PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION
No. 33975 A.D. 1936.

Improvements in the Method of and Apparatus for Refuelling Aircraft in the Air

We, SIR ALAN JOHN COBHAM, K.B.E., a British Subject, HUGH COLEMAN JOHNSON, a British subject, and PERCY RAYMOND ALLISON, a British Subject, all of Ford Aerodrome, Yapton, in the County of Sussex, and FLIGHT REFUELLING LIMITED, a Company organised under the Laws of Great Britain, of 8, Serjeants Inn, Temple, London, E.C.4, do hereby declare the nature of this invention to be as follows:—

This invention relates to improved apparatus for refuelling aircraft in the air.

The procedure is for the fuel to be transferred to the aircraft to be refuelled through a hose which hangs down from a tanker aircraft. Contact between the two aircraft may for example be established in the manner described in Specification No. 432,908. The present invention is concerned with an improved nozzle attachment for connecting the hose to the petrol-receiving fitting on the aircraft to be refuelled, hereinafter referred to as the liner.

The nozzle attachment according to the invention comprises a nozzle fitted to the end of the hose, a co-operating reception fitting on the liner, a cable or the like attached centrally to the nozzle, means on the liner for exerting a pull on the cable, an abutment on the reception fitting to arrest the portion of the nozzle to which the cable is attached, and manually operable means on the liner for drawing the remaining portion of the nozzle forwards relatively to the arrested portion into liquid-tight engagement with the reception fitting, thereby opening a valve in the nozzle to permit of the flow of fuel through the hose and into the reception fitting.

One form of nozzle and two alternative forms of co-operating reception fitting will now be described in further detail with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal section showing the nozzle being drawn into the first form of reception fitting,

Fig. 2 is a similar view showing the nozzle after it has been pulled right home, and

Fig. 3 is a longitudinal section similar to that in Fig. 1, showing the alternative form of reception fitting.

The cable, rope, wire or the like 10 by which the hose 11 (see Figs. 1 and 2) is pulled across from the tanker to the liner passes through a side tube 12 leading in from the side of the reception fitting 13 to a central hollow boss 14 supported in the mouth of the reception fitting by a spider 15 or the like. The end of the cable 10 is connected to a rod 16 disposed centrally of the nozzle 17 on the hose (which may be attached to the hose by means of a universal joint) and carrying a valve member 18. The rod is slidably mounted in front and rear spiders 19, 20 rigidly attached to the nozzle, and a compression spring 21 is disposed between the rear spider 20 and the valve member 18, which spring holds the valve member 18 against a seating 22 to close the mouth of the nozzle. As the nozzle 17 on the hose is drawn into the reception fitting 13 a ball 23 at the front end of the rod 16 comes into contact with the boss 14 through which the cable passes, thereby sealing the side tube 12 and preventing the passage of fuel through it. Under these conditions the hose cannot be pulled further in by the cable.

At the mouth of the reception fitting are one or more spring pressed rollers, balls or the like 24 (conveniently four) which, when the ball 23 comes into contact with the boss 14 as just described, contact with cam surfaces 25 on the outer portion of the nozzle on the hose. This is the position indicated in chain dotted lines in

Fig. 1. The rollers 24 are pressed inwards towards the nozzle by springs 26.

A manually operable link system is provided on the liner for applying pressure on the springs to force the rollers inwards. This system is controlled by a lever 27 which can be moved over about a pivot 30 from the position shown in Fig. 1 into that indicated in Fig. 2 in which it is held by a spring pressed stop 28 which co-operates with an extension 29 on the lever. Fixed to the lever 27 is a link 31 connected by elastic cables 32 to bell cranks 33. These bell cranks abut against plungers 34 which bear on the outer ends of the springs 26. When the lever 27 is moved clockwise about its pivot from the position shown in Fig. 1, the bell cranks 33 are likewise rocked clockwise, so as to apply pressure to the springs 26. This pressure forces the rollers 24 inwards and downwards along the cam surfaces 25 on the nozzle and thereby wedges the latter firmly into the reception fitting 13, as shown in Fig. 2. The reception fitting is provided with a rubber joint ring 35 at its mouth. The valve member 18 is held by the ball 23 abutting against the boss 14, so that the valve opens against the action of the spring 21, thereby allowing fuel to flow into the reception fitting.

The front end 36 of the nozzle is curved to the exact male curvature to suit the internal curvature of the reception fitting. This is most important as it has been found by experiment that unless these two parts coincide ball fashion there is a likelihood of a jam taking place. The radius of the ball end of the nozzle and the dimensions and curvature of the reception fitting are so determined as to ensure that the nozzle will enter and leave the reception fitting and be pulled home horizontally by the plungers and rollers without jamming of the nozzle in the reception fitting.

The reception fitting has an automatic non-return valve of the flap type (not shown) which is opened by the pressure of the inflowing fuel. When the hose is uncoupled again after the refuelling is completed, the back rush of petrol closes this flap valve.

If there should be a sudden pull on the hose during refuelling, e.g. owing to a bump, sufficient to overcome the force of the spring 40 associated with the stop 28, the handle 27 will be pulled back into the position shown in Fig. 1, thus allowing the nozzle to separate from the reception fitting.

Normally, however, the hose is uncoupled manually at the end of the refuelling operation by returning the hand lever 27 to its original position shown in Fig. 1, thereby releasing the pressure of the rollers 24 on the nozzle and enabling the hose to be pulled back into the tanker taking the cable with it.

The attachment of the cable 10 is made to the end of the rod 16 by a cut-away opening (not shown) at one end of the rod to permit a ball fixed to the end of the cable to enter into this cut-away, bayonet joint fashion. The cable is fixed at its inner end to a drum which forms part of the hauling gear on the liner. When the hose has been wound back to the tanker the cable can be readily detached from it by uncoupling the bayonet joint, and can then be wound back into the liner.

As described above, the opening of the valve 18 consists of two operations; as the nozzle is drawn in to the reception fitting the ball 23 comes into contact with the boss 14 at the mouth of the streamlined tube 13, thereby making a liquid-tight joint at that point. The ball 23 is prevented from proceeding down this tube owing to the cuplike shape of the boss 14. The second operation then takes place as and when the operator pleases. By the operation of the hand lever 27 extra tension is passed on to the four rollers 24 driving the rollers along the cam surfaces 25 and thereby forcing the whole nozzle forward and thus further into the reception fitting. As the ball 23 on the valve is already impinged against the cup seat in the boss 14 and, therefore, cannot proceed any further, the body of the nozzle over-runs the valve 18 leaving a space between the valve 18 and its seat 22, thereby in point of fact opening the valve. By virtue of the valve being spring loaded the nozzle when released from the reception fitting will offer no further force to the valve which will automatically close itself.

An alternative form of reception fitting is shown in Fig. 3 of the accompanying drawings. Here the tube 12 is coaxial with the spider 15.

Dated this 10th day of December, 1936.

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Patent Agents for the Applicants.

PROVISIONAL SPECIFICATION
No. 9493 A.D. 1937

Improvements in the Method of and Apparatus for Refuelling Aircraft in the Air

W, Sir Alan John Cobham, K.B.E., a British Subject, Hugh Coleman Johnson, a British Subject, and Percy Raymond Allison, a British Subject, all of Ford Aerodrome, Yapton, in the County of Sussex, and Flight Refuelling Limited, a Company organised under the Laws of Great Britain, of 8, Serjeants Inn, Temple, London, E.C.4, do hereby declare the nature of this invention to be as follows:—

The present invention provides certain modified constructions of the nozzle and co-operating reception fitting described in Specification No. 33975/36.

In the arrangements particularly described in that specification the nozzle on the end of the hose was drawn by the pull of the cable into the mouth of the reception fitting on the liner, and the manually operated means for causing the nozzle to overrun the valve and thereby open it was constituted by spring pressed balls or rollers which coacted with cam surfaces in the exterior of the nozzle, and were under the control of a manually operable link system for applying pressure to the springs.

According to one feature of the modified arrangement provided by the present invention, the nozzle is arranged to fit over instead of within the reception fitting. In this case the exterior of the reception fitting and the interior of the nozzle are suitably curved to prevent jamming. As before the nozzle contains a valve having a forwardly projecting abutment which engages a spider or the like in the reception fitting to check the further movement of the nozzle under the pull on the cable.

We have now devised various further forms of mechanism for effecting the necessary further forward movement of the nozzle relatively to the valve required to bring the nozzle into liquid tight engagement with the reception fitting and to open the valve.

In one such arrangement a number of levers are pivoted to the exterior of the reception fitting and these carry rollers or have bearing surfaces at their ends, which co-operate with cam surfaces on the exterior of the nozzle to force the latter forwards over the mouth of the reception fitting when the levers are moved inwards about their pivots.

This inward movement may be effected in various ways. Thus it may be derived from a sleeve which is slidable on the exterior of the reception fitting and is connected to the levers by links, which may incorporate springs for the sake of resilience. The sleeve may be reciprocated on the reception fitting by any convenient mechanism, such for example as a toggle linkage operated either mechanically or by a fluid controlled piston or spring dashpot. Alternatively the sleeve might be constituted as an annular hydraulic ram and operate in a cylinder disposed coaxially around the reception fitting.

In another arrangement the ends of the levers may be shaped to fit a co-operating surface on the exterior of the nozzle, the necessary travel being communicated to the nozzle by endwise instead of by pivotal movement of the levers.

In yet another arrangement the levers are attached at one end to links, and at the other are formed with noses to engage the nozzle. Intermediately they rest against spring loaded plungers or fulcrums. Between the links is located a cone which slides in the reception fitting and can be moved by manipulation of a linkage or hydraulic means to spread the ends of the levers apart and cause them to pivot about the plungers so that their noses approached one another and force the nozzle into binding engagement with the reception fitting. If the pull on the cable should at any time become excessive the springs will yield and allow the nozzle and reception fitting to separate.

The links at the ends of the levers are for retracting them out of position when not in use.

The ball end of the reception part may be fitted with a thin spherical metallic cup which may move over the co-operating surface of the nozzle so as to allow of small angular movements of the nozzle caused by variations in the trailing angle of the hose.

Parts that are liable to bump against each other may be vulcanized or covered with india rubber or a similar material in order to deaden the force of impact and therefore, prevent fracture of the parts. This expedient may also be adopted with the design of nozzle and reception fitting described in Specification No. 33975/36.

The present invention includes a further modification in the design of nozzle described in this specification and in Specification No. 33975/36, in which the cable, instead of being attached to the valve in the nozzle passes through a central hole in the valve spindle and is attached to a part fixed to the body of the nozzle, e.g. a spider supported in the nozzle behind the valve.

Dated this 3rd day of April, 1937.

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PROVISIONAL SPECIFICATION
No. 22737 A.D. 1937

Improvements in the Method of and Apparatus for Refuelling Aircraft in the Air

We, SIR ALAN JOHN COBHAM, K.B.E., a British Subject, HUGH COLEMAN JOHNSON, a British Subject, and PERCY RAYMOND ALLISON, a British Subject, all of Ford Aerodrome, Yapton, in the County of Sussex, and FLIGHT REFUELLING LIMITED, a Company organised under the Laws of Great Britain, of 8, Serjeants Inn, Temple, London, E.C.4, do hereby declare the nature of this invention to be as follows:—

In Specification No. 33975/36 are described various forms of hose nozzle and co-operating reception fitting for use in refuelling aircraft during flight. In each of these arrangements, the nozzle is only pulled by the cable for a relatively short distance into the reception fitting before the projecting valve stem meets an obstacle, and then the manually operated gear has to be put into action in order to force the nozzle home and thereby open the valve.

The present invention provides a modified arrangement, in which the nozzle is adapted to be pulled right home into the reception fitting by the pull on the cable, and in which, after the nozzle has been so pulled home, actuation of the manually operable gear causes forward movement of the rear part of the nozzle relatively to the forward part thereof, which is held fixed by the reception fitting, thereby opening the valve.

One form of nozzle according to the present invention will now be described in further detail, by way of example.

The rear portion of the nozzle is fixed to the hose pipe and is formed near its forward end with an annular groove, the forward side of which constitutes a cam surface to co-operate with the spring pressed rollers, balls or the like which are adapted to be forced inwardly by means of a manually operated gear as in the arrangements described in Specification No. 33975/36.

On the front of this rear portion is slidably mounted a nose piece, having its forward end shaped to fit the reception fitting.

A number of springs, conveniently four, are interposed between the rear portion of the nozzle and the nose piece, and tend to hold it in its forward position.

Within the nozzle is disposed a valve, which is normally held by a spring, abutting at its rear end against a spider attached to the rear portion of the nozzle, against a rearwardly facing valve seating formed on the interior face of the said rear portion. The valve stem projects forwardly through a spider fixed to the nose portion and acting as a guide for the valve stem. At its forward end, the valve stem terminates in a ball to which is attached the cable for drawing in the hose. The ball is substantially flush with the front end of the nose piece.

With this arrangement the nozzle can be drawn fully home into the reception fitting by a pull on the cable, and in this position the ball on the valve stem will just contact with an abutment which prevents further forward movement of the valve. If the manually operable gear is now actuated, the rollers will move in, and force the rear portion of the nozzle forward relatively to the valve and to the nose piece, thereby compressing the springs and opening the valve so as to permit fuel to flow from the hose into the reception fitting.

With this arrangement very little strain is imposed on the manually operable gear, as it only needs to move the rear portion of the nozzle forwards for a small distance compared with the distance that the nozzle has to be moved forward by the corresponding gear in the arrangements described in Specification No. 33975/36.

Whereas under Specification No. 33975/36 the nozzle could only be pulled into the reception cup for a limited distance, leaving it lying at an angle to the parallel of the receiver and depending for being finally brought into position, upon

the manual operation of the toggles, under the present invention, the nozzle is brought right home to the parallel of the receiver by the pulling in of the nozzle.

Furthermore, by the pulling in process alone, the valve stem on the nozzle makes a sealed joint with the abutment in the receiver, before the valve can be opened, and also by this bringing into position, the forward part of the nozzle also makes a petrol-tight joint by its abutment on the rubber ring incorporated in the receiver. Thus, by the pulling in process alone, a joint is established which leaves no possibility of loss of petrol during the act of opening the valve. The opening of the valve becomes a much simpler operation, since with the nozzle in position, it is left to the toggles to bear upon the rear portion with a straight thrust, thus opening the valve as a separate operation, independent of the pulling in process.

Dated this 19th day of August, 1937.

BREWER & SON,
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Patent Agents for the Applicants.

COMPLETE SPECIFICATION

Improvements in the Method of and Apparatus for Refuelling Aircraft in the Air

We, SIR ALAN JOHN COBHAM, K.B.E., a British Subject, HUGH COLEMAN JOHNSON, a British Subject, and PERCY RAYMOND ALLISON, a British Subject, all of Ford Aerodrome, Yapton, in the County of Sussex, and FLIGHT REFUELLING LIMITED, a Company organised under the Laws of Great Britain, of 8, Serjeants Inn, Temple, London, E.C.4, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improved apparatus for refuelling aircraft in the air.

The procedure generally adopted is for the fuel to be transferred to the aircraft to be refuelled through a hose which hangs down from a tanker aircraft. Contact between the two aircraft may for example be established in the manner described in Specification No. 432,908.

The invention provides, for use in the refuelling of an aircraft during flight, the combination of a ball or socket component of a hose coupling intended to connect directly or indirectly a refuelling hose carried by one aircraft with a fuel tank of another aircraft, and a device for clamping this component in liquid-tight engagement with a mating socket or ball component, which device can be released at will and is also adapted readily to yield and release the clamped parts when an abnormal pull is exerted by the hose both in the general axial direction of the coupling and in any direction inclined thereto within a substantial range of inclination, the component being so shaped in relation to the shape of the mating component and the disposition and construction of the clamping device being such that the components may be completely separated as a result of such an abnormal pull without jamming occurring. It will be understood that the range of inclination within which an abnormal pull of the hose will cause the clamping device to yield will be such as to ensure safe separation of the components in all conditions likely to be encountered in flight.

It has been proposed in Specification No. 369,228 to establish a connection between a coupling component on a refuelling hose and a mating component on the aircraft to be refuelled (which components do not however make a ball and socket joint) by means of a clamping device which will release in an emergency in the event of an abnormal upward pull of the hose due to the aircraft moving away from one another. It is, however, an essential feature of our invention that the coupling should disengage without jamming whatever the direction in which an abnormal pull of the hose occurs.

In one form of the invention a cable or the like attached to the component on the hose serves as a means for drawing it into preliminary engagement with the mating component, the clamping device being operative when the component on the hose has been brought into preliminary engagement as aforesaid to effect relative further movement of the components into clamping engagement. The component on the hose may include a valve which is normally held closed, but which is arranged to be opened on actuation of the clamping device to move said component from its position of preliminary engagement to its position of clamping engagement.

The invention will now be described in further detail with reference to certain examples of construction illustrated in the

accompanying drawings, in which:—

Fig. 1 is a longitudinal section through one construction, showing the nozzle being drawn into the reception fitting;

Figure 2 is a similar view of the same construction, showing the nozzle after it has been pulled home into the clamping position;

Fig. 3 is a longitudinal section through an alternative construction, showing the nozzle in the position of preliminary engagement with the reception fitting;

Fig. 4 is a similar view of the same arrangement, showing the nozzle having been moved forward into the clamping position, and

Figs. 5, 6 and 7 are longitudinal sections through three further constructions.

In the construction shown in Figs. 1 and 2, the cable, rope, wire or the like 10, by which the hose 11 is pulled across from the tanker to the receiving aircraft, passes through a side tube 12 leading in from the side of the reception fitting 13 to a central hollow boss 14 supported in the mouth of the reception fitting by a spider 15 or the like. The reception fitting terminates at its rear end in one or more petrol pipes (not shown) for conducting the fuel received from the hose into the petrol tanks of the receiving-aircraft. The end of the cable 10 is connected to a rod 16 disposed centrally of a nozzle 17 on the hose (which nozzle may be attached to an end fitting on the hose by means of a universal joint) and carrying a valve member 18. The rod, which constitutes the valve stem, is slidably mounted in front and rear spiders 19, 20 rigidly attached to the nozzle, and a compression spring 21 is disposed between the rear spider 20 and the valve member 18, which spring holds the valve member 18 against a seating 22 to close the mouth of the nozzle. As the nozzle 17 on the hose is drawn into the reception fitting 13 by the pull on the cable, a head 23, of ball or mushroom shape, at the front end of the rod 16 comes into contact with the boss 14 through which the cable passes, thereby sealing the side tube 12 and preventing the passage of fuel through it. Under these conditions the hose cannot be pulled further in by the cable, and this position of preliminary engagement of the nozzle with the reception fitting is indicated in chain-dotted lines in Fig. 1.

At the mouth of the reception fitting are a plurality of clamping rollers, balls or the like 24 (conveniently four) each of which is mounted on a plunger 34. When the head 23 comes into contact with the boss 14 as just described, the rollers 24 contact with the nozzle at the upper edge of a cam surface 25 thereon.

A manually operable link system is provided on the receiving aircraft for applying pressure to the rollers to force them inwards. This system is controlled by a lever 27, located at some distance from the reception fitting, which lever can be moved over about a pivot 30 from the position shown in Fig. 1 into that indicated in Fig. 2 in which it is held by a spring pressed stop 28 which co-operates with an extension 29 on the lever. Fixed to the lever 27 is a link 31 connected by cables 32 to bell cranks 33. These bell cranks abut against the plungers 34. When the lever 27 is moved clockwise about its pivot from the position shown in Fig. 1, the bell cranks 33 are rocked anti-clockwise, so as to apply pressure to the rollers 24 to force them inwards and downwards along the cam surface 25 on the nozzle and thereby force the latter forwards into its clamping position, in which it makes a liquid-tight joint with the reception fitting 13, as shown in Fig. 2. The reception fitting is provided with a rubber joint ring 35 at its mouth. The valve member 18 is held by the head 23 abutting against the boss 14, so that the valve opens against the action of the spring 21, thereby allowing fuel to flow into the reception fitting.

The front end 36 of the nozzle is curved to the exact male curvature to suit the internal curvature of the reception fitting. As will be appreciated from an inspection of the Figures, the radius of the ball end of the nozzle, the dimensions and curvature of the reception fitting and the disposition and construction of the clamping rollers are such as to ensure that the nozzle will leave the reception fitting without jamming notwithstanding that the pull of the hose may be at a substantial angle to the axis of the reception fitting.

If there should be a sudden pull on the hose during refuelling, e.g. owing to a bump, sufficient to overcome the force of the spring 40 associated with the stop 28, the bell cranks 33 will be turned clockwise about their pivots by the action of the cam surface 25 on the locking rollers 24, thereby pulling the handle 27 back into the position shown in Fig. 1, and allowing the nozzle to separate from the reception fitting. Instead of employing the spring 40 as the release device for permitting the nozzle to separate from the reception fitting when a predetermined separating force is exerted by the hose, the link 31 connecting the cables 32 and the handle 27 may embody a spring release arranged to yield and uncouple the bell cranks 33 from the handle at the predetermined value of the separating force.

Normally the hose is uncoupled manually at the end of the refuelling operation by returning the hand lever 27

to its original position shown in Fig. 1, thereby releasing the pressure of the rollers 24 on the nozzle, allowing them to be returned to the off position by the springs 26, and enabling the hose to be pulled back into the tanker taking the cable with it.

The attachment of the cable 10 is made to the head 23 on the rod 16 by a cut-away opening (not shown) at one end of the rod to permit a ball fixed to the end of the cable to enter into this cut-away. The cable is fixed at its inner end to a drum which forms part of the hauling gear on the receiving aircraft. When the hose has been wound back to the tanker the cable can be readily detached from it by uncoupling the joint, and can then be wound back into the receiving aircraft. Alternatively, provision may be made for disconnecting the cable from the nozzle on the receiving aircraft.

As an alternative to the arrangement illustrated in Figs. 1 and 2, a length of cable may pass through a bore in the centre of the rod 16 and be attached to a second spider (not shown) located on the hose side of the spider 20 by a ball on the end of the cable engaging a bayonet slot in the spider. The free end of this length of cable would be connected to the end of the cable wound on the drum of the receiving aircraft after contact has been established between the two aircraft. In this case the pull of the cable will draw the nozzle right home, past the position of preliminary engagement and into the position of clamping engagement, the valve opening when further forward movement of the rod 16 is prevented by the head 23 contacting with the abutment 14. The inward movement of the rollers 24 consequent upon actuation of the handle 27 will then serve only to clamp the nozzle in liquid-tight engagement with the reception fitting, without effecting further forward movement of the nozzle.

Again, it should be understood that the provision of a valve in this and the other constructions illustrated is by no means essential. All that is needed is an abutment on the nozzle to seal the passage by which the cable passes into the reception fitting when the nozzle is in the locking position. Where there is no valve in the nozzle the flow of fuel is of course controlled by valves on the supply aircraft which would not be opened until after the nozzle has been clamped into the reception fitting.

In the construction shown in Figs. 3 and 4, in the position of preliminary engagement of the nozzle 17 with the reception fitting 13 shown in Fig. 3, the nozzle is in liquid-tight engagement with the reception fitting.

The nozzle 17 is adapted to be pulled right home into the reception fitting 13 by the pull on the cable 10, and, after the nozzle has been so pulled home, actuation of the manually operable gear (the non-illustrated parts of which are similar to the corresponding parts in Figs. 1 and 2) causes forward movement of the rear part of the nozzle relatively to the forward part thereof, which is held fixed by the reception fitting, thereby opening the valve.

It will be appreciated that in this construction, as well as that illustrated in Figs. 1 and 2, the link system for actuating the clamping rollers 24 could, if desired, be replaced by a hydraulic or electrical system, provided some form of quick release is incorporated, which will enable the clamping device to release the clamped parts under an abnormal pull on the hose.

The rear portion 47 of the nozzle is fixed to the hose pipe 11 and is formed near its forward end with an annular groove 48, the forward side 25 of which constitutes a cam surface to co-operate with the locking rollers 24.

On the front of this rear portion is slidably mounted a nose piece 41, having its forward end shaped to fit the reception fitting. A number of springs 42, conveniently four, are interposed between the rear portion 47 of the nozzle and the nose piece 41, and tend to hold the latter in its forward position.

Within the nozzle is disposed a valve 18, which is normally held by a spring 21, abutting at its near end against a spider 20 attached to the rear portion of the nozzle, against a rearwardly facing valve seating 22 formed on the interior face of the said rear portion. The valve stem 16 projects forwardly through a spider 19 fixed to the nose piece 41 and acting as a guide for the valve stem.

At its forward end, the valve stem terminates in a head 23 to which is attached the cable 10 for drawing in the hose. The head 23 is substantially flush with the front end of the nose piece.

With this arrangement the nose piece can be drawn fully home into the reception fitting by a pull on the cable, and in this position the head 23 on the valve stem will just contact with the abutment 14 which prevents further forward movement of the valve. If the manually operable gear is now actuated, the clamping rollers 24 will move in, and force the rear portion 47 of the nozzle forward relatively to the valve 18 and to the nose piece 41, thereby compressing the springs 42 and opening the valve so as to permit fuel to

flow from the hose into the reception fitting (see Fig. 4).

With this arrangement very little strain is imposed on the manually operable gear, as it only needs to move the rear portion of the nozzle forwards for a small distance compared with the distance that the nozzle has to be moved forward by the corresponding gear in the arrangement shown in Figs. 1 and 2. Whereas in that arrangement the nozzle could only be pulled into the reception cup for a limited distance, leaving it lying at an angle to the axis of the receiver and depending for being finally brought into position upon the manual operation of the toggles, in the construction shown in Figs. 3 and 4 the nozzle is brought right home into the receiver by the pulling in of the cable.

Furthermore, by the pulling in process alone, the valve stem on the nozzle makes a sealed joint with the abutment in the receiver, before the valve can be opened, and also by this bringing into position, the nose piece of the nozzle also makes a petrol-tight joint by its abutment on the rubber ring 35 incorporated in the receiver. Thus, by the pulling in process alone, a joint is established which leaves no possibility of loss of petrol during the act of opening the valve. The opening of the valve becomes a much simpler operation, since with the nozzle in position, it is left to the toggles to bear upon the rear portion with a straight thrust, thus opening the valve as a separate operation, independent of the pulling in process.

In the constructions shown in Figs. 5—7, the nozzle 17 is arranged to fit over instead of within the reception fitting.

In the arrangement shown in Fig. 5 a number of levers 43 are pivoted to the exterior of the reception fitting and these carry locking rollers 24 at their ends, which co-operate with a cam surface 25 on the exterior of the nozzle to force the latter forwards over the mouth of the reception fitting when the levers are moved inwards about their pivots 44.

This inward movement may be effected in various ways. Thus it may be derived from a sleeve 45 which is slidable on the exterior of the reception fitting and is connected to the levers 43 by links 46, strong springs (not shown) being mounted between the anchor points of the links 49 to enable the clamping device to release the clamped parts when the hose exerts a predetermined separating force. The sleeve may be reciprocated on the reception fitting by any convenient mechanism, such for example as a toggle linkage 49 operated either mechanically or by a fluid controlled piston 50 or spring dashpot. Alternatively the sleeve might be constituted as an annular hydraulic ram and operate in a cylinder disposed coaxially around the reception fitting.

In yet another arrangement shown in Fig. 6 the levers 43 are attached at one end to links 51, and at the other are formed with noses 52 to engage the nozzle. Intermediately they rest against spring-loaded plungers or fulcrums 54. Between the links is located a cone 53 which slides in the reception fitting and can be moved by manipulation of a linkage 55 or hydraulic means to spread the ends of the levers 43 so that their noses 52 approach one another and force the nozzle into clamping engagement with the reception fitting. If the pull on the cable should at any time become excessive the springs 56 will yield and allow the nozzle and reception fitting to separate.

The links 51 at the ends of the levers 43 are for retracting them out of position when not in use.

The ball end of the reception fitting may be fitted with a thin spherical metallic cup 57, as shown in Fig. 7. This may move over the co-operating surface of the nozzle so as to allow of small angular movements of the nozzle caused by variations in the trailing angle of the hose.

Parts that are liable to bump against each other may be vulcanised or covered with india rubber or a similar material in order to deaden the force of impact and therefore prevent fracture of the parts.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. For use in the refuelling of an aircraft during flight, the combination of a ball or socket component of a hose coupling intended to connect directly or indirectly a refuelling hose carried by one aircraft with a fuel tank of another aircraft, and a device for clamping this component in liquid-tight engagement with a mating socket or ball component, which device can be released at will and is also adapted readily to yield and release the clamped parts when an abnormal pull is exerted by the hose both in the general axial direction of the coupling and in any direction inclined thereto within a substantial range of inclination, the component being so shaped in relation to the shape of the mating component and the disposition and construction of the clamping device being such that the components may be completely separated as a result of such an abnormal pull without jamming

flow from the hose into the reception fitting (see Fig. 4).

With this arrangement very little strain is imposed on the manually operable gear, as it only needs to move the rear portion of the nozzle forwards for a small distance compared with the distance that the nozzle has to be moved forward by the corresponding gear in the arrangement shown in Figs. 1 and 2. Whereas in that arrangement the nozzle could only be pulled into the reception cup for a limited distance, leaving it lying at an angle to the axis of the receiver and depending for being finally brought into position upon the manual operation of the toggles, in the construction shown in Figs. 3 and 4 the nozzle is brought right home into the receiver by the pulling in of the cable.

Furthermore, by the pulling in process alone, the valve stem on the nozzle makes a sealed joint with the abutment in the receiver, before the valve can be opened, and also by this bringing into position, the nose piece of the nozzle also makes a petrol-tight joint by its abutment on the rubber ring 35 incorporated in the receiver. Thus, by the pulling in process alone, a joint is established which leaves no possibility of loss of petrol during the act of opening the valve. The opening of the valve becomes a much simpler operation, since with the nozzle in position, it is left to the toggles to bear upon the rear portion with a straight thrust, thus opening the valve as a separate operation, independent of the pulling in process.

In the constructions shown in Figs. 5—7, the nozzle 17 is arranged to fit over instead of within the reception fitting.

In the arrangement shown in Fig. 5 a number of levers 43 are pivoted to the exterior of the reception fitting and these carry locking rollers 24 at their ends, which co-operate with a cam surface 25 on the exterior of the nozzle to force the latter forwards over the mouth of the reception fitting when the levers are moved inwards about their pivots 44.

This inward movement may be effected in various ways. Thus it may be derived from a sleeve 45 which is slidable on the exterior of the reception fitting and is connected to the levers 43 by links 46, strong springs (not shown) being mounted between the anchor points of the links 49 to enable the clamping device to release the clamped parts when the hose exerts a predetermined separating force. The sleeve may be reciprocated on the reception fitting by any convenient mechanism, such for example as a toggle linkage 49 operated either mechanically or by a fluid controlled piston 50 or spring dashpot. Alternatively the sleeve might be constituted as an annular hydraulic ram and operate in a cylinder disposed coaxially around the reception fitting.

In yet another arrangement shown in Fig. 6 the levers 43 are attached at one end to links 51, and at the other are formed with noses 52 to engage the nozzle. Intermediately they rest against spring-loaded plungers or fulcrums 54. Between the links is located a cone 53 which slides in the reception fitting and can be moved by manipulation of a linkage 55 or hydraulic means to spread the ends of the levers 43 so that their noses 52 approach one another and force the nozzle into clamping engagement with the reception fitting. If the pull on the cable should at any time become excessive the springs 56 will yield and allow the nozzle and reception fitting to separate.

The links 51 at the ends of the levers 43 are for retracting them out of position when not in use.

The ball end of the reception fitting may be fitted with a thin spherical metallic cup 57, as shown in Fig. 7. This may move over the co-operating surface of the nozzle so as to allow of small angular movements of the nozzle caused by variations in the trailing angle of the hose.

Parts that are liable to bump against each other may be vulcanised or covered with india rubber or a similar material in order to deaden the force of impact and therefore prevent fracture of the parts.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. For use in the refuelling of an aircraft during flight, the combination of a ball or socket component of a hose coupling intended to connect directly or indirectly a refuelling hose carried by one aircraft with a fuel tank of another aircraft, and a device for clamping this component in liquid-tight engagement with a mating socket or ball component, which device can be released at will and is also adapted readily to yield and release the clamped parts when an abnormal pull is exerted by the hose both in the general axial direction of the coupling and in any direction inclined thereto within a substantial range of inclination, the component being so shaped in relation to the shape of the mating component and the disposition and construction of the clamping device being such that the components may be completely separated as a result of such an abnormal pull without jamming

occurring.

2. Apparatus as claimed in Claim 1, in which means are provided on the aircraft to be refuelled for drawing a cable or the like attached to the component on the hose into the mating component and thereby bringing the components into preliminary engagement with one another, and in which actuation of the clamping device effects relative further movement of the components into clamping engagement.

3. Apparatus as claimed in Claim 2, wherein the component on the hose includes a valve which is normally held closed and wherein actuation of the clamping device is arranged to open the valve.

4. Apparatus as claimed in Claim 3, wherein the cable is attached to the valve stem, and wherein the mating component includes an abutment for preventing further forward movement of the component on the hose under the pull of the cable when it has reached the position of preliminary engagement, so that the further forward movement thereof into its clamping position on actuation of the clamping device results in the opening of the valve.

5. Apparatus as claimed in Claim 4, wherein the component on the hose is formed in two parts, having a spring or springs interposed between them, the arrangement being such that in the position of preliminary engagement the front portion thereof is in liquid-tight engagement with the mating component, the rear portion being movable relatively to the front portion against the action of the spring or springs to open the valve on actuation of the clamping device.

6. Apparatus according to any of the preceding claims, wherein the clamping device comprises a plurality of rollers or the equivalent which are movable inwardly to coact with a cam surface on the component on the hose to effect the desired clamping.

7. Apparatus according to any of the preceding claims, wherein the clamping device is furnished with a remote control.

8. Apparatus for establishing a fuel transferring connection between a hose and a fuel tank on an aircraft in flight substantially as described herein with reference to the accompanying drawings.

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