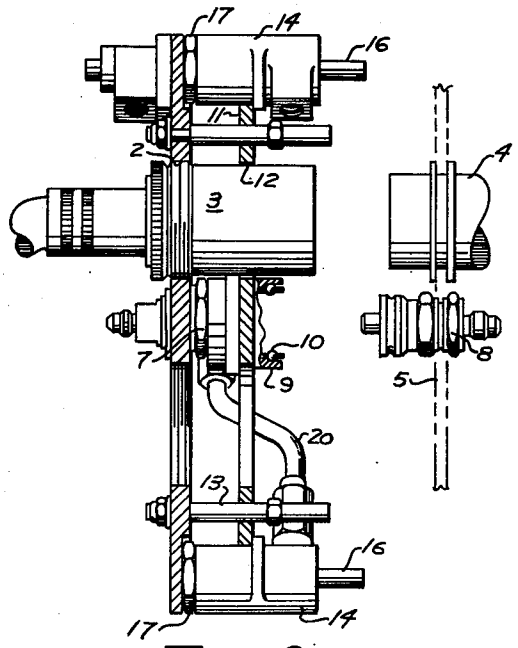


FIG. 2

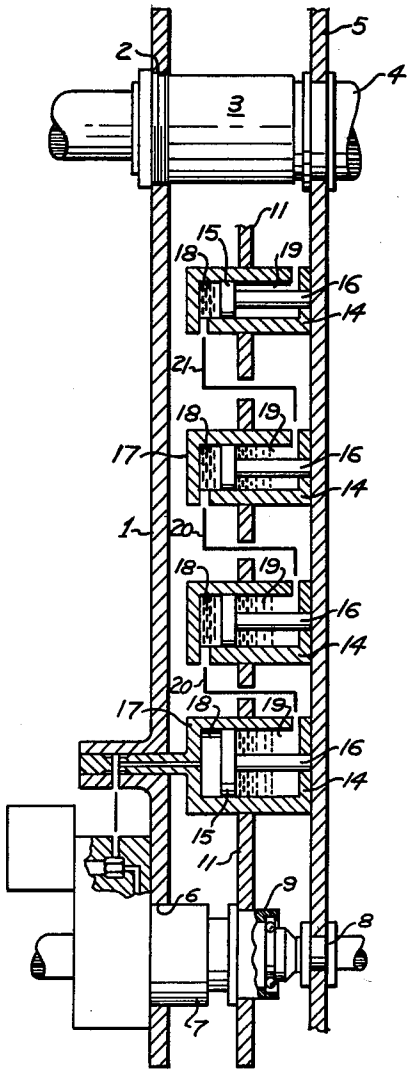


FIG. 3

INVENTOR.
A. K. FORSYTHE
BY
Donald C. Kenney
ATTORNEYS

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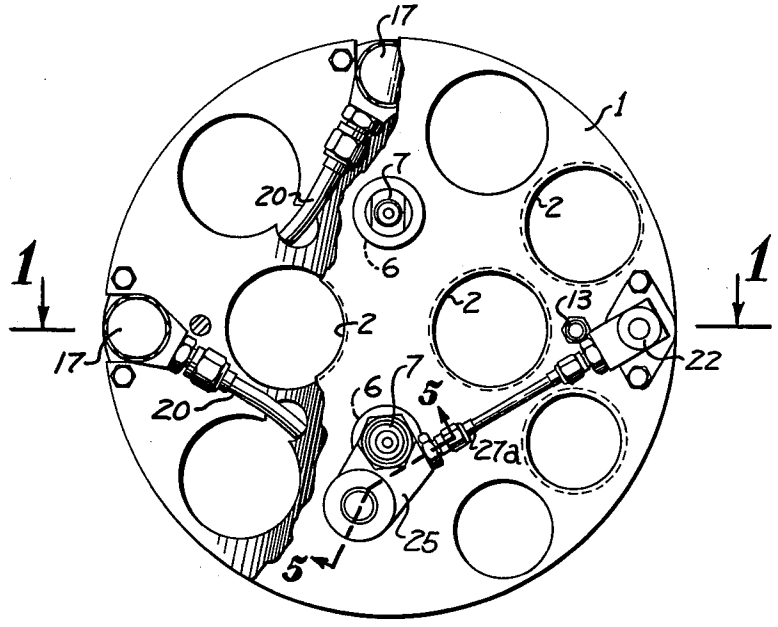


FIG.4

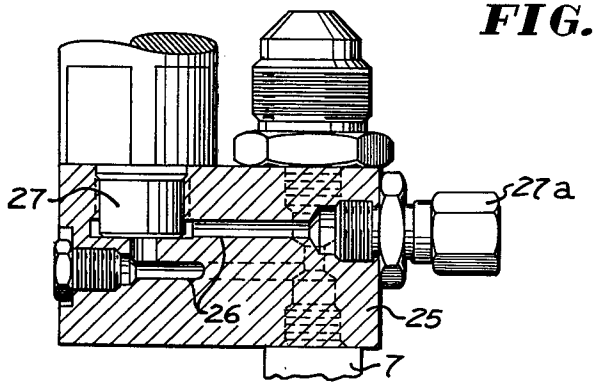


FIG.5

INVENTOR.
A. K. FORSYTHE
BY
Donald C. Kennerney
ATTORNEYS

United States Patent Office

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UMBILICAL SEPARATOR FOR ROCKETS

James E. Webb, Administrator of the National Aeronautics and Space Administration, with respect to an invention of Alan K. Forsythe

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5 Claims. (Cl. 89—1.7)

This invention relates to umbilical separators for rockets and included in the objects of this invention are:

First, to provide an umbilical separator for rockets whereby the various electrical connectors and fluid couplings may be quickly and dependably separated simultaneously on command.

Second, to provide an umbilical separator for rockets which utilizes one of the pressure fluid lines connected to the rocket as a source of energy to operate the separator, and a series of piston and cylinder units adapted to be connected thereto upon opening on remote command, a solenoid valve.

Third, to provide an umbilical separator for rockets wherein the piston and cylinder units operate thrust pins in unison and are so interconnected that all thrust pins are forced to move equal distances irrespective of the relative loads imposed on the pins so that the separator does not twist a cant to bind the connectors or couplings as they are being separated.

Fourth, to provide an umbilical separator for rockets which permits the use of conventional multiple conductor electrical connectors, and conventional fluid couplings of the type which may be separated without loss of fluid, and also permits these connectors and couplings to be arranged or grouped in any convenient manner.

With the above and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings, in which:

FIGURE 1 is a sectional view of the umbilical separator shown attached to a rocket, the rocket wall being indicated by broken lines, and with a representative electrical connector and fluid coupling shown in position, the remaining connectors and fluid coupling being omitted.

FIGURE 2 is a sectional view similar to FIGURE 1, but showing the umbilical separator separated from the rocket.

FIGURE 3 is a diagrammatical view showing the parts in their initial condition corresponding to FIGURE 1.

FIGURE 4 is an outer side view of the umbilical separator with the various electrical connectors omitted and with portions broken away to show underlying structure.

FIGURE 5 is an enlarged fragmentary sectional view through 5—5 of FIGURE 4 showing the solenoid valve for supplying pressure fluid to the separator.

The umbilical separator includes a mounting plate 1 having a plurality of screwthreaded openings 2 to accommodate the removable components 3 of various conventional multiple conductor electrical connectors, the fixed components 4 of which are secured in the wall 5 of a rocket.

In addition, the mounting plate 1 is provided with openings 6 which accommodate the removable components 7 of various conventional fluid couplings through which gas or liquids are supplied to the rocket. The removable components 7 are joined to fixed components 8 secured in the wall 5 of the rocket.

The couplings are of the type which separate by relative axial movement and, typical of this form of conventional coupling, a locking sleeve 9 is provided which cooperates with key balls 10 to lock the components together. The sleeve 9 is axially movable a short distance to free the key balls so that the coupling components may be released. The couplings are also of the type wherein one or both components seal upon separation.

Located between the mounting plate 1 and the wall 5 of the rocket is a release plate 11 having clearance holes 12 for the electrical connectors and accommodation holes in which the locking sleeves 9 are secured. The release plate 11 is guided for limited movement with respect to the mounting plate 1 by pins 13 secured in the mounting plate which also serve to dispose the mounting plate, connectors and couplings in proper relation to the wall 5 of the rocket.

Secured in equally spaced relation about the periphery of the release plate 11 is a plurality of cylinders 14. Four cylinders are shown; however, more or less may be provided, depending upon the size of the mounting plate and release plate needed to accommodate the various connectors and couplings. Each cylinder receives a piston 15, and a stem 16. The stems 16 are adapted to protrude from the ends of the cylinders 14 remote from the mounting plate 1, and when thrust outwardly from their respective cylinders, to force the umbilical separator free of the rocket.

The ends of the four cylinders 14 confronting the mounting plate 1 are provided with caps 17, which, initially, are spaced slightly from the mounting plate. Each stem is sealed with respect to its cylinder so that each cylinder is divided by its piston 15 into two sealed compartments 18 and 19, each compartment 18 being between a piston 15 and cap 17 and each compartment 19 surrounding a stem 16.

The four cylinders are joined in series by connecting lines 20; that is the compartment 19 of the first cylinder is connected to compartment 18 of the succeeding cylinder. The compartment 19 of the last cylinder is open to atmosphere; whereas the compartments interconnected by the lines 20 are completely filled with a liquid.

Still further, the cylinders and pistons are graduated in size; that is, the compartment 19 around the stem 16 of the preceding cylinder is equal in area to the area of the compartment 18 above the piston of a succeeding cylinder. As a consequence, a given displacement of the piston in the first cylinder causes equal displacement of the pistons in the succeeding cylinders.

The cap 17 of the first or initial cylinder is provided with a shaft 21 which projects through the mounting plate 1 and into a sleeve 22 secured thereon. The shaft 21 is provided with a passageway 23 leading from the chamber 18 of the first cylinder to a location within the sleeve 22 between spaced seals 24.

The removable component 7 of one of the couplings is joined to a valve block 25 secured to the mounting plate 1. The valve block is provided with a passageway 26 in which is interposed a solenoid valve 27 which is normally closed. A line 27*a* connects the downstream end of the passageway 26 with the sleeve 22 between the seals 24.

Operation of the umbilical separator is as follows:

When it is desired to cast off the various umbilical connections to a rocket immediately prior to launching, the solenoid valve is energized on remote command to open the selected pressure line to chamber 18 of the initial

cylinder. The pressure is transmitted through the liquid which series connects the cylinders so that all stems **16** are moved. By reason of the equal areas between preceding and succeeding chambers **19** and **18**, the stems **16** move equal distances. More particularly, the stems **16** are forced to move equal distances even if the resistance encountered by the stems should be unequal. The applied pressure is, of course, sufficiently high to insure an operating force well above that required to separate all the connectors and couplings.

It will be noted that the release plate **11** and cylinders **14** are capable of limited movement before the caps **17** engage the mounting plate **1**. This limited movement is utilized to shift the locking sleeves **9** of the various couplings to free the key balls **10** so that the couplings may be separated. Further movement of the cylinders as the stems **16** push away from the rocket cause the mounting plate to disconnect all of the connectors and couplings as shown in FIGURE 2.

While what hereinbefore has been described as the preferred embodiment of this invention, it is readily apparent that alterations and modifications may be resorted to without departing from the scope of this invention and such alterations and modifications are intended to be included within the scope of the appended claims.

We claim:

1. In an umbilical separator for rockets, the combination with a plurality of electrical connectors and fluid couplings for separable components carried respectively by the rocket wall and a common mounting plate, of:
- a plurality of piston and cylinder units each having an extensible stem, each unit defining major and minor chambers at opposite sides of its piston said units being positioned to force said mounting plate away from said rocket wall upon extension of said stems;
- liquid filled conduits connecting the minor chamber of a preceding unit with the major chamber of a succeeding unit, the effective areas of said connected chambers being equal, whereby on movement of the piston in the first of said units causes equal movement of the pistons in succeeding units;
- and a valve means responsive to remote command for operatively connecting one of the fluid coupling components carried by said mounting plate with said first unit, thereby to extend said stems and force said mounting plate and separable components carried thereby from said rocket wall.

2. The combination with a rocket having a plurality of fixed electrical connectors and fluid coupling components secured in a wall thereof, and mating separable components joined to umbilical lines for initial connection with said fixed components, of an umbilical separator, comprising:
- a mounting plate adapted to support said separable components;
- a normally closed pressure fluid control valve responsive to remote command and carried by said mounting plate;
- a series of piston and cylinder units including extensible stems, said units being positioned to force said mounting plate away from said rocket wall on extension of said stems;
- and liquid filled conduits series connecting said units, the effective areas of said units being so proportioned that movement of the piston and stem of an initial unit causes essentially identical movement of the stems of the other units, said initial unit being operatively connected with said valve to extend said stems and force said mounting plate and components carried thereby free of said rocket wall.

3. The combination with a rocket having a plurality of fixed electrical connector components and fluid coupling components in a wall thereof and mating separable components joined to umbilical lines for initial connections to said fixed components, wherein the separable fluid coupling components include locking means axially movable to unlock the separable fluid coupling components from the fixed components thereof, said umbilical separator comprising:

- a mounting plate adapted to support said separable components;
- a normally closed pressure fluid control valve responsive to remote command and carried by said mounting plate;
- a release plate disposed between said mounting plate and said rocket wall and connected to said locking means to effect unlocking movement thereof;
- and expansible means carried by said release plate and engageable with said mounting plate after a predetermined free movement, said expansible means being operatively connected with said valve for thrusting engagement with said rocket wall to cause unlocking movement of said locking means and thereafter engage said mounting plate to force said mounting plate and the components carried thereby away from said rocket wall.

4. The combination with a rocket having a plurality of fixed electrical connector components and fluid coupling components in a wall thereof and mating separable components joined to umbilical lines for initial connections to said fixed components, wherein the separable fluid coupling components include locking means axially movable to unlock the separable fluid coupling components from the fixed components thereof, said umbilical separator comprising:
- a mounting plate adapted to support said separable components;
- a normally closed pressure fluid control valve responsive to remote command and carried by said mounting plate;
- a release plate disposed between said mounting plate and said rocket wall and connected to said locking means to effect unlocking movement thereof;
- and a plurality of piston and cylinder units carried by said release plate and including extensible stems adapted to thrust against said rocket wall, said units being initially responsive to said valve to effect movement of said release plate to free said locking means and thereafter to thrust said mounting plate and components carried thereby away from said rocket wall.

5. The combination with a rocket having a plurality of fixed electrical connector components and fluid coupling components in a wall thereof and mating separable components joined to umbilical lines for initial connections to said fixed components, wherein the separable fluid coupling components include locking means axially movable to unlock the separable fluid coupling components from the fixed components thereof, said umbilical separator comprising:
- a mounting plate adapted to support said separable components;
- a normally closed pressure fluid control valve responsive to remote command and carried by said mounting plate;
- a release plate disposed between said mounting plate and said rocket wall and connected to said locking means to effect unlocking movement thereof;
- a series of piston and cylinder units equally spaced about the periphery of said release plate and including stems for thrust engagement with said rocket wall to move said release plate and mounting plate outwardly therefrom, there being free movement between said plates whereby said release plate has a predetermined travel before movement of said mounting plate;
- and liquid filled conduits series connecting said units, the effective areas of said units being so proportioned that movement of the piston and stem of an initial unit causes essentially identical movement of the

stems in the other units, said initial unit being operatively connected with said valve to effect, on command, extension of said stems thereby to cause said release plate to unlock said locking means and thereupon cause said mounting plate and components carried thereby to move free of said rocket walls.

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