J. A. WEIS AND F. J. KNORR.

AIRPLANE.

APPLICATION FILED AUG. 10, 1920.

1,427,665.

Patented Aug. 29, 1922.

5 SHEETS—SHEET 1.

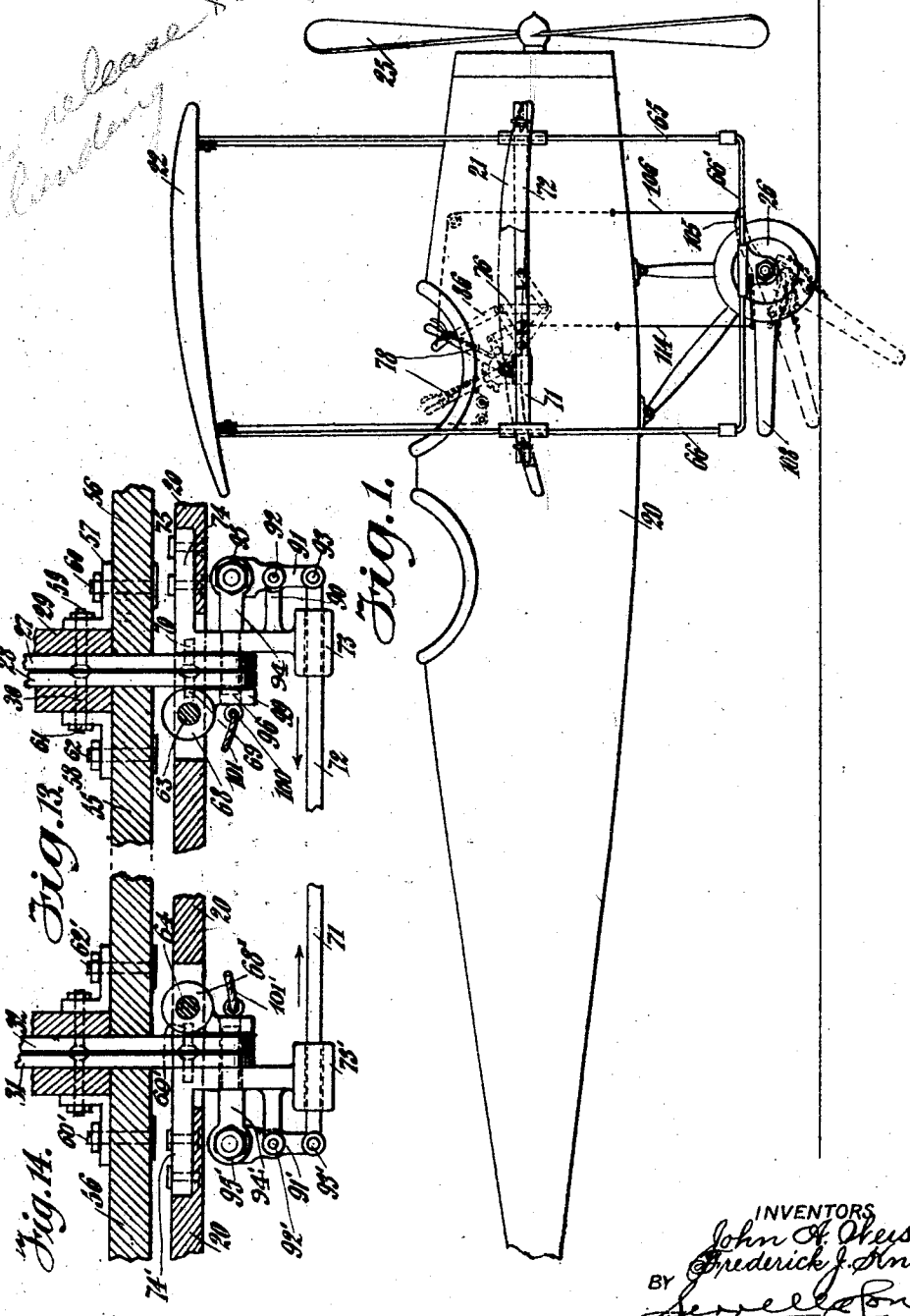


Fig. 1.

Fig. 1a.

Fig. 1b.

INVENTORS
John A. Weis
Frederick J. Knorr
BY
Lemuel Cox
THEIR ATTORNEYS

Draftsman

49

J. A. WEIS AND F. J. KNORR.

AIRPLANE.

APPLICATION FILED AUG. 10, 1920.

1,427,665.

Patented Aug. 29, 1922.

5 SHEETS—SHEET 2.

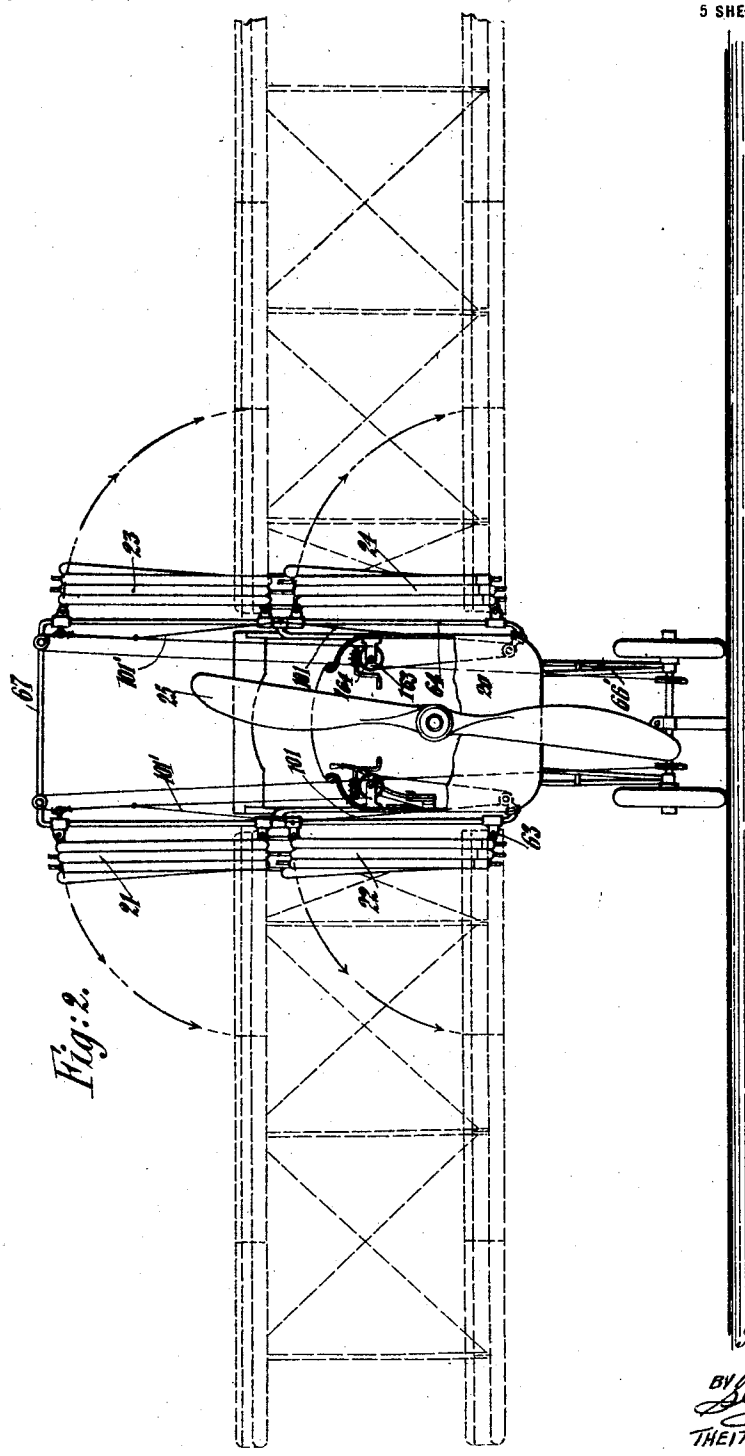


Fig. 2.

INVENTORS
John A. Weis
and
Frederick J. Knorr
BY
THEIR ATTORNEYS.

49

J. A. WEIS AND F. J. KNORR.

AIRPLANE.

APPLICATION FILED AUG. 10, 1920.

1,427,665. Patented Aug. 29, 1922.

5 SHEETS—SHEET 3.

Fig. 3.

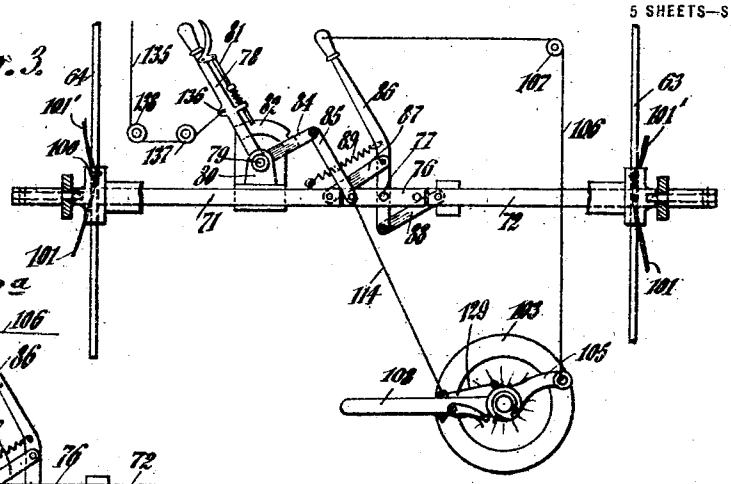


Fig. 3a.

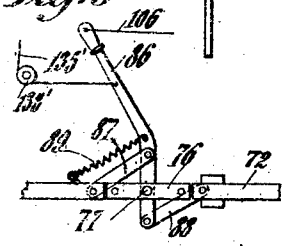


Fig. 4.

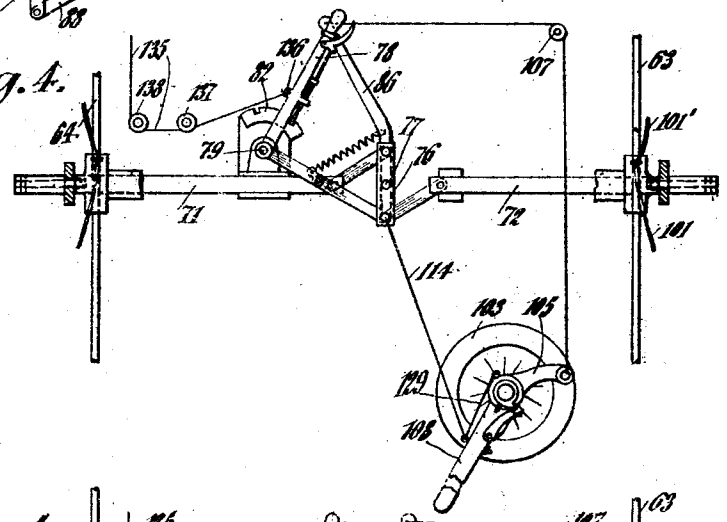


Fig. 5.

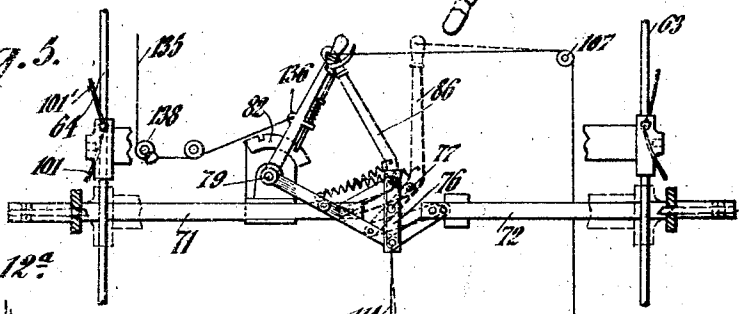
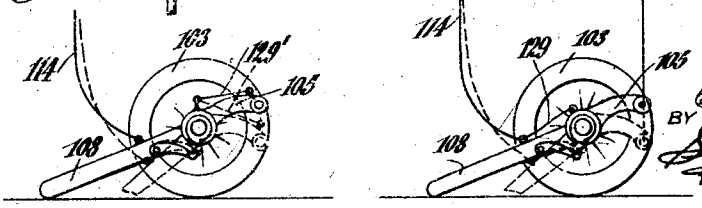


Fig. 12a.



INVENTORS,
John A. Weis
Frederick J. Knorr
BY
Lemuel Legon
THEIR ATTORNEYS

J. A. WEIS AND F. J. KNORR.

AIRPLANE.

APPLICATION FILED AUG. 10, 1920.

1,427,665. Patented Aug. 29, 1922.

5 SHEETS—SHEET 4.

Fig: 6.

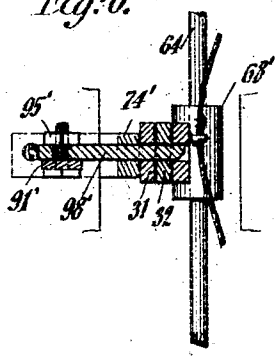


Fig: 7.

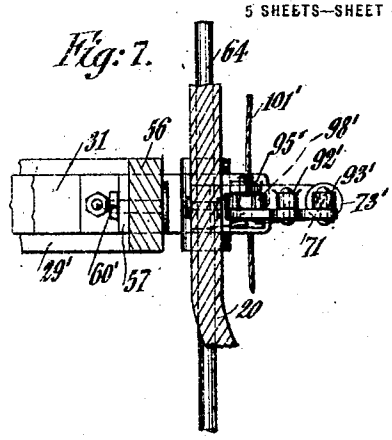


Fig: 10.

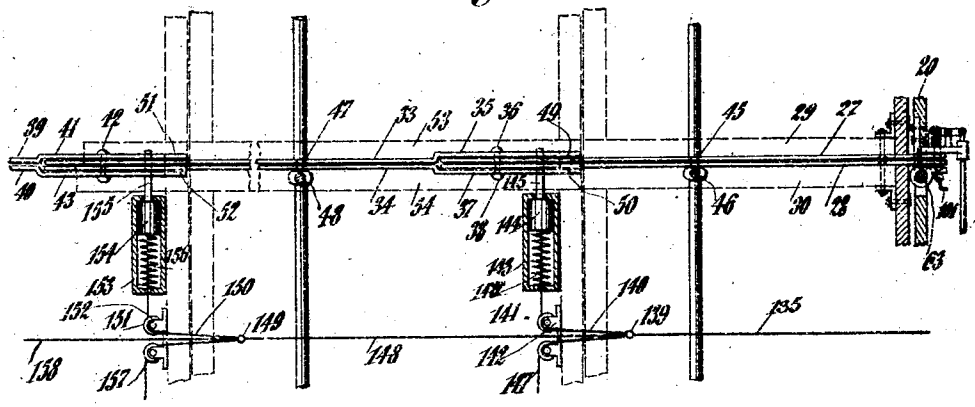


Fig: 8.

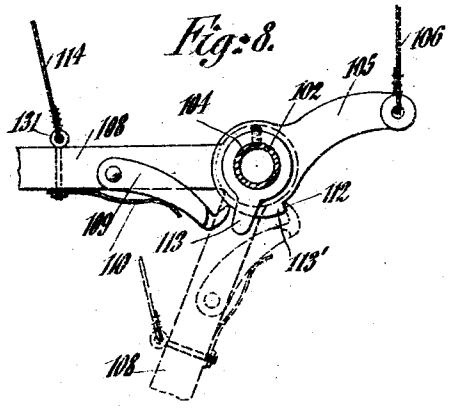
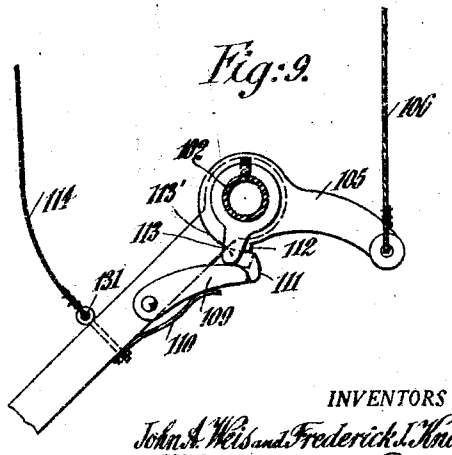


Fig: 9.



INVENTORS
John A. Weis and Frederick J. Knorr
BY
THEIR ATTORNEYS.

J. A. WEIS AND F. J. KNORR.

AIRPLANE.

APPLICATION FILED AUG. 10, 1920.

1,427,665.

Patented Aug. 29, 1922.

5 SHEETS—SHEET 5.

Fig. 11.

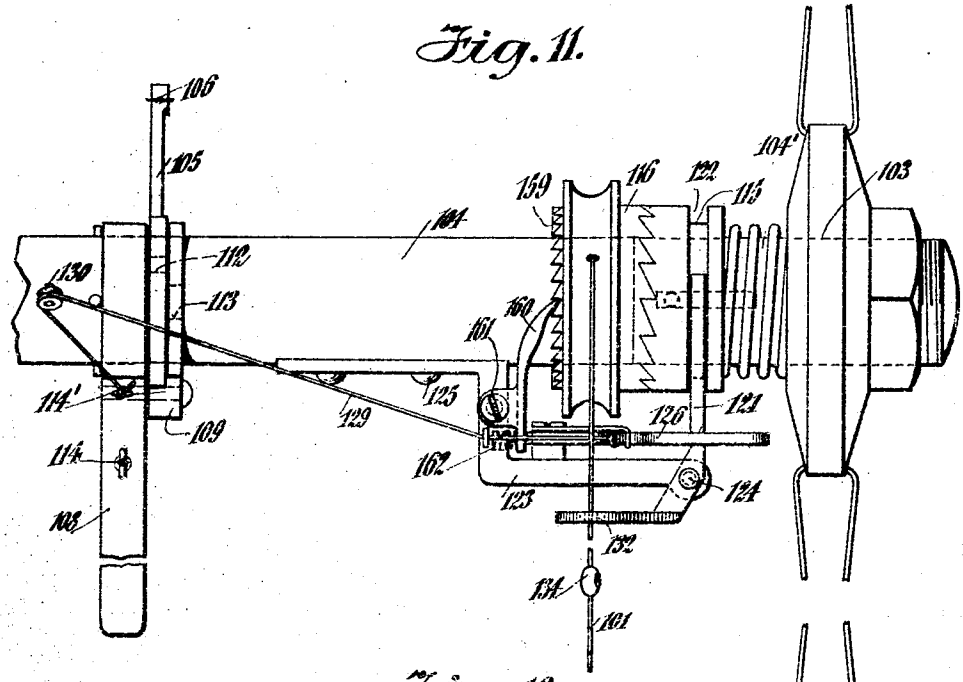
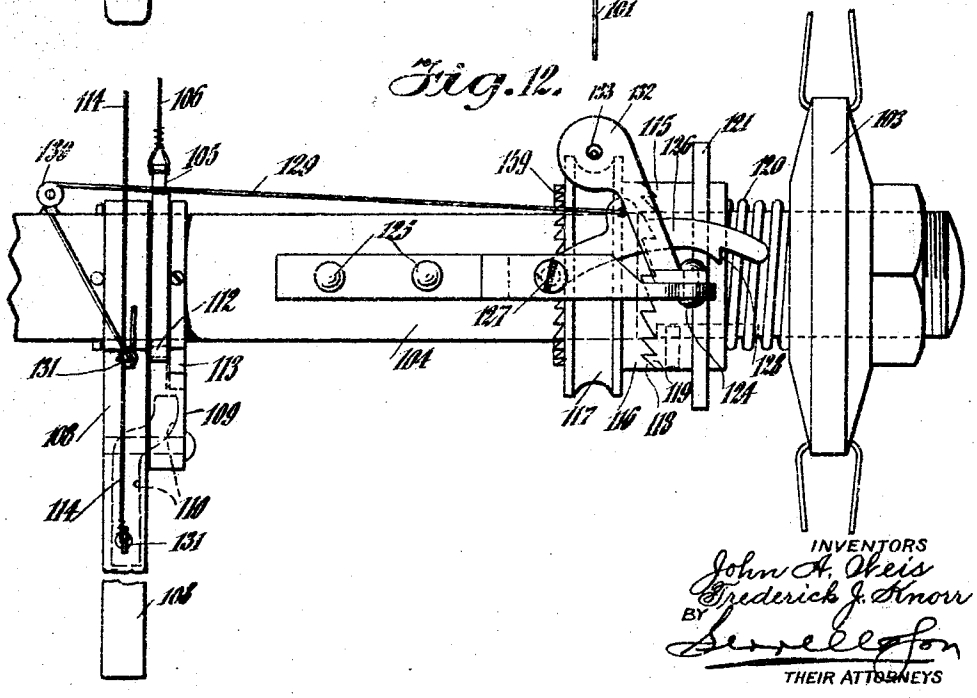


Fig. 12.



INVENTORS
John A. Weis
Frederick J. Knorr
BY
Dennelly & Son
THEIR ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN A. WEIS AND FREDERICK J. KNORR, OF NEW YORK, N. Y.; SAID KNORR ASSIGNOR TO SAID WEIS.

AIRPLANE.

1,427,665. Specification of Letters Patent. Patented Aug. 29, 1922.

Application filed August 10, 1920. Serial No. 402,618.

To all whom it may concern:

Be it known that we, JOHN A. WEIS and FREDERICK J. KNORR, both citizens of the United States, and residents of the borough of Manhattan, city, county, and State of New York, have invented an Improvement in Airplanes, of which the following is a specification.

This invention relates to airplanes in which the wings or planes of the structure are composed of a plurality of spars each consisting of pairs of links pivotally connected at their central portions with corresponding ends of each pair of links being pivotally connected to the adjacent ends of the next succeeding pair of links so as to make the plane or wing structures expansible and contractible. The invention relates more particularly to an apparatus by which the plane or wing structures are normally maintained when extended in locked positions in order to prevent any accidental folding or collapsing of the planes or wings and by which also automatically at predetermined times, for example when the airplane strikes the earth in alighting after a flight, the planes or wings are released and caused to collapse or fold up preferably by the tractive power of the airplane before the same comes to a stop. In accordance with the invention suitable means may be employed for extending the planes or wings either manually or by suitable application of power either by the traction of the airplane in starting or otherwise.

To accomplish these purposes the inner ends of the inner pairs of links forming the spars in each plane or wing are suitably extended through the body of the fuselage into the interior of the same, it being understood that corresponding links in each set are fixed in position on the fuselage and the other corresponding links of each inner set are slidable on a frame provided for this purpose so as to make it possible to operate the planes or wings in the same or similar manner to that disclosed in the copending application, Serial No. 310,987, filed July 15, 1919, by John A. Weis, one of the inventors of the apparatus disclosed and described in the present application. The apparatus to which the present invention relates includes devices for locking those portions of the links together which extend through the fuselage, as hereinbefore mentioned, together with means for maintaining these devices in a locked position, devices for maintaining the said parts of the links forming the spars of the planes or wings in a locked position, means for releasing the devices for maintaining the spars of the planes or wings in their locked position, and means automatically operative preferably upon the airplane striking the ground for releasing the devices for locking the links of the spars or wings in position and simultaneously folding up or collapsing the said wings or planes preferably by utilizing the tractive power of the plane after the same has come in contact with the ground and before coming to a stop in alighting after a flight. The apparatus also preferably includes auxiliary locking devices by which the end portions of the various pairs of links forming the spars of the planes or wings are normally locked together and automatically released when the apparatus is otherwise unlocked and automatically collapsed or contracted as hereinbefore stated, and the apparatus comprising our present invention will be hereinafter more particularly described.

In the drawing:

Fig. 1 is a side elevation of an airplane illustrating the present invention more or less diagrammatically. Fig. 2 is a front elevation showing the planes or wings in a contracted position. Fig. 3 is a diagrammatic illustration illustrating the apparatus for operating the locking mechanism when set to maintain the locks in place.

Fig. 3[a] is a partial elevation showing another form of connections of the lock operating ropes or cables.

Fig. 4 is a similar view showing the apparatus in a position in which the locks may be released.

Fig. 5 is a view similar to Figs. 3 and 4 showing the parts in a position in which the locks are released.

Fig. 6 is a sectional view showing a lock pin and the ends of a link of a spar through which the same passes to secure the same in place relatively to one another.

Fig. 7 is a similar view taken at right angles to the position shown in Fig. 6. Fig. 8 is a sectional elevation showing the axle of the running gear and the parts associated therewith for operating the lock releasing devices. Fig. 9 is a view similar to Fig. 8

showing the same parts in a different position. Fig. 10 is a sectional plan showing a portion of one of the spars of a plane and the parts associated therewith.

Fig. 11 is a partial plan of the running gear on an enlarged scale illustrating the construction of the parts employed for contracting the planes or wings after the same have been released or unlocked. Fig. 12 is a plan view of the parts shown in Fig. 11.

Fig. 12[a] is a partial elevation showing another form of connecting the cable for releasing the pawl that normally holds the running gear clutch out of engagement.

Fig. 13 is an enlarged sectional plan of the locking devices associated with a spar member of one plane, and

Fig. 14 is a similar view showing parts of the same locking devices associated with the other spar member of the same plane.

Referring to the drawing, the airplane in which our present invention is incorporated may comprise the usual fuselage or body member 20 fitted with sets of planes which are indicated at 21, 22, 23 and 24, together with a propeller 25 and a suitable running gear 26.

Each of the planes, irrespective of the number of the same which may be employed, is composed of a plurality of similarly constructed spars, and each spar is made of a plurality of links pivotally connected at their central portions, with the ends of the links in each pair pivotally connected to the corresponding ends of the links in the next adjacent pair, with the links in each pair in one spar being made to correspond to similar links in another spar of the same plane so that, for example the inner links of the pairs of spars in one plane, assuming two spars are employed, move in unison in one direction and the outer links in corresponding pairs of the same in the spars of a plane move in unison in the opposite direction in order to make the plane extensible and contractible, as shown and described in the aforesaid application. For the purposes of description in the present case but one plane will be specifically described, and furthermore the details of but one spar of the plane will be referred to specifically, inasmuch as the spars are similarly constructed and the planes are substantially duplicates of each other. To this end, as illustrated in the drawing, one of the spars may be constructed of links 27 and 28 forming a pair and fitted with frames 29 and 30 made of wood or other similar material to which the covering may be suitably attached and pivotally connected at their central portions as indicated at 45. These links form the inner links of one spar of a plane, the link 27 being the outside link and the link 28 being the inside link. The corresponding links of the other spar forming the same plane are indicated at 31 and 32 respectively in Fig. 14. The spar includes several of these links employed in pairs and the links next succeeding the links 27 and 28 are indicated at 33 and 34 respectively. The link 33 at one end adjacent the end of the link 27 is offset as indicated at 35 and similarly the link 34 at one end adjacent the end of the link 28 is offset as indicated at 37. The ends of the links 27 and 28 are pivotally connected to the offset ends of the links 33 and 34 as indicated at 36 in such a manner that the extremities of the links 27 and 28 lie within the offset ends 35 and 37 of the links 33 and 34. Similarly the next succeeding pair of links in this spar are indicated at 39 and 40. These are provided with offset ends 41 and 43 which span the adjacent ends of the links 33 and 34 and are pivotally connected thereto as indicated at 42, it being understood that the links 33 and 34 are connected together centrally by the pivot 47 in the same manner that the links 27 and 28 are connected by the pivot 45. It will furthermore be understood that when a plurality of planes are employed in the same apparatus the central pivotal points of the pairs of links forming the spars are connected by strut members 46 and 48 as indicated in Figs. 2 and 10 of the drawing. Also as shown in the drawing, the offset ends of the links 33 and 34 are provided with lugs or extensions 49 adapted to coact with the extremities of the links 27 and 28 or stops 50 thereon to prevent the parts of the spar from being moved further than into a straight line position and for maintaining the parts of the spar in a right line position when once this is assumed, and similarly the ends of the links 39 and 40 are provided with extensions 51 coacting with stops 52 on the adjacent ends of the links 33 and 34 for the same purpose as is also described in the aforesaid copending application. The links 33 and 34 are furthermore provided with frames 53 and 54 made of wood or similar material in the same manner that the links 27 and 28 are provided with the frames 29 and 30, and as will be understood each pair of the links forming the spar is similarly fitted with these frame members.

The corresponding inside links 28 and 32 of the spars forming one plane are connected preferably by a cross bar 55 and extending from the outside links 27 and 31 and between the same and the outer members of the frame of the plane there are cross bars 56 and 56′. A bracket 57 is preferably employed for securing the cross bar 56 in position, this bracket 57 being fixed to the cross bar by a bolt 60 and to the outside link 27 and its frame member 29 by a bolt 59. The cross bar 55 is connected in a similar manner by the use of a bracket 58, the cross bar 55 at one end being secured to the bracket 58

244. AERONAUTICS

49

by a bolt 62 and the bracket 58 secured to the inside link 28 and its frame 30 by a bolt 61. The opposite end of the cross bar 55 is similarly connected to the inside link 32 and its frame member as indicated in Fig. 14 of the drawing.

The members upon which the movable ends of the inner sets of links are made to slide preferably comprise a frame, it being understood that similar frames are employed on both sides of the fuselage. These frames may consist of upright rods 63 and 64 on one side of the fuselage and similar rods 65 and 66 on the opposite side and at the lower ends these upright rods may be connected by a rod 66′ and at their upper ends by a bar or connector member 67, the rods 66′ as will be understood lying beneath the fuselage and the connecting member 67 above the same. On the upright rod 63 there is slidably mounted a suitable sleeve or bracket 68 to which, as indicated at 69, the inner end of the link 28 is pivotally connected. The upright rod 64 is fitted with a similar bracket 68′ to which the inner end of the link 32 is pivotally connected as indicated at 69′. The inner end of the link 27 is pivotally connected as indicated at 70 in a bracket 74 which is fixed in position in the body or fuselage 20 by means of the bolts or rivet 75 or otherwise. The structure at the other side of the wing or plane is in all respects similar as will be seen by a comparison of Figs. 13 and 14, the bracket corresponding to the bracket 74 being indicated at 74′.

Also by reference to Figs. 3 to 5 inclusive, as well as Figs. 13 and 14, we employ lock rods 71 and 72 with each set of planes or winds, that is on both sides of the apparatus. The lock rod 72 is journaled in a bearing 73 fixed at the inner end of the bracket 74 and the lock rod 71 is journaled in a similar bracket 73′ at the inner end of the bracket 74′. As these lock rods and the parts associated therewith are similar, but placed in reversed positions, but one of them will be specifically described.

The lock rods 71 and 72 are sufficiently long to extend, when in their normal positions in the apparatus, slightly beyond the spars forming the planes with which they are associated; that is, the distant ends of the lock rods 71 and 72 extend beyond the spars forming these planes or wings. The inner ends of the lock rods 71 and 72 are, however, in all positions an appreciable distance apart. Lying between these inner or adjacent ends of the lock rods 71 and 72, we employ a lock bar 76. This is pivoted at 77 in a suitable frame and when in its normal position as shown in Fig. 3 it is in alignment with the lock rods 71 and 72 so that these lock rods cannot approach one another and consequently, as will be hereinafter described, prevent the movement of these lock rods and consequently prevent the movement of the locking pins and by so doing normally maintain the parts of the spars of the plane or planes in their locked extended positions. The lock bar 76 is operated by a lever 78. At one end this lever 78 is pivotally connected as indicated at 79 in a bracket 80 which is suitably secured in the fuselage or otherwise and the lever 78 carries a latch rod 81 adapted to engage in the notches in a rack 82 and is operated by a handle 83 or otherwise to maintain the lever in any of its positions. The lever 78 operates an arm 84 which, as will be understood, may be integral therewith so that the lever and arm become a bell crank lever, and a link 85 is pivotally connected at one end to the extremity of the arm 84 and at its opposite end to one end of the lock bar 76 so that by swinging the lever 78 from the position shown in Fig. 3 to that shown in Figs. 4 and 5 the arm 84 will have imparted thereto a clockwise rotary movement, forcing the link 85 downwardly and swinging the lock bar 76 in a counter-clockwise direction until the arm 84 and the link 85 are in alignment when, as shown in these figures of the drawing the lock bar 76 will have been turned through an angle of approximately 90°, and in all events out of alignment with the lock rods 71 and 72 so that these lock rods may be moved toward each other.

In order to shift the lock rods 71 and 72, we employ a lever 86 which is pivotally mounted on the same arbor that carries the lock bar 76 and extends appreciably to the opposite side of the pivotal point. At its extremity the lever 86 is pivotally connected to a link 88 which is also pivotally connected to the lock rod 72 adjacent the inner end thereof. A link 87 is pivotally connected at one end to the lever 86 as illustrated and at its opposite end to the lock rod 71 adjacent its inner extremity. Now as will be apparent after the lock bar 76 has been moved from the position shown in Fig. 3 to that shown in Figs. 4 and 5 the lever 86 may be swung in a clockwise direction as indicated in these figures of the drawing, and in being so moved, due to the link connections with the lock rods, the lock rods will be moved toward each other, that is, in swinging the lever 86 from the position shown in Fig. 4 to that shown in Fig. 5 the lock rods 71 and 72 will be moved sufficiently far toward each other to release the locking pins as hereinbefore described. The lever 86 as illustrated may be normally maintained in its initial position by means of a spring 89 or in any other suitable manner.

Referring particularly to Figs. 6, 7 and 13, it will be seen that the bracket 74 in a suitable position is provided with an arm 90.

Pivotally mounted at the end of this arm 90 is a lever 91, the pivotal point being indicated at 92. One end of the lever 91 is pivotally connected to the outer end of the lock rod 72 as is indicated at 93. Associated with the opposite end of the lever 91 is a lock pin member 94. The body portion of this lock pin member 94 is pivotally connected to the lever 91 as indicated at 95 and at its opposite end the lock pin member terminates in a lock pin 96 adapted to pass through and to be journaled in a bearing provided therefor in the arm of the bracket 74 and also to pass through apertures provided therefor in the inner extremities of the links 27 and 28 when the same are in alignment, and furthermore into a recess provided therefor in a lug 99 extending from the sleeve or bracket 68. When the parts are in the position as illustrated in Fig. 13, as will now be understood, the links 27—28 of the spar are locked to one another and to the bracket 68, which is pivotally connected to the link 28; this being possible only when the links of the spar are in alignment and consequently when the plane is in its extended position; that is when the plane is in position for use. A lug 99 in the bracket 68 is fitted with an eye 100 to which there is secured a rope or cable 101 by which, as hereinafter described, the sleeve or bracket 68 and the link 28 to which the same is secured may be swung when the parts are unlocked to contract the plane or cause the same to collapse.

The axle of the running gear is indicated at 102 and as customary this is fitted with wheels 103 and is provided with a suitable casing 104. Mounted on the casing in a suitable position and adapted to turn thereon is an arm 105. The free end of this arm 105 is connected to a cable or rope 106 which passes upwardly and over a pulley 107 so that the cable 106 at its opposite end may be connected to the lever 86. On the casing 104 adjacent the arm 105 a skid 108 is also connected at one end so as to turn on the casing. This skid 108 is fitted with a pawl 109 normally forced toward the axle by a spring 110. At the end of the pawl there is a tooth 111 adapted to engage and cooperate with a shoulder or tooth 112 provided for this purpose on the arm 105. The tooth on the pawl, however, is normally out of engagement with the tooth on the arm, as indicated in Figs. 3 and 8 of the drawing. The casing 104 is fitted with a lug or projection 113 and the arm 105 with a cam surface 113′ against which latter the edge of the tooth 111 normally contacts, the tooth 111 being offset, as is clearly shown in the drawing, so that in the operation of the parts, as hereinafter described, the pawl will not contact with the lug 113 in moving to its operative position and at a predetermined time, in the operation of the parts, will be released from engagement with the shoulder 112 on the arm 105 through the contact with this lug 113. The skid 108 is connected by a cable or rope 114 with the left hand end of the lock bar 76, as viewed in Fig. 3, so that the skid 108, when the lock bar is in its normal positions is also normally maintained in place, in which position it is substantially horizontal as shown in Figs. 3 and 8.

The major portion of the casing 104 is fixed to the axle 102 but at one end the casing is divided and the casing end 104′ is adapted to turn on the axle and to have one of the wheels secured thereto. On the casing end 104′ there is mounted a sleeve 115. This sleeve forms part of a coupling and is so mounted on the casing end as to turn therewith and to be shiftable longitudinally thereon. Also on the casing 104 and adjacent the sleeve 115 there is a collar 116 including a pulley 117. In one side of the sleeve 115 there is a series of teeth 118 and similarly in the adjacent side of the collar 116 there is a series of oppositely disposed teeth 119 by which, as will be understood, these members are constructed to form a clutch device. Extending between the sleeve 115 and the hub of the adjacent wheel there is a spring 120 and surrounding or partially surrounding the sleeve 115 there is a yoke 121 engaging in a circumferential recess 122 in the sleeve so that the same may be moved thereby out of engagement with the collar 116. The yoke 121 is pivotally mounted in a bracket 123 as indicated at 124 and the bracket 123 is connected to the casing 104 by rivets 125 or otherwise. We also employ a pawl 126 pivotally connected at 127 in the bracket 123 and having a tooth 128 adapted to engage a portion of the yoke 121 to normally maintain the sleeve 115 in its inoperative position away from the collar 116 and against the action of the spring 120. A rope or cable 129 is connected at one end to an eye provided for this purpose in the pawl 126 and extends over a pulley 130 mounted on the casing 104 and at its opposite end is secured in an eye 131 fixed on the skid 108 and to which also the rope or cable 114 is connected. The object of this cable, as will be hereinafter described, is to withdraw the pawl from engagement with the yoke 121 thereby freeing the sleeve 115 causing the same, by the action of the spring 120 to slide on the casing into operative engagement with the collar 116, this action taking place when the skid 108 is released. The yoke 121 terminates in an arm 132 extending away from the bracket 123 and provided with an aperture 133 through which the cable or rope 101 passes and which, in a suitable position, is provided with a block 134 so that when the cable 101 has been wound on the pulley sufficiently to cause the block 134 to contact with the arm 132 the con-

tinued movement of the cable swings the arm and this movement is communicated to the block by which the sleeve 115 is moved on the casing away from and out of engagement with the collar 116.

As stated in the introduction to the specification our invention may also include auxiliary locking devices for securing the adjacent ends of the links of the spars in position. To this end we prefer to employ cables, one of which is indicated at 135, which at one end is connected to an eye 136 provided therefor in the lever 78. This cable 135 passes over pulleys 137 and 138 and also over a pulley or pulleys, not shown in the drawing, to the space between the covering forming the upper and lower surfaces of the planes or wings to a ring 139 for example. The ring 139 has one end of a cable 140 attached thereto and this cable passes over a pulley 141 mounted in a block 142 and extends into a cylinder 143 secured on one of the cross bars forming the frame work of the wing or plane. In the cylinder 143 there is a plunger 144. This plunger carries a pin 145 extending through an aperture provided therefor in one end of the cylinder so as to enter and extend through holes provided therefor in the ends of the links 27 and 28 and the adjacent ends of the links 33 and 34 when these links are in their right line or extended position, the plunger 144 being maintained in its normal position as indicated in Fig. 10 of the drawing by a spring 146. As will be understood a cable 147 corresponding to the cable 140 also extends from the ring 139 to a plunger in a cylinder corresponding to the cylinders 143 and plunger 144 and employed in an oppositely disposed position to secure the corresponding parts of the cooperating spar in place. A cable 148 is also connected at one end in the ring 139 and this extends to a ring 149. A cable 150 extends from the ring 149 over a pulley 151 mounted in a block 152 and into a cylinder 153 where the same is connected to a plunger 154 contained within the cylinder 153. The plunger 154 is fitted with a pin 155 which extends through an opening provided therefor in one end of the cylinder so as to pass through holes in the ends of the links 33 and 34 and corresponding holes in the ends of the links 39 and 40 when the links are in their extended or right line position in order to lock these parts of the spar to one another, and the plunger 154 is normally maintained in its initial position by means of a spring 156. A cable 157 similar to the cable 147 extends over a pulley to a plunger in a cylinder corresponding to the cylinder 153 and containing a plunger corresponding to the plunger 154 for securing in a locked position the corresponding parts of the cooperating spar of the plane. Similar to the cable 148, a cable 158 is connected at one end to the ring 149 and extends therefrom to the next forward plunger in a cylinder corresponding to the cylinders 143 and 153 so as to make it possible to withdraw this plunger to release the parts of the spar from their locked positions, and these structures are continued to the end of a spar irrespective of the number of sets of links of which it may be composed.

In the operation of the hereinbefore described apparatus the planes or wings and the parts thereof are extensible and contractible and may be locked in their extended positions for use and unlocked and automatically contracted when the airplane alights on the ground. Assuming the parts to be in position for use, that is with the planes extended, the locking and releasing devices are in the positions shown in Figs. 1, 3 and 13 and 14 of the drawing. With the parts in these positions, as will be understood, it is impossible for the planes to be contracted. When, however, the airplane is about to come into contact with the ground the pilot swings the lever 78 from the position shown in Fig. 3 to that shown in Fig. 4. In so doing the cable 135 is moved sufficiently far to withdraw the plungers 144 and 154 into their respective cylinders thereby removing the locking pins 145 and 155 and all the corresponding locking pins to unlock or release the ends of the links forming the spars. At the same time, that is by the shifting of the lever 78 from the position shown in Fig. 3 to that shown in Fig. 4, the lock bar 76 is likewise moved from the position shown in Fig. 3 to that shown in Fig. 4 thereby making it possible to move the lock rods 71 and 72 toward each other and also permitting the skid 108 to fall to the position shown in Fig. 4 in which the tooth 111 at the end of the pawl 109 engages with the shoulder 112 on the arm 105. In this movement of the skid, as will be understood, the pawl is prevented from coming into contact with the lug 113, due to the fact that the edge of the tooth rides along the face of the cam 113′, eventually sliding off of the same and into its operative position in engagement with the shoulder 112. Now when the airplane is about to alight the skid having assumed the position shown in Fig. 4 will first come into contact with the ground and in doing so will be moved in the opposite direction or swung upwardly, and in this movement will carry the arm 105 along with it so as to move this arm 105 downwardly. As the skid 108 falls to its operative position it pulls on the cable 129 thereby releasing the pawl 126 and permitting the sleeve 115, due to the action of the spring 120, to move into operative engagement with the collar 116. As the arm 105 moves downwardly it pulls on the cable 106 thereby swinging the lever 86 from the position shown in Figs. 3

and 4 to the position shown in Fig. 5 and in so doing, through the action of the links 87 and 88, causes the lock rods 71 and 72 to move toward each other. This inward movement of the lock rods 71 and 72 swings the levers 91 and withdraws the lock pins 96 so that all the links forming the spars of the planes are released and may be contracted. Immediately upon the running gear striking the ground the wheels will, of course, begin to turn and cause the casing end 104′ to turn and carry with it the sleeve 115 which, as the same is connected with the collar 116, also turns this collar and the pulley 117. As the pulley 117 turns, the cable 101 is wound thereon and through the winding of the cable the sliding brackets 68 and 68′ are drawn upwardly on the rods on which they slide and in so doing the sets of links of which the spars of the planes are composed are folded together and the planes drawn in or collapsed. After the planes are contracted to the desired extent the block 134 strikes the arm 132 and in so doing swings the same and the yoke 121, thereby moving the sleeve 115 along the casing against the action of the spring 120 so as to release the sleeve from the collar 116 to make the pulley 117 inoperative leaving the same then free to turn on the casing as will be understood. In order to prevent any accidental turning of the collar and pulley 117 in the other direction one face of the collar may be provided with a circular rack 159 adapted to be engaged by a pawl 160 pivoted at 161 in the bracket 123 and normally maintained in position, with its extremity in engagement with the teeth of the rack 159 by means of a spring 162 or otherwise. When the sleeve 115 has been withdrawn from engagement with the collar 116 the pawl 126 is permitted to drop into place so that the tooth 128 again engages a portion of the yoke 121 to maintain the sleeve 115 in its inoperative position. This, as will be understood, is due to the fact that the skid has been raised whereby the tension on the cable 129 is released. It will also be understood that as the skid 108 is turned upwardly, due to striking the ground and after having carried with it the arm 105 a sufficient distance to move the lock rods inwardly or toward each other to release the main locks, the pawl 109 moving against the surface of the lug 113 is swung against the action of the spring 110 so that the tooth 111 of the pawl is withdrawn from engagement with the shoulder 112 thereby permitting the lever 86 to be returned to its initial position by the action of the spring 89 or otherwise, and this movement also returns the lock rods 71 and 72 to their initial positions so that these parts are in place to reengage the spars to lock the same in position when again extended for use. The spars, as hereinbefore stated, may be extended to expand the planes or wings or bring the same into their right line operative positions by means of suitable windlasses 163 operated manually through a crank and worm gear 164 or otherwise, the cable 101 being connected to a windlass so that when wound thereon in the proper direction the corresponding sliding bracket 68 will be drawn down and carry with it the extremities of the links connected thereto so that when these links are in their right line positions the lock pins, both the main lock pins and the auxiliary lock pins, will automatically snap into place to lock the parts of the spars in their fixed locked and operative positions in which they will remain until released automatically, as hereinbefore described, or otherwise.

In some instances it may be advisable to operate the main and auxiliary locks simultaneously, and this may be done, as will be apparent by reference to Fig. 3ª, by employing a rope or cable 135′ in lieu of the cable 135 and connecting this cable 135′ at one end thereof to a suitable point in the lever 86 and then running the cable over a pulley 138′ and to the auxiliary lock retaining and releasing devices in the same manner that the cable 135 is connected, as hereinbefore described. By so connecting this cable for operating the auxiliary locks it will be understood that when the lever 86 is moved from the position shown in Figs. 3ª and 4 to that shown in Fig. 5 the main locks will be released and at the same time the auxiliary locks will also be released.

In some instances also, it may be inadvisable to release the clutch member 115 by raising or withdrawing the pawl 126 when the skid member 108 is dropped. For example, if by chance the landing ground were uneven and the skid should fall into a gully, the parts, obviously, would not operate as hereinbefore described, because the clutch would be thrown in and the pulley 117 operated from the wheels before the main locks were released and the planes thus made contractible. This obviously would result in breaking some parts of the apparatus. To obviate this difficulty, it may therefore be advisable, as shown in Fig. 12ª to connect the pawl 126 by a cable 129′ which is also connected to the arm 105 instead of to the skid 108 to which, as hereinbefore described, the cable 129 is connected. By thus connecting the cable 129′ the pawl 126 will not be raised and the clutch member 115 released and the clutch made operative until the arm 105 has been drawn downwardly sufficiently far to release the main locks and therefore the plane contracting devices cannot be made operative until after the main locks are released. Furthermore, it may be advisable to provide sufficient play in the cable 129′ to insure the releasing of the main locks before the clutch member 115 is released and thrown

into engagement with its complementary clutch member 116.

It will be understood that we do not limit ourselves with the precise construction of the parts illustrated and hereinbefore described, as obvious equivalents may be employed without departing from the nature and spirit of our invention. For example, the apparatus may be designed to unlock the planes automatically when the shiftable parts of the spars are lowered instead of raised in being contracted, and the locking features may be employed and automatically operated with any given number of planes, and furthermore may be applied directly to a hydroplane, for example, instead of employing the specific devices which we have described and which are, as described, adapted for use in an ordinary airplane when alighting on the surface of the ground.

While as herein shown and described our present invention relates more especially to the locking and releasing of the planes which are of the expansible and contractible type, it will be obvious and understood that the locking and releasing devices may be applied to other types of airplanes in which the wings are integral structures and in which these planes or wings are shiftable from an operative to an inoperative position and vice versa by being moved from their normal positions in flight to rearward or forward positions, or positions upwardly or downwardly from the normal flight positions.

We claim as our invention:

1. In an airplane, a plane shiftable from a normal and extended operative to an inoperative position, devices for shifting said plane from its normal and extended operative position to its inoperative position, and means for operating the said devices automatically upon the alighting of the airplane.

2. In an airplane, a plane shiftable to and from a normal operative to an inoperative position, and devices automatically operative upon the alighting of the airplane for shifting the plane from its operative to its inoperative position.

3. In an airplane, a plane shiftable from an operative to an inoperative position, means for locking the plane in its operative position, and devices for automatically unlocking the said plane upon the alighting of the aeroplane.

4. In an airplane, a plane shiftable from an operative to an inoperative position, means for locking the plane in its operative position, and means automatically operative in the alighting of the airplane for unlocking the said plane.

5. In an airplane, a plane shiftable from an operative to an inoperative position, devices for locking the said plane in its operative position, and means for automatically unlocking the said plane and shifting the same from its operative to its inoperative position upon the alighting of the aeroplane.

6. In an airplane, a plane shiftable from an operative to an inoperative position, devices for locking the said plane in its operative position, and means for automatically unlocking the said plane and shifting the same from its operative to its inoperative position in the alighting of the airplane.

7. In an airplane, an expansible and longitudinally contractible plane, devices for contracting the said plane by moving the parts thereof from a normally extended position to a contracted collapsible position, and means for operating the said devices automatically upon the alighting of the airplane.

8. In an airplane, an expansible and contractible plane, and means operative upon the alighting of the airplane for automatically contracting the said plane.

9. In an airplane, an expansible and contractible plane, means for locking the said plane in its extended or expansible position, and devices automatically operative for unlocking the said plane when the airplane alights.

10. In an airplane, an expansible and contractible plane, means for locking the said plane in its extended or expansible position, and means operative upon the alighting of the airplane for automatically unlocking the said plane.

11. In an airplane, an expansible and contractible plane, means for locking the said plane in its extended or expansible position, and devices for automatically unlocking and contracting the said plane when the airplane alights.

12. In an airplane, an expansible and contractible plane, means for locking the said plane in its extended or expansible position, and devices operative upon the alighting of the airplane for automatically unlocking the said plane and simultaneously contracting the same.

13. In an airplane, a plane shiftable from an operative to an inoperative position, a lock for engaging parts of the said plane to maintain the same in its operative position, means for maintaining said lock against accidental displacement, and devices for releasing said lock automatically when the airplane alights.

14. In an airplane, an expansible and contractible plane, a lock for engaging parts of the said plane to maintain the same in an operative position, means for preventing an accidental displacement of the said lock, and devices for automatically releasing the said lock and contracting the said plane upon the alighting of the airplane.

15. In an airplane, a plane shiftable from a normal operative to an inoperative posi-

tion, a lock for securing the said plane in its operative position, devices for preventing the accidental displacement of the said lock, means for releasing the said devices, and means operative after the aforesaid means are released for automatically releasing the said lock when the airplane alights.

16. In an airplane, a plane shiftable from a normal operative to an inoperative position, a lock for securing the said plane in its operative position, devices for preventing the accidental displacement of the said lock, means for releasing the said devices, and means operative after the aforesaid means are released for automatically releasing the said lock and shifting the said plane from an operative to an inoperative position upon the alighting of the airplane.

17. In an airplane, an expansible and contractible structure, a lock for securing the said plane in its extended or expansible position, devices for preventing the accidental displacement of the said lock, means for releasing the said devices, means operative upon the release of the aforesaid means for automatically unlocking the said lock and simultaneously contracting the said plane in the alighting of the airplane.

18. In an airplane, a plane shiftable from a normal operative to an inoperative position, a lock pin for engaging parts of the said plane to maintain the same in its normal operative position, a safety lock for preventing the accidental movement of the said lock pins, means for shifting the safety lock to release the said lock pins, and means for shifting the said lock pins to release the said plane.

19. In an airplane, a plane shiftable from a normal operative to an inoperative position, a lock pin for engaging parts of the said plane to maintain the same in its normal operative position, a safety lock for preventing the accidental movement of the said lock pins, means for shifting the safety lock to release the said lock pins, and means for shifting the said lock pins to release the said plane and simultaneously shifting the said plane from its operative to its inoperative position.

20. In an airplane, a plane shiftable from a normal operative to an inoperative position, lock pins for engaging parts of the said plane to normally maintain the same in its operative position, a safety lock for preventing an accidental displacement of the lock pins, means for moving the safety lock to release the lock pins, and means automatically operative upon the alighting of the airplane for shifting the lock pins to release the said plane.

21. In an airplane, a plane shiftable from a normal operative to an inoperative position, lock pins for engaging parts of the said plane to normally maintain the same in its operative position, a safety lock for preventing an accidental displacement of the lock pins, means for moving the safety lock to release the lock pins, and means automatically operative upon the alighting of the airplane for shifting the lock pins to release the said plane and simultaneously shift the said plane from its operative to its inoperative position.

22. In an airplane, an expansible and contractible plane, lock pins for normally maintaining the said plane in its extended or expansible position, a safety lock for preventing an accidental movement of the lock pins, devices for actuating the safety lock to release the lock pins, and means automatically operative after the release of the lock pins and upon the alighting of the airplane for automatically moving the said lock pins to release the said plane.

23. In an airplane, an expansible and contractible plane, lock pins for normally maintaining the said plane in its extended or expansible position, a safety lock for preventing an accidental movement of the lock pins, devices for actuating the safety lock to release the lock pins, and means automatically operative after the release of the lock pins and upon the alighting of the airplane for automatically moving the said lock pins to release the said plane and to simultaneously contract the said plane.

24. In an airplane, a plane shiftable from a normal operative to an inoperative position, devices for maintaining the said plane in its operative position, means for releasing the said devices, and means actuated by the running gear upon the alighting of the airplane for releasing the means for maintaining the plane in its operative position and simultaneously shifting the plane from a normal operative position to its inoperative position.

25. In an airplane, an expansible and contractible plane, means for normally maintaining the said plane in its extended or expansible position, means for releasing the aforesaid means, and devices operated from the running gear upon the airplane alighting upon the ground for releasing the means for holding the plane in its operative position.

26. In an airplane, an expansible and contractible plane, means for normally maintaining the said plane in its extended or expansible position, means for releasing the aforesaid means, and devices operated from the running gear upon the airplane alighting upon the ground for releasing the means for holding the plane in its operative position and simultaneously contracting the said plane.

27. In an airplane, an expansible and contractible plane, main lock pins for engaging parts of the said plane to maintain the same in its operative position, auxiliary lock pins

for engaging other parts of the said plane to maintain the same in operative position, a safety lock for preventing the accidental shifting of the main lock pins, means for actuating the safety lock to release the main lock pins and simultaneously actuate the auxiliary lock pins, and devices automatically operative upon the alighting of the airplane for releasing the main lock pins and thus making the plane contractible.

28. In an airplane, an expansible and contractible plane, main lock pins for engaging parts of the said plane to maintain the same in its operative position, auxiliary lock pins for engaging other parts of the said plane to maintain the same in operative position, a safety lock for preventing the accidental shifting of the main lock pins, means for actuating the safety lock to release the main lock pins and simultaneously actuate the auxiliary lock pins, and devices automatically operative upon the alighting of the airplane for releasing the main lock pins and automatically contracting the said plane.

29. In an airplane, a plane shiftable from a normal operative to an inoperative position, lock pins for normally maintaining the plane in its operative position, a safety lock for preventing accidental displacement of the said lock pins, a running gear, a skid associated with the running gear and normally maintained in an inoperative position by the said safety lock and which, upon the release of the safety lock, is permitted to maintain an operative position, and means actuated by the said skid when the same strikes the ground for shifting the said lock pins to release the said plane.

30. In an airplane, a plane shiftable from a normal operative to an inoperative position, lock pins for normally maintaining the plane in its operative position, a safety lock for preventing accidental displacement of the said lock pins, a running gear, a skid associated with the running gear and normally maintained in an inoperative position by the said safety lock and which, upon the release of the safety lock, is permitted to maintain an operative position, and means actuated by the said skid when the same strikes the ground for shifting the said lock pins to release the said plane and to simultaneously shift the said plane from an operative to an inoperative position.

31. In an airplane, an expansible and contractible plane, lock pins for normally maintaining the said plane in an operative position, a safety lock for preventing the accidental displacement of the said lock pins, means for actuating the safety lock, a running gear, a skid associated with the running gear and normally maintained in an inoperative position by the said safety lock and permitted when the safety lock is actuated to assume an operative position, and means actuated by the said skid upon striking the ground for releasing the said lock pins and make the said plane contractible.

32. In an airplane, an expansible and contractible plane, lock pins for normally maintaining the said plane in an operative position, a safety lock for preventing the accidental displacement of the said lock pins, means for actuating the safety lock, a running gear, a skid associated with the running gear and normally maintained in an inoperative position by the said safety lock and permitted when the safety lock is actuated to assume an operative position, and means actuated by the said skid upon striking the ground for releasing the said lock pins and to simultaneously contract the said plane.

33. In an airplane, a plane shiftable from a normal operative position to an inoperative position, lock pins for maintaining the said plane in its normal operative position, a safety lock for preventing the accidental shifting of the said lock pins, a running gear, a skid associated with the running gear normally maintained in an inoperative position by the said safety lock and permitted when the safety lock is shifted to assume an operative position, a lever arm also associated with the said running gear and adapted to be engaged and operated by the said skid in striking the ground for releasing the said lock pins to make the said plane shiftable.

34. In an airplane, a plane shiftable from a normal operative position to an inoperative position, lock pins for maintaining the said plane in its normal operative position, a safety lock for preventing the accidental shifting of the said lock pins, a running gear, a skid associated with the running gear normally maintained in an inoperative position by the said safety lock and permitted when the safety lock is shifted to assumed an operative position, a lever arm also associated with the said running gear and adapted to be engaged and operated by the said skid in striking the ground for releasing the said lock pins to make the said plane shiftable, and devices operative when the plane is shiftable for shifting the same from its normal operative to its inoperative position.

35. In an airplane, an expansible and contractible plane, lock pins for maintaining the said plane in a normal extended or expansible position, a safety lock for preventing an accidental shifting of the said lock pins, means for moving the said safety lock, a running gear, a skid associated with the running gear and normally maintained in an inoperative position by the said safety lock and permitted to assume an operative position when the safety lock is shifted, and an arm also associated with the said running gear and engaged and operated by the said skid

upon the same striking the ground to shift the said lock bars to release the said plane.

36. In an airplane, an expansible and contractible plane, lock pins for maintaining the said plane in a normal extended or expansible position, a safety lock for preventing an accidental shifting of the said lock pins, means for moving the said safety lock, a running gear, a skid associated with the running gear and normally maintained in an inoperative position by the said safety lock and permitted to assume an operative position when the safety lock is shifted, an arm also associated with the said running gear and engaged and operated by the said skid upon the same striking the ground to shift the said lock bars to release the said plane, and devices also operated by the running gear for automatically contracting the said plane after the same has been released.

Signed by us this 15th day of July, 1920.

JOHN A. WEIS.
FREDERICK J. KNORR.