Jan. 31, 1956 F. J. DITTER 2,733,026

AIRCRAFT SKI

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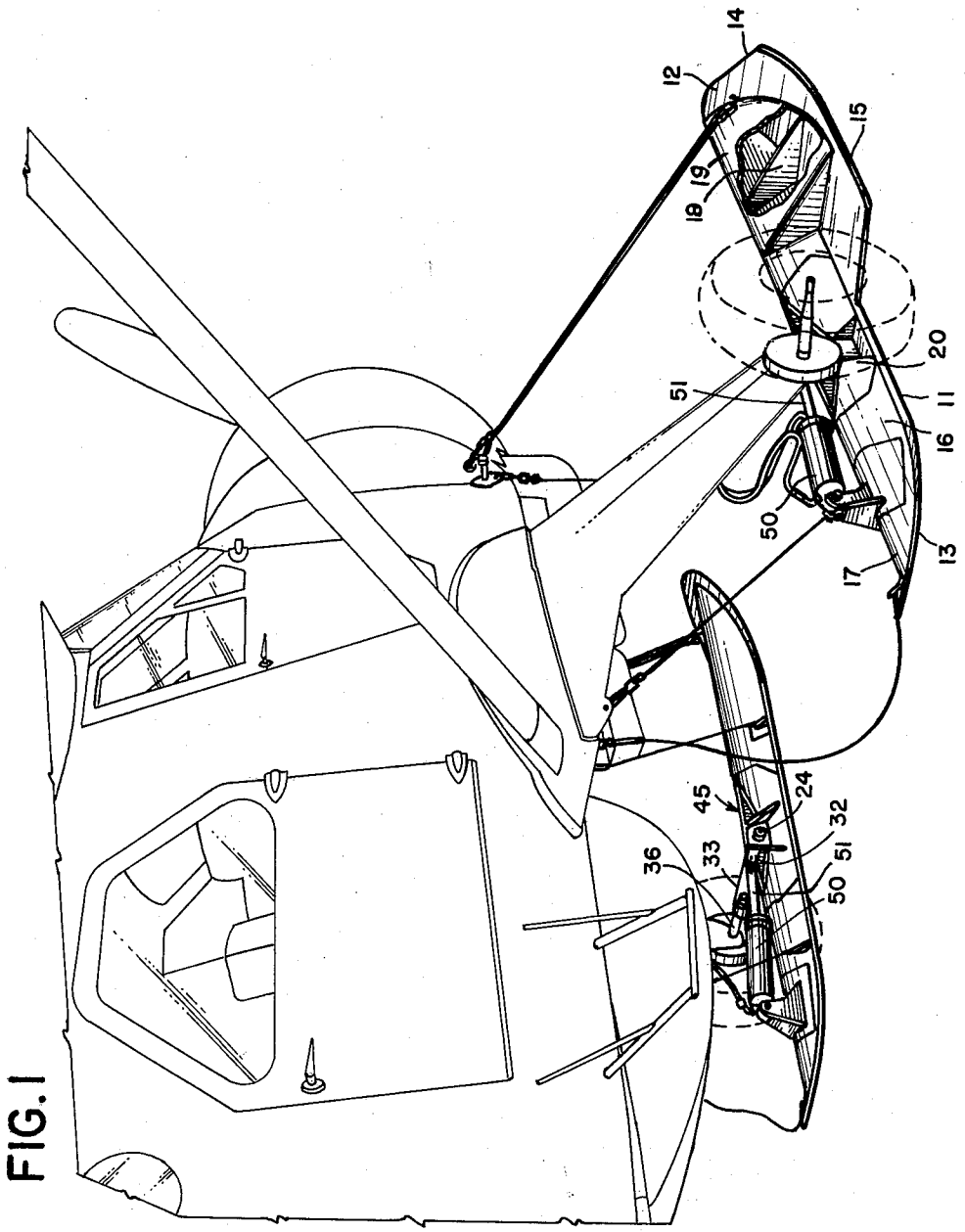


FIG. 1

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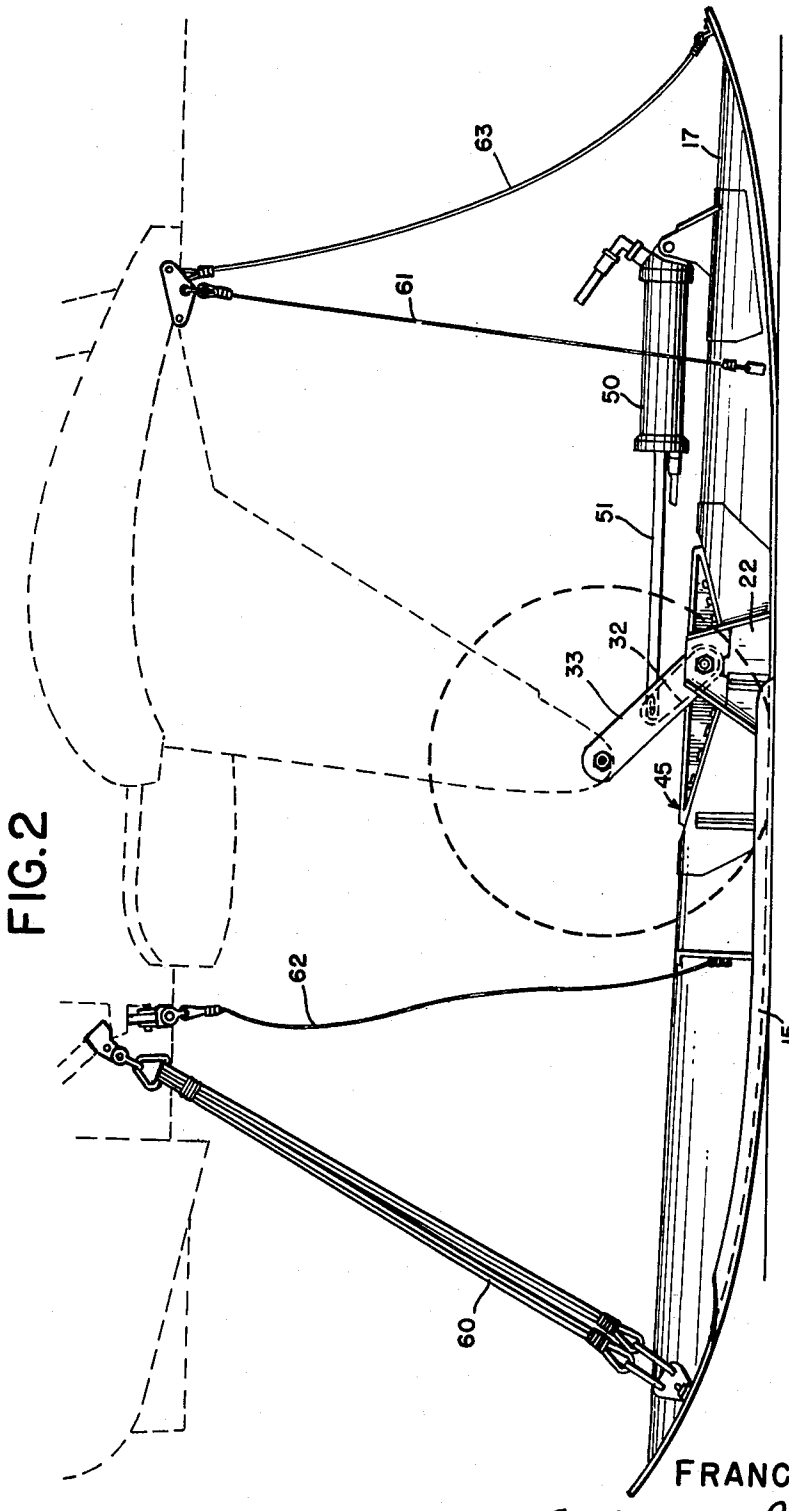


FIG.2

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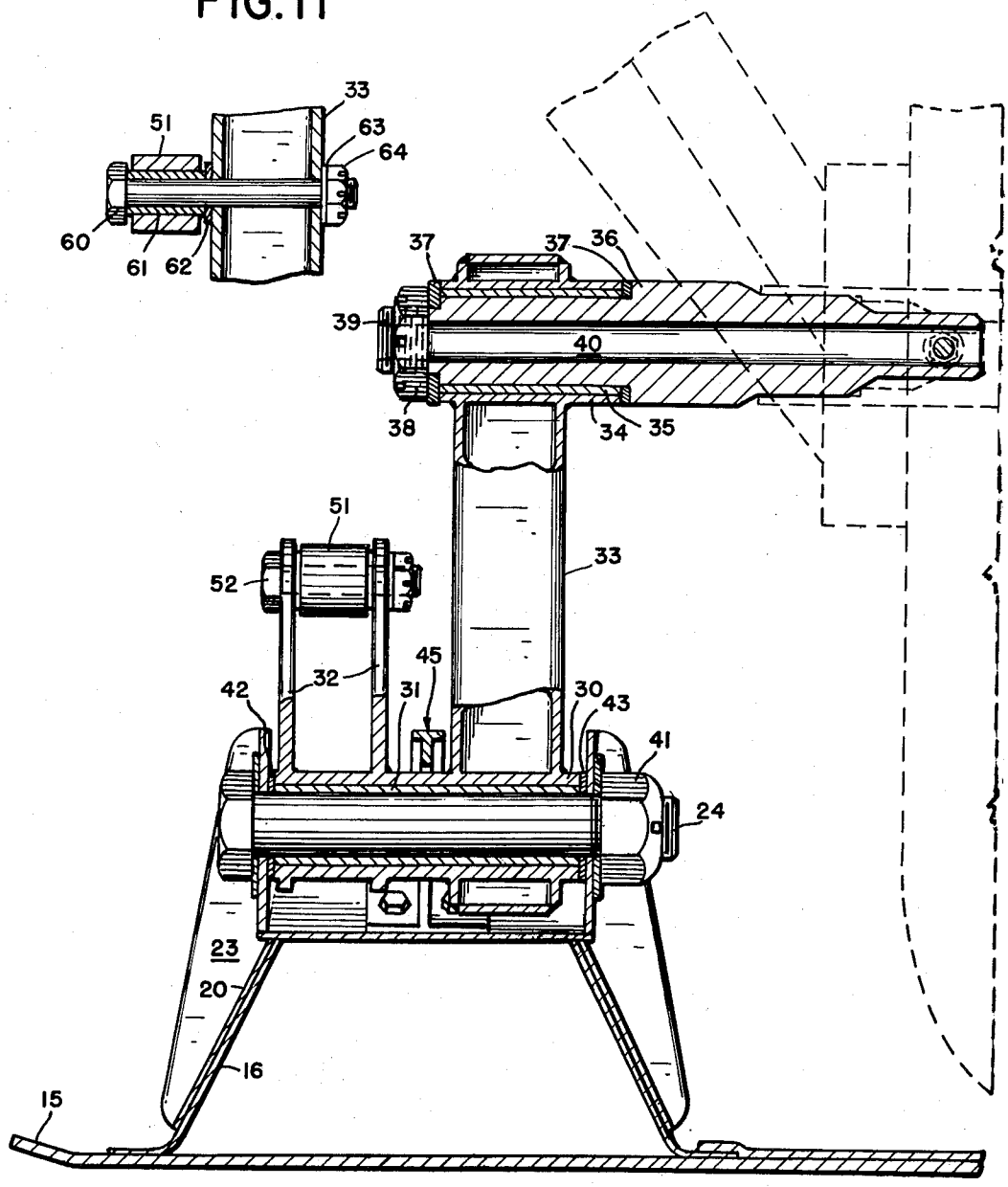
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FIG. 3

FIG. 11



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FIG. 4

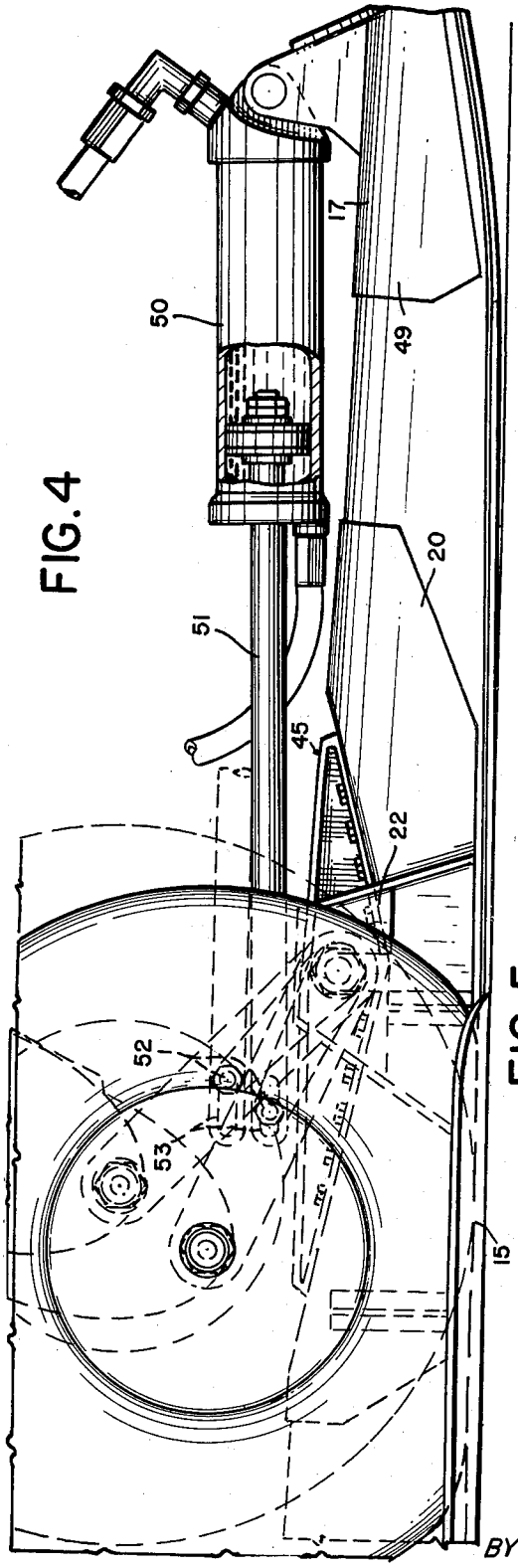


FIG. 6

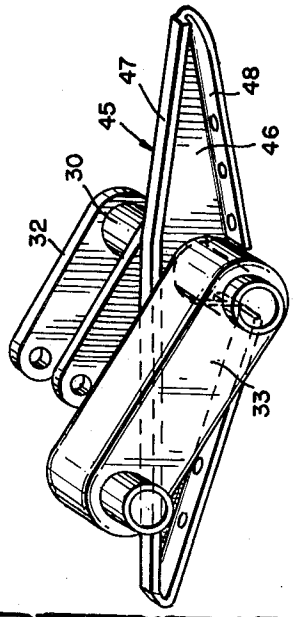
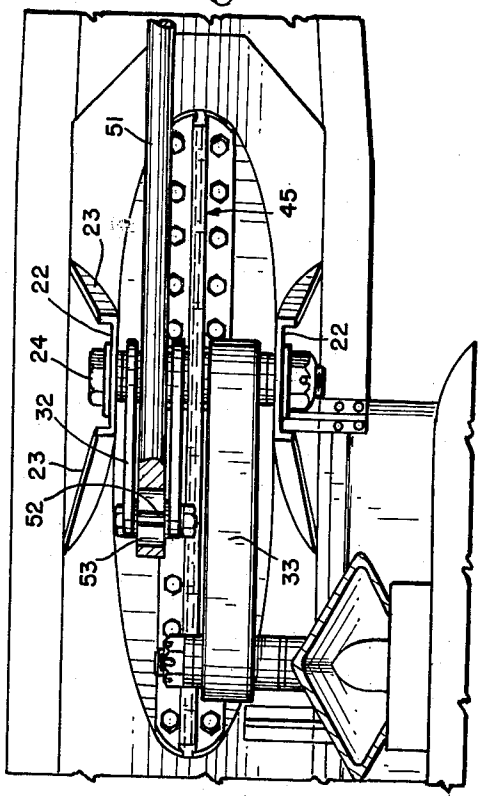


FIG. 5



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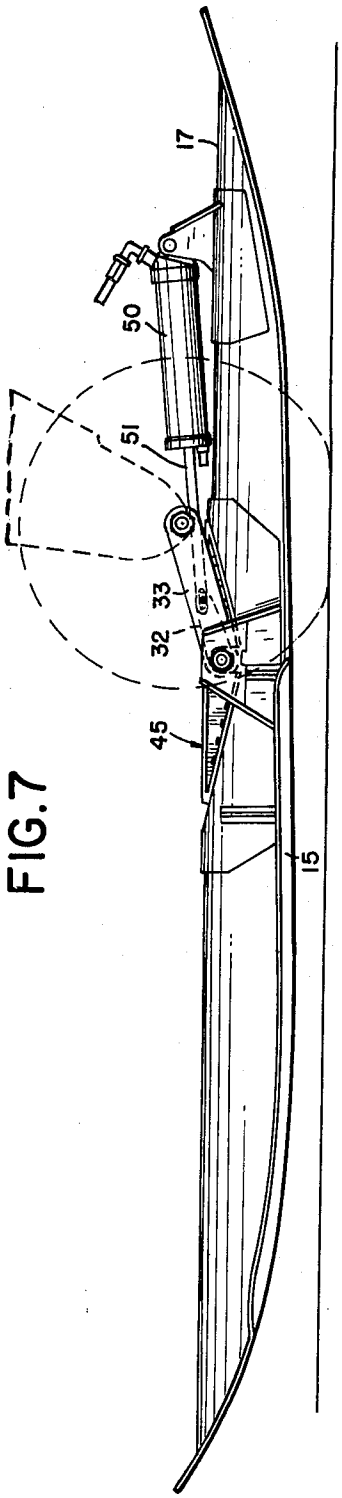


FIG.7

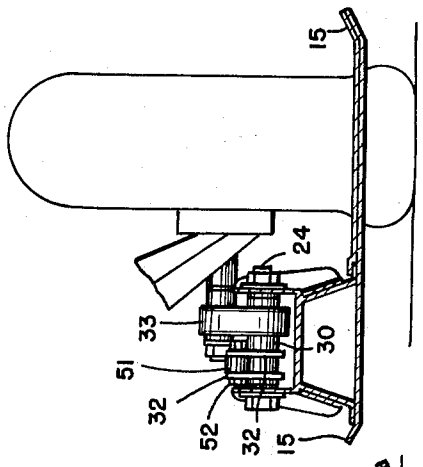


FIG.8

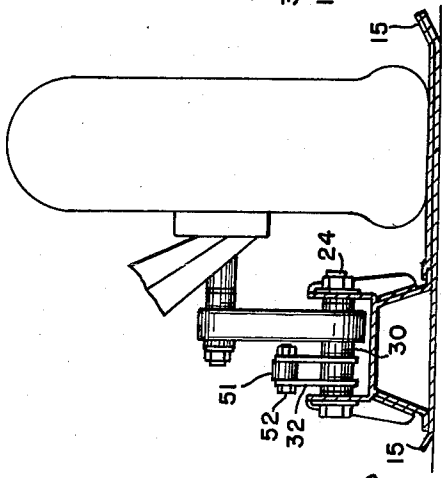


FIG.9

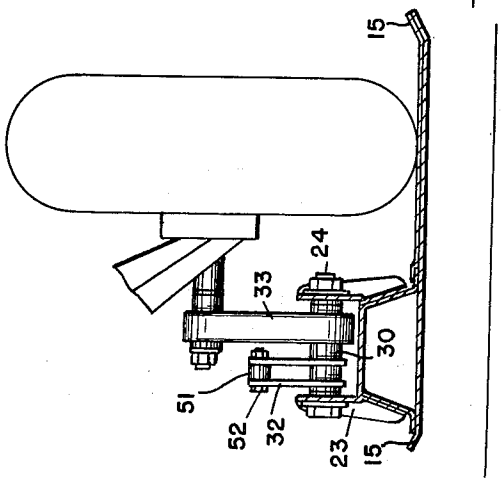


FIG.10

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2,733,026

AIRCRAFT SKI

Francis J. Ditter, Minneapolis, Minn.

Application May 17, 1952, Serial No. 288,517

3 Claims. (Cl. 244—108)

The present invention relates to a novel aircraft ski adapted to be employed in combination with the conventional wheel landing gear of an aircraft. The ski is adapted to be actuated from the condition in which the wheel is in landing position to the condition in which the ski is in landing position. In addition, the invention contemplates the use of the landing wheel on top of the ski such that the compression of the tire on landing assists in the shock absorbing function.

It is therefore an object of the present invention to provide novel aircraft skis adapted to be employed in conjunction with conventional aircraft wheel landing gear.

The following description of the invention will be with particular reference to the drawings in which

Figure 1 is a perspective view of the forward portion of the aircraft equipped with the skis of the present invention;

Fig. 2 is a side elevation of the ski of Figure 1 showing the ski mounted on the aircraft, the latter being indicated in dotted lines;

Fig. 3 is a cross sectional view of the ski taken through the mounting pedestal located intermediate the ends of the ski;

Fig. 4 is a fragmentary side elevation partly in section showing the ski in landing position, the solid lines indicating the position of the parts at the moment of actual landing, the dotted lines indicating the position of the parts during flight;

Fig. 5 is a plan view of a portion of Fig. 4 showing the mounting pedestal;

Fig. 6 is a perspective showing details of the mounting and actuating mechanism;

Fig. 7 is a side elevation showing the wheel in landing position;

Fig. 8 is a fragmentary cross section of the ski illustrating the position of the wheel when the ski is retracted;

Fig. 9 is a fragmentary cross section indicating the position of the wheel with the ski in landing position and the compression of the tire on the ski at the point of landing; and

Fig. 10 is a fragmentary cross section showing position of the wheel with the ski in landing position, under flight conditions; and

Fig. 11 is a fragmentary cross section showing a modification of the actuating arrangement.

With particular reference to Figure 1, the ski is composed of a base shoe generally indicated at **11**, which is curved both longitudinally and transversely. The forward or toe portion of the base shoe **12** is curved upwardly as is the rear or heel portion **13**. The base shoe has a lateral portion **14** extending along the approximate forward half of the ski. There is provided a flange **15** which is curved upwardly along the outside edge of the lateral portion **14**, and along the inside edge of the ski as shown in Fig. 3.

Superimposed on the base shoe is a channel member **16** which has a generally inverted V-shape in cross section. This channel may be formed by rolling a piece of sheet stock. Accordingly the base **17** of the V is a straight line longitudinally and is curved in cross-section. A flange is provided at the outward edges of the V for suitable fastening such as riveting to the base shoe. The ski may be provided with transverse reinforcing diaphragms located inside of the channel and being secured thereto and to the base shoe. In the forward portion of the ski these reinforcing diaphragms **18** extend from the outside of the channel out over the lateral portion **14** of the ski to serve as additional support therefor. This portion of the ski is provided with a suitable cover **19**.

The ski is attached to the landing gear by the following means. At the intermediate portion of the ski the channel **16** is cut out and a saddle **20** is provided. This saddle is shaped to the general contour of the channel **16** but likewise has its central portion cut out. At the sides of the saddle there are provided a pair of pedestal members **22** which may be seen in Figs. 2, 4 and 5. These pedestal members are composed of sheet members suitably attached to the saddle **20** by means of flanges or legs **23** which extend downwardly along the saddle **20** and are welded thereto. These pedestal members are provided with openings near the top thereof for insertion of a bolt or pin **24**.

The actuating mechanism can best be seen with reference to Figs. 3 and 6. A tube **30** provided with a bronze bushing **31** has attached to it a hydraulic crank arm **32** and a ski crank arm **33**. These are suitably attached to the tube **30**, for example by welding. The hydraulic crank arm is illustrated as a pair of arms, while the ski crank arm is illustrated in Fig. 6 as a built-up enclosed structure. At the upper portion of the ski crank arm there is provided a transverse tube **34** likewise provided with a bronze bushing **35**. The tube **34** and the bushing **35** are adapted to be slipped onto a stub shaft **36** which is suitably attached at the end not shown to the inside of the regular landing wheel shaft. A pair of bearing washers **37** and **38** are employed and the bushing **35** is retained on the shaft **36** by means of nut **38** which screws onto the threaded section **39** at the end of shaft **36**. A central opening **40** is provided in shaft **36** for the purpose of lightening the weight of this member.

The ski is mounted to this mounting mechanism as illustrated in Fig. 3. The bolt or pin **24** passes through the opening in the pedestal member **22** and through tube **30** and bushing **31** and through the opening in the opposite pedestal member, and is held by means of nut **41**. Suitable bearing washers **42** and **43** are provided to permit the entire ski assembly to rotate about the pin **24**.

In Fig. 6 there is illustrated a bridging support member generally indicated at **45**. This bridging member is composed of a central web **46** and lateral flanges **47** and **48**. The bridging support member is cut out in the lower central portion so that it may be placed in position over tube **30** after tube **30** has been attached to the pedestal supports. This bridging member may then be bolted down to the top of pedestal member **20**. The purpose of this bridging member is essentially to add strength at the point at which the central portion of the ski has been cut out. By thus cutting out the central portion of the ski and providing this bridging support member, it is possible to obtain a very low pivot point on the ski for the actuation of the ski. Furthermore this is of particular value for installation and maintenance purposes.

In Fig. 4 there is illustrated the actuating mechanism for the ski. Suitably mounted on the saddle **49** is a motive power means such as a hydraulic cylinder **50**, although other suitable motive power means, such as air cylinders, electric jacks, and the like, may be substituted

for this hydraulic cylinder. The piston rod **51** is attached at its outer end to the hydraulic crank arms **32** by means of bolt **52**. The piston arm is provided with an elongated slot **53** at its outer end through which the bolt **52** passes. The elongated slot permits the tire to be used as part of the shock absorbing mechanism. At the same time this use of the tire to absorb shock has been accomplished without placing any load on the hydraulic cylinder or the hydraulic system. In Fig. 4 in the dotted lines will be seen the position of the wheel during flight but when the ski has been lowered for landing. Under these conditions the wheel bears lightly on the top of the lateral surface **14**. It will be seen in the dotted lines of Fig. 4 that the pin **52** is near the inner end of the slot **53**. In the solid lines in Fig. 4 will be seen the position of the tire at the point of impact with the landing surface. The tire is compressed to assume part of the load. As a result of this compression the ski crank arm **33** has rotated counterclockwise from the dotted line position to the solid line position. The pin **52** has likewise moved from the dotted line position to the solid line position, as has the piston rod **51**. The slot **53** has permitted this movement without any longitudinal movement of the piston rod **51**. Thus no change has been made in the load on the hydraulic system by the impact of landing.

In Figs. 7 and 8 is seen the relative position of the parts when the landing wheel is in operative position. In Fig. 9 will be seen the position of the parts at the point of landing on the ski. Fig. 10 shows the relative position of the parts during flight when the ski is in landing position.

In Fig. 2 is illustrated the means for regulating the ski by means of cables so that it will assume a suitable attitude during flight. For this purpose there is provided near the forward end of the ski heavy elastic cables **60**. These tend to keep the nose of the ski elevated against the pull of the rear limit cable **61**, which is a heavy steel cable, the purpose of which is to keep the nose of the ski from being pulled up into contact with the airplane or into the path of the propeller. The steel cable **62** provided ahead of the wheel is a limit cable which is normally slack, but which will keep the nose of the ski from falling in the event that the elastic shock cable **60** is not able to maintain it in normal flight level. At the rear of the ski is provided an auxiliary steel limiting cable **63** which likewise serves to keep the nose of the ski from rising too high.

When the plane is taxiing on the ski the compression of the tire provides a small amount of slack in the limit cables to provide a reasonable amount of pitching of the ski caused by unevenness of the landing surface. During flight, however, the tire again expands and the ski is held in proper attitude by the combination of the shock cord and the limit cables.

In Fig. 11 there is illustrated a modification of the invention in which there is provided a single crank arm and the actuating means is attached to this crank arm. The ski crank arm **33** has a hole passing therethrough in which bolt **60** is supported in the following manner. A spacer sleeve **61** of greater length than the thickness of rod **51** is placed on bolt **60**. This bolt is then passed through slot **53**, washer **62** placed thereon, and the bolt then passed through the hole in crank arm **33**. A washer **63** and nut **64** hold the assembly together without frictional engagement along the sides of rod **51**. This modification may necessitate some lateral adjustment of the mounting for the hydraulic cylinder as well as some centering of the ski crank arm on the tube **30**. This modification provides a simpler and less expensive structure for some installations. Other modifications may be made without departing from the spirit of the invention. For example, the slot **53** may be placed in the lever arm for actuating the ski rather than in the rod **51**. Likewise, mechanical stops may be provided to limit the movement of the ski crank without the application of any additional load on the hydraulic system.

It will thus be seen that there has been provided a novel ski structure which may be mounted on the conventional aircraft landing gear, such that both the ski and the wheel may be in position at the same time. In addition, the ski is actuatable from the wheel landing gear to the ski landing gear. This may be performed during flight by means of controls located in the cabin. The ski is likewise provided with a lateral extension to the ski surface which serves to increase the landing area and to provide a bearing surface for the wheel such that the compression of the tire may be relied on for part of the shock absorbing structure. The actuating system is provided with a means which permits this compression without any load on the hydraulic system. Furthermore, the ski is mounted inside of the wheel such that the ski is almost directly beneath the landing gear structure instead of being laterally outwardly a considerable distance if the ski were placed outside the wheel.

I claim as my invention:

1. An aircraft landing ski adapted to be mounted on the wheel shaft of an airplane comprising a single elongated landing surface, and a lateral landing surface extending outward along the forward portion thereof, means for attaching said ski to the wheel shaft of an airplane at the inner end of said wheel shaft such that the elongated landing surface is inside of the wheel and the lateral portion of said landing surface is in line with said wheel, a lever arm mounted on the ski and on the inner end of said wheel shaft, a second lever arm operable with said first lever arm, means for operating said second lever arm including a rod having an elongated slot therein and being attached to said second lever arm by means of a pin passing through said slot.

2. An aircraft ski comprising a single elongated landing surface and a lateral landing surface extending outwardly along the forward end of said ski, and means for mounting said ski on an airplane such that the elongated landing surface is to one side of the wheel and the lateral surface is in line therewith, means associated with said means for mounting, for actuating said ski so that the landing wheel is lowermost in one position of said actuating means and so the ski is lowermost in another position of said actuating means with the wheel positioned on top of and in contact with said lateral surface.

3. An aircraft ski comprising an elongated landing surface, an inverted channel member overlying said elongated surface and secured thereto, a saddle overlying said inverted channel, said channel and said saddle being cut out near the middle thereof, support means carried by said saddle for pivotally mounting said ski on a landing gear, said pivotal mounting being disposed below the base of said inverted channel and a longitudinal removable bridging support member extending over said pivotal mounting from a forward portion of the saddle to a rearward portion of said saddle.

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