

Oct. 13, 1964

F. D. BOND, JR., ETAL

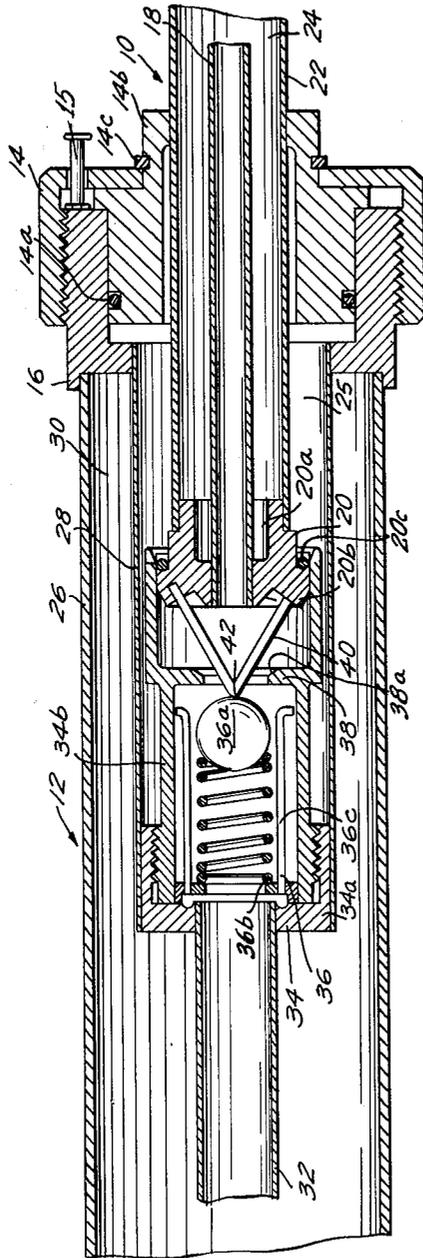
3,152,452

VACUUM-INSULATED VALVED COUPLING

Filed Dec. 21, 1960

4 Sheets-Sheet 1

FIG. 1



INVENTORS  
FRANK D. BOND, JR.  
JOHN M. CANTY  
JOHN A. PAIVANAS  
BY  
*Thomas L. Strain*  
ATTORNEY

Oct. 13, 1964

F. D. BOND, JR., ETAL

3,152,452

VACUUM-INSULATED VALVED COUPLING

Filed Dec. 21, 1960

4 Sheets-Sheet 2

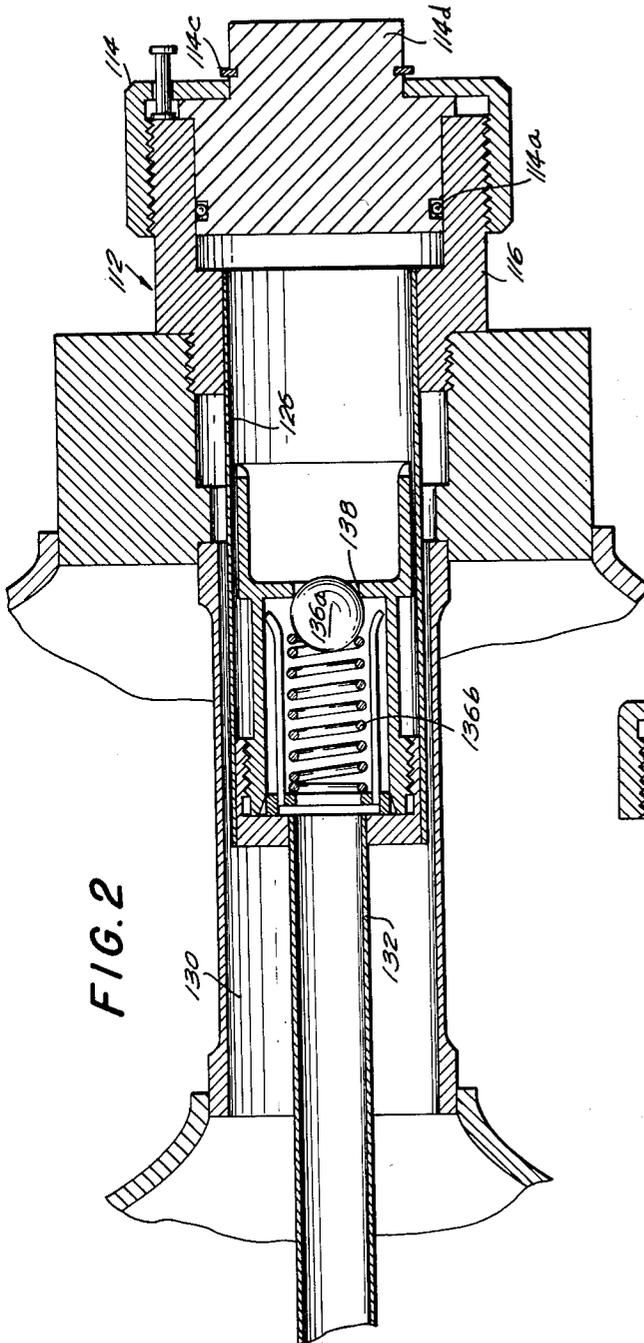


FIG. 2

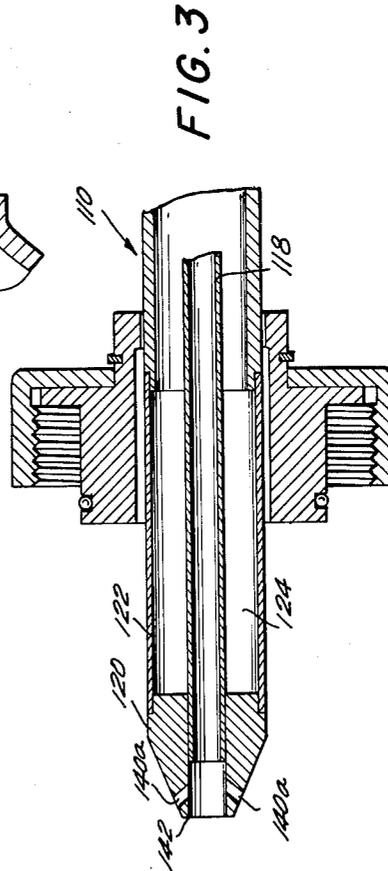


FIG. 3

INVENTORS.  
FRANK D. BOND, JR.  
JOHN M. CANTY  
JOHN A. PAIVANAS  
BY *Thomas J. O'Brien*  
ATTORNEY

Oct. 13, 1964

F. D. BOND, JR., ETAL

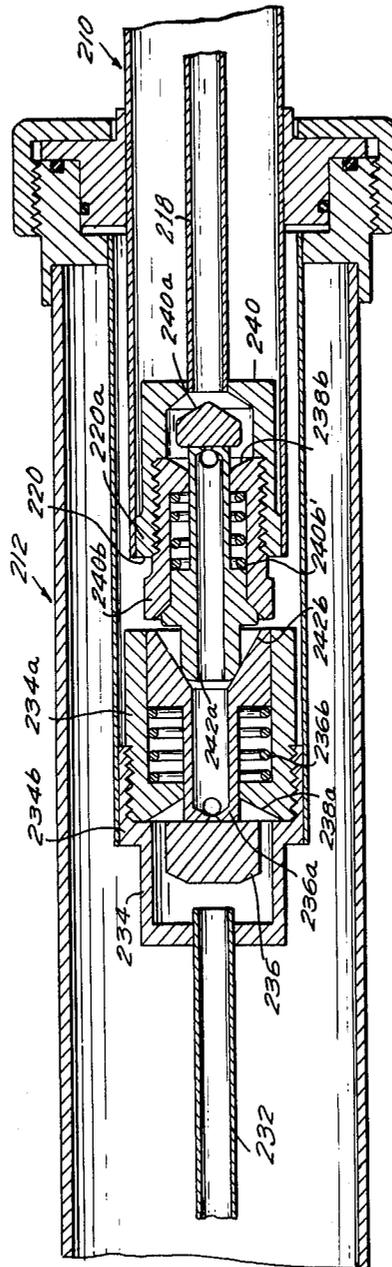
3,152,452

VACUUM-INSULATED VALVED COUPLING

Filed Dec. 21, 1960

4 Sheets-Sheet 3

FIG. 4



INVENTORS,  
FRANK D. BOND, JR.  
JOHN M. CANTY  
JOHN A. PAIVANAS  
BY *Thomas L. O'Brien*  
ATTORNEY

Oct. 13, 1964

F. D. BOND, JR., ETAL

3,152,452

VACUUM-INSULATED VALVED COUPLING

Filed Dec. 21, 1960

4 Sheets-Sheet 4

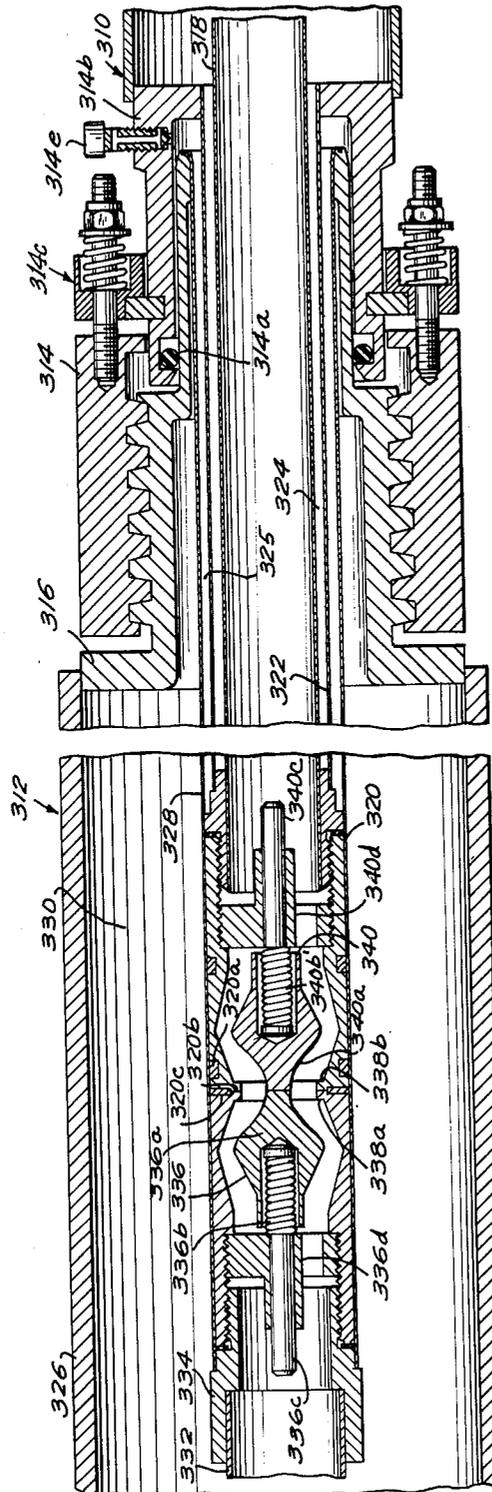


FIG. 5

INVENTORS.  
FRANK D. BOND, JR.  
JOHN M. CANTY  
JOHN A. PAVANAS  
BY  
*Thomas L. O'Brien*  
ATTORNEY

1

2

3,152,452

## VACUUM-INSULATED VALVED COUPLING

Frank D. Bond, Jr., Buffalo, John M. Canty, Tonawanda,  
and John A. Paivanas, Williamsville, N.Y., assignors  
to Union Carbide Corporation, a corporation of New  
York

Filed Dec. 21, 1960, Ser. No. 77,376  
13 Claims. (Cl. 62-45)

This invention relates to apparatus for handling cryo-  
genic fluids and more particularly to apparatus for con-  
veniently transferring low-boiling liquefied gases from  
one storage container to another.

In transferring low-boiling liquefied gases from one  
container to another, special precautions must be taken  
to avoid considerable liquid losses due to evaporation.  
The transfer apparatus must be designed not only for  
strength and durability but also to minimize the heat  
leakage into the apparatus from the ambient atmosphere.  
It is, therefore, a principal object of the present inven-  
tion to provide a transfer apparatus meeting the above  
requirements. A further object is to provide a transfer  
apparatus that is capable of being installed at any loca-  
tion or position in a liquid transfer line. Another object  
is to provide an apparatus having a minimum of moving  
or operating parts exposed to the ambient atmosphere so  
as to afford high reliability of operation at low cryogenic  
liquid temperatures.

These and other objects of the invention will become  
apparent from the accompanying description and draw-  
ings, in which:

FIG. 1 is a view of a longitudinal cross-section through  
a transfer apparatus embodying features of the present  
invention;

FIG. 2 is a view of a longitudinal cross-section through  
a transfer apparatus, fitted within the neck tube of a  
double-walled liquefied gas storage container, which in-  
corporates the feature of the present invention;

FIG. 3 is a view of a longitudinal cross-section through  
an insertable portion of a transfer apparatus which em-  
bodies features of the present invention;

FIG. 4 is a view, in longitudinal cross-section, of a  
transfer apparatus embodying features of the present  
invention;

FIG. 5 is a view, in longitudinal cross-section, of an-  
other variation of a transfer apparatus embodying fea-  
tures of the present invention.

According to this invention, quantities of a volatile  
cryogenic liquid may be transferred, either intermittently  
or continuously, from, for example, one storage container  
to another with a minimum of evaporation losses during  
the transfer process. In accomplishing this, the inven-  
tion performs two primary functions: that of a transfer  
valve; and that of a transfer conduit connector. Such a  
"valved coupling," as the invention will hereinafter be  
designated, can be employed as either a connecting means  
between two liquid transfer lines, or a connecting means  
between a cryogenic liquid storage container and a liquid  
transfer line. In either instance, the entire coupling will  
usually remain at near ambient temperature at all times,  
except during and shortly after periods when cold liquid is  
transferred. During cooldown of the inner parts of the  
coupling just prior to liquid transfer, a thermal gradient  
is produced between the inner conduit and the outer con-  
duit of the coupling, and is easily maintained by use of  
long heat conduction paths of small cross-sectional areas.

This thermal gradient within the coupling is especially  
important when the coupling is employed as a connecting  
means on a cryogenic liquid storage container inasmuch  
as the transfer of heat to the stored liquid by the cou-  
pling parts is greatly reduced during transfer of liquid  
and is virtually eliminated during periods when no liquid

transfer is being made. After the beginning of the liquid  
transfer process, particularly where the liquid is trans-  
mitted intermittently or infrequently, the coupling must  
be rapidly cooled to the temperature of the transferred  
liquid. Otherwise an appreciable amount of the liquid  
transferred would be evaporated because of the heat con-  
tent of the parts being cooled and because of heat leakage  
through the coupling parts.

The valved coupling comprises two members, one being  
slidably insertable within the other, which are coupled  
together by engaging a ring nut of the insertable member  
on an annular connector of the other. Each member  
comprises a liquefied gas conduit, a thin-walled shell at-  
tached to and surrounding a portion of the conduit there-  
by forming an evacuable insulation space, and a valve  
guide unit which houses a valve element, such valve  
guide unit being integrally connected to the liquefied gas  
conduit. The outer shell of the inserted member is inte-  
grally attached to one end of the respective valve guide  
unit, and the outer shell of the other member is inte-  
grally attached to the annular connector. When the two  
members are coupled together, the respective valve ele-  
ments are brought into contact and at least one of the  
valve elements is urged from its valve seat surface on  
the respective valve guide unit thereby permitting the  
liquefied gas to flow from one conduit to the other.  
Except when coupled together, at least one valve element  
is urged into a valve seat surface engaging position  
thereby preventing any flow of liquefied gas through the  
respective liquefied gas conduit.

With particular reference to the embodiment depicted  
in FIG. 1, the valved coupling is shown connected within  
a liquefied gas transfer line. Member 10 is shown inserted  
within member 12 and fastened therein by a removable  
annular ring nut 14 which is secured to a fixed annular  
connector 16. Member 10 comprises a liquefied gas con-  
duit 18 which is integrally secured to valve guide unit 20  
at the open end thereof. Thin-walled shell or tube 22  
concentrically encloses conduit 18 and a portion of valve  
guide unit 20, such shell being integrally fastened to  
valve guide unit 20 thereby forming an evacuable annular  
insulation space 24 between conduit 18 and shell 22.  
Integrally attached to annular connector 16 is a thin-  
walled outer shell 26 of member 12, and a thin-walled  
inner shell 28. Outer shell 26 concentrically encloses  
inner shell 28 thereby forming an evacuable annular  
insulation space 30. Within inner shell 28, liquefied gas  
conduit 32 is integrally attached to valve guide unit 34.  
Valve element 36, which is housed within valve guide 34,  
seats against valve seat surface 38 of valve guide unit 34.  
When the valved coupling is disconnected, valve element  
36 is urged against surface 38 thereby preventing ingress  
and egress to conduit 32.

Within the insertable member 10, valve guide unit 20  
may comprise a hollow threaded conduit adaptor 20a and  
a hollow valve seat member 20b which is threadedly se-  
cured to conduit adaptor 20a. Valve element 40 prefer-  
ably comprises a tripod assembly integrally attached to  
hollow valve guide unit 20 such that upon the insertion of  
member 10 into member 12 and connection thereto, valve  
element 40 contacts valve element 36 at mating contact  
surface 42.

Valve guide unit 34 may comprise, for example, a hol-  
low threaded conduit adaptor 34a and a hollow valve seat  
member 34b which is threadedly secured to conduit adap-  
tor 34a. Valve seat member 34b extends axially outward  
and forms an annular receptacle separated into two sec-  
tions by valve seat surface 38. The conduit-end section  
houses valve element 36 which comprises a ball 36a, a  
spring 36b upon which the ball sits and by which the ball  
is urged against valve seat surface 38, and a spring guide  
member 36c which retains spring 36b and ball 36a in

axial alignment with valve seat member 34b. Thus, valve element 36 is on the inner or product liquid side of the seat and presents a minimum exposure to atmospheric air whenever the coupling is disconnected. The second section of valve seat member 34b receives valve guide unit 20. The depth of this section is such that valve guide unit 20 enters the section just prior to the contacting of mating contact surface 42 with valve element 36.

The second or outer section of valve seat member 34b is slightly larger than valve guide unit 20 and preferably at least one circumferential sealing ring 20c, affixed near the open end of valve guide unit 20, seals shut the space between valve seat member 34b and valve guide unit 20. Alternately such a sealing ring could be affixed within, and near the open end of, valve seat member 34b. Further pressure sealing is preferably accomplished by circumferential sealing ring 14a which is affixed to adaptor flange 14b, such flange being integrally attached to thin-walled shell 22 upstream of the valve guide unit 20, and upon which ring nut 14 is positioned and held in place by snap ring 14c. Adaptor flange 14b is slightly smaller than connector 16 and upon insertion of member 10 within member 12, sealing ring 14a seals shut the annular space between adaptor flange 14b and connector 16. Sealing rings 14a and 20c close off the ends of air space 25 between thin-walled shell 22 of member 10 and thin-walled inner shell 28 of member 12 when the two members, 10 and 12, are coupled together. By turning ring nut 14, valve element 36 is controllably moved away from seat surface 38, as desired. Thus, throttling action through the valve may be accomplished. Indicator pin 15 may be used to indicate the degree of valve opening.

The embodiment of FIG. 1 may also be conveniently used by attaching member 12 directly onto a vacuum-jacketed storage container for cryogenic liquid (not shown). In this arrangement, outer shell 26 is attached directly to the outer casing of the storage vessel and conduit 32 either passes through the container vacuum space and enters the inner vessel, or is inserted within a neck tube of the inner container. In the former arrangement, the evacuated space 30 of the valved coupling would communicate directly with the vacuum-insulation space of the container.

Member 12 is especially suited for installation into the neck tube of a cryogenic liquid storage container as shown in FIG. 2, inasmuch as it constitutes the valve-functioning part of the invention and member 10 constitutes the transfer conduit connector part of the invention. In this embodiment, the thin-walled inner shell 126 of member 112 slips within the neck tube of the storage container having an outer shell, an inner storage vessel, and an insulation space therebetween. For such use of this valved coupling with a vacuum-insulated storage container, it is not necessary that the coupling member 112 be evacuated or otherwise insulated. Thus, space 130 between liquefied gas conduit 132 and the neck tube is not evacuated but is at a positive pressure since such space communicates with the interior of the inner storage vessel and consequently is kept at a uniform temperature by evaporation of the stored product liquid. Ball 136a is shown firmly seated against valve seat surface 138 by spring 136b thereby closing off the liquefied gas conduit 132. When the storage container is not being filled or emptied, member 112 is sealed from the surrounding atmosphere by threaded ring nut 114, which is mounted on valve plug 114d and held in place by snap ring 114c, and which is threadedly engaged to fixed threaded annular connector 116. Valve plug 114d has affixed to it a circumferential sealing ring 114a which aids in securing a relatively gas tight closure of member 112 with connector 116. In this embodiment, a portion of annular connector 116 is attached directly to the outer shell of the storage container.

Another embodiment of a transfer conduit connector is shown in FIG. 3. Member 110 comprises liquefied gas conduit 118, valve guide unit 120, thin-walled shell 122,

and evacuable insulation space 124; all of which are similar in form and disposition to the embodiment described as member 10 in FIG. 1. The essential difference is the configuration of valve guide unit 120. Instead of supporting a valve element such as valve element 40 in FIG. 1, valve guide unit 120 is itself also such a valve element in that holes 140a around the periphery of valve guide unit 120 permit the flow of liquid through liquefied gas conduit 118. The open end of valve guide unit 120 is tapered so that it will partially pass through the valve seat surface 38 of FIG. 1 before coming into contact with surface 38a, which is the front side of seating surface 38. As member 110 is coupled to its valve-functioning counterpart, mating contact surface 142 on valve guide unit 120 contacts ball 36a and urges it from valve seat surface 38 thereby allowing the liquid to flow past the ball and through valve guide holes 140a, or vice versa if the liquid is flowing in the opposite direction.

The valved coupling embodiment shown in FIG. 4 is substantially the same as that shown in FIG. 1 except for the configuration of valve guide unit 234 and 220, and the respective valve elements 236 and 240. Both valve elements are preferably spring-loaded and slideably inserted within the respective valve guide unit. As in FIG. 1, valve guide unit 234 and 220 preferably comprise hollow threaded conduit adaptors 234a and 220a, respectively, which threadedly engage hollow valve seat members 234b and 240b, respectively.

Valve element 236 comprises a hollow annular valve member 236a and a spring 236b which urges member 236a against valve seat surface 238a, when member 210 is not coupled into member 212, and thereby prevents ingress and egress to liquefied gas conduit 232. Valve element 240 comprises a hollow annular valve member 240a and a spring 240b which urges member 240a against valve seat surface 238b, when the valve coupling is disconnected, thereby preventing ingress and egress to liquefied gas conduit 218.

When member 210 is inserted into, and coupled within, member 212, valve member 236a is contacted by valve member 240a at the respective mating contact surfaces 242a and 242b. Such contact urges both valve members from their respective valve seats thereby allowing the passage of liquid from one conduit to the other through the two hollow valve members.

While FIG. 4 is a useful embodiment for many purposes, when used for handling very low-boiling liquids such as liquid helium and hydrogen, it is advisable to purge the two members with gas of the same composition just before joining them together. This will exclude air and atmospheric moisture which could cause sticking of the moving parts, since they are located on the atmospheric side of the valve seats.

A further embodiment shown in FIG. 5 is similar to FIG. 1 in that member 310 is slidably coupled within member 312 threadedly engaging removable annular ring nut 314 on to fixed threaded annular connector 316. Member 310 comprises a liquefied gas conduit 318 which is integrally attached to valve guide unit 320, and a thin-walled shell 322 which concentrically encloses a portion of valve guide unit 320 and a portion of conduit 318 and which is integrally attached to valve guide unit 320 thereby forming an evacuable insulation space 324 between conduit 318 and shell 322. Member 312 comprises a thin-walled outer shell 326 and a thin-walled inner shell 328, both of which are integrally attached to connector 316. Outer shell 326 concentrically encloses the outer surface of inner shell 328 thereby forming an evacuable insulation space 330. Within inner shell 328, liquefied gas conduit 332 is integrally attached to valve guide unit 334 and forms an extension of the outer surface of inner shell 328 of evacuable insulation space 330.

Valve element 336, which is slidably positioned within valve guide unit 334, comprises annular valve member 336a, and a spring 336b housed within valve element 336

such that it urges member 336a against valve seat surface 338a of valve guide unit 334 when the valved coupling is disconnected. Valve seat member 336a is held in position within valve guide 334 by guide unit rod 336c which slides within spider nut assembly 335d. Valve element 340 is slidably positioned within valve guide unit 320 in the same manner as valve element 336 within valve guide unit 334. Valve element 340 also comprises an annular valve member 340a, a spring 340b, a guide rod 340c, a spider nut assembly 340d, and a valve seat surface 338b, all of which cooperate in the same manner as the respective parts of valve element 336.

Valve guide unit 320 of member 310 is slightly smaller than thin-walled inner shell 328 of member 312 and at least one circumferential sealing ring 320a is preferably affixed to the outer surface and near the open-end of valve guide unit 320. Upon the insertion of member 310 into member 312, sealing ring 320a contacts the inner surface of inner shell 328 thereby forming a seal between the two aforementioned surfaces. Further, a circumferential sealing ring 314a is preferably positioned such that just prior to the contacting of valve member 336a by valve member 340a, it seals the space between adaptor flange 314b, which is integrally attached to thin-walled shell 322 upstream of valve guide unit 320, and adaptor 316. Consequently upon coupling of members 310 and 312, air space 325 between thin-walled shell 322 of member 310 and a thin-walled inner shell 328 of member 312 is isolated from the surrounding atmosphere by sealing ring 320a at the inner end and sealing ring 314a at the outer end. The small radial clearance of air space 325 serves to reduce heat transfer to the inner cold parts by gas recirculation and convection within this annular space to a very low value. A firm mating seal joint 320b, which aids in sealing the air space 325, is accomplished upon coupling members 310 and 312 because sealing surface 320c is affixed to the open end of valve guide unit 320. Sealing surface 320c is located in a reduced area section, namely the joint between valve guide unit 320 and 334. Use of such reduced diameter sealing area also decreases the force, exerted by the internal working pressure of the liquid passing through such valve guides, upon the various other parts of the valved coupling. Consequently these parts, such as thin-walled shell 322 and ring nut 314, may be designed for smaller forces thereby permitting the valved coupling to be made lighter and more convenient to handle. If desired, reduced diameter sealing surface 320c may consist of a seal ring attached to either the first or second valve guide unit.

Also, coupling assembly 314c which comprises a threaded bolt, a spring, and a tension nut is preferably employed to maintain a seating force exerted by inserted member 310 upon member 312 thereby insuring a firm axial contact between valve guide unit 320 and 334. Preferably three or more such coupling assemblies should be employed to insure that the seating force will be constant about the circumference of the valve guides.

If desired, bleed valve 314e may be employed, upon coupling the two mated members, to purge space 325 of air and thus prevent air from freezing within the close fitting parts when the product liquid is transferred. In addition, the bleed valve may be opened just prior to separation of the two mated members to ensure that no significant residual pressure exists between the two mating parts which upon separation might cause injury to the operator.

Remote operation of the valved couplings shown in FIGS. 1, 2, 4 and 5, afforded by the elimination of the stem required for an externally operated valve, results in the advantages of low heat leakage into the valve components because of the long heat conducting path and small area used and low cooldown losses because of the relatively small mass of metal to be cooled whenever a transfer of liquid is made. Such remote operation is provided by utilizing an extended probe to open the valve as well as transfer the product, and by utilizing a spring-

loaded valve element to close at least the fixed transfer conduit upon disengagement of the removable extended probe.

Probe members 10 of FIG. 1, 110 of FIG. 3, 210 of FIG. 4 and 310 of FIG. 5 are designed to be preferably attached to the end of a flexible transfer conduit. Such a conduit might comprise, for example, a flexible corrugated metallic inner conduit, a larger flexible corrugated metallic jacket being concentrically spaced around the inner conduit so as to form an evacuable annular insulation space therebetween, the minimum diameter of the flexible corrugated jacket being greater than the maximum diameter of the flexible corrugated inner conduit. The above-mentioned evacuable insulation space would be an extension of the evacuable insulation space of the probe member inasmuch as the probe's outer shell would be integrally joined to the corrugated jacket and the probe's liquefied gas conduit would be integrally joined to the corrugated inner conduit. If the valve functioning part of the invention were to be used in conjunction with a transfer line rather than being positioned within a neck tube of a storage container, the transfer line would be joined to such valve in the same manner as described above with reference to the probe member.

The term "vacuum" as used hereinafter is intended to refer to the vacuum pressure in the aforementioned evacuable insulation space of the valved coupling-transfer line assembly. The term applies to sub-atmospheric pressure conditions not substantially greater than 1,000 microns of mercury, and preferably less than 100 microns of mercury absolute.

In the preferred embodiments of this invention, the insulating space contains an opacified insulating material. The term "opacified insulation" as used herein refers to a two-component insulating system comprising a low heat conductive, radiation-permeable material and a radiant heat impervious material which is capable of reducing the passage of infrared radiation rays without significantly increasing the thermal conductivity of the insulating system. Also, the term "radiant heat barrier" as used herein refers to radiation opaque or radiant heat energy impervious materials which reduce the penetration of infrared heat rays through the insulating system either by radiant heat reflection, radiant heat absorption or both.

The opacified insulation may take the form of the combination of a low heat conductive material and a multiplicity of spaced radiation-impervious barriers. As more fully described and claimed in copending U.S. Serial No. 597,947 filed July 16, 1956, now Patent 3,007,596 in the name of L. C. Matsch, the low heat conductive material may be a fiber insulation which may be produced in sheet form. Examples include a filamentary glass material such as glass wool and fiber glass, preferably having fiber diameters less than about 50 microns. Also such fibrous materials preferably have a fiber orientation substantially perpendicular to the direction of heat flow across the insulation space. The spaced radiation-impervious barriers may comprise either a metal, metal oxide, or metal coated material, such as aluminum coated plastic film, or other radiation reflective or radiation adsorptive material or a suitable combination thereof. Radiation reflective materials comprising thin metal foils are particularly suited in the practice of the present invention, for example, reflective sheets of aluminum foil having a thickness between 0.2 millimeter and 0.002 millimeter. When fiber sheets are used as the low-conductive material, they may additionally serve as a support means for relatively fragile impervious sheets. For example, it is preferred that an aluminum foil-fiber sheet insulation be spirally wrapped around the inner liquefied gas conduit with one end of the insulation wrapping in contact with the inner vessel, and the other end nearest the outer shell, or in actual contact therewith.

It will be appreciated that other forms of opacified insulation may be used. For example, the radiation impervious barrier may be incorporated directly into the low heat conductive material.

Even though the previously described preferred opacified insulation is more effective than straight vacuum insulation at higher internal pressures (poorer vacuum), its effective thermal insulation life is extended if the pressure can be maintained at or below a desired level. A gas removing material such as an adsorbent may be used in the insulation space to remove by adsorption any gas entering through the joints of the transfer line. In particular, crystalline zeolitic molecular sieves having pores of at least about 5 Angstrom units in size, as disclosed in U.S. Patent No. 2,900,800 issued in the name of P. E. Loveday, are preferred as the adsorbent since they have extremely high adsorptive capacity at the temperature and pressure conditions existing in the insulation jacket and are chemically inert toward any gases which might leak into the insulating jacket.

In order to exemplify the operation of this valved coupling, assume that the product liquid is to be transferred from a storage container through the valve-functioning part of the coupling and then through the probe member into a transfer line leading to a smaller portable storage container. The pressure of the larger storage container in all probability would be several times greater than the pressure within the portable container. Consequently, upon the coupling of the two mated members of the valved coupling, the transfer of liquid through the coupling would refrigerate the valve guide unit, and were it not for the sealing ring adjacent the valve guide unit opening of the probe member, such liquid and the resulting refrigeration effects would be transmitted back to the ring nut and connector joint thereby possibly freezing them in their relative positions and also resulting in substantial evaporation of valuable liquid. The aforementioned sealing ring, in addition to the sealing ring adjacent the downstream end of the probe member, seals off an intervening air space which aids in preventing frost accumulation in the ring nut-connector joint thereby preventing freezing of the joint. If the mating hose probe is oriented in a downwardly inclined direction, a sealing ring disposed adjacent the ring nut-connector joint would probably be sufficient to seal the joint and prevent frost accumulation thereon inasmuch as the liquid would not run into the intervening space.

The springs controlling the valve elements of FIGS. 4 and 5 may be designed such that one or the other of the valve elements is disengaged from its valve seat prior to the disengagement of the other. This would be advantageous, for example, where it is desired to open the probe-transfer line conduit prior to the opening of the valve-storage container conduit thereby helping to reduce the pressure drop across or through the valve elements.

Although preferred embodiments of this invention have been described in detail, it is contemplated that modifications of the apparatus may be made and that some features may be employed without others, all within the spirit and scope of the invention.

For example, the ring nut may be attached to the fixed member instead of to the removable or insertable member, with essentially the same results being achieved.

What is claimed is:

1. A vacuum-insulated valved coupling for transferring low-boiling liquefied gases, comprising in combination first and second mated members which are intimately joined, the second within the first, when the coupling is connected; said first mated member comprising a thin-walled inner shell for receiving said second mated member, a first liquefied gas conduit, and a first valve guide unit integrally joining such conduit to one end of the inner shell, a thin-walled outer shell which encloses said inner shell and said first liquefied gas conduit thereby forming a first evacuable insulation space, and an annular

connector enclosing one end of such insulation space by integrally joining one end of said outer shell to the end of said inner shell opposite to the conduit-inner shell joint; said second mated member comprising a second valve guide unit, a second liquefied gas conduit integrally joined to said second valve guide unit, a thin-walled shell enclosing said second liquefied gas conduit thereby forming a second evacuable insulation space, such shell being integrally joined to said second valve guide unit and constructed to define a clearance space with said inner shell when said first and second mated members are joined, coupling means associated with said annular connector for coupling said second mated member to said first mated member when inserted therein; means operated by the coupled cooperative arrangement of said annular connector and said coupling means for controlling liquefied gas transfer from one liquefied gas conduit to the other when said first and second mated members are coupled, said means comprising a first valve element slideably positioned within said first valve guide unit, a second valve element positioned in said second valve guide unit, said first valve element and said first valve guide unit having respective cooperating valve seat surfaces, said first valve element and said second valve element having mating contact portions positioned for axial contact in coupling said first and second mated members; the first and second valve elements being arranged and constructed so that said first valve element is urged to a valve seat surface engaging position thereby preventing ingress and egress to said first liquefied gas conduit until said first and second mated members are coupled thereby axially contacting said first valve element with said second valve element, the displacement of said first valve element from its valve seat surface engaging position to permit the transfer of liquefied gas from one mated member to the other being controlled by the relative positions of the coupled annular connector and the coupling means; at least one circumferential sealing ring affixed to said second valve guide unit such that upon insertion of said second valve guide unit in said first mated member such sealing ring contacts the inner surface of said inner shell, and at least one circumferential sealing ring affixed to said coupling means such that upon insertion of said second mated member in said first mated member such sealing ring contacts said annular connector, such sealing rings being constructed and arranged to isolate said clearance space prior to contact between said first and second valve elements; and a bleed valve affixed to said coupling means in communication with said clearance space to permit purging said clearance space prior to contact between said first and second valve elements.

2. A vacuum-insulated valved coupling according to claim 1 wherein said first valve guide unit comprises a hollow conduit adaptor and a hollow valve seat member secured in said conduit adaptor.

3. A vacuum-insulated valved coupling according to claim 2 wherein said hollow valve seat member comprises an annular receptacle separated into two axially oriented sections by said valve seat surface, the conduit-end section of such valve seat member having positioned therein said first valve element; said first valve element comprises a ball, a spring for seating and urging said ball against the valve seat surface of said first valve seat member, and a spring guide member for axially aligning said spring with said first valve seat member; and wherein said second valve element is integrally attached to and supported by said second valve guide.

4. A vacuum-insulated valved coupling according to claim 3 wherein a tripod assembly comprises said second valve cooperating element.

5. A vacuum-insulated valved coupling according to claim 3 wherein said second valve guide has affixed in proximity to the end thereof at least one circumferential sealing ring so constructed and arranged that upon insertion of said second valve guide in said annular receptacle

said circumferential sealing ring contacts the inner surface of such receptacle.

6. A vacuum-insulated valved coupling according to claim 1 wherein said first mated member is positioned within a neck tube of a double-walled liquefied gas storage container, said neck tube comprising said thin-walled outer shell of said first mated member arranged such that said first evacuable insulation space communicates with the interior of the storage container.

7. A valved coupling according to claim 1 wherein said second valve element comprises a tapered perforated end section of said second valve guide; and the end of such tapered section comprises the mating contact surface of said second valve element.

8. A vacuum-insulated valved coupling according to claim 1 wherein said second valve element is slideably positioned within said second valve guide unit, such second valve element and said second valve guide unit having respective cooperating valve seat surfaces such that such second valve element is urged into a valve seat surface engaging position thereby preventing ingress and egress to said second liquefied gas conduit until said first and second mated members are coupled thereby axially contacting said first valve element with said second valve element the displacement of said second valve element from its valve seat surface engaging position to permit the transfer of liquefied gas from one mated member to the other being controlled by the relative positions of said coupled annular connector and coupling means.

9. A valved coupling according to claim 8 including valve springs so constructed and arranged that said first and second valve elements are spring-loaded; said first and second valve guide units each comprise a hollow threaded conduit adaptor and a hollow valve seat member threadedly engaged therein wherein the respective spring-loaded valve element is slideably positioned.

10. A vacuum-insulated valved coupling according to

claim 8 wherein said first and second valve elements each comprise an annular valve member; such valve elements each being slideably positioned within the respective valve guide units by a spider nut assembly comprising a guide rod attached to such valve member and a spider nut which is threadedly secured within said valve guide unit, wherein said guide rod is slideably inserted.

11. A vacuum-insulated valved coupling according to claim 8 including an adaptor flange for positioning said coupling means, such flange being integrally attached to said thin-walled shell such that said flange is insertable on said first mated member thereby permitting coupling of said mated members by securing said coupling means to said annular connector.

12. A vacuum-insulated valved coupling according to claim 8 wherein a sealing surface on the open end of said second valve guide unit is provided to fluid tightly join with said first valve guide unit against said second valve guide unit upon coupling with said first and second mated members.

13. A vacuum-insulated valved coupling according to claim 8 wherein a sealing ring affixed to the open end of said second valve guide unit is provided to fluid tightly join said first valve guide unit against said second valve guide unit upon coupling said first and second mated members.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

2,322,449	Johnson et al. -----	June 22, 1943
2,785,536	Hinckley -----	Mar. 19, 1957
2,858,146	Bleyle -----	Oct. 28, 1958
2,867,242	Harris -----	Jan. 6, 1959
2,964,064	Jones -----	Dec. 13, 1960
2,980,448	Holben -----	Apr. 18, 1961
3,009,716	Bradfute -----	Nov. 21, 1961