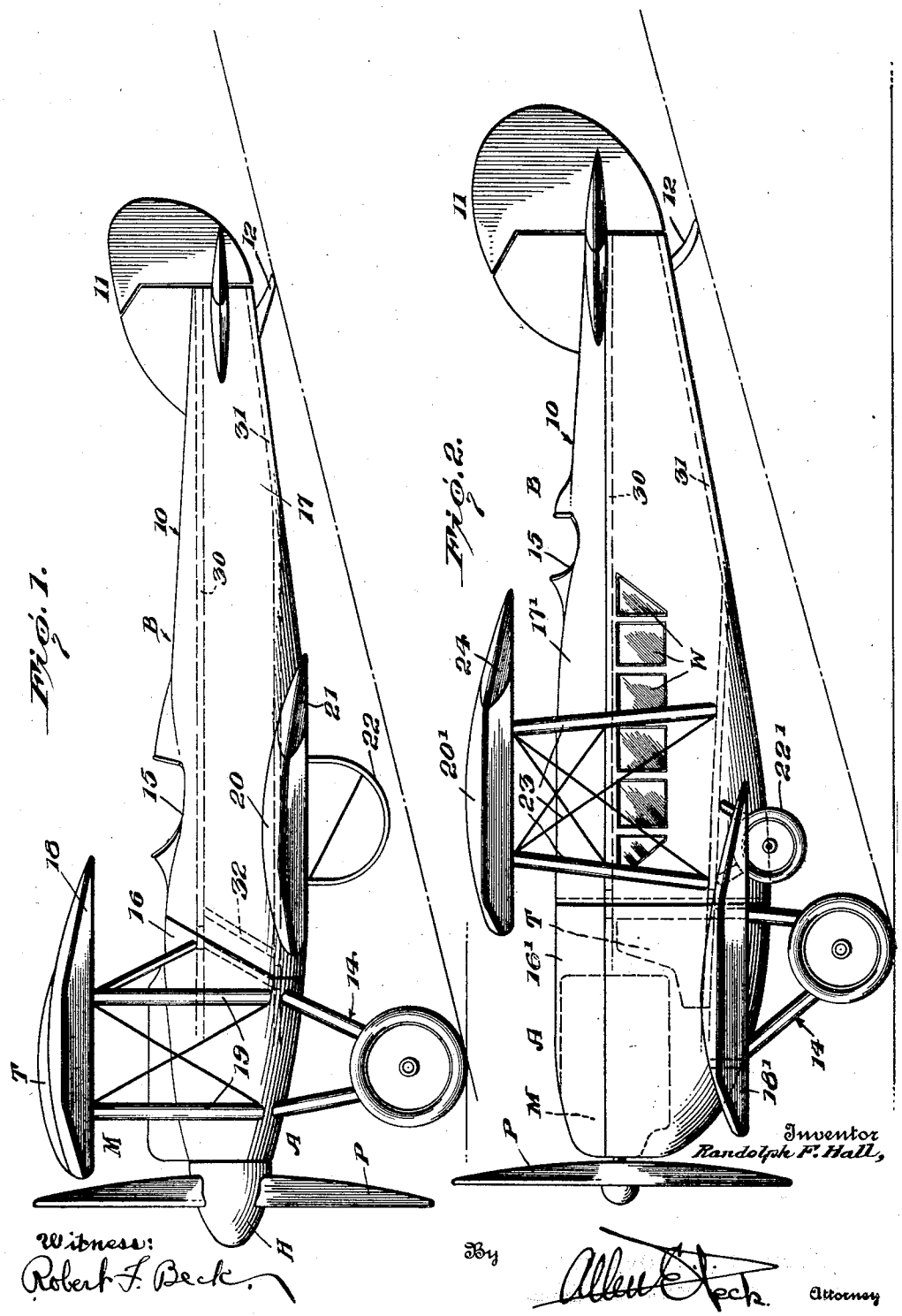
Aug. 4, 1925. 1,548,598

R. F. HALL

AIRPLANE

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R. F. HALL

AIRPLANE

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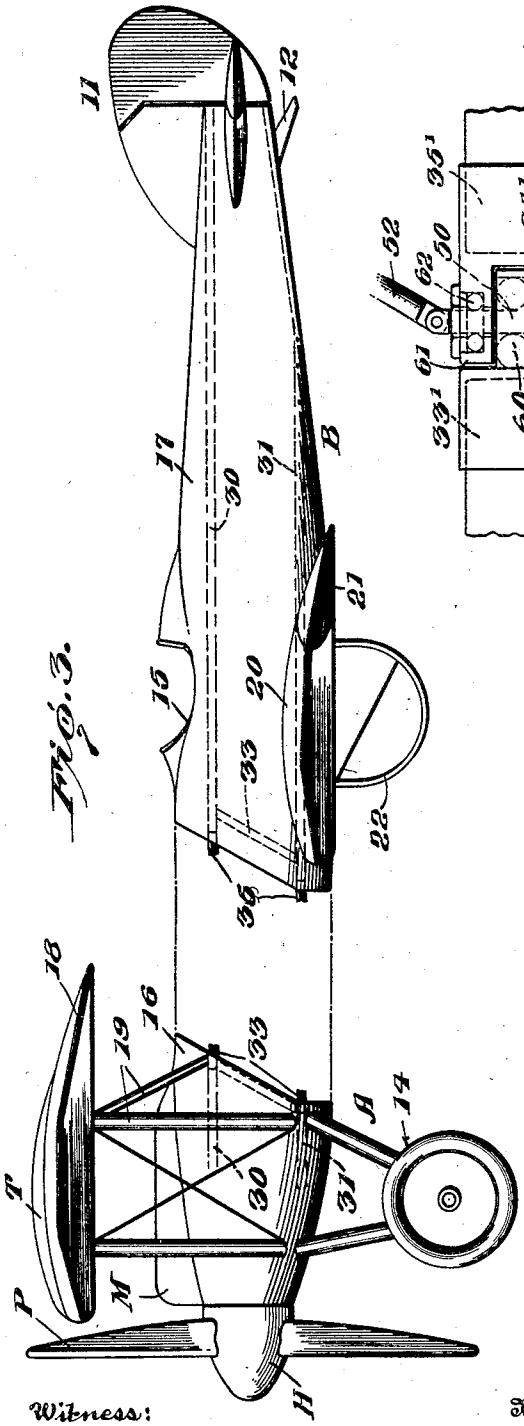


Fig. 3.

Fig. 1.

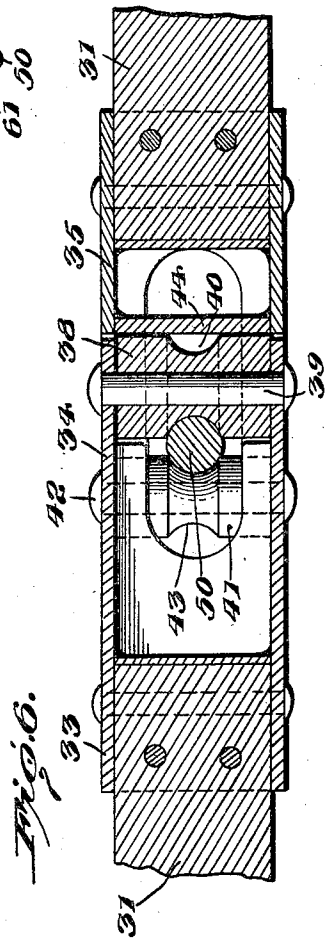


Fig. 2.

Witness:
Robert F. Beck

By

Inventor
Randolph F. Hall,
Albert F. Beck.
Attorney

Aug. 4, 1925. 1,548,598

R. F. HALL

AIRPLANE

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Fig. 4.

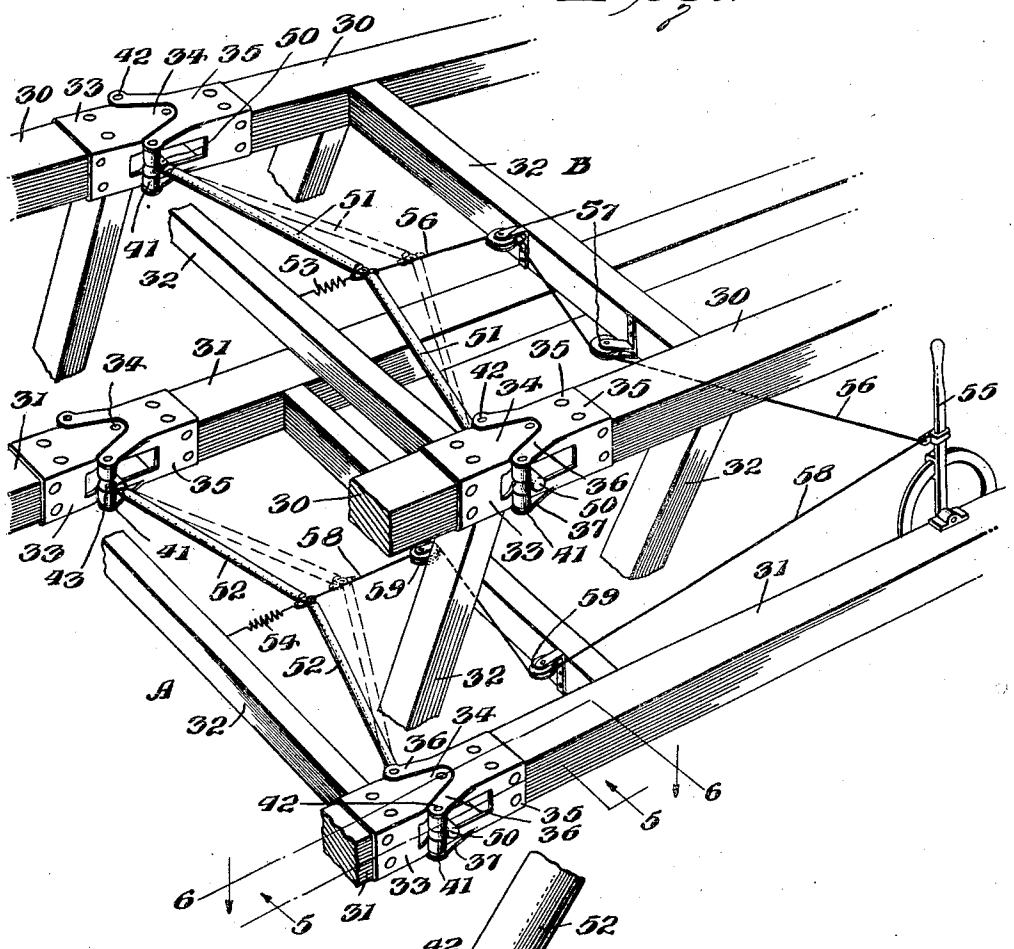
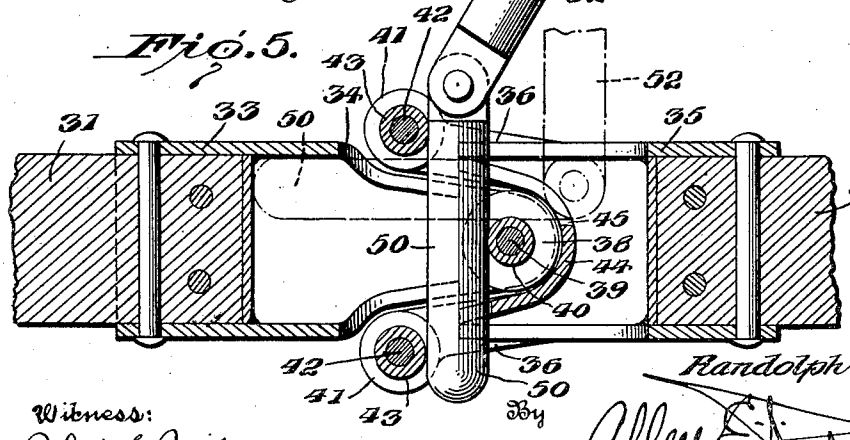


Fig. 5.



Witness:
Robert F. Becker

Inventor
Randolph F. Hall,
By
Allen E. Jacks. Attorney

Patented Aug. 4, 1925. 1,548,598

UNITED STATES PATENT OFFICE.

RANDOLPH F. HALL, OF ITHACA, NEW YORK, ASSIGNOR OF ONE-THIRD TO THEODORE P. HALL, OF WALLINGFORD, CONNECTICUT, AND ONE-SIXTH TO PAUL WILSON, OF ITHACA, NEW YORK.

AIRPLANE.

Application filed December 11, 1922. Serial No. 606,139.

To all whom it may concern:

Be it known that I, RANDOLPH F. HALL, a citizen of the United States of America, and a resident of Ithaca, county of Tompkins, State of New York, have invented certain new and useful Improvements in Airplanes, of which the following is a specification.

This invention relates to certain improvements in airplanes; and the nature and objects of the invention will be readily recognized and understood by those skilled in the art in the light of the following explanation and detailed description of the accompanying drawings illustrating what I at present consider to be the preferred embodiments or mechanical expressions of the invention from among various other forms, arrangements, combinations and constructions of which the invention is capable within the spirit and scope thereof.

One of the serious problems encountered in the operation and use of airplanes is the fire hazard, and the main contributing cause to the existence of this hazard is due to and arises from the use in airplanes of power plants requiring highly explosive or combustible fuels and oils for the operation thereof, such as the internal combustion motor types at present in universal use as airplane power plants. The use of a power plant of the internal combustion motor type necessitates the provision in an airplane of supplies of highly explosive and combustible fuel and oils, together with suitable supply lines for conducting and delivering fuel and oils to a motor. It is exceedingly difficult to prevent the possibility of leakage and escape of fuel and oils from an internal combustion motor and the supply lines therefor installed in an airplane and subjected to considerable vibration and various other conditions tending to cause loosening and opening of joints and packing. Due to the fact that internal combustion motors become highly heated in operation, and to the presence of other agencies tending to cause the ignition of combustible or explosive materials, such as the motor exhaust, and the ignition and other electrical systems which may be associated with a motor and from which exposed sparking may take place, it will be readily apparent and follows that any leakage or escape of the highly combustible fuel or oils from an internal combustion motor installed in the confined and limited space of an airplane presents a possibility of ignition thereof and resulting fire in the airplane. Fire may result from a variety of other causes than the ignition of fuel and oils leaking from a motor above referred to, as through accident to or abnormal conditions in a motor or the fuel and oil supply systems therefor, or from ignition of the supplies of fuel and oils from causes other than motor conditions, so that the installation of power plants of the internal combustion motor type is always attended by a fire hazard. The degree and extent of this fire hazard is dependent upon a number of conditions as determined by the particular type of airplane and power plant, and the manner of installation of the power plant with its fuel and oil supplies, as will be readily understood by those familiar with the operation of airplanes.

Through the medium of various refinements in the design and construction of airplanes and in power plants and the installation thereof, the fire hazard has been materially reduced but not eliminated. Experience has shown that with the known means for the prevention or extinguishing of airplane fires it is generally impossible to check or extinguish a fire in an airplane in flight and that the usual result of a fire once started is the destruction of the airplane and its occupants.

The present invention is directed to the problem of protecting an airplane and the occupants thereof against injury or destruction from fire in an airplane resulting from the fire hazard attendant the presence of an internal combustion motor power plant with its fuel and oil supply systems; and the main or basic object of the invention is the solution of this problem by localizing or grouping together the power plant and supply systems therefor in a detachable or removable portion of an airplane, so that, in the event of fire in flight this detachable portion with the power plant and supply systems therefor can be readily and instantly detached and dropped from the airplane

to prevent spread of the fire with the resulting injury to or destruction of the airplane and its occupants, and the airplane with its occupants can then be maneuvered to effect a landing.

A further object of the invention is the provision of an airplane formed of units which are detachable in flight, with one of the units having a power plant for the airplane mounted and installed thereon, and the other of said units arranged to permit control of the airplane therefrom and to provide for carrying pilot and useful load; and further to so form, construct and arrange the control or useful load unit of the airplane that it forms and provides in and of itself a complete balanced glider capable of sustaining and being maneuvered with the useful load carried thereby, so that upon detachment of the power unit therefrom with the airplane in flight, the control unit can be controlled and landed by the pilot therein.

A further object of the invention is the provision of an airplane formed of a series of units which are detachable in flight and on and among which the total supporting and controlling surfaces for the airplane formed by the assembled units are so distributed and mounted that one of the units when detached from the airplane is provided with supporting and control surfaces arranged and mounted in such a manner thereon as to form therewith a complete balanced and controllable glider capable of sustaining and being maneuvered in flight with the useful load which the unit carries in assembled position as an element of the airplane.

A further object of the invention is the protection of the occupants of airplanes against the dangers of fire in flight, by forming an airplane of a rear unit comprising a complete balanced and controllable glider having space for pilot and occupants or useful load, and a forward unit provided with supporting surfaces and having a complete power plant mounted thereon and installed therein, the forward unit being detachably connected to and mounted on the rear unit with the combined units and supporting surfaces forming a complete balanced airplane controllable from and by the control surfaces of the rear or glider unit and providing an airplane of general conventional design and high aerodynamical efficiency; so that in the event of fire in the forward or power unit it can be detached and dropped from the rear unit which then forms a glider by means of which the occupants of the airplane may descend and effect a landing.

A further object of the invention is the provision of efficent and practical mechanism for detachably locking and connecting together airplane units, such as above referred to, into assembled airplane forming relation and position, and to further provide such mechanism so that it is operable from an accessible point, preferably the control or pilot's cockpit of the airplane, to readily and instantly unlock and detach the units from the airplane in flight.

With the foregoing and various other objects in view, which other objects will be readily recognized by and apparent to those skilled in the aeronautical art, the invention consists in certain novel features in airplane design, and in the construction, combination and assembly of elements, as will be more fully and particularly pointed out and specified hereinafter.

Referring to the accompanying drawings:

Fig. 1 is a view in side elevation of a tractor biplane having positive stagger, and embodying features of the invention.

Fig. 2 is a view in side elevation of another design of tractor biplane of the enclosed cabin type having negative stagger and incorporating features of the invention.

Fig. 3 is a view in side elevation of the design of Fig. 1 with the forward and rear units embodying the invention in detached relation.

Fig. 4 is a detail perspective view, more or less diagrammatical, of one form and arrangement of mechanism for detachably locking the forward and rear units embodying the invention together into assembled airplane forming relation and position, portions of an airplane fuselage frame being diagrammatically shown.

Fig. 5 is a detail horizontal section through one of the detachable connections for locking the units together, taken on the line 5—5 of Fig. 4, and showing in dotted outline the position of the locking pin in released or unit detaching position.

Fig. 6 is a vertical longitudinal section through one of the detachable connections taken on the line 6—6, of Fig. 4.

Fig. 7 is a detail view in top plan of a modified form of detachable unit connection and locking pin therefor.

Several physical expressions or mechanical adaptations of the principles of the various features of the invention are illustrated in the accompanying drawings as applied to and embodied in airplanes of tractor biplane design of the land type. However, attention is here directed to the fact that the illustrated and described mechanical expressions of the features of the invention and the particular designs and types of airplanes in which these features are embodied, are intended purely by way of exemplification and not by way of limitation, to permit of a detailed explanation of the principles of the invention and the results obtained thereby. It will be clear and read-

ily apparent to those familiar with and skilled in the aeronautical art that the invention and the various features thereof are capable of other mechanical adaptations than the illustrated and described examples, and the embodiment in and application to other various types, both land and water, of monoplane or multiplane, and pusher or tractor designs.

In Figs. 1 and 3 of the accompanying drawings an airplane of more or less conventional design of the tractor biplane, land type and embodying the features of the invention is illustrated. This embodiment of the invention provides an airplane having a fuselage 10 of streamline form with the usual tail assembly or empennage 11 and the tail skid 12 mounted on the rear or after end thereof, and the landing carriage or chassis 14 mounted at the forward portion thereof. A pilot's or control cockpit 15 is formed in the fuselage 10 and provides the point from which the airplane is controlled. The foregoing arrangement conforms to conventional design practice and will be readily recognized by and clear to those skilled in this art.

The fuselage 10 of the airplane is divided transversely between the landing carriage or chassis 14 thereon and the control cockpit 15 formed in the fuselage, into a forward section 16 and a rear or after section 17, which forward and rear sections are detachably assembled and locked together in longitudinal or fore and aft alinement to form the complete streamline fuselage 10 of the airplane, as will be more fully and particularly referred to and described hereinafter.

The forward section 16 of the fuselage 10 having the chassis 14 thereon, is provided with a supporting surface or wing 18 mounted thereabove and spaced therefrom by any suitable or desired arrangement of streamline struts 19 extending upwardly from the forward section 16, with the wing 18 attached thereto and supported thereby in proper position above the section 16 and in desired relation with respect to the assembled fuselage 10. A suitable power plant for the airplane is mounted on the forward section 16 of the fuselage 10, and in the present instance includes a motor M mounted and enclosed within the fuselage section 16, and a fuel supply tank or tanks T for the motor M mounted on and faired or streamlined with the supporting surface or wing 18. A tractor propeller P having a streamlined hub or cap H is mounted on the forward or nose end of the fuselage section 16 and operatively connected with and driven by the motor M, as will be readily understood by those familiar with this art. Thus, by the foregoing arrangement and assembly of indicated elements and structure on and with the forward detachable section 16 of the fuselage 10, a forward detachable unit A of the complete airplane is formed, which unit A includes the complete power plant for the airplane, a portion of the total supporting surfaces therefor and the landing carriage or chassis. Although in the example illustrated the power plant is distributed between the fuselage section 16 and the supporting surfaces 18, it is not intended or desired to limit the invention to such arrangement and mounting of the power plant, as the invention contemplates any suitable or desired arrangement, mounting and installation of power plant and associated elements, on and forming a part of the detachable unit A of the airplane, as will be evident to anyone familiar with this art. Preferably, although not essential, the rear or after end of the fuselage section 16 of the forward or power unit A is provided with any suitable fireproof bulkhead (not shown), or other equivalent arrangement, closing or shutting off the forward fuselage section 16 from the rear or after section 17 in assembled position of these sections to form the fuselage 10.

The rear or after section 17 of the fuselage 10 having the pilot's or control cockpit 15 formed therein and the tail assembly or empennage 11 and tail skid 12 of the airplane mounted and arranged on the after or tail end thereof, is provided with a supporting surface or wing 20 mounted on and suitably supported by and from the lower forward portion thereof. The wing 20 is provided with any desired lateral control surfaces, such as the ailerons 21 operable from the control cockpit 15 of the fuselage 17. The section 17 of the fuselage 10 with the supporting surface or wing 20 and the empennage 11 and tail skid 12 mounted thereon and associated therewith provides a rear detachable unit B which when connected to and mounted in assembled position with the forward or power unit A, forms the complete airplane. The supporting surface 20 is so designed, arranged and mounted on the rear unit B with respect to the empennage 11 and the suporting surface 18 of the forward or power unit A, that when the forward and rear units A and B are assembled and detachably connected to form the complete airplane, the combined supporting surfaces 18 and 20 provide the total supporting surfaces to sustain, and together with the empennage surfaces, to properly balance the complete airplane structure in flight.

In the illustrated example, the design and mounting of the supporting surface 18 above the forward fuselage section 16, and the supporting surface 20 on the lower portion of the rear section 17, provides a supporting surface or wing arrangement in the complete assembled airplane of the biplane type having a decided positive stagger. The po-

sition of the pilot's or control cockpit 15 in the rear fuselage section so that in the complete airplane this cockpit is aft of the upper wing 18, results in an airplane in which a pilot has good visibility, and together with the aerodynamic efficiency gained by positive stagger in a multiplane type, provides a design particularly adapted and efficient for military operations.

One of the main features of the invention, which together and in combination with the broad features thereof exemplified by the foregoing described design, arrangement and construction practically eliminates or materially reduces the dangers from the fire hazard hereinbefore explained, resides in the formation of the rear unit B of the airplane to provide a complete controllable glider capable of sustaining and being maneuvered with the useful load carried thereby when detached from the airplane. In the design of Figs. 1 and 3 of the accompanying drawings, the fuselage section 17 of the rear unit B forms the fuselage of the glider and is provided at its forward or nose end with a suitable bulkhead (not shown) or other suitable structure for closing the end thereof. The empennage 11 of the airplane mounted on the after end of the fuselage section 17 provides the proper stabilizing and rear control surfaces for the glider and the rear lower wing 20 of the biplane wing arrangement of the airplane forms a monoplane wing of the cantilever type for the glider. The wing 20 is so designed and mounted in position on the fuselage section 17 with respect to the empennage 11 that it balances with the empennage surfaces and forms the required supporting surface to sustain the unit B as a glider when detached from the airplane. The control cockpit 15 of the airplane positioned in the fuselage section 17 forms the control cockpit for the glider unit B from which point the empennage surfaces and the wing ailerons are operable to permit control and maneuvering of the glider formed by the unit B when detached. A suitable landing carriage or chassis arrangement is provided on the fuselage section 17 of the unit B and cooperates with the tail skid 12 of the airplane to permit of landing the glider. In the present instance the glider chassis is formed by landing skids 22 mounted on the fuselage section 17 below the wing 20 and control cockpit 15, and so positioned with respect to the center of gravity of the unit B when functioning as a glider as to permit of its being readily and properly landed.

From the foregoing description and explanation of the design of Figs. 1 and 3, it will be apparent that by detachably assembling and locking the forward power unit A with and to the rear control or glider unit B, a complete balanced airplane is formed controllable from the cockpit 15 through the medium of the control surfaces 21 of the wing 20 and the control surfaces of the empennage 11 mounted on and forming elements of the rear glider unit B. The power plant mounted on and in the forward or power unit A is controlled from the pilot's or control cockpit 15 in the rear or glider forming unit B through the medium of the usual or any other desired control operating mechanism (not shown), and such control operating mechanism may be suitably arranged and installed in any desired manner so as to be disconnected or severed upon detachment of the rear units A and B in flight. The forward and rear units A and B are detachably assembled connected and locked together to form the complete airplane by suitable means operable from the control cockpit 15 of the airplane to detach the units A and B in flight. One possible form and mechanical expression of such means is illustrated in the accompanying drawings and described in detail hereinafter as an example of this feature of the invention.

In the event of fire in the forward or power unit A of the complete assembled airplane, or any other cause making it desirable to detach and drop the forward unit, the detachable locking means for the units is operated from the control cockpit and the forward or power unit A is released and dropped from the rear unit. Upon detachment and dropping of the forward or power unit A from the rear or control unit B, the latter unit then forms and provides a complete balanced and controllable glider capable of sustaining and being landed with the pilot and useful load carried thereby. Thus, by detaching and dropping the portion of the airplane in which the fire is seated, and that portion in which the power plant with the supplies of highly combustible fuel and oils are grouped and localized, prevents the spread of the fire to the useful load portion of the airplane, and due to the formation of the useful load portion to provide a complete glider permits of the occupants thereof maneuvering the glider to effect a landing, thereby protecting the occupants and useful load from injury or destruction.

A design and arrangement of tractor biplane presenting a different interpretation of the basic principles and features of the invention than the exemplification thereof presented by the foregoing described design illustrated in Figs. 1 and 3, is disclosed in Fig. 2 of the accompanying drawings. The design and arrangement of Fig. 2 provides an airplane of the enclosed cabin type having a fuselage 10 upon the after or tail end of which an empennage 11 and tail

skid 12 are mounted, and at the forward portion of which a landing carriage chassis 14 is mounted. The fuselage 10 is formed of the forward section 16′ and the rear or after section 17′ which sections are detachably assembled and locked together in longitudinal or fore and aft alinement to provide the complete streamline fuselage 10 for the airplane, as hereinbefore explained with reference to the design of Fig. 1.

The forward fuselage section 16′ has the complete airplane power plant including the motor M and supply tanks T grouped and mounted thereon and totally enclosed therein, and if desired a fire-proof bulkhead (not shown) closing and shutting off the rear end of the section 16′ from the after fuselage section 17′. A propeller P is mounted at the nose end of the fuselage section 16′ and is driven by and from the power plant in the usual or any other desired manner. A supporting surface or wing 18′ is mounted on the lower or under portion of the fuselage section 16′ and with the other structure and elements above described forms therewith the forward or power unit A of the complete airplane.

The rear fuselage section 17′ is formed to provide an enclosed cabin for passengers or other useful load, and has suitable windows or ports W in the sides thereof, together with doors or the like (not shown) by means of which access to and from the enclosed cabin is obtained. An open pilot's or control cockpit 15 is formed in the fuselage section 17′ from which the assembled airplane is adapted to be controlled. A supporting surface or wing 20′ is mounted on the forward portion of the fuselage section 17′, and is supported thereabove and spaced therefrom by suitable stream-line struts and brace wires 23 extending upwardly from opposite sides of the section 17′ with the wing 20′ attached thereto. The wing 20′ is provided with the usual or any other desired lateral control surfaces or ailerons 24 connected with and operable from the pilot's or control cockpit. The wing 20′ is so designed, mounted and arranged on the fuselage section 17′ with respect to the empennage 11 mounted thereon, as to balance therewith and form a glider, capable of control from the cockpit 15, as explained with reference to the design of Fig. 1. The rear or glider unit B of Fig. 2, so formed is provided with a landing carriage or chassis 22′ of the wheeled type under the forward portion thereof which is so mounted as to properly cooperate with the tail skid 12 as to permit landing of the glider formed by the unit B.

The forward power unit A and the rear control and glider unit B of the design of Fig. 2, are detachably assembled and locked together by suitable means operable from the control cockpit 15, as referred to hereinafter, and these units when so assembled provide a complete controllable airplane having supporting surfaces or wing arrangement of the biplane type with a decided negative stagger formed by the combined wings 18′ and 20′. The function of the design of Fig. 2 is similar to that described with reference to Figs. 1 and 3, the rear control unit B of the complete airplane forming a complete glider when the forward unit A is detached and dropped therefrom, which glider is capable of sustaining and being maneuvered with the useful load carried thereby through the medium of the wing 20′ and the control surfaces operable from the cockpit 15. The design of Fig. 2 with the fuselage of the enclosed cabin type is particularly adapted to commercial work, although not so limited.

One form, arrangement and construction of means for detachably assembling and locking the forward and rear units A and B of the designs illustrated and described above, into airplane forming position and relation is disclosed in Figs. 4 to 7, inclusive, of the accompanying drawings. The illustrated fuselages 10 of the airplane designs shown, are of the type formed of a frame enclosed within and covered by a suitable covering or skin, which fuselage types are well known and familiar to those skilled in this art. The fuselage frames include opposite spaced pairs of upper and lower main longitudinal beams or longérons 30 and 31 extending longitudinally or fore and aft of the fuselage, and suitably interconnected and interbraced to form the main fuselage frames. According to the invention an airplane fuselage is formed of sections and in the fuselage types illustrated each section is formed of a suitably covered frame including the opposite spaced pairs of upper and lower longérons 30 and 31, which longérons in assembled position of the fuselage sections are longitudinally alined and detachably locked together with the coverings of the section in unbroken continuation to form the complete fuselage, by means of certain detachable connections joining the section longérons and mechanism for locking and unlocking such connections to permit of the sections being readily and instantly detached in flight.

The adjacent end portions of the fuselage sections 16 and 17 of the airplane design of Fig. 1, are diagrammatically illustrated in Fig. 4 of the drawings, together with one form and embodiment of detachable connections therefor and mechanism for locking and unlocking the same to assemble or detach the airplane units. In the illustrated example, portions of the fuselage section frames are shown including the opposite spaced pairs of upper and lower longérons

30 and 31, and suitable interconnecting and interbracing struts or cross beams 32 extending between and maintaining the longérons in proper relation. The rear or after ends of the longérons 30 and 31 of the fuselage section of the forward power unit A are provided with the fittings 33 secured thereto and thereover. The fittings 33 are formed with the rearwardly extending projections or tongues 34 in longitudinal alinement and extension of the longérons to which they are respectively secured. A series of fittings 35 are secured to and over the forward ends of the longérons 30 and 31 of the fuselage section 17 of the rear control or glider unit B of the airplane. The fittings 35 are formed to provide vertically disposed grooves or sockets adapted to receive the tongues 34, respectively, of the fittings 33 on the longérons 30 and 31 of the forward unit A, when the units A and B are in assembled airplane forming relation with the longérons 30 and 31 in longitudinal alinement. The vertically disposed grooves or sockets of the fittings 35 are defined by a pair of upper outwardly and forwardly diverging projections or arms 36, and a similar pair of lower outwardly and forwardly diverging arms 37 spaced below and in vertical alinement with the upper pair of arms 36.

Referring particularly to Figs. 5 and 6 of the accompanying drawings in which the fittings 33 and 35 are illustrated in detail. The tongues 34 of the fittings 33 are formed with a transverse horizontally disposed opening therethrough forming each tongue 34 into a pair of vertically alined upper and lower projections between the outer ends of which a vertically disposed roller 38 is rotatably mounted on a pin 39 extending between and attached to the upper and lower projections forming the tongue 34. Each roller 38 is formed with a circumferential groove 40 therearound intermediate the ends thereof, for a purpose described hereinafter. Each fitting 35 is provided with a pair of opposite vertically disposed rollers 41 rotatably mounted on pins 42 extending between the outer ends of each alined pair of upper and lower arms 36 and 37, respectively. The rollers 41 are each provided with a circumferential groove 43 extending therearound and intermediate the ends thereof. The fittings 35, in the present instance, are each formed hollow to the rear or inwardly from the base of the groove or socket provided by the arms 36 and 37, and the side walls of each fitting to the rear of the groove or socket are provided with alined openings therethrough, as will be clear by reference to the drawings. The base of the vertically disposed groove or socket in each fitting 35 is formed by a vertically disposed curved wall or web 44 extending across the fitting inwardly from the arms 36 and 37, and diverging forwardly and outwardly toward and terminating a distance from the opposite side rollers 41, respectively, to form a transverse horizontally disposed passage through the fitting between the rollers 41 and the groove or socket base 44. One side of the curved groove base 44, in the present instance the inner side thereof, is cut away at 45 (see Fig. 5) a distance inwardly toward the center of the fitting to provide an opening therethrough opposite and in line with the adjacent opening through the inner side of the fitting 35.

In assembled airplane forming position of the forward and rear units A and B, the longérons 30 and 31 of the fuselage sections 16 and 17 are in longitudinal alinement, with the tongues 34 of the fittings 33 on the forward fuselage section 16 fitting into and received by the grooves or sockets formed in the respective fittings 35 on the rear fuselage section 17, as clearly shown in Fig. 4 of the accompanying drawings. Each tongue 34 fits into the groove of the fitting 35 respectively adjacent and alined therewith, and the roller 38 at the end of the tongue 34 is located at the inner or base end of the groove of the fitting 35, so that a passage is formed transversely through the fitting 35 and the tongue 34 of the fitting 33, between the roller 38 of tongue 34 and the opposite side rollers 41 between the arms 36 and 37 of the fitting 35. Each connected or coupled pair of fittings 33 and 35 is provided with a locking pin 50 extending transversely through the fittings between and bearing on the rollers 38 and 43 in the grooves 40 and 43 thereof, respectively, as particularly shown in detail in Fig. 5. Thus, with the units A and B in assembled position and the pins 50 extending through the respective interconnected fittings 33 and 35, the units are locked together in airplane forming position and relation. The pins 50 are removable from locking position to permit detachment of the units A and B from assembled airplane forming position, by drawing them outwardly from the interconnected fittings 33 and 35, the pins bearing on the rollers 38 and 39 which act as roller bearings therefor and permit of the pins being withdrawn against the forces and pressures exerted thereon when in locking position in the fittings 33 and 35 connecting the units A and B together.

Mechanism for maintaining the pins 50 in the locking position, and for withdrawing the pins from locking position to permit detachment of the units A and B in flight is provided, and one form and embodiment thereof is more or less diagrammatically illustrated in Fig. 4 of the drawings. The illustrated example comprises a pair of pivotally coupled links 51 extending

between the opposite pair of upper longérons 30 and pivotally connected at their opposite outer ends to the opposite upper locking pins 50, respectively; and a similar pair of pivotally coupled links 52 extending between the opposite pair of lower longérons 31, directly below and in vertical alinement with the upper links 51, and pivotally connected at their opposite outer ends to the opposite locking pins 50, respectively. A coil spring 53 is attached at one end to the links 51 at their point of pivotal connection, and at the opposite end to a structural element, such as the cross beam 32 between the upper longérons 30, of the forward fuselage 16. The coil spring 53 normally tends to draw or force the pivoted links 51 forwardly and thus maintain the pins 50 pivotally connected thereto in locked position extending through the connected fittings 33 and 35, respectively. A similar coil spring 54 is attached between the lower pivoted links 52 and a cross beam 32 between the lower longérons 31 of the forward fuselage section 16, and normally maintains the locking pins 50 pivotally connected thereto in locking position. An operating lever for the locking pins 50 is suitably mounted on the rear fuselage section 17 and operable from the control cockpit 15 therein. The lever 55 is connected with the upper pair of pivoted links 51 by an operating cable 56 extending over and guided by a series of pulleys 57, and is connected with the lower pair of pivoted links 52 by an operating cable 58 extending over and guided by a series of pulleys 59. The upper and lower pairs of pivoted links 51 and 52 are so connected by the cables 56 and 58, respectively, with the operating lever 55, that by proper movement of the operating lever the links 51 and 52 are drawn rearwardly against the tension of the springs 53 and 54 to simultaneously withdraw the locking pins 50 respectively connected therewith from locking position.

The forward and rear units A and B are assembled and locked together to form the complete airplane by the locking pins 50 extending through the connected fittings 33 and 35 on the fuselage sections, as above described. In order to unlock and detach the units A and B in flight, the operating lever 55 in the control cockpit 15 is actuated to draw the pivoted links 51 and 52 rearwardly and through their pivotal connections with the locking pins 50, respectively, to simultaneously withdraw these pins from the coupled fittings 33 and 35. The position of the links 51 and 52 with the locking pins withdrawn is indicated in dotted lines in Fig. 4 of the drawings. Immediately upon withdrawal of the pins 50 from locking position and uncoupling of the connected fittings 33 and 35, the forward or power unit A is released and drops from the rear unit B. The release and dropping of the unit A swings or snaps the locking pins 50 forwardly into the position in the cut away portions 45 of the groove base walls 44 of the fittings 35, as indicated in dotted lines in Fig. 5, and further breaks or severs the connection of the springs 53 and 54 with the fuselage section 16 of the forward unit A leaving the pins 50 in the position indicated.

A modified form of detachable connection or coupling is illustrated in Fig. 7 of the drawings. In this form the fitting 33′ for the forward fuselage section 16 is provided with a tongue 34′ having an aperture extending transversely therethrough and a ball race therearound in which a series of ball bearings 60 are suitably mounted and confined. A type of fitting 35′ is provided for use on the rear fuselage section 17, which is formed with spaced arms 61 adapted to receive the tongue 34′ of the fitting 33′ therebetween, and having alined bores therethrough provided with ball bearings 62 surrounding the same and suitably mounted in the arms 61. In connected or coupled position the tongue 34′ of the fitting 33′ extends between the spaced arms 61 of the fitting 35′ with the bore through the tongue in alinement with the bores through the arms 61, and the locking pin 50 is extended through these alined bores and locks the fittings 33′ and 35′ together. The pin 50 in locking position bears on the ball bearings 60 of the fitting 33′ and 62 of the fitting 35′, thus permitting of ready withdrawal of the pin to detach the fittings.

With the above described mechanism it is possible to rigidly and detachably connect and lock the forward and rear units A and B together in assembled position to form a complete airplane having the requisite factor of safety, and further presenting a clean design with a minimum of head resistance and high performance for the particular type. However, the illustrated mechanism for detachably connecting and locking the airplane units together is disclosed herewith merely as an example of one manner of accomplishing the desired results, and it is not intended to limit the invention to the mechanism disclosed as it will be clear that other forms, embodiments and types of mechanism and means can be utilized for the purposes and to secure the results of the illustrated mechanism. Further, it is evident that several features of the detachable locking mechanism illustrated, such as the detachable fittings, are capable of general application and therefore it is not desired to limit.

It is seen from the foregoing description and explanation of the illustrated embodiments of the various features of the inven-

tion, that in the event of any cause arising making it desirable to detach and drop the power unit of the airplane during flight, the locking mechanism is actuated from the control cockpit in the glider unit and the power unit is instantly released and drops from the rear or glider unit, with the latter unit forming a glider capable of sustaining the load carried thereby and of being maneuvered to effect a landing therewith. The units can be detached in flight with the airplane in any position, although they are preferably detached with the airplane in a dive or glide, so that when the forward unit is detached and drops from the glider unit the latter is in a normal position under complete control.

Although the invention is primarily directed to protection of the occupants and useful load of airplanes against the dangers of the fire hazard, the basic and generic principles of the invention are adapted to other uses and to secure other results in the operation of airplanes. A glider unit or units may be incorporated in an airplane, or combined with other units to form an airplane, from which a glider unit can be detached and the remaining structure will provide a complete airplane capable of continuing flight with a glider unit or units detached therefrom, so that, delivery of occupants and useful load can be made from an airplane in flight without the necessity of landing.

That broad feature of the invention which provides an airplane formed of units with the total supporting and controlling surfaces of the airplane distributed among and between the units in such a manner that a unit or units of the airplane form complete controllable gliders when detached, is capable of embodiment in various supporting surface or wing arrangements of both the monoplane and multiplane types, and it is not intended by the illustrated examples to limit the invention to the biplane types disclosed and described.

The invention further contemplates the provision of an auxiliary power plant, if desired in a glider unit, and the term "glider" as used in the foregoing description and in the claims appended hereinafter, is intended to include the provision of auxiliary power plants in a glider unit, as well as to include any airplane unit which when detached from an airplane provides controllable and maneuverable means capable of flight.

It is further evident that various changes, variations, substitutions and modifications in arrangements, combinations, and constructions might be resorted to without departing from the spirit and scope of the invention and hence I do not wish to limit the invention to the exact disclosures hereof.

Desiring to protect my invention in the broadest manner legally possible, what I claim is:

1. An airplane comprising a forward unit and a rear unit, the said units detachably connected to form the complete airplane, and the said rear unit formed to provide a complete glider when detached from said forward unit.

2. An airplane comprising a forward unit and a rear unit detachably connected therewith and thereto, a power plant mounted on said forward unit, and the said rear unit forming a complete controllable glider when detached from said forward unit.

3. An airplane comprising a forward unit and a rear unit detachably connected therewith to form the complete airplane, supporting surfaces for the airplane mounted on said forward and rear units and in airplane forming relation of said units providing the total supporting surfaces therefor, and the said rear unit formed to provide a complete controllable glider with the portion of the airplane supporting surfaces mounted thereon forming the supporting surfaces for the glider.

4. An airplane comprising a forward unit and a rear unit detachably connected together to form the complete airplane, supporting surfaces for the airplane mounted on said forward and rear units and in airplane forming relation of said units providing the total supporting surfaces for the airplane, control surfaces for the airplane mounted on said rear unit, and the said rear unit formed to provide a complete controllable glider with the portion of the airplane supporting and control surfaces mounted thereon providing balanced supporting and control surfaces for the glider.

5. An airplane comprising a forward unit and a rear unit detachably connected therewith to form the complete airplane, said forward unit having a power plant mounted thereon and the said rear unit provided with a control cockpit, supporting surfaces mounted on said forward and rear units and in airplane forming relation of said units providing the total supporting surfaces for the airplane, control surfaces for the airplane mounted on said rear unit and operable from the control cockpit thereof, and the portion of the supporting surfaces and the control surfaces of the airplane mounted on said rear unit to form a balanced maneuverable glider controllable from the control cockpit thereof.

6. An airplane comprising a forward unit and a rear unit detachably connected to form the complete airplane, the forward unit having the power plant for the airplane mounted thereon, the rear unit provided with a control cockpit for the airplane, and the said rear unit formed to

provide a complete balanced glider controllable from said control cockpit when detached from said forward unit.

7. An airplane comprising a forward unit and a rear unit detachably connected to form the complete airplane, said forward unit having a power plant for the airplane mounted thereon and said rear unit provided with a control cockpit for the airplane, means operable from said control cockpit for detaching said units in flight, and the said rear unit when detached from the airplane formed to provide a complete balanced glider controllable from the airplane control cockpit thereof.

8. An airplane comprising a forward unit and a rear unit detachably connected therewith to form the complete airplane, said forward unit including supporting surfaces, a chassis, and a power plant for the airplane mounted thereon, said rear unit including supporting surfaces, control surfaces for the airplane, a control cockpit from which said control surfaces are operable, and an auxiliary chassis, and the said rear unit when detached from said forward unit providing a complete balanced glider controllable from said control cockpit.

9. An airplane comprising a forward unit and a rear unit detachably connected therewith to form the complete airplane, said forward unit having the power plant for the airplane mounted thereon, supporting surfaces for the airplane mounted on said forward and rear units, control surfaces for the airplane mounted on said rear unit, a control cockpit from which said control surfaces are operable provided on said rear unit, and that portion of the total airplane supporting surfaces mounted on said rear unit so arranged with respect to the airplane control surfaces mounted thereon as to form of the rear unit when detached a balanced glider controllable from the airplane control cockpit on said rear unit and capable of sustaining the useful load carried thereby when connected with said forward unit as an element of the airplane.

10. An airplane formed of detachably connected units, and one of said units providing a complete balanced and maneuverable glider when detached from the airplane.

11. An airplane formed of units detachable in flight, one of said units provided with a power plant for the airplane, and another of said units forming a complete balanced and maneuverable glider when detached from said airplane.

12. An airplane formed of units detachable in flight, the total supporting surfaces for the airplane distributed among said units and the control surfaces for the airplane mounted on one of said units, the said unit having the airplane control surfaces mounted thereon providing a glider when detached from the airplane, with that portion of the total airplane surfaces mounted on said unit balanced with said control surfaces and forming the supporting surfaces for the glider.

13. An airplane formed of units detachable in flight, the total supporting surfaces for the airplane distributed among and mounted on said units, one of said units having the control surfaces for the airplane mounted thereon and provided with a control cockpit for which said surfaces are operable, and said control surface unit when detached from the airplane providing a glider controllable by said control surfaces from the control cockpit and sustained in flight by that portion of the total airplane surfaces mounted thereon.

14. An airplane formed of units detachable in flight, one of said units provided with a complete power plant for the airplane, and another of said units adapted to carry the useful load of the airplane and providing the control point therefor, the said control and useful load unit forming a complete balanced glider when detached from the airplane.

15. An airplane formed of a power unit and a control and useful load unit detachable in flight, said power unit having a complete power plant for the airplane mounted thereon, said control and useful load unit providing the point from which the airplane is controlled in flight, means operable from said control unit for detaching said power unit therefrom, and the said control and useful load unit providing a complete balanced glider controllable from the airplane control point provided thereon when the power unit is detached therefrom.

16. An airplane formed of a power unit and a control and useful load unit, said units detachably connected to form the complete airplane, the power unit provided with a complete power plant for the airplane and in assembled airplane forming relation with the control and useful load unit the said power plant separated and shut off from the latter unit, the control and useful load unit provided with the control point for the airplane, means operable from the control unit for detaching the power unit therefrom in flight, and the said control and useful load unit providing a complete balanced glider controllable from the airplane control point thereon with the power unit detached therefrom.

17. In an airplane, a complete balanced and controllable glider forming a composite element of the complete airplane detachable in flight.

18. In an airplane, a complete balanced and controllable glider forming a detachable element of and providing the control surfaces for the complete airplane.

19. In an airplane, a glider forming a detachable element of the complete airplane, and the supporting surface of the glider providing a portion of the total supporting surfaces of the complete airplane.

20. In an airplane, a complete balanced and controllable glider forming a detachable element of the complete airplane, and the glider body providing the useful load carrying portion of the complete airplane body.

21. In an airplane, a complete balanced and controllable glider including a fuselage, supporting and control surfaces, and a landing chassis, said glider forming a detachable element of the complete airplane with the fuselage providing a part of the airplane fuselage, the supporting surface providing a portion of the total supporting surface of the airplane, and the glider control surfaces providing the airplane control surfaces, respectively.

22. In an airplane, a complete balanced and controllable glider including an empennage, the said glider forming a detachable element of the complete airplane with the glider empennage providing the empennage for the airplane.

23. An airplane including a fuselage and supporting and control surfaces, said fuselage formed into sections detachably connected together with the airplane supporting surfaces distributed among and mounted on said sections, and with the airplane control surfaces mounted on one of said fuselage sections, said fuselage section having the control surfaces thereon forming a glider with that portion of the total airplane supporting surfaces mounted thereon balanced with and forming the supporting surface for the glider.

24. An airplane including a fuselage having a landing chassis at the forward portion thereof, an empennage mounted at the tail portion thereof, and supporting surfaces mounted thereon and spaced therealong, said fuselage divided into sections aft of said chassis and between said spaced supporting surfaces, means detachably connecting said fuselage sections, and the after section of said fuselage with the airplane empennage and a portion of the total supporting surfaces of the airplane mounted thereon forming a balanced glider when detached from the forward section of said fuselage.

25. An airplane including a fuselage divided transversely into sections, means detachably connecting said sections, supporting surfaces distributed among and mounted on said sections and providing the total supporting surfaces for the airplane, control surfaces for the airplane mounted on one of said sections, the said fuselage section having the control surfaces thereon provided with a control cockpit for the airplane and forming a glider with that portion of the airplane supporting surfaces mounted thereon providing the supporting surface of the glider and the control surfaces balanced with said supporting surface and operable from said control cockpit to provide the control surfaces for the glider.

26. An airplane of the multiplane type formed of detachable units, one of said units carrying the upper supporting surfaces and the other of said units carrying the lower supporting surfaces of the total supporting surfaces of the airplane, and one of said units formed to provide a complete balanced and controllable glider when detached, with the portion of the airplane surfaces carried thereby forming the supporting surface of the glider.

27. A detachable fitting for connecting airplane structural elements, comprising a tongue member having roller bearings thereon, a groove member having roller bearings thereon and adapted to receive said tongue member, and a locking pin for engaging said members in connected position, the said pin bearing on said roller bearings to permit withdrawal thereof from locking position.

28. A fitting for detachably connecting airplane structural elements, comprising a tongue member adapted to be mounted on one element and a groove member adapted to be mounted on the other element, said tongue member adapted to fit into said groove member, a locking pin adapted to extend transversely through said members to lock the same in connected position, and anti-friction bearings mounted on said members and engaged by said pin in locking position thereof, whereby said pin can be withdrawn from locking position against the forces to which subjected.

29. A detachable fitting for connecting airplane structural elements, comprising a bifurcated tongue member having a roller bearing mounted across the ends thereof, a groove member having a transverse opening therethrough, a roller bearing mounted across the opening at the end of each leg of the groove member, the said groove member adapted to receive said tongue member, and a locking pin extending through said bifurcated tongue member and the opening in said groove member, between and bearing on said roller bearings to permit withdrawal of the pin from locking position connecting the said members.

30. A detachable fitting for connecting airplane structural elements, embodying a tongue member having an anti-friction bearing thereon, a groove member having anti-friction bearings thereon and adapted to receive said tongue member, a locking pin for engaging and locking said members in connected relation, the said pin bearing on said anti-friction bearings to permit

withdrawal thereof to disconnect said members, and actuating means for withdrawing said pin to disconnect said members.

31. In an airplane including a fuselage and a supporting surface, the fuselage formed in detachable sections, and the total supporting surface distributed among and carried by said sections.

32. In an airplane including a fuselage and a supporting surface, the fuselage formed in detachable sections, and each section carrying a portion of the total supporting surface.

33. In an airplane including a fuselage and a supporting surface, the fuselage formed of detachable sections, and a portion of the total supporting surface mounted on, carried by and removable with each section, respectively, the portions of the supporting surface in assembled relation of the fuselage sections providing the total supporting surface in balanced relation with the airplane.

34. In an airplane, a fuselage formed in detachable sections, one of said sections provided with the landing chassis of the airplane, and another of said sections provided with a supplementary chassis.

35. In an airplane, a fuselage formed in detachable sections, an undercarriage on one of said sections, a tail skid on another of said sections, and a supplementary undercarriage mounted on said tail skid carrying section.

36. In an airplane, a fuselage formed in detachable sections, a landing chassis for the airplane embodying an undercarriage on one section and a tail skid on another section, and a supplementary undercarriage on the tail skid section for cooperation with said tail skid to form a landing chassis for the said section.

37. In an airplane of the type embodying a multiplane supporting surface structure, a fuselage formed of detachable sections, one of said sections carrying the upper supporting surfaces and another of said sections carrying the lower supporting surfaces of the multiplane structure.

38. In an airplane, a fuselage formed of a forward section and a rear section detachably connected, a supporting surface carried by the forward section and a supporting surface carried by the rear section, the said supporting surfaces forming the total supporting surface of the airplane with the sections in connected relation.

Signed at Ithaca, New York, this 8th day of December, 1922.

RANDOLPH F. HALL.